Installation and Operating Instructions

Series 509-71-20
Smart Auto-Cal™ System
with HART® Protocol
using 409-9100-57
Electronics Package
AMETEK Drexelbrook makes no warranty of any kind with regard to the material contained in this manual, including, but not limited to, implied warranties or fitness for a particular purpose. Drexelbrook shall not be liable for errors contained herein or for incidental or consequential damages in connection with the performance or use of material.

Copyright 2000 AMETEK Drexelbrook
Series 509-71-20
Smart Auto-Cal™ System
with HART® Protocol
using 409-9100-57
Electronics Package
Table of Contents

SECTION 1 INTRODUCTION ........................................................................................................... 1
  1.1 Product Description ........................................................................................................... 1
  1.2 Model Number .................................................................................................................... 2

SECTION 2 INSTALLATION ........................................................................................................... 3
  2.1 Unpacking .......................................................................................................................... 3
  2.2 Mounting Location and Dimensions ................................................................................... 3
  2.3 Wiring the Electronics Package ....................................................................................... 7
  2.4 Wiring the Sensing Element ............................................................................................. 7

SECTION 3 CONFIGURATION and CALIBRATION with DREXELBROOK PC SOFTWARE .......... 11
  3.1 General Description ......................................................................................................... 11
     3.1.1 System Requirements .............................................................................................. 11
     3.1.2 Connect the Modem ............................................................................................... 11
     3.1.3 Install the Software ............................................................................................... 13
  3.2 Description of Function Keys ......................................................................................... 14
  3.3 Point Calibration ............................................................................................................. 15
  3.4 Level Configuration ........................................................................................................ 16
  3.5 Level Calibration ............................................................................................................ 17
  3.6 Channel Configuration .................................................................................................. 18
  3.7 Real Time View .............................................................................................................. 19
  3.8 Meter Configuration ....................................................................................................... 19

SECTION 4 TROUBLESHOOTING .............................................................................................. 21
  4.1 Troubleshooting the Loop ............................................................................................... 21
  4.2 Troubleshooting the Electronics Package ......................................................................... 23
     4.2.1 Transmitter Drift Test ......................................................................................... 24
  4.3 Troubleshooting the Sensing Element ............................................................................. 24
  4.4 Troubleshooting the Coaxial Cable ................................................................................ 27
  4.5 Telephone Assistance ..................................................................................................... 28
  4.6 Equipment Return .......................................................................................................... 28
  4.7 Field Service .................................................................................................................... 29
  4.8 Customer Training .......................................................................................................... 29

SECTION 5 SPECIFICATIONS ...................................................................................................... 30
SECTION 1
INTRODUCTION

1.1 Product Description

The Drexelbrook Series 509-71-20 Series Smart Auto-Cal system provides level measurement with enhanced accuracy using multiple measuring sensors and a specialized software package.

Using one 4 to 20 mA signal loop and four point level sensing elements, the Auto-Cal software is able to automatically recalibrate the continuous measurement channel to provide a consistent level measurement. See Figure 1-1.

Figure 1-1
Smart Auto-Cal System
Typical Tank Configuration
1.2 Model Number

509-0071-020 Smart Auto-Cal System

The system is comprised of:
- one 409-9100-57 electronics package that includes a 401-44-1 digital integral meter,
- five 380-xxx-12 coaxial cables,
- one 700-205-15 continuous level sensing element, and
- four 700-202-2 point level sensing elements.

The electronics package is enclosed in a NEMA 4X housing and meets the following NEMA classifications:

- NEMA 4X Waterproof/Corrosion Resistant.

The electronics package and sensing element are connected by a three-terminal coaxial cable. Drexelbrook cables are available in:
  - General Purpose: 380-XXX-12
  - High Temperature: 380-XXX-11
  - Composite: 380-XXX-18
  (first 10 feet high temperature)

The XXX in the model number indicates the length of the cable in feet. 25 feet is standard (e.g., 380-025-12). Longer and shorter lengths are available. Cable can also be purchased in bulk lengths with termination kits. Consult factory for maximum recommended lengths per specific application.
SECTION 2 INSTALLATION

2.1 Unpacking

Carefully remove the contents of the shipping carton and check each item against the packing list before destroying any packing material. If there is any shortage or damage, report it to the factory immediately.

2.2 Mounting Location and Dimensions

The 509-71-20 Series electronics package and sensing elements are designed for field mounting, but should be mounted in a location as free as possible from vibration, corrosive atmospheres, or mechanical damage.

For convenience, place the electronics package in a reasonably accessible location. Ambient temperature should be between -40°F and 160°F (-40°C to 70°C).

The following sensing element mounting and installation instructions should be followed:

- In applications requiring an insulated sensing element, use particular care during installation. There is always the danger of puncturing the insulation.

- Sensing elements should not be mounted in the direct stream of a filling nozzle or chute. If this is not possible, install a deflecting baffle between the probe and the fill.

- **Do not take the sensing element apart or loosen the packing glands.** Follow instructions in Figure 2-1.

![Figure 2-1 General Sensing Element Installation](image-url)
2.2 Mounting Dimensions and Location (cont.)

Figure 2-2 shows the mounting dimensions of the 10x12 NEMA 4X fiberglass housing.

Figure 2-3 shows the mounting dimensions for the point level sensing elements (700-202-2).

Figure 2-4 shows the mounting dimensions for the continuous sensing element (700-205-15).

Material is Polyester Fiberglass
All dimensions in inches (mm).

Figure 2-2
Housing for Electronics Package
### Sensing Element Standard Specifications

<table>
<thead>
<tr>
<th>Sensing Element</th>
<th>Metal Wetted Parts</th>
<th>Insulation Material</th>
<th>&quot;Csl&quot;</th>
<th>&quot;A&quot;</th>
<th>&quot;B&quot;</th>
<th>&quot;C&quot;</th>
<th>&quot;D&quot;</th>
<th>&quot;E&quot; Max.</th>
<th>Insertion Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>700-0202-002</td>
<td>316 SST</td>
<td>TFE</td>
<td>10</td>
<td>8 1/2</td>
<td>3/4 Dia</td>
<td>11 1/2</td>
<td>3/8 Dia</td>
<td>7&quot;</td>
<td>18 (457)</td>
</tr>
</tbody>
</table>

All dimensions in inches (mm).

---

**Figure 2-3**

Point Level Sensing Element

---

INSTALLING SENSING ELEMENT IN LIQUIDS

CSL MUST EXTEND 2" (51) MINIMUM INTO VESSEL OR BEYOND MAXIMUM WALL BUILD-UP.

INSTALLING SENSING ELEMENT IN GRANULARS

CSL MUST EXTEND 2" (51) MINIMUM INTO VESSEL OR BEYOND MAXIMUM WALL BUILD-UP. LOCATION TO BE DETERMINED CONSIDERING ANGLE OF REPOSE. 15° ANGLE OF REPOSE RECOMMENDED (ANGLE RANGE TO BE BETWEEN 5° TO 45°).
Figure 2-4
Continuous Level Sensing Element

NOTES:
1. COTE-SHIELD MUST EXTEND THRU NOZZLE & PAST MATERIAL BUILD-UP ON ROOF OF VESSEL
2. OPTIONAL FLANGE MOUNTING. MINIMUM FLANGE SIZE: 1 1/2 ASME.
3. 3/16 (5) DIA. 316 SST. FLEXIBLE BARE CABLE.

| DIMENSIONS |
|------------------|------------------|------------------|------------------|
| SENSING ELEMENT  | CSL              | BOTTOM CONNECTION| WEIGHT           |
| 700-0205-015      | 10 (254)         | 7/8 (22) DIA     | 7/8 (22) DIA     |
| ALL METAL         |                  | 3/4-10 UNC-2B    | LENGTH 21" (533) |
| WETTED PARTS     |                  | THREAD           | P/N 752-0280-004 |
| 316 SST           |                  |                  |                  |

All dimensions in inches (mm).
2.3 Wiring the Electronics Package

The 409-9100-57 electronics package is prewired at the factory. It has a built-in current limiter that holds the signal current to a maximum of 28 mA. The following customer wiring connections need to be made at time of installation. Refer to the appropriate figure.

- Signal connections from each of the five terminal blocks to the remote sensing elements. See Figure 2-5. The signal connections are made to the set of terminal blocks inside the electronics package. Due to the low power consumption of the instrument, the wiring can be light gauge (e.g. 20 AWG). Twisted shielded pair cable is recommended.

- Coaxial cable connections (three terminal) to sensing elements. See Figure 2-6 and 2-7 for the point level and continuous level connections respectively. See also 2.3 Wiring the Sensing Element.

- Power connections. See Figure 2-8.

2.3 Wiring the Sensing Element

Only coaxial cables supplied by AMETEK Drexelbrook should be used to connect the electronics package to the sensing elements. Use of other cables can result in unstable calibration.

Use the following precaution when making the cable connections to the sensing elements.

- Do not connect the cable to the sensing element until after the sensing element has been installed in the vessel and the condulet housing has been secured.
Figure 2-5
Wiring the Terminal Blocks
Figure 2-6
Point Level (700-202-2)
Sensing Element Wiring

Figure 2-7
Continuous Level (700-205-15)
Sensing Element Wiring
Figure 2-8
Power Connections
3.1 General Description

The Smart Auto-Cal software allows the use of Windows®-based personal, laptop, or notebook computer to calibrate the HART® protocol electronics package.

3.1.1 System Requirements

—PC Requirements
Windows 95/98/NT or higher. It is recommended that the software be installed on a hard drive with 0.5 megabytes or more of space available.

—Input to Modem
RS232 from the COM1 or COM2 serial port. The PC provides operating power for the modem but not for the transmitter.

—Output
4-20 mA in HART® Protocol

—Cable (included with Modem)
5-foot modem cable to loop connection

3.1.2 Connect the Modem

Refer to Figure 3-1 for a connection diagram and use the following procedure to install the hardware that is necessary to run the PC software.

a. Connect the Drexelbrook Modem 401-700-002 to the COM1 or COM2 serial port of the computer.

b. Connect the 4-20 mA loop connectors to the transmitter loop. Modem is polarity insensitive.

c. Turn on the computer.
509-71-20 Series Smart Auto-Cal System

**Figure 3-1**
Modem Assembly and Loop Connection

**Figure 3-2**
Loop Lead Connections on Electronics Package
3.1.3 Install the Software

a. Place the 401-700-006 software Disk 1 (of 3) into the disk drive (usually drive a:).

b. Double-click My Computer > 3½ Floppy (A:) > Setup

c. Follow screen instructions in HARTWin Setup to create HARTWin program file.

d. Double click HARTWin icon and the program should run under a window.

e. The software starts communicating with the HART protocol transmitter and returns with Tag ID and all existing configuration information.
3.2 Description of Function Buttons

Figure 3-2 shows a PC calibration software menu screen. The following paragraphs describe the function buttons.

Figure 3-2
PC Software Menu Screen

NOTE
If the data field has been edited but not sent to the transmitter (Write to Transmitter), the data field is shown in red.

Read Transmitter
Reads all pertinent data from the transmitter and displays it on the screen. The Read function also updates the real time window.
3.2 Description of Function Buttons (cont.)

Write to Transmitter
Sends new or edited configuration data to the transmitter. Data field that has been edited but not sent to the transmitter is displayed in red.

Real Time View
Displays the realtime values of level, capacitance of the level channel and each Auto-Cal channel, loop current, percentage, and status.

Point Calibration
Calibrates the HART® protocol transmitter. Two known tank levels are required. A low calibration point must be established at a low (below channel #5) or empty tank. A high calibration point is established at any tank level greater than 50%.

D/A Trim
Allows a field reference meter to be connected to the 4-20 mA loop for adjusting output current. D/A Trim is factory set.

Configure Meter
Configures the Digital Integral Meter (440-44-1) used for local indication. See 3.8 Meter Configuration.

3.3 Point Calibration

Point calibration uses the actual level in the vessel (two known level points) for calibration of all sensors.

The point level sensors are calibrated in air (uncovered). One point calibration is done for all four point level sensors.

a. Empty vessel.

b. Click on Point Calibration.

c. Click on Point Level Air.

This completes the calibration of the four point level sensors.
3.3. Point Calibration (cont.)

With vessel still empty or at any level less than 25%:

d. Click on **Point Calibration**.

e. Enter value for the low point of the continuous calibration. Click on **Continuous Low Point**.

Fill vessel to high point of continuous calibration. (Recommended high point is 50% or higher level.)

c. Enter value for the high point of the continuous calibration. Click on **Continuous Hi Point**.

Calibration is complete.

**NOTE**

**DO NOT** change **Lower** or **Upper Capacitance** data values, as they were derived from the above calibration procedure.

3.4 Level Configuration

a. Use **Tag ID** (8 characters) to identify the unit or vessel. Use the **Scratchpad** (32 characters) to record the date of calibration or other similar notes. Press Tab or Enter.

b. Edit **Damping Time** from 0-90 seconds, if desired.

c. Click on **Write to Transmitter**. All data is permanently stored in the continuous level electronics.

d. Tab to the **Level Configuration** section of the menu.
3.4 Level Configuration (cont.)

e. Select **Level Units**. The default selection is **feet**. Choose the units that correspond to the level measurement.

![Level Units Selection]

f. Edit the **Maximum Level** value to match the actual tank height (not the length of the continuous sensing element).

g. Press Tab to **Level Calibration** menu.

3.5 Level Calibration

The values for **Lower Level** and **Lower Capacitance** default to the **Continuous Low Point** value entered during **Point Calibration**.

The values for **Upper Level** and **Upper Capacitance** change with the point level.

Enter the 4 and 20 mA loop values (**LRV** and **URV**) to set the current window of the vessel.

h. Edit **LRV** (Lower Range Value) to display the output when the transmitter generates 4 mA current. The default LRV is 0 feet.

i. Edit **URV** (Upper Range Value) to display the output when the transmitter generates 20 mA current. The default URV is 100 feet (450 pF).

j. Press **Write to Transmitter**.

Level calibration is complete.
3.6 Channel Configuration

In the Smart Auto-Cal software, each point level sensor is an Auto-Cal channel capable of recalibrating the continuous level calibration when tank level reaches each sensor.

<table>
<thead>
<tr>
<th>Channel Calibration</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration Direction</td>
<td></td>
</tr>
<tr>
<td>Channel 1 Level</td>
<td>25.00 ft</td>
</tr>
<tr>
<td>Channel 1 Lower Capacitance</td>
<td>15.94 pf</td>
</tr>
<tr>
<td>Channel 1 Setback Capacitance</td>
<td>1.00 pf</td>
</tr>
<tr>
<td>Channel 2 Level</td>
<td>50.00 ft</td>
</tr>
<tr>
<td>Channel 2 Lower Capacitance</td>
<td>15.16 pf</td>
</tr>
<tr>
<td>Channel 2 Setback Capacitance</td>
<td>1.00 pf</td>
</tr>
<tr>
<td>Channel 3 Level</td>
<td>75.00 ft</td>
</tr>
<tr>
<td>Channel 3 Lower Capacitance</td>
<td>14.39 pf</td>
</tr>
<tr>
<td>Channel 3 Setback Capacitance</td>
<td>1.00 pf</td>
</tr>
<tr>
<td>Channel 4 Level</td>
<td>100.00 ft</td>
</tr>
<tr>
<td>Channel 4 Lower Capacitance</td>
<td>16.42 pf</td>
</tr>
<tr>
<td>Channel 4 Setback Capacitance</td>
<td>1.00 pf</td>
</tr>
</tbody>
</table>

To configure each Auto-Cal channel:

a. Designate and label each channel.

b. Enter the direction for the calibration (Calibration Direction).

up - As the level rises, the continuous level calibration is updated at each point level sensor (capacitance + setback capacitance).

down - As the level falls, the continuous level calibration is updated at each point level sensor (capacitance + \( \frac{1}{2} \) setback capacitance).

up/down - Both up and down conditions apply.
3.7 Channel Configuration (cont.)

c. Enter the vessel level corresponding to the physical mounting location of each point level sensor. (Channel n Level).

d. Enter a capacitance value only if a Point Cal in Air has not been done (vessel could not be emptied).

e. Enter the preload value which will cause the continuous calibration to recalibrate. (Channel n Setback Capacitance). Factory setting is 1 pF.

f. Press Write to Transmitter.

Channel calibration is complete.

3.7 Real Time View

![Real Time View]

<table>
<thead>
<tr>
<th>Real Time View</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
</tr>
<tr>
<td>Level Capacity</td>
</tr>
<tr>
<td>Channel 1 Capacitance</td>
</tr>
<tr>
<td>Channel 2 Capacitance</td>
</tr>
<tr>
<td>Channel 3 Capacitance</td>
</tr>
<tr>
<td>Channel 4 Capacitance</td>
</tr>
<tr>
<td>Loop Current</td>
</tr>
<tr>
<td>Percentage</td>
</tr>
</tbody>
</table>

Status: OK

Updating Channel 3 and Channel 4

3.8 Meter Configuration

A digital integral meter (401-44-1) is a full 4-digit meter used for local indication. The display can be configured to read any engineering units up to four digits, e.g. 4-20 mA, gallons, inches, feet, etc. See Figure 3-3.

![Digital Integral Meter]
To program the meter, click on **Configure Meter**.

![Configure Meter](image)

The meter is configured by:
- setting the minimum value equal to the value to be displayed at the LRV and,
- setting the maximum value equal to the value to be displayed at the URV.

To set the meter display range equal to the calibration range:

- **Minimum Value** = LRV
- **Maximum Value** = URV

A new meter (with factory default settings) attached to an electronic unit that is not connected to a sensing element displays **U5xx**, with the xx denoting any number. The lack of sensing element causes an output less than the LRV (less than 4 mA).

— **Meter displays R (Over range)**

If an over range condition, the meter displays R instead of a value.

— **Meter displays U (Under range)**

If an under range condition, the meter displays U instead of a value.

Perform normal troubleshooting procedures for an over or under range condition.
4.1 Troubleshooting the
Loop

Specific transmitter loop connections vary from installation to installation, but generally can be represented by the typical loop connection drawing in Figure 4-1. When troubleshooting the loop connection, verify the following items:

- Loop devices are wired in series.
- There are at least 250 ohms total loop resistance.
- There is at least 12 Vdc available for the transmitter when a loop current of 20 mA is flowing.

Figure 4-2 provides a flow chart for troubleshooting loop communication.
4.1 Troubleshooting the Loop (cont.)

Start
Modem does not communicate with transmitter.

Is there a minimum of 250 ohms loop resistance?

Yes
Are you connected to a DCS?

No
Are you using the Drexelbrook supplied Viator model 1000A modem?

Yes
Is It Polling?

No
Check:
1. Is the modem non-isolated from ground and/or is your laptop plugged into AC power. If so you may have a ground problem. Contact the Service department.
2. Some laptops don't provide enough voltage to drive the modem correctly from the Com Port. Check with modem supplier or try a different laptop.
3. Checkout "Yes" response tests listed below.

Yes
Make it stop polling or power transmitter from a separate source - then re-check operation.

No
Check:
1. Is the correct Com port selected at startup?
2. Is there any software running that would re-direct the Com Port such as Windows, mouse drivers, terminal emmulation software, or TSR's. (This can be tested by booting from the Drexelbrook Calibration software in the A: drive)
3. Possible bad RS-232 cable or defective modem.
4. Check modem connections to the loop per the loop drawing on Figure 3-1.

Are you connected to a DCS?

No
Check:
1. Is the correct Com port selected at startup?
2. Is there any software running that would re-direct the Com Port such as Windows, mouse drivers, terminal emmulation software, or TSR's. (This can be tested by booting from the Drexelbrook Calibration software in the A: drive)
3. Possible bad RS-232 cable or defective modem.
4. Check modem connections to the loop per the loop drawing on Figure 3-1.

Yes
Are you using the Drexelbrook supplied Viator model 1000A modem?

Yes
Check:
1. Is the correct Com port selected at startup?
2. Is there any software running that would re-direct the Com Port such as Windows, mouse drivers, terminal emmulation software, or TSR's. (This can be tested by booting from the Drexelbrook Calibration software in the A: drive)
3. Possible bad RS-232 cable or defective modem.
4. Check modem connections to the loop per the loop drawing on Figure 3-1.

No
Check:
1. 1. If current is greater than 23.5 mA disconnect at the sensing element and re-check. If current returns to normal, check sensing element. If current does not return to normal, test transmitter. 2. If loop current is 0 mA, check polarity of loop at transmitter. If it is OK, check for open loop. 3. If loop current is between 0 and 3 mA transmitter is likely bad. 4. Check voltage at transmitter it should be at least 12 volts when 20 mA is flowing in the loop 5. Disconnect the three probe cable connections at the transmitter and retry. If it now communicates, check the cable and probe.

Is the loop current between 3.5 and 23.5 mA?

No
1. Check Power Supply and loop source resistance (the 250 ohms may be built in as with the Drexelbrook 401-500 series or most DCS inputs).
2. If not there add enough resistance for loop to be at least 250 ohms.

Yes
Check:
1. Check calibrator connections to the loop per the loop drawing Figure 3-1.
2. Check for "noise" and ripple on the loop with an oscilloscope. Maximum noise level per the HART Foundation is 1.2 mV rms (500 - 10 kHz). The maximum ripple (47 - 125 Hz) specification is .2V p-p. Line noise can sometimes be traced to things like motor speed controller wiring in close proximity with the transmitter. Noise can sometimes be overcome by increasing the loop resistance thereby increasing the calibrator signal. Noise effects can also be reduced by connecting the calibrator directly at the transmitter. Generally noise is only a problem when the calibrator is communicating with the transmitter and does not affect the normal operation of the transmitter.
3. Check voltage at transmitter. It should be at least 12 volts when 20 mA is flowing in the loop.
4.2 Troubleshooting the Electronics Package

To troubleshoot the electronics package, use the following test.

The test requires the use of high quality fixed capacitors in the picofarad ranges or a Drexelbrook calibrator box (C-box 401-6-81). Contact the Drexelbrook Service department if necessary. Fixed temperature stable capacitors (NPO types) can often be found at many electronic supply houses.

1. Determine the span range currently selected on the electronic unit.

2. Using the MAX pF values, select a capacitance value near the midpoint of the MAX pF range. For example, position #4 has a MAX pF range of 2000 pF. Select a 1000 pF capacitance for this test.

<table>
<thead>
<tr>
<th>SPAN JUMPER POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>RANGE</td>
</tr>
<tr>
<td>2  3  4  5  6</td>
</tr>
<tr>
<td>MAX pF</td>
</tr>
<tr>
<td>100 450 2000 10000 40000</td>
</tr>
</tbody>
</table>

3. Remove all three connections of the coaxial cable at the transmitter's probe terminals.

4. Place capacitor on transmitter from probe to ground terminals.

5. Using Real Time view, verify that the displayed capacitance value is within the value and tolerance printed on the test capacitor. If using a Drexelbrook C-box, add the standing capacitance of the box (10pF low range, 20 pF normal range).

6. If the displayed capacitance value is within the stated tolerance, the unit is working. If the displayed capacitance value is not accurate, call 1-800-527-6297.
4.2.1 Transmitter Drift Test

If symptoms point toward calibration drift, it is important to determine if the apparent drift is coming from the transmitter, the sensing element, or the application of the equipment. The following test determines if the transmitter is stable.

1. Remove coaxial cable from the transmitter terminals.

2. Without changing any data stored in the transmitter, connect a Drexelbrook capacitance substitution box (401-6-8) or an NPO test capacitor from the PROBE terminal to the GND terminal on the transmitter. (Select a capacitance value that produces between 4 and 20 mA of loop current.)

3. Observe the loop current over a 12-hour period to confirm the stability of the unit. If the readings remain stable for this period, then the problem is not in the transmitter. If the loop current has changed more than 1% during the test period, then the unit is defective. Please contact the Service department for repair or replacement.

4.3 Troubleshooting the Sensing Element

Troubleshooting the sensing element requires the use of an analog ohmmeter. Digital meters do not properly measure resistance for the purpose of this test. An analog ohmmeter typically provides more current when measuring resistance, which is required to detect a pinhole or crack in the sensing element insulation. In addition, digital meters frequently give erroneous results due to a battery-like effect when dissimilar metals contact conductive liquids.

NOTES

The sensing element is intrinsically safe. Therefore, when using this product, it is recommended that all service activity comply with appropriate guidelines.

Remove the sensing element from the vessel to a safe area. The test outlined in steps 1 and 2 can be performed in a metal test vessel filled with tap water.

In the following tests, if it is not possible to raise or lower the level in the vessel, the sensing element may be suspended in a pipe or other container that is filled with just plain tap water.
4.3 Troubleshooting the Sensing Element (cont.)

—Testing the Sensing Element
Step 1 (Figure 4-3)

With the material below the sensor, and the coaxial cable disconnected at the sensing element, measure the resistance from the sensing element center connector to ground connector (or conduit). The ohmmeter should be set to R x 10000 scale. The reading should be infinite (open circuit). Readings of less than one meg-ohm indicate excessive electrical leakage, probably due to product leakage or condensation in the packing seal or conduit. Contact the Service department for recommended repairs.

Figure 4-3
Sensing Element Testing, Material Below the Sensing Element
4.3 Troubleshooting the Sensing Element (cont.)

—Testing the Sensing Element
Step 2 (Figure 4-4)

Raise the level in the vessel to cover as much of the sensor as possible. Repeat the measurement made in step 1. Readings of 1 meg-ohm or less indicate a pinhole or crack in the sensing element insulation. Failed insulation is not field repairable. Call the Service department for further assistance.

Figure 4-4
Sensing Element Testing, Material Above the Sensing Element
4.4 Troubleshooting the Coaxial Cable

**NOTE**

If there is water or other conductive material in the conduit it can change the electrical properties of the coax cable and cause the system to perform poorly. Moisture in the conduit may not be detected by the following test. The only sure way is to inspect the coax and associated conduit for trapped water.

1. Disconnect all three wires of the coaxial cable at the electronic unit.

2. Disconnect all wires at the sensing element end of the coax.

3. Using an ohmmeter, measure between two of the coaxial cable conductors. Note any reading. Repeat for all three conductors. All readings should show an open circuit, (infinite resistance).

4. Check for continuity of each conductor. Short out two of the coaxial cable conductors and measure these two conductors at the other end. A reading close to 0 ohms should be shown.
4.5 Telephone Assistance

If there are questions about your Drexelbrook equipment:
- contact your local Drexelbrook representative,
- call the Service department toll-free at 1-800-527-6297 (in US and Canada) or 1-215-674-1234 (outside North America),
- fax the following information to the Service department at 1-215-443-5117.

4.6 Equipment Return

In order to provide the best service, any equipment being returned for repair or credit must be pre-approved and have a return number issued by the factory.

In many applications, sensing elements are exposed to hazardous materials.
- OSHA mandates that our employees be informed and protected from hazardous chemicals.
- Material Safety Data Sheets (MSDS) listing the hazardous materials that the sensing element has been exposed to must accompany any repair.
- It is your responsibility to fully disclose all chemicals and decontaminate the sensing elements.
4.6 Equipment Return (cont.)

To obtain a return authorization number (RA #), contact the Service department at 1-800-527-6297 (US and Canada) or 1-215-674-1234 (outside North America). Please provide the following information:

Model Number of Return Equipment _________________________
Serial Number ___________________________________________
Original Purchase Order Number _____________________________
Process Materials that equipment has been exposed to _________________

MSDS sheets for any hazardous materials
Billing Address ______________________________________________

Shipping Address ____________________________________________

Purchase Order Number for Repairs ___________________________

Please include a purchase order even if the repair is under warranty. If repair is covered under warranty, you will not be charged.

Ship equipment freight prepaid to:
AMETEK Drexelbrook
205 Keith Valley Road
Horsham, PA 19044
COD shipments will not be accepted.

4.7 Field Service

Trained field service personnel are available on a time-plus-expense basis to assist in start-ups, diagnosing difficult application problems, or in-plant training of personnel. Preventative Maintenance and Certification service contracts are also available to maintain plant efficiency. Contact the Service department at 1-800-527-6297 for further information.

4.8 Customer Training

Instrument Training Seminars for customers are conducted at the factory. These sessions, guided by Drexelbrook engineers and specialists, provide detailed information on all aspects of level measurement, including theory and practice of instrument operation. Contact the Training Department for further information.
SECTION 5
SPECIFICATIONS

— **Power Requirement**
  12 to 50 VDC
  Minimum of 12 VDC at 20 mA

— **Input Range**
  409-9100-57: 1.0 to 45,000 pF

— **Output Range**
  4-20 mA

— **Accuracy**
  ±0.25% of range. Accuracy includes the combined effects of linearity, hysteresis, and repeatability. It refers to the transmitter only and is measured at reference conditions of 25 degrees C ±1°, 10-55% R.H. and 24 ±1.2 Vdc, using an admittance standard (applied to the transmitter sensor terminals) in place of the sensor.

— **Load Resistance**
  Maximum Load Resistance = 750 ohms
  Minimum Load Resistance = 250 ohms

— **Temperature Effect**
  ±1% of range per 50°F (30°C).

— **Supply Voltage Effect**
  <0.1% from 12 to 50 VDC.

— **Effect of Load Resistance**
  <0.1% for full resistance range at 24 VDC supply.

— **Response to Step Change**
  1 second standard (to 90% of final value);
  0-90 seconds available with delay.

— **Ambient Temperature**
  -40°F to +185°F (-40°C to 85°C)

— **Calibration Adjustments**
  Range Span, 5 positions

— **Lowest Permitted Resistance**
  (bare sensing element to ground) causing 5% error in:
  600 ohms - 409-9100-57
---Intrinsic Safety---

---Sensing Element Cable Length---
150 feet maximum.

---Coaxial Cable---
General Purpose 380-XXX-12
.51" (13mm) OD at largest point,
160°F (70°C) temperature limit.

Composite Cable
(first 10 feet high temperature) 380-XXX-18
.62" (16mm) OD at largest point, 450°F (230°C) temperature limit for first 10 feet.
160°F (70°C) temperature limit for remainder.

High Temperature Cable 380-XXX-11
.51" (13mm) OD at largest point,
450°F (230°C) temperature limit.