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# Installation and Operating Instructions

Series 509-71-20  
Smart Auto-Cal™ System  
with HART® Protocol  
using 409-9100-57  
Electronics Package

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Series 509-71-20  
Smart Auto-Cal™ System  
with HART® Protocol  
using 409-9100-57  
Electronics Package

*"When the measurement matters"*

**AMETEK®**  
**DREXELBROOK**

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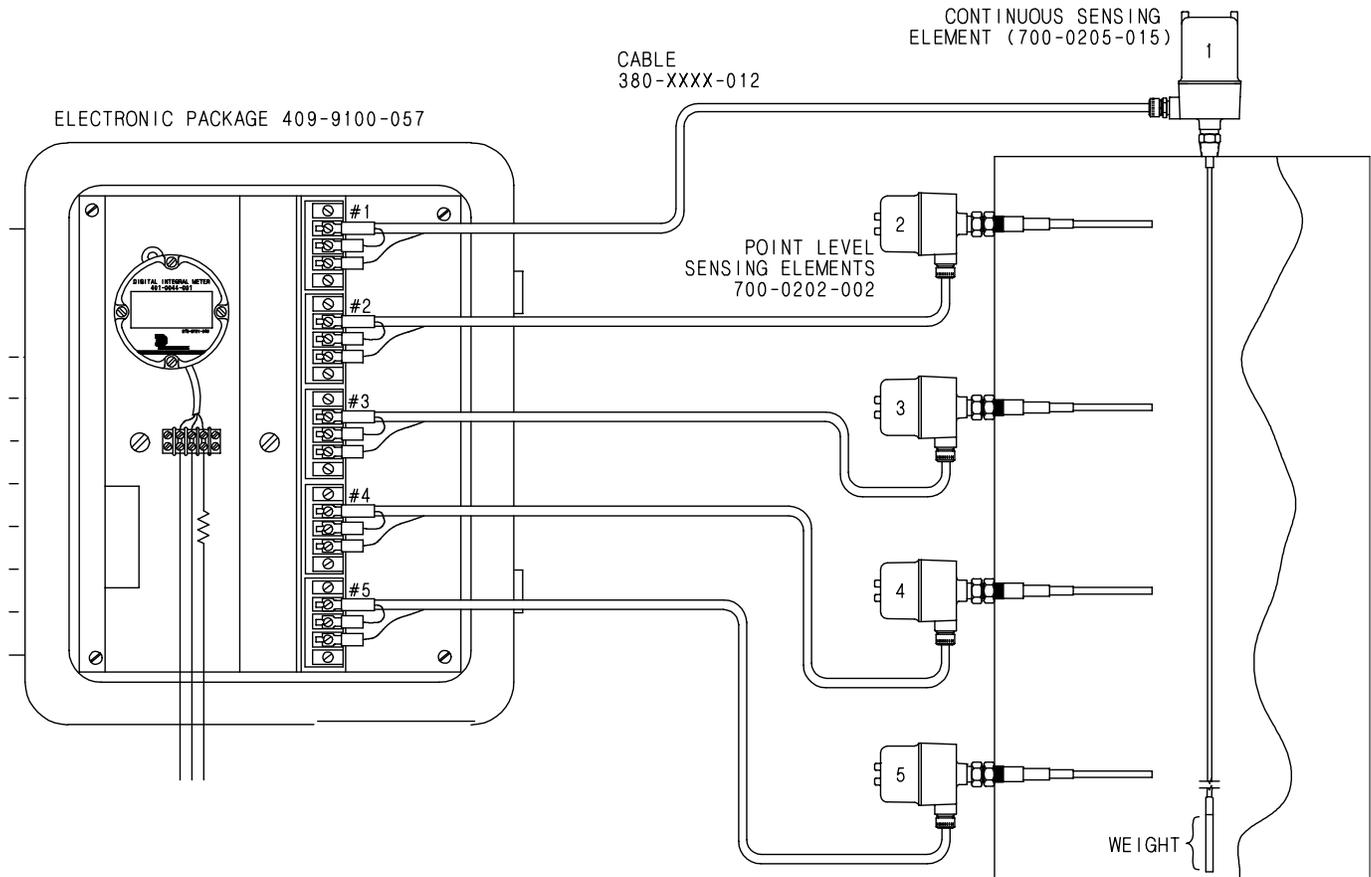
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## SECTION 1 INTRODUCTION

### 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**

**5 0 9 - 0 0 7 1 - 0 2 0** 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.

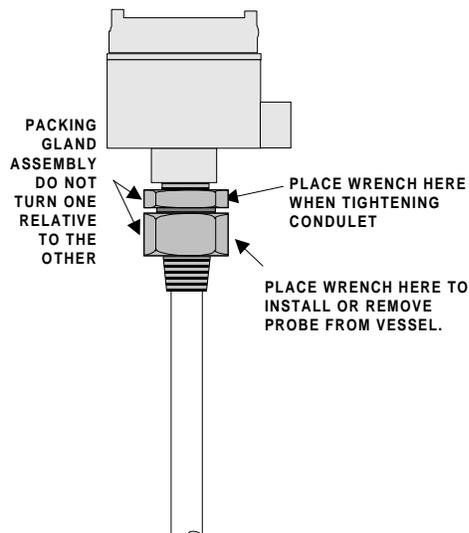
### 2.2 Mounting Location and Dimensions

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.



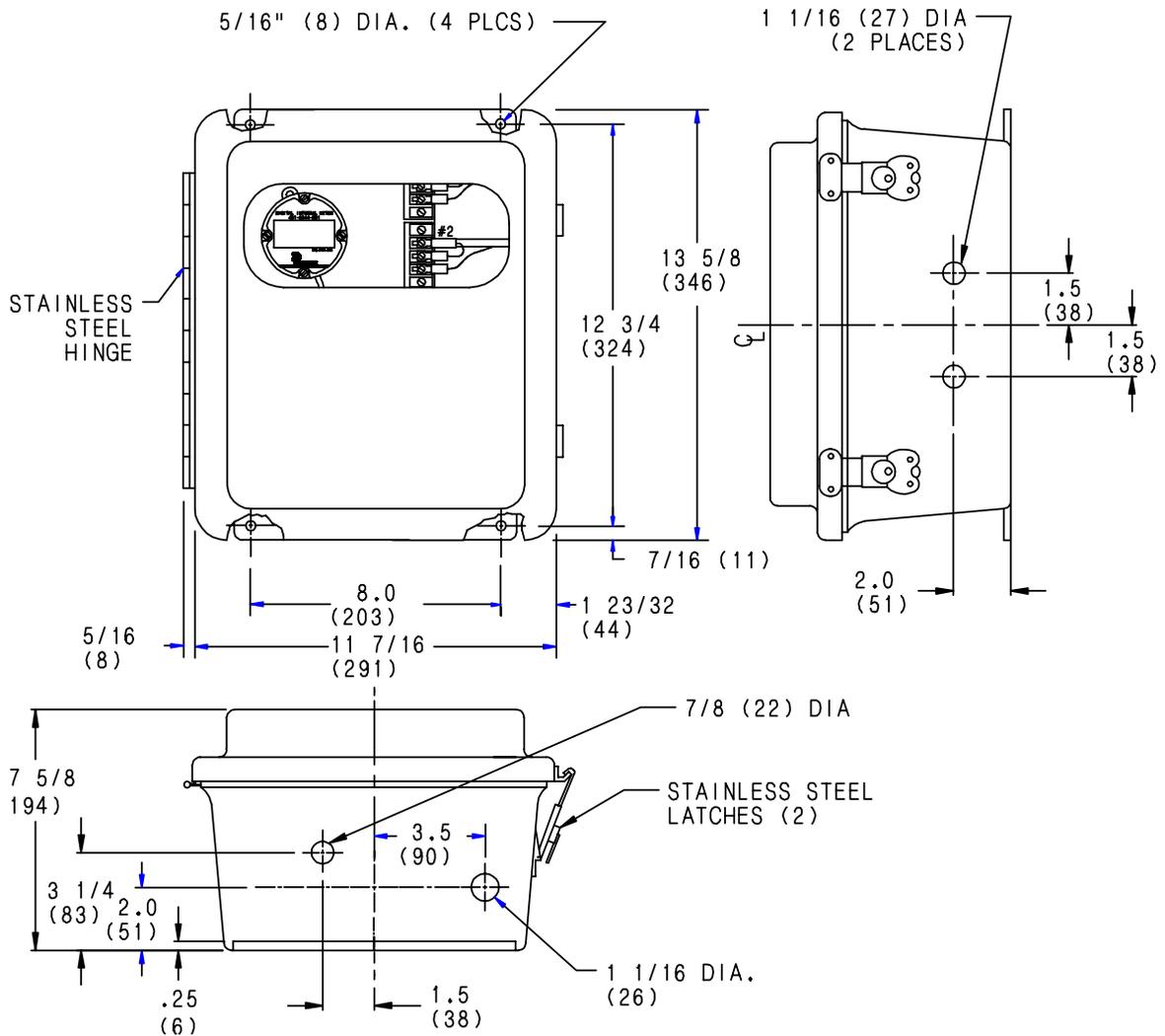
**Figure 2-1**  
**General Sensing Element Installation**

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).

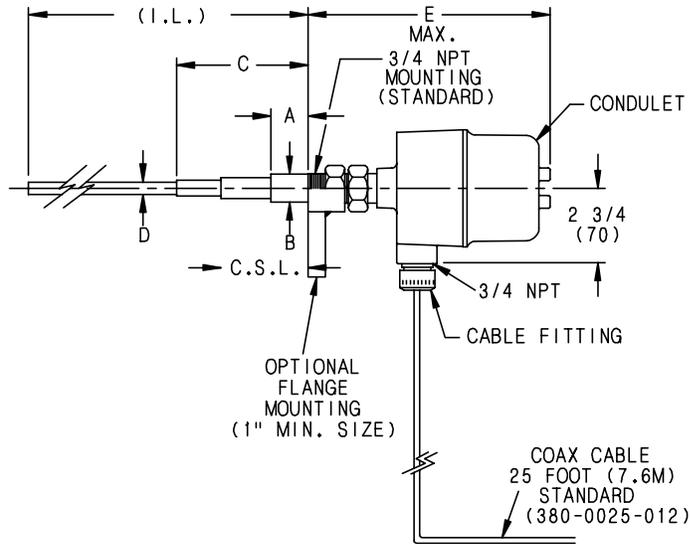


**Material is Polyester Fiberglass  
All dimensions in inches (mm).**

**Figure 2-2  
Housing for Electronics Package**

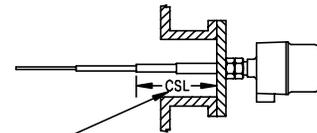
SENSING ELEMENT STANDARD SPECIFICATIONS

SENSING ELEMENT	METAL WETTED PARTS	INSULATION MATERIAL	"CSL" COTE-SHIELD LENGTH	"A"	"B"	"C"	"D"	"E" MAX.	INSERTION LENGTH
700-0202-002	316 SST	TFE	10 (254)	8 1/2 (216)	3/4 DIA (19)	11 1/2 (292)	3/8 DIA (10)	7" (178)	18 (457)



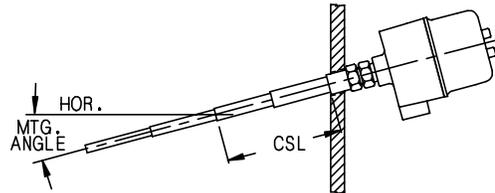
All dimensions in inches (mm).

**INSTALLING SENSING ELEMENT  
IN LIQUIDS**



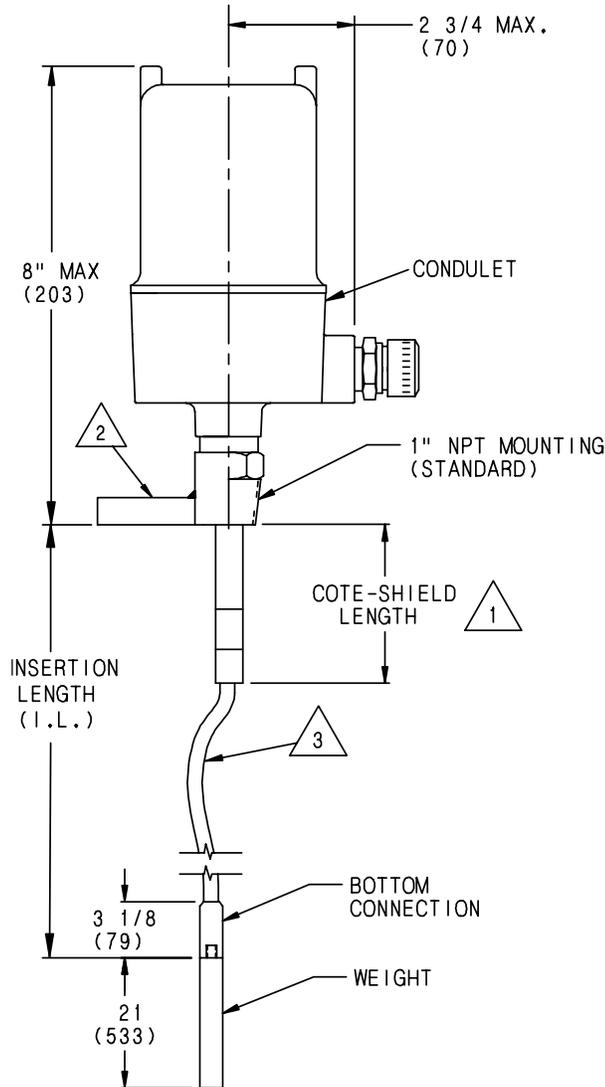
CSL MUST EXTEND 2" (51) MINIMUM INTO VESSEL OR BEYOND MAXIMUM WALL BUILD-UP.

**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 2-3  
Point 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 ALL METAL WETTED PARTS 316 SST	10 (254)	7/8 (22) DIA 3/4-10 UNC-2B THREAD	7/8 (22) DIA LENGTH 21" (533) P/N 752-0280-004

All dimensions in inches (mm).

**Figure 2-4**  
**Continuous Level Sensing Element**

### 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.

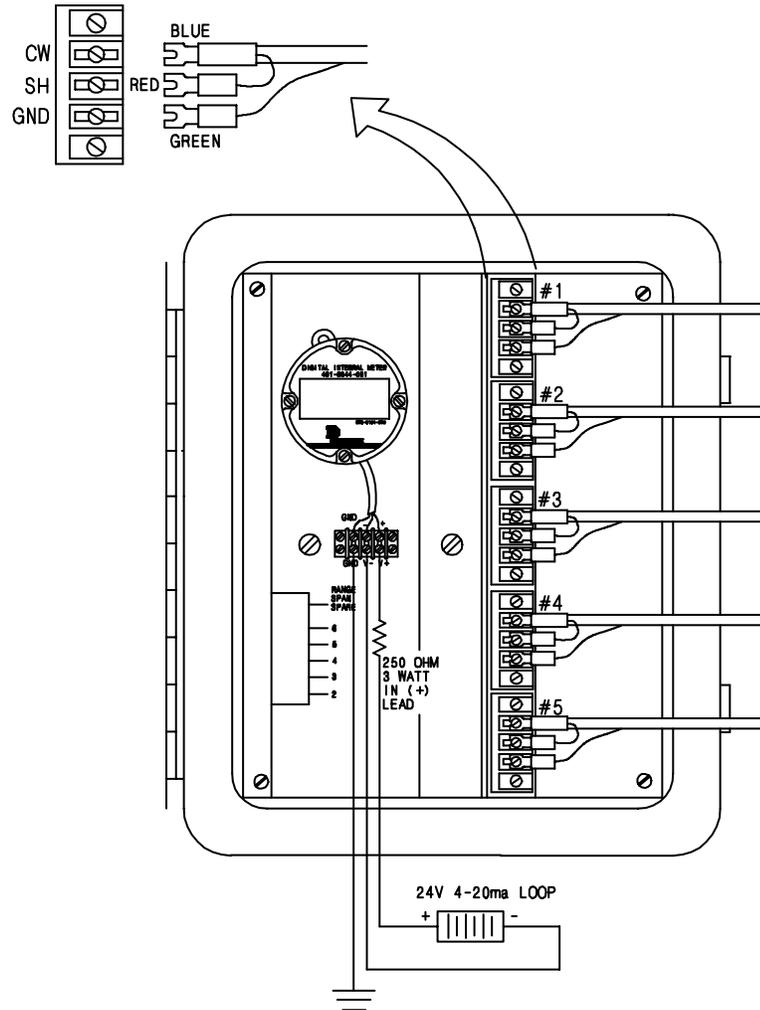
- Signal connections from each of the five terminal blocks to the remote sensing elements. See Figure 2-5. The signal connections are made to the set of terminal blocks inside the electronics package. Due to the low power consumption of the instrument, the wiring can be light gauge (e.g. 20 AWG). Twisted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

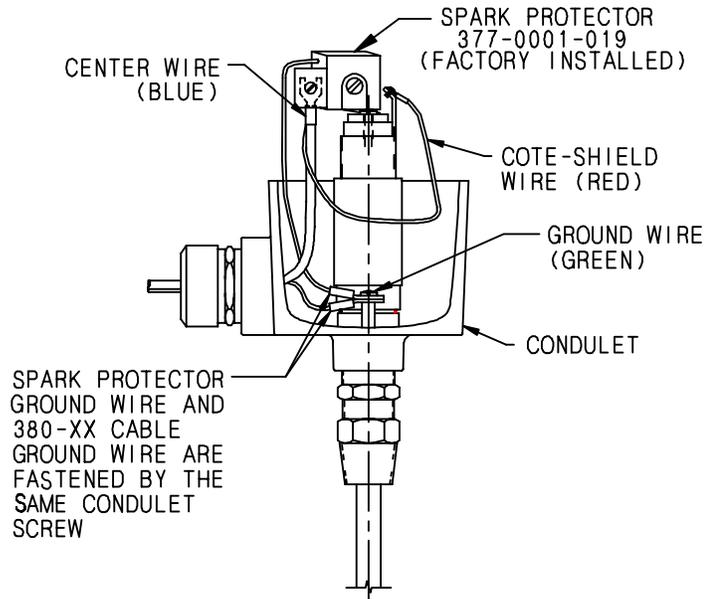
Only coaxial cables supplied by AMETEK Drexelbrook should be used to connect the electronics package to the sensing elements. Use of other cables can result in unstable calibration.

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

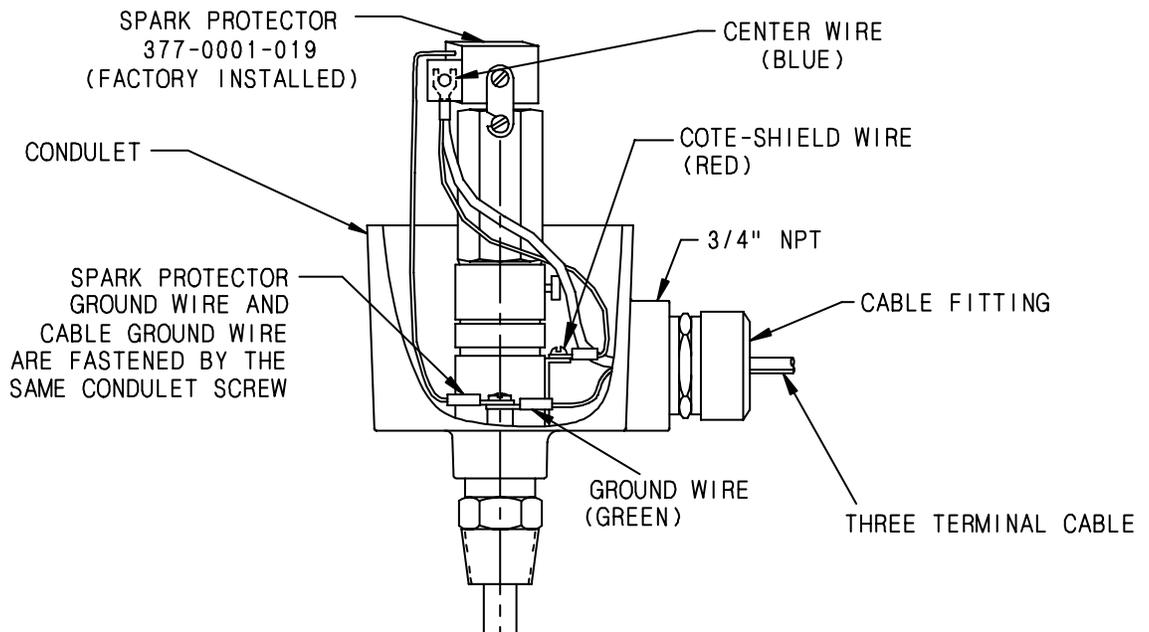
- Do not connect the cable to the sensing element until after the sensing element has been installed in the vessel and the conduit housing has been secured.



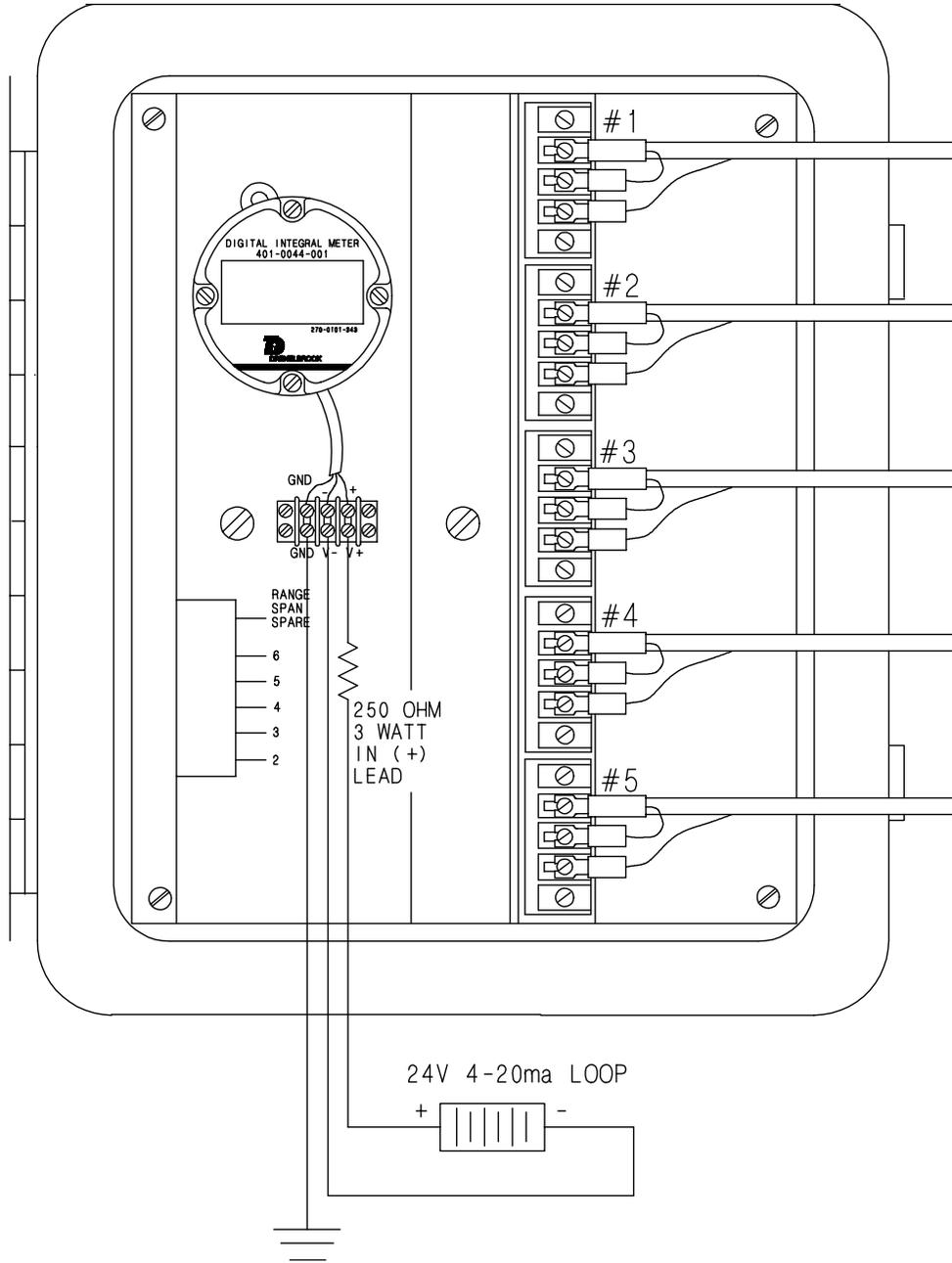
**Figure 2-5**  
**Wiring the Terminal Blocks**



**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**

### SECTION 3 CONFIGURATION and CALIBRATION with DREXELBROOK PC SOFTWARE

This section instructs the user how to use the Drexelbrook PC software to configure and calibrate the 509-71-20 Smart Auto-Cal system.

#### 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

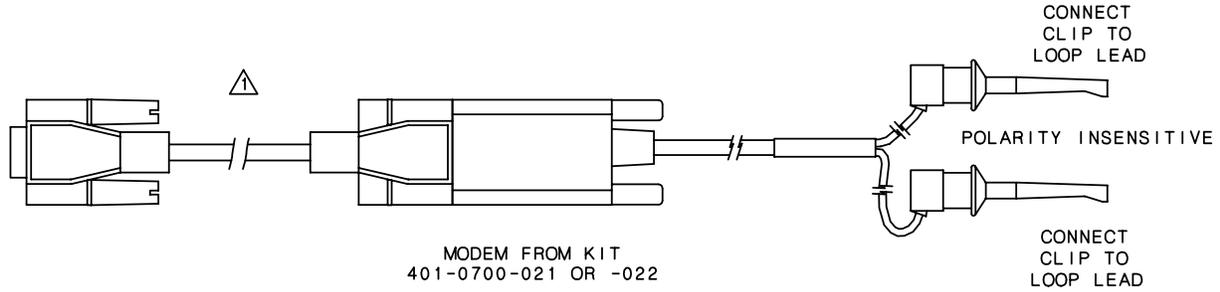
###### **—Cable (included with Modem)**

5-foot modem cable to loop connection

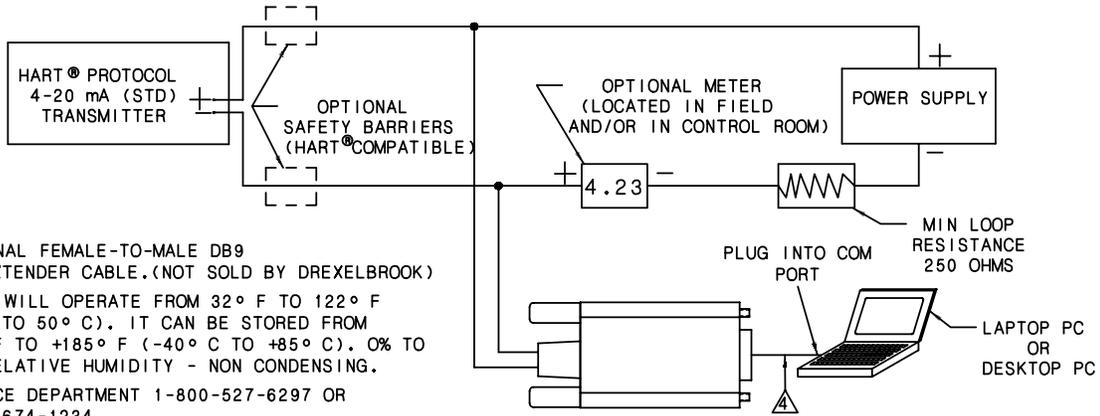
##### 3.1.2 Connect the Modem

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.



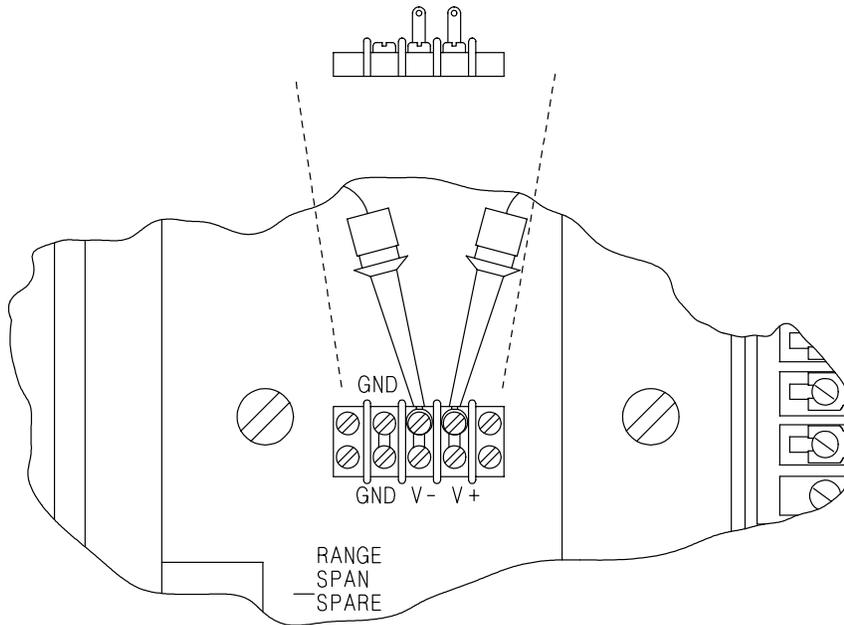
**INDIVIDUAL LOOP COMPONENT WIRING**



**ΔNOTES:**

1. OPTIONAL FEMALE-TO-MALE DB9  
12" EXTENDER CABLE. (NOT SOLD BY DREXELBROOK)
2. MODEM WILL OPERATE FROM 32° F TO 122° F  
(0° C TO 50° C). IT CAN BE STORED FROM  
-40° F TO +185° F (-40° C TO +85° C). 0% TO  
95% RELATIVE HUMIDITY - NON CONDENSING.
3. SERVICE DEPARTMENT 1-800-527-6297 OR  
1-215-674-1234.
4. SOME COMPUTERS MAY REQUIRE A SHORT CABLE FOR CONNECTION TO COMPORT (NOT SOLD BY DREXELBROOK).

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



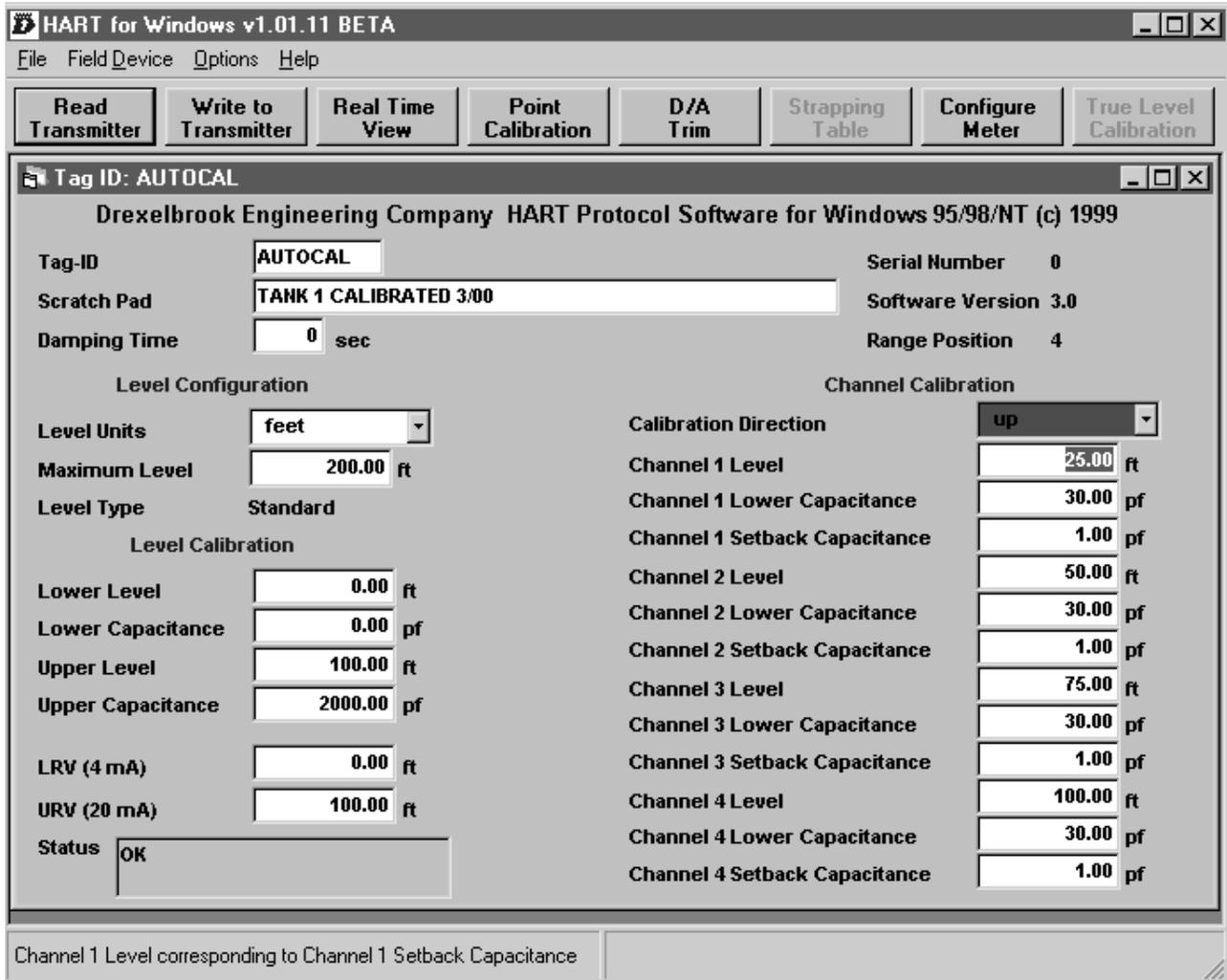
**Figure 3-2  
Loop Lead Connections on Electronics Package**

### 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

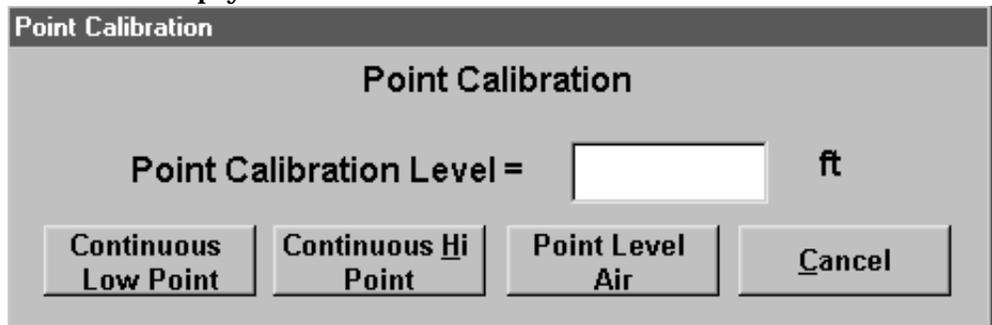
Configures the Digital Integral Meter (440-44-1) used for local indication. See *3.8 Meter Configuration*.

### 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.

The screenshot shows a 'Level Configuration' menu with the following settings:

Level Configuration	
Level Units	feet
Maximum Level	200.00 ft
Level Type	Standard
Level Calibration	
Lower Level	0.00 ft
Lower Capacitance	0.00 pf
Upper Level	100.00 ft
Upper Capacitance	2000.00 pf
LRV (4 mA)	0.00 ft
URV (20 mA)	100.00 ft

### 3.4 Level Configuration (cont.)

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



- 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.

Calibration Direction	Up	
Channel 1 Level	25.00	ft
Channel 1 Lower Capacitance	15.94	pf
Channel 1 Setback Capacitance	1.00	pf
Channel 2 Level	50.00	ft
Channel 2 Lower Capacitance	15.16	pf
Channel 2 Setback Capacitance	1.00	pf
Channel 3 Level	75.00	ft
Channel 3 Lower Capacitance	14.39	pf
Channel 3 Setback Capacitance	1.00	pf
Channel 4 Level	100.00	ft
Channel 4 Lower Capacitance	16.42	pf
Channel 4 Setback Capacitance	1.00	pf

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 + 1/2 setback capacitance).

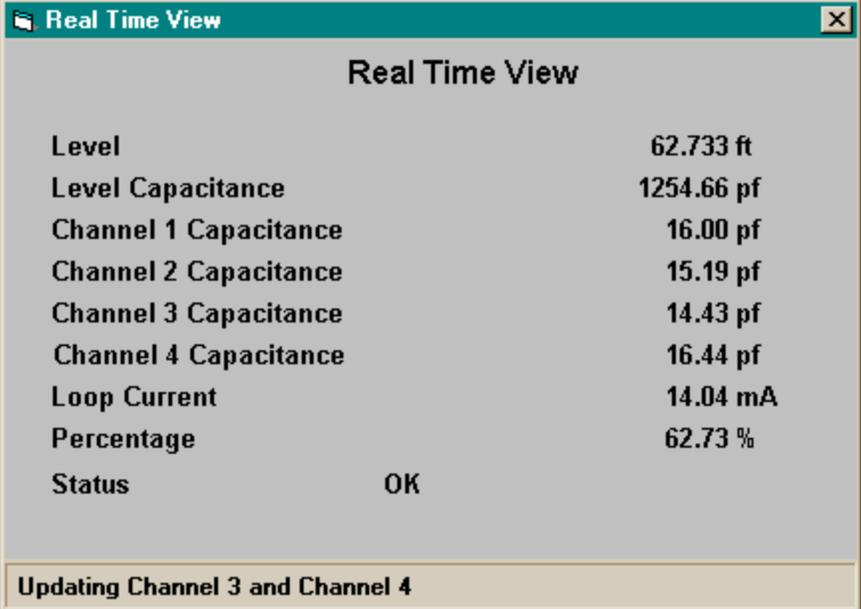
**up/down** - Both **up** and **down** conditions apply.

### 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



The screenshot shows a window titled "Real Time View" with a close button in the top right corner. The window displays the following data:

Real Time View	
Level	62.733 ft
Level Capacitance	1254.66 pf
Channel 1 Capacitance	16.00 pf
Channel 2 Capacitance	15.19 pf
Channel 3 Capacitance	14.43 pf
Channel 4 Capacitance	16.44 pf
Loop Current	14.04 mA
Percentage	62.73 %
Status	OK

At the bottom of the window, a status bar indicates "Updating Channel 3 and Channel 4".

### 3.8 Meter Configuration

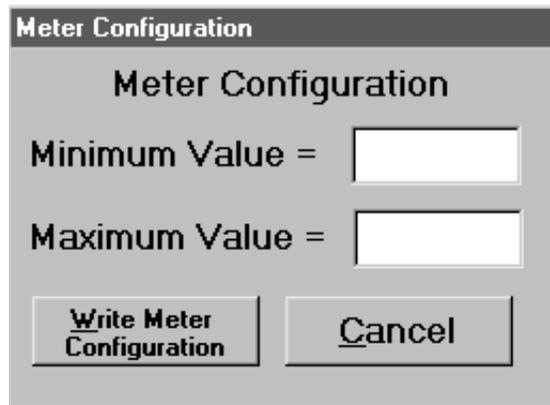


**Figure 3-3**  
**Digital Integral Meter**

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.

### 3.8 Meter Configuration (cont.)

To program the meter, click on **Configure Meter**.



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.

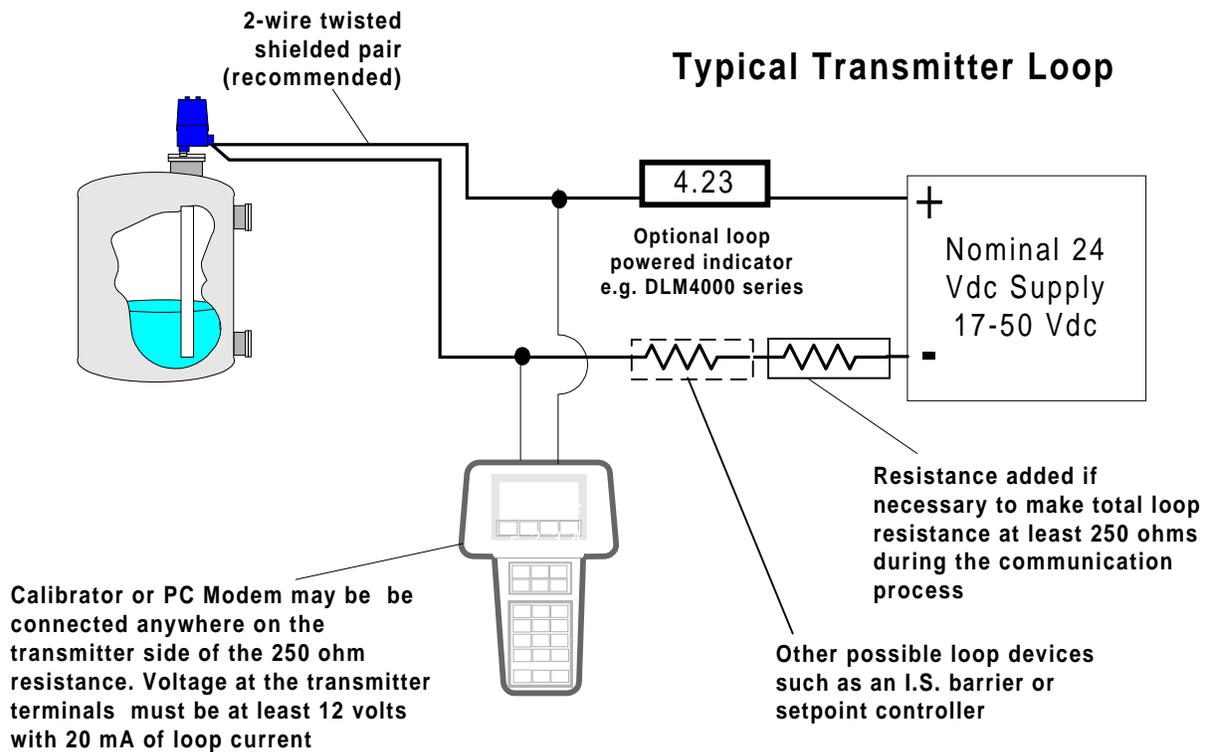
Perform normal troubleshooting procedures for an over or under range condition.

SECTION 4 TROUBLESHOOTING

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 4-1**  
**Typical Transmitter Loop**

Figure 4-2 provides a flow chart for troubleshooting loop communication.

4.1 Troubleshooting the Loop (cont.)

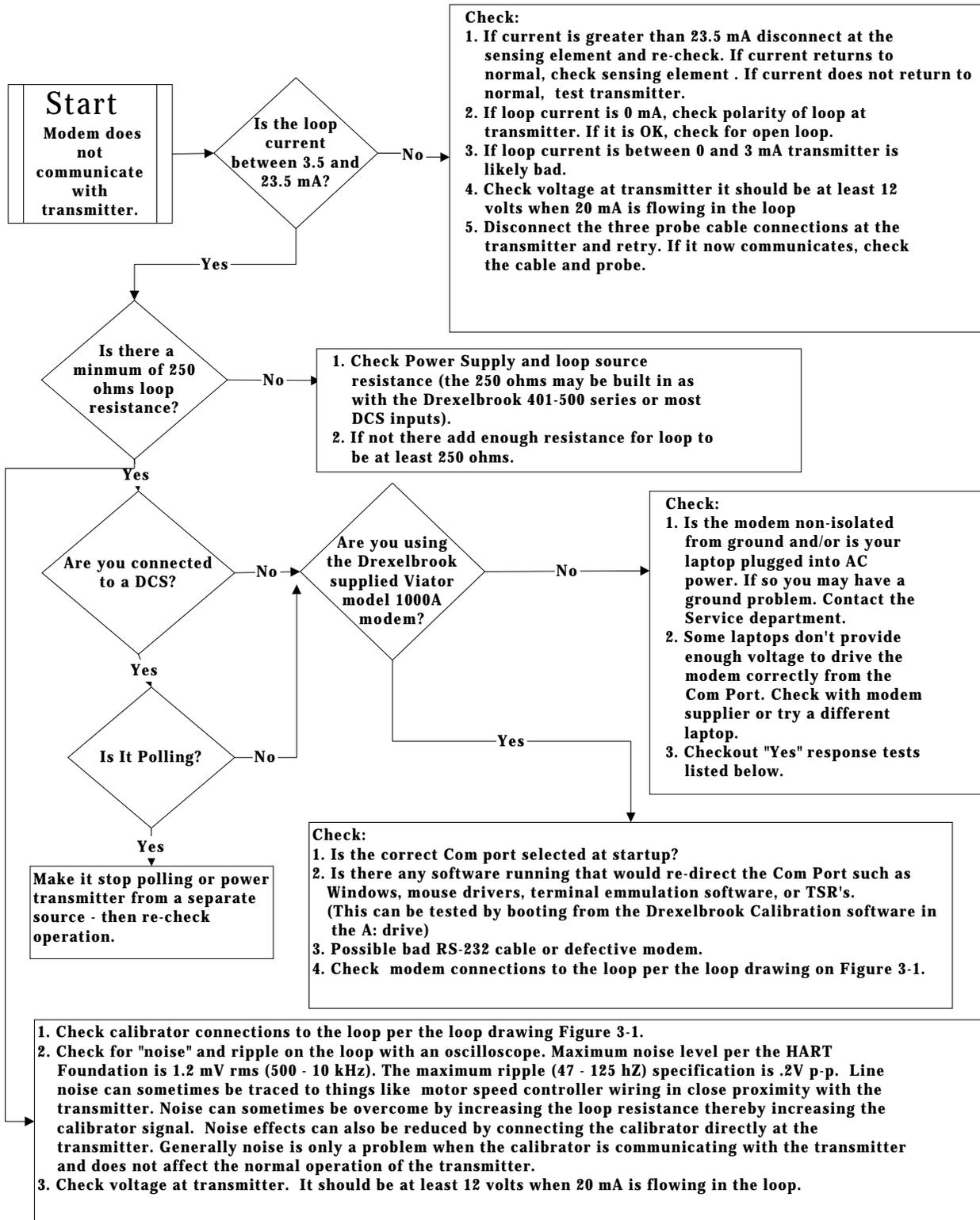


Figure 4-2  
Loop Troubleshooting

### 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.

<i>SPAN RANGE</i>	<i>JUMPER POSITION</i>				
	2	3	4	5	6
<i>MAX pF</i>	100	450	2000	10000	40000

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.

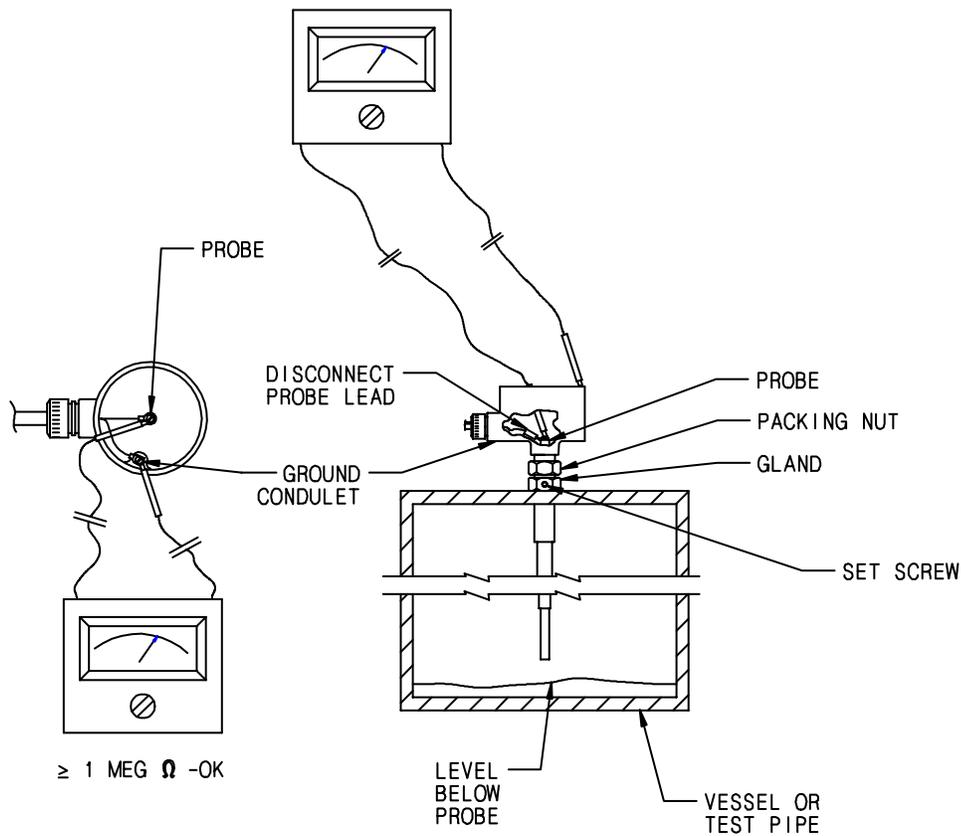
Remove the sensing element from the vessel to a safe area. The test outlined in steps 1 and 2 can be performed in a metal test vessel filled with tap water.

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 condulet). 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 condulet. Contact the Service department for recommended repairs.

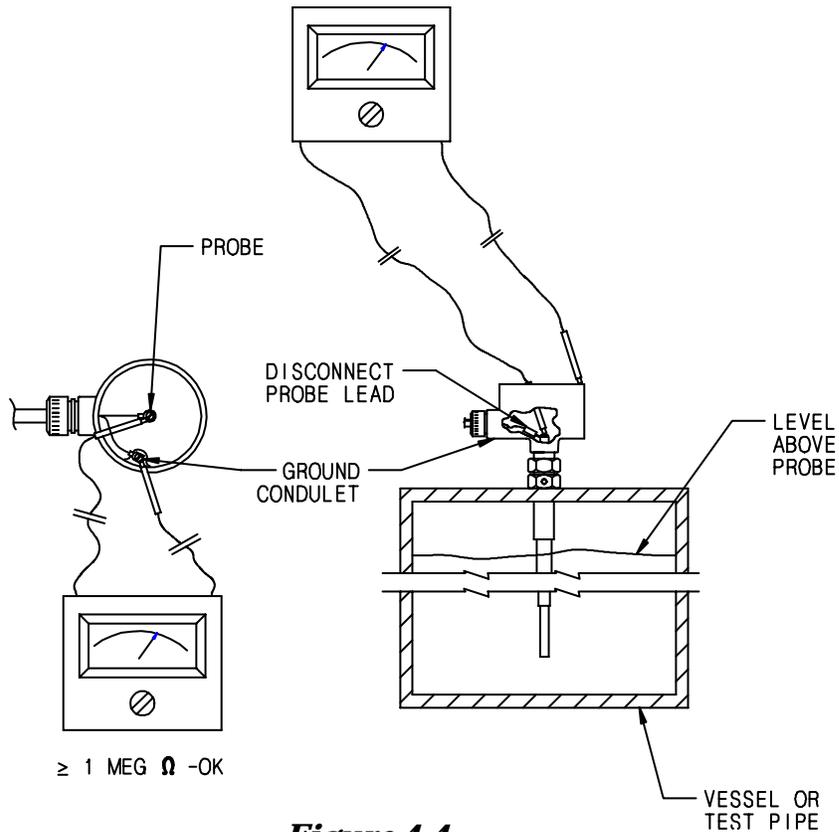


**Figure 4-3**  
**Sensing Element Testing,**  
**Material Below the Sensing Element**

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.



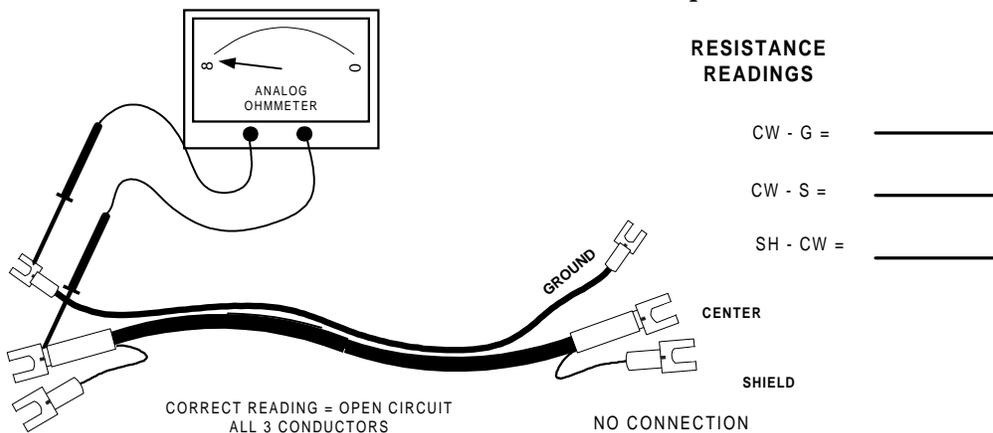
**Figure 4-4  
Sensing Element Testing,  
Material Above the Sensing Element**

4.4 Troubleshooting the Coaxial Cable

**NOTE**

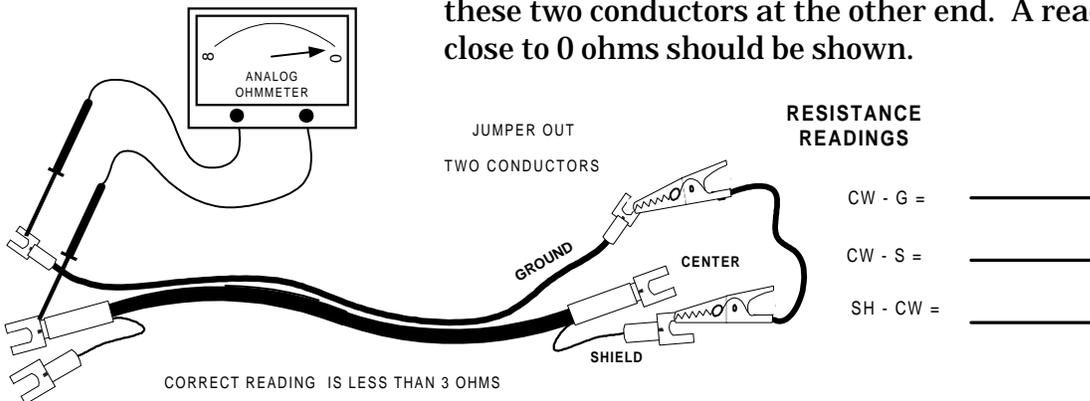
If there is water or other conductive material in the conduit it can change the electrical properties of the coax cable and cause the system to perform poorly. Moisture in the conduit may not be detected by the following test. The only sure way is to inspect the coax and associated conduit for trapped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



**CHECK FOR SHORT CIRCUIT**

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.



**CHECK FOR CONTINUITY**

**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.

Customer Name _____	Company _____	City/State _____
Phone # _____	Fax # _____	
Purchase Order # _____	DE # _____	
Electronic Package Model # _____	Serial # _____	Range Jumper Position _____
Sensing Element Model # _____	Serial # _____	Insertion Length _____ Mounting _____
Sensing Element Model # _____	Serial # _____	Insertion Length _____ Mounting _____
Sensing Element Model # _____	Serial # _____	Insertion Length _____ Mounting _____
Sensing Element Model # _____	Serial # _____	Insertion Length _____ Mounting _____
Sensing Element Model # _____	Serial # _____	Insertion Length _____ Mounting _____
Process Material _____	Temp. _____	Press. _____ Other _____

**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 Calibration 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**

± .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

**SECTION 5  
SPECIFICATIONS (cont.)**

**—*Intrinsic Safety***

Sensing element and cable: Designed to be intrinsically safe for Class I Groups A, B, C and D; Class II Groups E, F, and G, (Class III, Div. 1). Electronics and signal wires: Intrinsically safe for Class I Groups A, B, C, and D, Class II Groups E, F and G (Div. 1) when powered by an intrinsically safe power supply. Non-incendive for Class I Groups A, B, C, and D; Class II Groups E, F, and G, Class III, (Div. 2).

**—*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.

*"When the measurement matters"*

**AMETEK<sup>®</sup>**  
**DREXELBROOK**

*An ISO 9001 Certified Company*

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