Installation and Operating Instructions

Series 509-76-718
Interface Controller
for
Electrostatic Separator Applications
using 409-1000 Universal III™
with HART Protocol®
Series 509-76-718
Interface Controller
for
Electrostatic Separator Applications
using 409-1000 Universal III™
with HART Protocol®
Table of Contents

SECTION 1 INTRODUCTION ................................................................................................... 1
  1.1 Electrostatic Separator Operation .................................................................................... 1
  1.2 Model Numbering ............................................................................................................... 2

SECTION 2 INSTALLATION ..................................................................................................... 3
  2.1 Installation Guidelines ..................................................................................................... .. 3
  2.2 Radio Frequency Interference (RFI) ................................................................................ 9
  2.3 Digital Integral Meter ......................................................................................................... 11
  2.4 Range Span Jumper ........................................................................................................... .1 2

SECTION 3 CALIBRATION WITH DREXELBROOK PC SOFTWARE (Pink Section) ...... 13
  3.1 General Description ......................................................................................................... ... 13
  3.2 Model Number ................................................................................................................ ..... 13
  3.3 System Requirements ......................................................................................................... 14
  3.4 Installing the Modem........................................................................................................ .. 14
  3.5 Installing the Software on a Hard Drive .......................................................................... 15
  3.5.1 Running Laptop Software from the Hard Drive as a DOS Program .................... 15
  3.5.2 Running Laptop Software from the Hard Drive in Windows 3.1® ...................... 16
  3.5.3 Running Laptop Software from the Hard Drive in Windows 95 or 98® .................. 17
  3.6 Description of Function Keys ............................................................................................ 18
  3.7 Configuration ....................................................................................................................... 20
  3.8 Calibration ............................................................................................................................ 21
  3.8.1 Point Calibration ........................................................................................................ 22
  3.8.2 Calculating Zero and Span Capacitance ................................................................... 24
  3.9 Configuring the Digital Integral Meter .............................................................................. 27

SECTION 4 CALIBRATION WITH MODEL 275 CALIBRATOR
with DEVICE DESCRIPTION (Yellow Section) ................................................................. 29
  4.1 Drexelbrook Device Description ......................................................................................... 29
  4.2 Configuration ....................................................................................................................... 30
  4.3 Point Calibration .................................................................................................................. 33
  4.4 D/A Trim ............................................................................................................................... 33
  4.5 Digital Integral Meter (DIM) Configuration ................................................................. 35
# Table of Contents (cont.)

<table>
<thead>
<tr>
<th>SECTION 5  TROUBLESHOOTING</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Identifying a Problem/Symptom</td>
<td>37</td>
</tr>
<tr>
<td>5.2 Troubleshooting the Loop Connection</td>
<td>37</td>
</tr>
<tr>
<td>5.2.1 Supply Voltage Check</td>
<td>39</td>
</tr>
<tr>
<td>5.3 Model 275 Calibrator cannot identify or find device</td>
<td>40</td>
</tr>
<tr>
<td>5.4 Model 275 Calibrator with device description cannot identify or find device</td>
<td>41</td>
</tr>
<tr>
<td>5.5 Universal III transmitter does not communicate with Drexelbrook PC software</td>
<td>42</td>
</tr>
<tr>
<td>5.6 Troubleshooting the Electronic Unit</td>
<td>43</td>
</tr>
<tr>
<td>5.6.1 Electronic Unit Drift Test</td>
<td>44</td>
</tr>
<tr>
<td>5.7 Troubleshooting the Sensing Element</td>
<td>46</td>
</tr>
<tr>
<td>5.8 Troubleshooting the Coaxial Cable</td>
<td>48</td>
</tr>
<tr>
<td>5.9 Radio Frequency Interference</td>
<td>48</td>
</tr>
<tr>
<td>5.10 Telephone Assistance</td>
<td>52</td>
</tr>
<tr>
<td>5.11 Equipment Return</td>
<td>52</td>
</tr>
<tr>
<td>5.12 Field Service</td>
<td>53</td>
</tr>
<tr>
<td>5.13 Customer Training</td>
<td>53</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SECTION 6  SPECIFICATIONS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1 Electronic Unit Specifications</td>
<td>54</td>
</tr>
<tr>
<td>6.2 Coaxial Cable Specifications</td>
<td>55</td>
</tr>
</tbody>
</table>

| APPENDIX A  CALIBRATION WITH MODEL 275 CALIBRATOR without DEVICE DESCRIPTION (Green Section) | A-1 |
| APPENDIX B  ADDITIONAL TROUBLESHOOTING | B-1 |
The instructions in this manual are for the Drexelbrook Interface Controller 509-76-718 which measures the interface that forms between oil and water in an electrostatic separator (including a desalter, electrostatic coalescer, or thermo-electric heater treater).

The output signal is a 4-20 mA 24Vdc and digital HART® protocol signal.

1.1 Electrostatic Separator Operation

This system measures the interface between water and oil. However, there usually is an emulsion layer present between the oil and water phases. The standard system measures the point where electrically the emulsion changes from oil phase (oil surrounding water droplets) to water phase (water surrounding oil droplets.)

An accurate interface measurement is important to maximize throughput of an electrostatic precipitator. Maximum throughput and efficiency occurs when:

• the interface is maintained in a fixed narrow range.

• the interface is kept close to the grids, but low enough to prevent the water from contacting the high voltage grids, causing a short circuit and tripping of the grid circuit breakers.

• the interface is prevented from falling too low and allowing oil to be discharged through the water outlet.

The Drexelbrook system uses radio frequency technology to make the interface measurement. This technology is designed to handle the high voltage environment, temperature, pressure, corrosive atmosphere, wax, sediment, and buildup unique to electrostatic separator applications.
The Drexelbrook 509-76-718 interface controller is comprised of the following components:

- **409-1000-x-Ay** electronic unit (transmitter) using HART protocol for communication and calibration in explosionproof/NEMA 4 housing. Includes a factory installed loop surge arrester (see **377-4-12** below).
  - x = integral or remote
  - y = range span jumper position

- **377-4-12** loop surge arrester protects the electronic unit from voltage surges on the loop supply wires. Surges are often caused by poor quality electrical service and nearby lightning strikes. The surge arrester mounts on the 4-20 loop side of the electronic unit.

- **380-xxx-12** interconnecting coaxial cable. The xxx denotes the number of feet, with a maximum length of 150 feet (45.6M).

- **700-2-224** immersion type sensing element with factory supplied metallic inactive section and 6-inch cooling extension. Includes condulet and factory-installed electrostatic filter (see **385-28-4** below). Older systems may have a similar filter mounted on the sensing element terminals of the electronic unit.

- **385-28-4** electrostatic filter used to protect the electronic unit from electrostatic fields due to the high voltage grids. The electrostatic filter mounts on the sensing element.
For mounting and wiring drawings, see pages 5-8.

2.1 Installation Guidelines

- Do not install the sensing element in an internal displacer, stilling well or external chamber (side arm). The interface that forms in these chambers may not be representative of the vessels internal interface. See Figure 2-1.

*Figure 2-1
Mounting Guidelines*
2.1 Installation Guidelines (cont.)

- The sensing element must be installed in a location that provides maximum phase separation. If sample taps are used to check the interface, the ideal mounting location for the sensing element is near the inside extensions of the sample taps.

- When installing flange-mounted sensing elements, keep mating surfaces and bolts free of paint and corrosion to ensure proper electrical contact with the vessel. Avoid using Teflon™ tape when installing threaded sensing elements. Brushable pipe sealant is acceptable.

- If the installation area is rated explosionproof (requiring conduit seal fittings), they should be used in accordance with company standards and local codes.

- Do not coil up excess 380-0xx-12 interconnecting coax. Coiled coax acts as an antenna to pick up stray 60 Hz noise. Factory supplied coax cable may be shortened (at the sensing element end). Termination kits are available for shortening the coax cable.

Refer to Figure 2-2.
All dimensions given in inches (mm)

Figure 2-3
Mounting Dimensions
Figure 2-4
Wiring Diagram

NOTES:

1. ALL DEVICES MUST BE WIRED IN SERIES.
   VOLTAGE DRIVEN DEVICES REQUIRE A SERIES VOLTAGE DROPPING RESISTOR.
2. SIGNAL TERMINALS + & - CAN OPERATE WITH MINIMUM OF 12.2 VDC WITH 20 mA FLOWING.
3. IF THE FIELD WIRING IS TO BE IN HAZARDOUS AREAS, THEN SUITABLE SAFETY BARRIERS ARE REQUIRED BETWEEN THE POWER SUPPLY AND THE FIELD TO PROVIDE FOR INTRINSICALLY SAFE FIELD WIRING.
Figure 2-5
Alternate Wiring
Figure 2-6
Wiring with RFI Filters

EXPLOSION PROOF MOUNTING AND WIRING OF RFI FILTERS

COTYPE SHIELD (RED)
PROBE CENTER WIRE (BLUE)
GROUND (GREEN)
3 TERMINAL CABLE TO PROBE
SIGNAL FILTER 401-0016-019 (INCLUDES COVER AND GASKET)
SIGNAL WIRES TO SIGNAL LOOP
SIGNAL FILTER 401-0016-020 (INCLUDES COVER AND GASKET)
MOUNTING AND WIRING OF RFI FILTER DIVISION 2 AND WEATHER PROOF
2.2 Radio Frequency Interference (RFI)

When installing the Universal III transmitter, follow these recommendations to avoid problems with Radio Frequency Interference (RFI).

- Choose a location to mount the electronic unit at least 6 feet (2M) from a walkway where personnel using walkie talkies may pass.

- If electronic unit is mounted remotely from the sensing element, connect the sensing element to the electronic unit by placing the coaxial cable in grounded metal conduit. Integral sensing element connections are already shielded.

- Use Twisted Shielded Pair wiring for all loop wiring connections. Loop connection wiring should also be in grounded metallic conduit.

- Do not run power wiring in the same conduit with signal cables.

- Ground the electronic unit and housing with a minimum of 14 gauge wire to a good earth ground. Make sure that conduits entering and leaving the housing have a good electrical ground connection to the housing.

If the recommendations listed above are followed it is usually not necessary to add RFI filtering to protect against signal strengths of 10 Volts/Meter or less. This degree of protection is usually sufficient to protect against walkie talkies that are used 3 feet (1M) or more from a typical electronic unit. If greater protection is required, or filters have already been provided, install RFI filters as shown in Figure 2-7.
Division 2 and Weatherproof Mounting and Wiring of RFI Filters

Explosionproof Mounting and Wiring of RFI Filters

Figure 2-7
RFI Filters
### 2.3 Digital Integral Meter

An optional digital integral meter (DIM) (401-44-1) can be used with the Universal III electronic unit for local indication. When purchased with the Universal III instrument, a housing with viewport is supplied. The meter display is visible through the viewport.

If the meter is added as a retrofit to an existing installation, a new housing dome with viewport (260-2-222) is required and supplied as part of the retrofit package.

To install the meter:
- remove the top label from the transmitter to expose two threaded holes and ribbon cable socket,
- plug the mini ribbon cable into the socket,
- secure meter to top of electronic unit with screws.

The meter is not inserted into the 4-20 mA loop. The meter receives power and data directly from the Drexelbrook smart transmitter via attached mini ribbon cable. See Figure 2-8.

When a smart transmitter is powered down or the ribbon cable is disconnected, there is a one minute delay before the DIM begins to display.

The meter is configured using either the Drexelbrook PC software (**F2-Meter**) or via the Model 275 Calibrator (with device description). See Sections 3.9 and 4.5.

![Figure 2-8 Digital Integral Meter](image-url)
2.4 Range Span Jumper

The Range span jumper allows the tuning range of the instrument to be changed. It provides an adjustment for the change in capacitance required to produce full scale current.

- The range span jumper is located on the side of the transmitter chassis.

<table>
<thead>
<tr>
<th>SPAN RANGE</th>
<th>JUMPER POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MAX pF</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>450</td>
</tr>
<tr>
<td>2000</td>
</tr>
<tr>
<td>10000</td>
</tr>
<tr>
<td>45000</td>
</tr>
</tbody>
</table>
SECTION 3
CALIBRATION WITH DREXELBROOK PC SOFTWARE

3.1 General Description

This section instructs the user how to use the Drexelbrook 401-700-20 Series PC calibrator software to calibrate the Universal III™ Series 509-76-718 Interface Controller.

The 401-700-20 software package allows the use of any DOS or Windows®-based personal, laptop, or notebook computer to calibrate the HART® protocol transmitter.

3.2 Model Number

4 0 1 - 0 7 0 0 - 0 2 X

X=1 PC Software Package includes Modem Assembly shown in Figure 3-1 and cable.

X=2 PC Software Package includes Modem Assembly shown in Figure 3-1, cable, and PC software 3½-inch disk.

4 0 1 - 0 7 0 0 - 0 0 6

PC Software 3½-inch disk only.

Figure 3-1
Modem Assembly
3.3 System Requirements

—PC Requirements
8088 DOS-based PC or higher using DOS version 3.1 or higher. While it is possible to operate from the 1.44 megabyte floppy disk furnished with the 401-700-20 package, 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 electronic unit.

—Output (to Transmitter being Calibrated)
4-20 mA in HART® Protocol.

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

3.4 Installing the Modem

Refer to Figure 3-2 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 loop connectors of the modem to the 4-20 loop wiring. This connection can be made at any convenient point after the 250 ohm loop resistor. Modem is polarity insensitive.

c. Connect the loop wires to the modem.

d. Turn on the computer.
3.5 Installing the PC Software onto the Hard Drive

**NOTE**
While it is possible to operate from the 1.44 megabyte floppy disk furnished with the 401-700-20 package, it is recommended that the software be installed on a hard drive with 0.5 megabytes or more of space available.

**NOTE**
The PC calibrator software is a DOS-based program. It cannot be installed directly from a Windows® operating system.

a. If you are using Windows®, go to the MS DOS prompt to install the PC software.

b. Place the 401-700-006 software disk into the disk drive (usually drive a:).

c. At the c: prompt, type a: install. The program will create a directory on the hard drive called HART60 and place the program file there.

d. At this point, the software is loaded onto the hard drive, you can:
•run the software from the DOS mode, or
•create a program icon (or shortcut) and run the software in Windows®.

3.5.1 Running PC Software from the Hard Drive as a DOS Program

To run the PC software from DOS:

a. Type cd:\HART60

b. Type HART60
3.5.2 Running PC Software from the Hard Drive in Windows 3.1®

To run the software from Windows 3.1:

a. Go to Program Manager and create a DE LOGO icon.

   a1) Click on File, choose New, select Program Item, press OK.

   a2) Type the following in the Program Item Properties menu:
       Description: HART60
       Command Line: c:\hart60\hart60.exe
       Working Directory: c:\hart60
       Click OK.

   Steps a1 and a2 should have placed the DE LOGO icon in a group in the Program Manager.

b. Double click on the DE LOGO icon and the HART program should run under a window.

c. The software starts communicating with the HART transmitter and returns with Tag ID and all existing configuration information. Press F1 at any time for on-line HELP.

   NOTE
   On new units the Tag ID is preset by the factory to the unit’s serial number.

d. Press F3 to read the HART transmitter’s present database. It takes several seconds to load the information in the transmitter. When finished loading, the screen shows the transmitter’s database parameters, except any user-defined strapping table information.
3.5.3 Running PC Software from the Hard Drive in Windows 95 or 98®

a. Click the **Start** button, and then point to **Settings**.

b. Click **Taskbar**, and then click the **Start Menu Programs** tab.

c. Click **Add** and type `c:\hart60\hart60.exe`

d. Click **Next**, and then double-click the **Programs** menu where Hart60 is to appear.

e. Choose a name and icon and then click **Finish** and **OK**.

Steps a. through e. should have placed the DE LOGO icon in the Programs menu.  

f. Double click on the DE LOGO icon and the HART program should run under a window.

g. The software starts communicating with the HART transmitter and returns with Tag ID and all existing configuration information. Press **F1** at any time for on-line **HELP**.

**NOTE**
On new units the Tag ID is preset by the factory to the unit’s serial number.

h. Press **F3** to read the HART transmitter’s present database. It takes several seconds to load the information in the transmitter. When finished loading, the screen shows the transmitter’s database parameters, except any user-defined strapping table information.
### 3.6 Description of the Function Keys

Figure 3-3 shows a PC software configuration screen and the following paragraphs describe the data fields.

<table>
<thead>
<tr>
<th>Function Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F2 Sys</td>
<td>Access System information.</td>
</tr>
<tr>
<td>F3 Read</td>
<td>Configure strapping table.</td>
</tr>
<tr>
<td>F4 View</td>
<td>Access toll-free service phone number.</td>
</tr>
<tr>
<td>F5 Write</td>
<td>Print configuration screen.</td>
</tr>
<tr>
<td>F6 Pt.CAL</td>
<td></td>
</tr>
<tr>
<td>F7 Cm</td>
<td></td>
</tr>
<tr>
<td>F8 File</td>
<td></td>
</tr>
<tr>
<td>F9 Exit</td>
<td></td>
</tr>
</tbody>
</table>

**Table: Configure strapping table.**

**Service:**
Access toll-free service phone number.

**Print:**
Print configuration screen.

---

**Figure 3-3**

*Calibration Menu Screen*

**NOTE**
If the data field has been edited but not sent to the transmitter (F5 Write), an asterisk (*) is displayed next to the data entry. Also, if an incomplete upload (F3 Read) has occurred, the data not received will have a question mark next to its data field.

**F1 HELP**
Access Help menu and Screens

**F2 SYS**
Access and configure System information.

- **Table:** Configure strapping table.
- **Service:** Access toll-free service phone number.
- **Print:** Print configuration screen.

---

*Example Configuration Screen*

<table>
<thead>
<tr>
<th>Tag-ID: LT-101</th>
<th>Serial # 109</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scratch Pad: Calibrated 9/97</td>
<td>Software Ver.-.--</td>
</tr>
<tr>
<td>Analog Loop Assign: Level</td>
<td>Range Pos. 2</td>
</tr>
<tr>
<td>Damping Time: 0 Sec</td>
<td>Type XX</td>
</tr>
</tbody>
</table>

**LEVEL CONFIGURATION**

- Level Units: feet
- Maximum Level: 20 ft
- Level Type: Standard

**VEssel CONFIGURATION**

- Vessel Units: gallons
- Maximum Capacity: 1000 gal
- Vessel Type: Vertical

---

**LRV (4 mA):** 0 ft
**URV (20 mA):** 20 ft

**LEVEL CALIBRATION**

- Lower Level: 0 ft
- Upper Level: 20 ft
- Lower Capacitance: 10 pF
- Upper Capacitance: 100 pF

---

**Date and Time:** 09-04-1999 15:17:31

**Save data file to disk**

**F1 Help**
3.6 Description of the Function Keys (cont.)

<table>
<thead>
<tr>
<th>Function Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F3 READ</strong></td>
<td>Reads all pertinent data from the transmitter and displays it on the screen. The Tag-ID is displayed in the communication window. Once the tag is read and a valid HART protocol transmitter is detected, you may use the ESC key to abort the interrogation if this is not the correct loop. However, if an incomplete upload has occurred, the data not received will have a question mark (?) next to its data field. The <strong>READ</strong> function also updates the realtime window level, vessel, capacitance, current and status after completing data load.</td>
</tr>
<tr>
<td><strong>F4 VIEW</strong></td>
<td>Displays the realtime values of level, capacity, capacitance, and loop current. If the transmitter status is anything other than OK, a detailed status message is displayed. Use the ESC key to abort the PV update.</td>
</tr>
<tr>
<td><strong>F5 WRITE</strong></td>
<td>Sends new or edited configuration data to the transmitter. Data that has been edited but not sent to the transmitter has an asterisk next to its data field.</td>
</tr>
<tr>
<td><strong>F6 PT. CAL</strong></td>
<td>Calibrates the Hart protocol transmitter using Point calibration described in paragraph 4.3. You must know exactly where your level is at the time of Point Cal so that the transmitter can equate the entered level value with the input signal. Try to hold the level constant for at least five seconds after executing the Point Calibration.</td>
</tr>
<tr>
<td><strong>F7 CM</strong></td>
<td>Selects the Communication Port: COM1, COM2, or DEMO. Selecting DEMO allows the user to navigate the PC software without having an electronic unit or modem attached.</td>
</tr>
</tbody>
</table>
3.6 Description of the Function Keys (cont.)

F8  FILE
This function loads or saves the data in a file. Files are saved with an .SLT and .TXT file extension. .TXT files are read and printed using word processing software.

F9  EXIT
Exit software.

3.7 Configuration

a. Begin calibration by using 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.

b. Select Level or Vessel in the Analog Loop Assign data field and press Enter.

NOTE
With an electrostatic separator, it is usually important to know the level in inches of the interface. For this reason, it is recommended that the analog loop be assigned to Level (e.g. inches).

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

d. Press F5 Write.

e. Move to the LEVEL CONFIGURATION menu using the down arrow or Tab key.

f. Select Level Units. The default is feet. Press Enter and choose the units that correspond to the level measurement.

g. Edit the Maximum Level to agree with the maximum tank height. The Maximum Level value is used to calculate the gallon capacity of the tank. Maximum Level is defined as nominal tank size - how much the tank actually holds. Do not confuse Maximum Level with URV.

h. Press F5 Write.

Application Note
When defining LRV and URV and associated calibration parameters, the point of reference for the measurement can be made from either the tip of the sensing element or the tank bottom.
3.7 Configuration (cont.)

Using the *tip of the sensing element as the reference point* provides an output signal that stops at the sensing element tip. Therefore, the output will read empty when the level of the material drops off the sensing element, even though there is still material below the tip of the sensing element.

Using the *tank bottom as the reference point* provides an output signal that stops at the bottom of the vessel. Typically, the sensing element does not extend to the bottom of the tank. Therefore, the output will still show some level reading even when the tank is truly empty.

i. Set 4 mA (LRV) and 20 mA (URV) points.

*LRV* (Lower Range Value) is the distance from either the sensor tip or tank bottom to the point that will be 4 mA.

*URV* (Upper Range Value) is the distance from either the sensor tip or tank bottom to the point that will be 20 mA.

j. Press F5 Write.

*Configuration is now complete.*

3.8 Calibration

There are two ways to calibrate the instrument:

1. Point calibration (*section 3.8.1*) requires moving the interface to two known levels.

2. Capacitance calibration requires entering picofarad values by typing in calculated picofarad values in the *LOWER CAPACITANCE* and *UPPER CAPACITANCE* menu items.
3.8.1 Point Calibration

The Point to Point method of calibration is the most accurate way to calibrate the system with two level points. The high or low level must be known and should be held steady for accurate calibration.

The Pt. Cal menu is accessed by pressing F6.

Use the following steps to do a Point Cal:

a. Apply power to the transmitter.

b. Fill the vessel with crude oil.

c. Bring vessel up to normal operating temperature and pressure.

d. Allow time for an interface to form.

e. Turn on the electrostatic grids.

f. Lower the water level until the sensing element is completely covered with oil (for best accuracy). See Figure 3-4.

g. Press F6. Type in a value for the low point of the two point calibration. Press Tab or (↓) to LO CAL and Enter.

Figure 3-4
Setting Low Point Calibration
3.8.1 Point Calibration (cont.)

**NOTE**
It is sometimes difficult or impossible to obtain a full tank of oil. If this is the case, lower the interface level to the lowest possible level and use this point to perform a low level calibration. The calibration will be linear and accurate even though the tank was not completely full of oil for the low point calibration. *The further apart the lower and upper calibration points are from each other, the better the accuracy of the system.*

h. Raise the interface level to a point just above the factory installed metallic inactive section. This ensures that the sensing element is completely covered with water. See Figure 3-5.

i. Press **F6** and enter the high level (in inches) that corresponds to the level of a full tank of water.

**NOTE**
It is sometimes difficult or impossible to obtain a full tank of water. If this is the case, raise the interface level to the highest possible level and use this point to perform a high level calibration, The calibration will be linear and accurate even though the tank was not completely full of water for the high point calibration. *The further apart the lower and upper calibration points are from each other, the better the accuracy of the system.*

j. Press **F5** Write.

![Figure 3-5](image-url)
*Setting High Point Calibration*
3.8.2 Calculating Zero and Span Capacitance

Calibration numbers consist of the low level capacitance and upper level capacitance measured in picofarads (pF). The low level capacitance is the amount of capacitance generated by the sensing element when covered in oil. The upper level capacitance is generated when covered with water.

The point calibration procedure (Section 3.9) recorded the inches and realtime capacitance for the low point and high point calibration. If it is impossible to perform a point calibration, the theoretical capacitance in picoFarads can be mathematically calculated.

To calculate the upper and lower level capacitance values, use the following data:

a. The sensing element typically generates 30 pF per foot of active length covered with oil. *(This value may vary due to the amount of entrained water in your crude oil.)*

b. The sensing element generates 56 pF per foot for each foot of active length covered with water.

c. Each foot of factory-supplied metallic inactive generates 47 pF.

d. The packing gland generates 40 pF.

**NOTE**

Above data applies only to sensing element model 700-2-224.

To obtain the proper calibration numbers you will need to know:
- sensing element model number (700-2-224).
- sensing element insertion length.
- sensing element factory installed metal inactive length.
- desired length of sensing element to be covered to produce zero percent output, (usually set to the sensing element tip).
- desired length of sensing element to be covered by the interface to produce 100 percent output.
3.8.2 Calculating Zero and Span Capacitance (cont.)

Refer to Figure 3-6, Application Example.

**ZERO CAPACITANCE**

\[ C_{(ZERO)} = C_{(GLAND)} + C_{(INACTIVE)} + C_{(OIL)} \]

\[ C_{(ZERO)} = 40 + (3\text{ft.})(47) + (8.5\text{ft.})(30) \]

\[ C_{(ZERO)} = 40 + 141 + 255 \]

\[ C_{(ZERO)} = 416 \text{ Picofarads} \]

**SPAN CAPACITANCE**

\[ C_{(SPAN)} = C_{(GLAND)} + C_{(INACTIVE)} + C_{(WATER)} + C_{(OIL)} \]

\[ C_{(SPAN)} = 40 + (3\text{ft.})(47) + (7.5\text{ft.})(56) + (1\text{ft.})(30) \]

\[ C_{(SPAN)} = 40 + 141 + 420 + 30 \]

\[ C_{(SPAN)} = 631 \text{ Picofarads} \]

To enter the calculated values as calibration points in the PC software:

a. Press Tab or (↓) to Level Calibration menu.

b. Enter Lower Level value. Press Tab or (↓).

c. Enter Upper Level value. Press Tab or (↓).

d. Enter Lower Capacitance \( C_{(ZERO)} \) value. Press Tab or (↓).

e. Enter Upper Capacitance \( C_{(SPAN)} \) value. Press Tab or (↓).

f. Press **F5** Write.
3.8.2 Calculating Zero and Span Capacitance (cont.)

LEVEL CONFIGURATION
Level Units...........feet Maximum Level........12 ft Level Type...........Standard

VESSEL CONFIGURATION
Vessel Units.........gallons Maximum Capacity.....12000 gal Vessel Type..........Horizontal

LRV ( 4 mA ).........0 ft LRV 0 %
URV ( 20 mA ).........8.5 ft URV 100 %

Status: * OK *

Save data file to disk

Figure 3-6
Application Example
3.9 Configuring the Digital Integral Meter

A digital integral meter (401-44-1) is available as an option for the Universal III electronic unit. Refer to Section 2.3 for meter installation.

The digital integral meter 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.

To program the meter, access the Meter submenu (Figure 3-7):

Press F2.
Select Meter from the list of options.

![Figure 3-7 Meter Display Menu](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.

Factory default settings are:
Min Value = 4
Max Value = 20

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

Min Value = LRV
Max Value = URV

Refer to Figure 3-8 for an example of setting the display range of the meter.
**Figure 3-8**

*Digital Integral Meter Configuration Example*

In this example:  
- when level is at LRV point, meter displays 0.00 mA.
- when level reaches 1185 gallons, meter displays 18.00 mA.

**NOTES**

A new meter (with factory default settings) attached to an electronic unit that is not connected to a sensing element (e.g. bench check) will read **U5xx**, (under range) 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 occurs, the meter displays **R** instead of a value.

—**Meter displays U (Under range)**

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

Perform normal troubleshooting procedures for an over or under range condition.

When a smart transmitter is powered down or the ribbon cable is disconnected, there is a 1 minute delay before the DIM begins to display.

If the display becomes garbled:
- remove power from the smart transmitter,
- wait one minute,
- re-apply power to restart the meter.
SECTION 4  
CALIBRATION WITH  
MODEL 275 CALIBRATOR  
(with  
DREXELBROOK DEVICE  
DESCRIPTION)

### 4.1 Drexelbrook Device Description

The Drexelbrook device description for the HART Model 275 calibrator makes it easy to calibrate a Universal III electronic unit. The device description is software stored in the memory module (located in the back portion) of the calibrator.

To determine if your Model 275 calibrator is loaded with the Drexelbrook device description, do the following steps:

- Turn on the calibrator.
- From the top screen, push **1. Offline**.
- Push **1. New Configuration**
- A **Table of Contents** is shown that list all the Manufacturers in alphabetical order.
- Drexelbrook is third on the list in the current release.
- Select the Manufacturer (Drexelbrook) and a list of supported devices is displayed (Universal III).
- Return to top screen, by backing up from arrow keys.

The Memory Module with the device description can be purchased as a direct replacement either from Drexelbrook (401-700-25) or from the local Fisher-Rosemount Service Center.

Appendix A describes configuration of the Universal III electronic unit with a Rosemount 275 handheld calibrator without a device description.
4.2 Configuration

After the Universal III electronic unit is installed and loop power is applied, per Section 2, do the following:

1. Connect the Model 275 calibrator as shown in Figure 4-1.

2. Turn on the calibrator and look for the **ONLINE** screen to appear. **ONLINE** means that the calibrator has recognized the Universal III transmitter and is ready to communicate.
Refer to the following block diagram.
Following is the keystroke sequence to calibrate the Universal III transmitter using the Model 275 calibrator.

Select **Device Setup**.
Select **Configuration Menu**.
Select **Level Config**.

Select **Level Type**—edit **Level Type**—return to **Level Config** screen.

Select **Level Units**—edit **Level Units**—return to **Level Config** screen.

Select **Max Level**—edit **Max Level**—return to **Level Config** screen.

Select **LRV**—edit **LRV**—return to **Level Config** screen.

Select **URV**—edit **URV**—return to **Level Config** screen.

Select **Damp Time**—edit **Damp Time**—return to **Level Config** screen.

Select **Chg Anlg Loop Assign**—edit **Current Loop Assign**. Current loop assign is **Level**. Go to next screen and select **Exit**.
4.3 Point Calibration

Point calibration uses two actual levels in the vessel for calibration. The further apart the two points are for the calibration, then the better the accuracy of the overall measurement. Refer to the following diagram. Following is the keystroke sequence for Point Calibration using the Model 275 Communicator.

Select **Device Setup**.
Select **Configuration Menu**.
Select **Calibration**.

Select **Point Cal**—select either **Low Point Cal** or **High Point Cal** depending on whether you plan to raise or lower the level for your second point—edit value to agree with the present actual level and return to **Point Cal** screen.

Raise or lower the interface level and repeat the above steps.

**Exit**—Calibration is complete for one point.
4.4 D/A Trim

Refer to the following diagram for the D/A Trim sequence. D/A Trim allows a field reference meter to be connected to the 4-20 loop for adjusting transmitter output to match 4-20 loop current.

Strapping Table configuration is not used with electrostatic desalters because the output is linear with height.
A digital integral meter (401-44-1) is available as an option for the Universal III electronic unit for local indication (refer to Section 2.3).

The digital integral meter 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.

To program the meter, access the meter configuration menu (Figure 4-2):

- go to Start>Online>Device Setup>
- Configuration> Meter Config.

![Figure 4-2](image)

**Meter Configuration Menu**

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.

Factory default settings are:
- Min Value = 4
- Max Value = 20

To set the meter display range equal to the calibration range:
- Min Value = LRV
- Max Value = URV

Refer to Figure 4-3 for an example of setting the display range of the meter.
**Figure 4-3**

*Digital Integral Meter Configuration Example*

In this example: when level is at LRV point, meter displays 0.00 mA. 
when level reaches 1185 gallons, meter displays 18.00 mA.

**NOTES**

A new meter (with factory default settings) attached to an electronic unit that is not connected to a sensing element (e.g. bench check) will read **U5xx** (under range), 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 occurs, the meter displays **R** instead of a value.

—**Meter displays U (Under range)**
If an under range condition occurs, the meter displays **U** instead of a value.

Perform normal troubleshooting procedures for an over or under range condition.

When a smart transmitter is powered down or the ribbon cable is disconnected, there is a 1 minute delay before the DIM begins to display.

If the display becomes garbled:
- remove power from the smart transmitter,
- wait one minute,
- re-apply power to restart the meter.
SECTION 5
TROUBLESHOOTING

5.1 Identifying a Problem/Symptom

Use Table 5-1 as a guide to find and correct a problem when it occurs. Most problems are not related to electronic unit failure. It is important to be methodical when tracking down a problem. If you experience a problem that you cannot solve using this guide, call the Drexelbrook Service Department at 1-800-527-6297 (USA and Canada) or 215-674-1234. You may also e-mail us at the Internet address: Service@Drexelbrook.com. Further service information may be found at our Internet World Wide Web address http://www.drexelbrook.com.

If difficulty occurs, divide the controller into its components, e.g. incoming power, electronic unit, sensing element, coax cable, etc. Each system component can be tested individually. Most tests can be performed easily using only a screwdriver, digital volt-ohmmeter, and an analog ohmmeter (such as a Simpson 260, Triplett, or others).

If the electrostatic interface controller is still not working properly after completing the tests for each component, there may still be a problem but not related to the hardware. Field experience has shown that most field problems are due to water damage, incorrect assumptions made about vessel conditions and/or incomplete separation of the crude oil.
<table>
<thead>
<tr>
<th>Problem/Symptom</th>
<th>Tests in order of probability</th>
<th>Reference Section</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model 275 Calibrator</strong> givens error message that no device was found</td>
<td>Check calibrator connections</td>
<td>5.2 and 5.3</td>
<td>Often a result of loop connection problems</td>
</tr>
<tr>
<td></td>
<td>Check for 250Ω resistance (min.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check voltage at transmitter</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check transmitter</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td><strong>Model 275 Calibrator</strong> givens error message that device could not be identified</td>
<td>Check calibrator connections</td>
<td>5.2 and 5.3</td>
<td>Often a result of loop connection problems</td>
</tr>
<tr>
<td></td>
<td>Check for 250Ω resistance (min.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check voltage at transmitter</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check transmitter</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td><strong>Can't communicate with transmitter using Drexelbrook PC Software</strong></td>
<td>Check calibrator connections</td>
<td>5.2 and 5.5</td>
<td>Often a result of loop connection problems</td>
</tr>
<tr>
<td></td>
<td>Check for 250Ω resistance (min.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check voltage at transmitter</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check transmitter</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Try another modem</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check supply voltage</td>
<td>5.2.1</td>
<td></td>
</tr>
<tr>
<td><strong>0 mA output all the time</strong> (no measurable output current at any time)</td>
<td>Check voltage at transmitter</td>
<td>5.2 (5.3, 5.4, or 5.5)</td>
<td>Probable loop problem. Faulty connection in loop.</td>
</tr>
<tr>
<td></td>
<td>Check polarity of loop</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Test transmitter</td>
<td>5.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check coax cable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transmitter damaged due 5.6 to lack of electrostatic filter</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Output less than 4 mA</strong></td>
<td>Electronic unit and/or sensing element not properly grounded</td>
<td>2.2</td>
<td>Good earth ground required</td>
</tr>
<tr>
<td></td>
<td>Check for proper span range jumper position</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inadequate power supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coax cable is damaged</td>
<td>5.8</td>
<td></td>
</tr>
<tr>
<td><strong>More than 20 mA output all the time</strong> (output current always exceeds 20 mA)</td>
<td>Check for moisture in head of sensor sensing element</td>
<td>5.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Test transmitter</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Test coax cable</td>
<td>5.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check calibration</td>
<td>Section 6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shield wire grounded at sensing element or transmitter</td>
<td>Figure 2-12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shield wire at sensing element must be cut and taped. Shield wire at transmitter must be connected to shield screw.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problem/Symptom</td>
<td>Tests in order of probability</td>
<td>Reference Section</td>
<td>Comments</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------</td>
<td>-------------------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>Output drifts</strong> (output Test transmitter with varies slowly over time e.g. hours or days)</td>
<td>May be normal changes in interface level.</td>
<td>5.6</td>
<td>Pull sample from sample taps to verify interface level.</td>
</tr>
<tr>
<td><strong>Output drifts</strong> - (sample taps show interface is element conduit steady)</td>
<td>Moisture in sensing conduit</td>
<td>5.7</td>
<td>Dry conduit and conduit. Find source of moisture.</td>
</tr>
<tr>
<td></td>
<td>Test sensing element</td>
<td>5.7</td>
<td>Special potting compound available for severe moisture problems.</td>
</tr>
<tr>
<td></td>
<td>Test transmitter</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td><strong>Output intermittent</strong> - Check sensing element/cable connections (output jumps quickly usually between &gt; 0mA and some on-scale value)</td>
<td>Supply voltage too low</td>
<td>5.2.1</td>
<td>Faulty sensing element or cable connection.</td>
</tr>
<tr>
<td></td>
<td>Too much loop resistance</td>
<td>Figure 5-1</td>
<td></td>
</tr>
<tr>
<td><strong>Inaccurate readings</strong> (Level readings are incorrect compared to Sightglass usually does not represent internal tank conditions)</td>
<td>Interface is not forming</td>
<td></td>
<td>Take samples over again. Ignore sightglass. See Appendix B. (Misinterpreting Emulsion)</td>
</tr>
<tr>
<td><strong>System needs frequent recalibration (zero pF continually increase)</strong></td>
<td>Sediment builds up, covering bottom of sensor, elevating the lower capacitance value</td>
<td></td>
<td>Tank needs maintenance. See Appendix B.</td>
</tr>
<tr>
<td><strong>Oil in discharge water</strong></td>
<td>Calibration is incorrect</td>
<td>Section 3 or 4</td>
<td>Check interface.</td>
</tr>
</tbody>
</table>
5.2 Troubleshooting the Loop Connection

Specific loop connections vary according to installation. Figure 5-1 shows a typical loop connection. When troubleshooting the loop connection, verify the following items.

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

**Figure 5-1**

*Typical System Loop*

5.2.1 Supply Voltage Check

On the transmitter:

a. Measure across V— and V+.

b. Voltage should be greater than 12 Vdc.
5.3 Model 275 Calibrator cannot identify or find device

If the Model 275 calibrator (generic) gives error message that no device description was found, use the following flowchart to troubleshoot.

![Flowchart](image)

1. Check calibrator connections to the loop per the loop drawing Figure 5.1.
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. If wiring is correct, go to section 5.6 to test transmitter.
5.4 Model 275  
Calibrator with device description cannot identify or find device

This condition may be the result of trying to calibrate a transmitter with software less than version 3.0 (transmitters shipped prior to approximately January 1997). There are two options you can use to identify the device and delete the error message.

—Option 1
Configure the transmitter as a "generic" device per the instructions in Appendix B of this manual.

—Option 2
Contact the Drexelbrook Service department (1-800-527-6297) about upgrading your transmitter to the latest software.
5.5 Universal III

transmitter does not communicate with Drexelbrook PC software

Start

Modern does not communicate with transmitter.

Is the loop current between 3.5 and 23.5 mA?

Yes

No

Is there a minimum of 250 ohms loop resistance?

Yes

No

Are you connected to a DCS?

Yes

No

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

Yes

No

Is it polling?

Yes

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.

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.

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

1. Check calibrator connections to the loop per the loop drawing Figure 5-1.
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. If wiring is OK, go to section 5.6 to test transmitter.
5.6 Troubleshooting the Electronic Unit

Troubleshoot the electronic unit using one of the following tests, depending on the calibrating device.

The following tests require the use of high quality fixed capacitors in the picofarad ranges or a Drexelbrook capacitance substitution box (C-box). Contact the Drexelbrook Service department if you need a capacitance substitution box. Fixed temperature stable capacitors (NPO types) can often be found at many electronic supply houses.

—ELECTRONIC UNIT TEST

Using a PC or 275 Calibrator with Device Description

1. Determine the span range currently selected on the electronic unit. See Figure 5-2.

2. Using the MAX pF values listed in Figure 5-2, 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.

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

4. Place capacitor on electronic unit from probe to ground terminals.

5a. Using a PC - Using the real-time view (F4), verify that the displayed capacitance value is within the value and tolerance printed on the test capacitor. If using a Drexelbrook C-box, be sure to add the standing capacitance of the box (10pF low range, 20 pF normal range).

5b. Using a Model 275 calibrator with device description - Viewing the HOME screen, verify that the displayed capacitance value is within the value and tolerance printed on the test capacitor. If using a Drexelbrook C-box, be sure to add the standing capacitance of the box (10pF low range, 20pF 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.

<table>
<thead>
<tr>
<th>SPAN RANGE</th>
<th>JUMPER POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>MAX pF</td>
<td>20</td>
</tr>
</tbody>
</table>

Figure 5-2
Span Range Capacitance Values
5.6 Troubleshooting the Electronic Unit
(cont.)

—ELECTRONIC UNIT TEST
Using a Model 275 Calibrator without a Device
Description (Generic Mode)

1. Visually verify the span range of the electronic unit.

2. Using the C-box, adjust the capacitance until 4 mA is achieved. Record value.

3. Adjust C-box capacitance until 20 mA is achieved. Record value.

4. Using Figure 5-2, verify that the capacitance value recorded at 20 mA is less than the MAX pF value for the Span Range Position of the electronic unit.

<table>
<thead>
<tr>
<th>SPAN RANGE</th>
<th>JUMPER POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MAX pF</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>450</td>
</tr>
<tr>
<td>2000</td>
</tr>
<tr>
<td>10000</td>
</tr>
<tr>
<td>45000</td>
</tr>
</tbody>
</table>

Figure 5-2
Span Range Capacitance Values

5. Verify that the loop configuration is Level Config (signal output linear to level vs. Vessel Config).

6. Subtract pF value recorded for 4 mA from the pF value recorded for 20 mA. Divide this number in half.
   Example: 4 mA = 120 pF  20 mA = 800 pF
   800 pF - 120 pF = 680 pF
   680 pF ÷ 2 = 340 pF

7. Adjust the capacitance box (C-box) to the number figured in step 6. The signal should read approximately 50%.

8. If the display reads 50%, the unit is working properly. If the display is is not accurate, contact the Service department at 1-800-527-6297 for further assistance.
If symptoms point toward calibration drift, it is important to determine if the apparent drift is coming from the electronic unit, the sensing element, or the application of the equipment. The following test determines if the electronic unit is stable. In most cases, no drift will be found in the electronic unit.

1. Remove coaxial cable from the electronic unit terminals.

2. Without changing any data, connect a Drexelbrook capacitance substitution box (401-6-8) or an NPO test capacitor from the PROBE terminal to the GND terminal on the electronic unit. (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 electronic unit. If the loop current has changed more than 1% during the test period, then the unit is defective. Please contact the Service department for further instructions regarding repair or replacement.

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.

**NOTE**
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 metal pipe or other metal container that is filled with just plain tap water.
5.7 Troubleshooting the Sensing Element (cont.)

The following test can be performed in the vessel or in a metal test pipe filled with water.

1. See Figure 5-3. Disconnect the wires that are attached to the sensing element. Using an analog meter (such as a Simpson 260 or a Triplett) set to the R x 10,000 scale. Measure from the steel center rod to the condulet ground or the outside of a metal test pipe or tank. A good sensing element will measure an open circuit.

2. If a low ohmmeter reading was measured (less than 50,000 ohms) and the sensing element is covered with water, lower the level. If the ohmmeter reading is no longer low, it is highly likely that the sensing element insulation has been cut or damaged. The sensing element should be removed for further inspection.

3. If a low reading was measured regardless of where the tank level is, look carefully for moisture or process material inside the sensing element condulet head and associated conduit. If foreign material is present, clean with solvent and dry compressed air. Measure the sensing element resistance again.

**NOTE**

An analog ohmmeter must be used for this test due to its ohm per volt rating. (A digital meter will provide erroneous readings).

*Figure 5-3*

*Testing the Sensing Element*
5.8 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.
509-76-718 Series Electrostatic Interface Controller

SMART TRANSMITTER
409-10XX

Company __________________________ City-State __________________________ Purchase Order # __________________________
Your Name __________________________ Phone # __________________________ Fax # __________________________
Drexelbrook
DEorder # __________________________ E-mail __________________________

ELECTRONIC UNIT
Model #: 409
Serial #: __________________________
Chassis Mounted in same housing as sensor?  [ ] Yes  [ ] No  Length of coax __________ ft.

SENSOR
Model #: 700
Serial #: __________________________
Insertion Length __________________________
Cote-Shield
Length (if present) __________________________
Metal Inactive
Length (if present) __________________________
NPT Mounting
[ ] ¾  [ ] 1  [ ] 1½  [ ] 2 inch
Flange size __________________________

VEssel
Construction:
[ ] Metal  [ ] Plastic  [ ] Concrete
Describe grounding method __________________________
Is this an interface measurement?  [ ] No  [ ] Yes
Agitation?
[ ] No  [ ] Yes
Horsepower __________________________

CALIBRATION
Has the system been calibrated?  [ ] No  [ ] Yes
If yes, describe calibration methods e.g., done in bucket, tank emptied and filled, calibrator used, other.
________________________
________________________
________________________

Detailed description of problem: __________________________
________________________
________________________
________________________

TROUBLESHOOTING GUIDE
Drexelbrook Engineering Company
Service Department (800) 527-6297 FAX(215) 443-5117

Vessel Sketch
Show principal tank dimensions, including vessel construction, mounting location, nozzles, and other tank structure, level, etc.

PROCESS CONDITIONS
Material in tank __________________________ Percent water __________________________
Temperature __________________________ deg. F
Conductivity __________________________ mhos/cm
Pressure __________________________ p.s.i.
Dielectric constant __________________________

CONFIGURATION DATA
Level Units __________________________ Vessel Units __________________________
Maximum Level __________________________ Vessel Type __________________________
Level Type __________________________ Lower level __________________________
LRV __________________________ Upper level __________________________
URV __________________________ Lower Capacitance __________________________
[ ] Yes  [ ] No  [ ] No  [ ] Yes
Horsepower __________________________
________________________
________________________
________________________
________________________
________________________
________________________

Circle range span jumper position (located on side of chassis) 1 2 3 4 5 6

49
Measure DC voltage at +/- terminals of the transmitter ______ vdc. Polarity correct? Yes _____ No _____
Measure DC loop current at the transmitter ______ mA. (It should be between 3.5 and 24mA).
Measure the total loop resistance ______. (It should be between 250 and 550 ohms when attempting to communicate with the transmitter)
Are the communicator leads connected in parallel to the loop? (see Figure 1) Yes _____ No _____
Are they connected on the transmitter side of the 250 ohm (min.) resistor? Yes _____ No _____
Are there any other smart devices in the loop? Yes _____ No _____
Are they communicating? Yes _____ No _____ (If “yes”, make them stop communicating before continuing)
What output is the transmitter providing? mA _____

**Method of communicating**

- Rosemount 268 Handheld Calibrator
- Drexelbrook Laptop software
  - Software version ______
- Rosemount 275 Handheld Calibrator
  - Has Drexelbrook device description? Yes _____ No _____
- Other
  - Describe ______________________________________

**Communication Problems**
Check electronic unit response by disconnecting the sensor leads and placing a 100 pF capacitor across CW - G

What serial port is the modem connected to? Com1 _____ Com2 _____
Have you had a mouse or other device connected to the same port since you last re-booted? Yes _____ No _____
What operating system are you using? Windows 95 _____ Windows 98 _____ Windows 3.11 _____ DOS _____ Don't know _____
Is your computer running on AC or battery power? AC _____ Battery _____ Is your battery fully charged? Yes _____ No _____
Do you have any power saving features enabled that may turn off the serial port? Yes _____ No _____ Don't know _____

Make sure there is sufficient loop resistance (250 - 550 ohms) try adding an extra 100 ohm resistor in series and attempt to communicate.
Try connecting your modem or calibrator across the 250 - 550 loop resistor (instead of across the loop) communications improved?

Is your Hand-held calibrator battery fully charged? Yes _____ No _____
Disconnect the coaxial cable at the transmitter terminals. Can you communicate? Yes _____ No _____
Are there any devices in the loop, or in close proximity to the transmitter that may generate electrical noise? Yes _____ No _____
The loop noise specification is 0.2Vdc PP. Does loop noise exceed this spec.? Yes _____ No _____
Can you communicate with the transmitter if you use a different power source or battery pack? Yes _____ No _____
If using laptop software there may be a software conflict or com port conflict that may be resolved by not running Windows. To run the laptop software in DOS mode perform the following:

Reboot the computer, after the screen showing your computer’s memory press the F8 key.
In the window that follows select 6 (command prompt only) and hit enter.
This should put you at C:\> from this point type CD HART Then type HART60 to launch the laptop software in DOS mode.
509-76-718 Series Electrostatic Interface Controller

**SENSING ELEMENT CHECK**
- Disconnect the sensor wires.
- Measure sensor resistance. A good sensor should read open circuit.

**FILTER CHECKS**
- Sensor Mounted 385-28-4 electrostatic filter
- Transmitter Mount 385-28-3 electrostatic filter

**COAX CABLE CHECK**
- Correct Reading = Open Circuit
- All 3 Conductors
- Check for Short Circuit
- Resistance readings:
  - CW - G =
  - CW - S =
  - SH - CW =

**RESISTANCE CHECK**
- PAD - LUG = 580 - 640 ohms

**SUPPLY VOLTAGE CHECK**
- Measure the voltage across the electronic unit V+ and V- terminals. The voltage must be greater than 12 VDC

**ELECTRONIC UNIT CHECK**
- Disconnect sensor wires.
- Output as viewed in real time view or with a hand held mA meter should drop below 4 ma. and display neg. level values.
- Place several test capacitors across the Probe (blue) and GND (green) screws. The real time view should accurately display the picofarads of the selected capacitor.

**ELECTRONIC UNIT DRIFT TEST**
- Disconnect sensor wires.
- Place an NPO type capacitor across the CW and GND terminals. Choose a value that produces an on scale ma. reading. If calibration data is known choose a value midway between the lower capacitance and upper capacitance, typically 40 - 2000 pF.)
- Note the output current. This value should pass or fail.

**GROUNDING**
- Measure ground continuity from housing ground screw to metal wall of vessel. A good ground will measure less than 5 ohms.

**COMPUTER SERIAL PORT CHECK**
1. Remove the modem from the serial port.
2. Measure the DC voltage from pin #3 to ground. You should measure +5 V
3. Launch the D.E. PC software. Select the com port using the D.E. software you select the com port observe your voltmeter the voltage reading should change from +5 VDC to -5 VDC as the port tries to communicate.
4. If the voltage never changes the port is not being turned on. The port setting may be wrong or the serial port may be defective.
### 5.10 Telephone Assistance

If you are having difficulty with your Drexelbrook equipment, and attempts to locate the problem have failed, notify your local Drexelbrook representative, or call the factory toll free 1-800-527-6297 or 1-215-674-1234. Drexelbrook Engineering Company is located at 205 Keith Valley Road, Horsham, PA 19044.

To help us solve your problem quickly, please have as much of the following information as possible when you call:

- Instrument Model # ____________________________
- P.O. #_________________________________________
- Date___________________________________________
- Insertion Length_________________________________
- Application_____________________________________
- Material being measured_________________________
- Temperature_____________________________________
- Pressure________________________________________
- Agitation_______________________________________
- Brief description of the problem ___________________
- Checkout procedures that failed ___________________

### 5.11 Equipment Return

Do not return equipment without first contacting the factory for a return authorization number. Any equipment being returned must include the following information in addition to the above.

- Reason for Return_______________________________
- Return Authorization # _________________________
- Person to contact at your company__________
- “Ship To” address_____________________________

If available, please also include the original P.O. number and the original Drexelbrook order number.

To keep the paperwork in order, you must include a purchase order with returned equipment, even though it may be coming back for warranty repair. You will not be charged if the equipment is covered under warranty. Please return your equipment with freight charges prepaid. We regret that we cannot accept collect shipments. Drexelbrook usually has exchange units available for faster turnaround of repair orders. If you prefer your own unit repaired rather than exchanged, please mark clearly on the return unit, “Do Not Exchange”.

Spare instruments are generally in factory stock. If the application is critical, a spare chassis is recommended.
5.12 Field Service  
Trained field servicemen are available on a time-plus-expense basis to assist in start-ups, diagnosing difficult application problems, or in-plant training of personnel. Contact the service department for further details.

5.13 Customer Training  
Periodically, Drexelbrook instrument training seminars for customers are held at the factory. These sessions are guided by Drexelbrook engineers and specialists, and provide detailed information on all aspects of level measurement, including theory and practice of instrument operation. For more information about these valuable workshops, write to Drexelbrook Engineering, attention: Communications/ Training Group, or call direct (215) 674-1234.
SECTION 6
SPECIFICATIONS

6.1 Electronic Unit Specifications

--Power Requirement
12 to 50 Vdc
Minimum of 12 Vdc at 20 mA

--Input Range
409-1000: 1.0 to 45,000 pF

--Output Range
4-20 mA and HART Protocol

--Accuracy
± .25% of range. Accuracy includes the combined effects of linearity, hysteresis, and repeatability. It refers to the electronic unit 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 electronic unit 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.

--Fail-Safe
Low-Level Fail-Safe (LLFS) standard.
Also called direct-acting because current increases as the level increases.
High-level Fail-Safe (HLFS).
Also called reverse-acting because current decreases as level increases.
6.1 Electronic Unit Specifications (cont.)

**NOTE**

THERE ARE NO DEVICES THAT ARE ABSOLUTELY “fail-safe.” Fail-safe means that in the event of the most probable failures, the instruments will fail safely. Probable failures include things such as loss of power and transistor and component failures. If your application needs absolute fail-safe, a back-up instrument should be installed.

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

—Calibration Adjustments
Range Span, 6 positions (side panel)

—Lowest Permitted Resistance
(bare sensing element to ground) causing 5% error in each model:
- 600 ohms - 409-1000
- 100K ohms - 409-1030

—Intrinsic Safety

6.2 Coaxial Cable Specifications

—Coaxial Cable Length
150 feet (45.6M) maximum.

—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 (3M).
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.
WATER IN CONDULETS AND CONDUIT is the leading cause of equipment failure. All conduit must be sealed and drain breathers must be used. Non-corrosive RTV potting compound (part number 290-1-18) is available to fill the sensing element housing if moisture infiltration is a problem.

LACK OF ELECTROSTATIC FILTER (part number 385-28-4 or 385-28-1) on installations that use high voltage grids will cause a full scale output or false high readings when the electric grids are switched on. By not using this filter, damaging voltage can reach the electronic unit.

MISINTERPRETING THE ELECTRICAL PROPERTIES OF THE EMULSION LAYER. Depending on electrical nature of the emulsion layer it may be read as either oil or water by the Drexelbrook interface system. If the emulsion layer consists primarily of water with some oil droplets, then the interface control will read the emulsion layer as water. If the emulsion layer is mainly oil with some water droplets, the level control will read the emulsion as oil. Typically the level control reads the level close to the middle of the emulsion layer. It is possible to look at a sample, noting its black color and assume it is oil. An electrical test to detect conductivity may prove it is actually water.

VESSEL UPSET. When the interface monitoring system produces questionable output and equipment failure is not the cause, check for the proper functioning of the electrostatic separator. The grids may be malfunctioning or shut off.

- Is it possible that chemical addition is required, or not functioning, or improper?
- Has temperature control been lost?
- Has the throughput been increased, reducing the residence time?

All of these vessel upset conditions can result in no interface forming and the Drexelbrook system will read no interface.

ZERO SHIFT. Careful notes may reveal that over time the
number of picofarads required to produce 4 mA is increasing. An increasing zero calibration value may indicate a buildup of sludge, silt and sand on bottom of vessel that has begun to cover the sensing element. The vessel needs to be cleaned. Zero calibration data can be easily recorded using a 401-6-81 calibrator or by using the realtime view on the smart transmitter. In extreme cases the residence time, throughput, and efficiency of the electrostatic separator may be significantly degraded. Other indications of bottom buildup are that the zero check tap is clogged, and the back wash system is inoperative or not run regularly.