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# Installation and Operating Instructions

Series 509-7X  
Universal III™ Transmitter  
with HART® Protocol  
using 409-1000 Electronics

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# Series 509-7X Universal III™ Transmitter with HART® Protocol using 409-1000 Electronics



**AMETEK®**  
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*An ISO 9001 Certified Company*

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## Section 1: Introduction

### 1.1 System Description

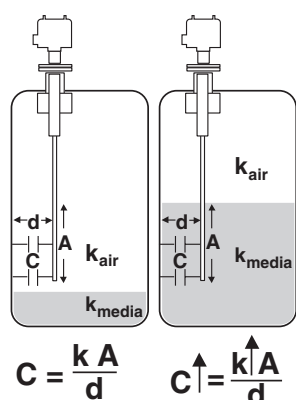


Figure 1-1 Capacitance Sensing Element

### 1.2 Technology

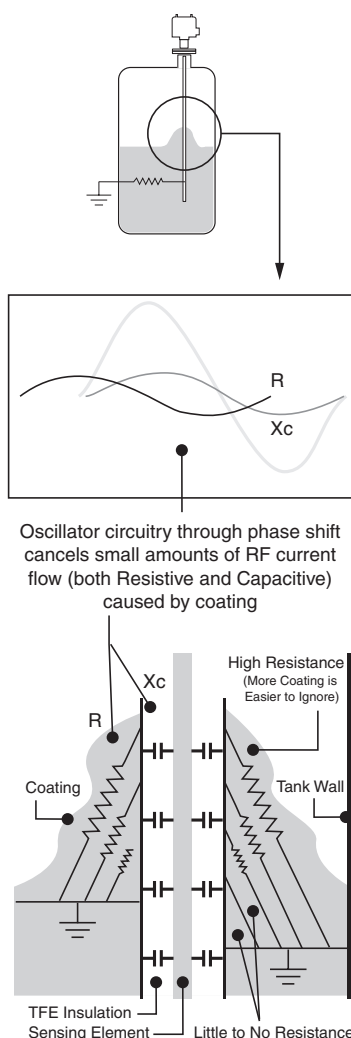


Figure 1-2  
RF Admittance Sensing  
Element with Cote-Shield

The instructions in this manual are for the Drexelbrook 509-7X-XXX Series Universal III™ for level measurement in liquids, slurries, interfaces and granulars.

Each Drexelbrook 509-7X-XXX system consists of a Universal III™ (409-1000) series two-wire, 4-20 mA electronic unit and a 700 series sensing element (probe). A 380 series connecting cable is also supplied for connection of the sensing element to the electronic unit.

The 509-7X-XXX is an admittance-to-current transducer. A change in level produces a change in admittance which results in a change of current. It is termed a two-wire transmitter because the same two wires that are used to power the unit also indicate the change in level (4-20 mA).

In a simple capacitance probe, when the level rises and material covers the sensing element, the capacitance within the circuit between the probe and the medium (conductive applications) or the probe and the vessel wall (insulating applications) increases. This is due to the dielectric constant (k) of the material, which causes a bridge misbalance. The signal is demodulated (rectified), amplified and the output is increased. There are drawbacks, however, especially when there is coating of the probe.

An RF Admittance level transmitter is the next generation. Although similar to the capacitance concept, Universal III™ employs a radio frequency signal and adds the Cote-Shield™ circuitry within the Electronics Unit.

Built-in oscillator buffer and chopper drive circuits permit separate measurement of resistance and capacitance. Since the resistance and the capacitance of any coating are of equal magnitude (by physical laws), the error generated by a coating can be measured and subtracted from the total output.

This patented Cote-Shield™ circuitry is designed into Universal III™ series and enables the instrument to ignore the effect of buildup or material coating on the sensing element. The sensing element is mounted in the vessel and provides a change in RF admittance indicating presence of material.

The Cote-Shield™ element of the sensor prevents the transmission of RF current through the coating on the sensing element. The only path to ground available for the RF current is through the material being measured.

The result is an accurate measurement regardless of the amount of coating on the probe, making it by far the most versatile technology, good for very wide range conditions from cryogenics to high temperature, from vacuum to 10,000psi pressure, and works with all types of materials.

### 1.3 Model Numbering

Universal III System						
509 - 007						
	<b>Application</b>					
	5	Conductive Liquids				
	6	Interface				
	7	Insulating Liquids				
	9	Granular Solids				
		<b>Package</b>				
		7	Remote			
		9	Integral			
			<b>Sensing Element Reference Number (Next Page)</b>			
509 - 007	X	-	X	X	X	

Universal III Electronic Unit						
409 - 10						
	<b>Type</b>					
	0	0	Insulating or Conducting Material			
	3	0	Coating Material			
			<b>Agency Approvals</b>			
			O	No Approvals		
			F	FM		
			C	CSA		
			K	KEMA		
			I	FM, CSA, and KEMA		
				<b>Frequency</b>		
			0	100 KHz		
			1	15 KHz		
				<b>Housing</b>		
			1	Chassis Only		
			4	Remote Type 4X Explosion-Proof		
			6	Remote Type 4X Explosion-Proof with DrexelCote		
			7	Type 4X Fiberglass		
			8	Integral Type 4X Explosion-Proof with DrexelCote		
			9	Integral Type 4X Explosion-Proof		
409 - 10	X	0	-	X	X	X

## 1.4 Sensing Element Reference Number

Sensing Element Reference Number	Typical Application	Sensing Element Model #	Material of Construction	O.D. and Mounting	Temperature and Pressure
0075-X09	Water-like Conductive Liquids	700-001-22	TFE-covered rod	Probe 3/8" OD 3/4" NPT	100°F @ 1000 PSI 300°F @ 500 PSI
0077-X06	Concentric Water-like Insulating Liquids	700-001-24	TFE-covered rod with carbon steel concentric Shield	Concentric Shield 1.66" OD 1 1/2" NPT	100°F @ 1000 PSI 300°F @ 500 PSI
0075-X07	Low Viscosity Conducting Liquids	700-002-24	TFE-covered rod	Probe 3/4" OD 3/4" NPT	100°F @ 1000 PSI 450°F @ 500 PSI
0076-X02	Interface of Liquids Containing Ketones and Esters	700-002-27	FEP-covered rod	Probe .56" OD 3/4" NPT	100°F @ 1000 PSI 300°F @ 500 PSI
0075-X05	Thick Conducting Liquids	700-002-37	"X"*-covered rod	Probe .54" OD 3/4" NPT	100°F @ 1000 PSI 250°F @ 500 PSI
0075-X06	Conducting Liquids and Interfaces	700-002-57	"X"*-covered rod	Probe .84" OD 1" NPT	100°F @ 1000 PSI 250°F @ 500 PSI
0079-X20	Agitated Conducting Liquids and Granulars	700-005-18	"X"*-covered cable	Cable Probe 5/16" OD 3/4" NPT	100°F @ 1000 PSI 250°F @ 500 PSI
0079-X09	Heavy-duty for Abrasive Granulars	700-005-19	Urethane-covered cable	Cable Probe 3/4" OD 2" NPT	150°F @ 5 PSI 150°F @ 5 PSI
0077-X25	Long Lengths of Conducting Liquids	700-005-54	PFA-covered cable	Cable Probe .093" OD 3/4" NPT	100°F @ 1000 PSI 300°F @ 500 PSI
0079-701 0077-714	Insulating Liquids and Granulars	700-205-78	"X"* covered cable	Cable Probe 5/16" OD 1" NPT	250°F @ 5 PSI 250°F @ 5 PSI
*"X" is a fluorocarbon-type insulation					

## 1.5 Area Classifications

The standard electronic unit in a Type 4X housing (409-10XX-XX7) meets the following classifications:

- Type 4X Waterproof/Corrosion Resistant.

The standard electronic unit mounted in the explosionproof housing (409-10XX-XX4) is dual-rated and meets the following conditions:

- Type 4X Waterproof/Corrosion Resistant
- Type 7 Explosionproof FM Approved for CL.I Gr. A,B,C & D, CL.II Gr. E, F, & G CL. III.

See Section 1.4 for detailed specifications of sensing elements that are most often recommended with a 509-7X-XXX system. Contact the factory or your local representative if additional information is required.

The electronic unit 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 carton and check each item against the packing list before destroying any packing material. If there is any shortage or damage, report it immediately to the factory.

### 2.2 Mounting the Electronic Unit

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

The Universal IIITM (409-1000) Series system was designed for field mounting, but it should be mounted in a location as free as possible from vibration, corrosive atmospheres, and any possibility of mechanical damage. For convenience at start-up, mount the instrument in a reasonably accessible location. Ambient temperatures should be between  $-40^{\circ}\text{F}$  and  $185^{\circ}\text{F}$  ( $-40^{\circ}\text{C}$  and  $85^{\circ}\text{C}$ ).



- When installing conduit to the electronic unit, be sure that vertical conduit runs will not cause water to enter the electronic unit housing, as shown in Figure 2-1.



- Always install to NEC® and/or local requirements/codes/directives as mandated by the authority having jurisdiction.



- For electronic units with display option, the meter display can be rotated to the proper viewing orientation after installation. Refer to Section 2.16 for instructions.



- Cable fittings supplied are weather-resistant. They are NOT certified as explosionproof (XP) or flameproof (d) unless they are specifically marked.

Figure 2-1 shows the recommended conduit installation. See Figure 2-2 for dimensions when installing conduit to the electronic unit.

2.2 Mounting the Electronic Unit (Continued)

Figure 2-1  
Recommended Conduit Connection

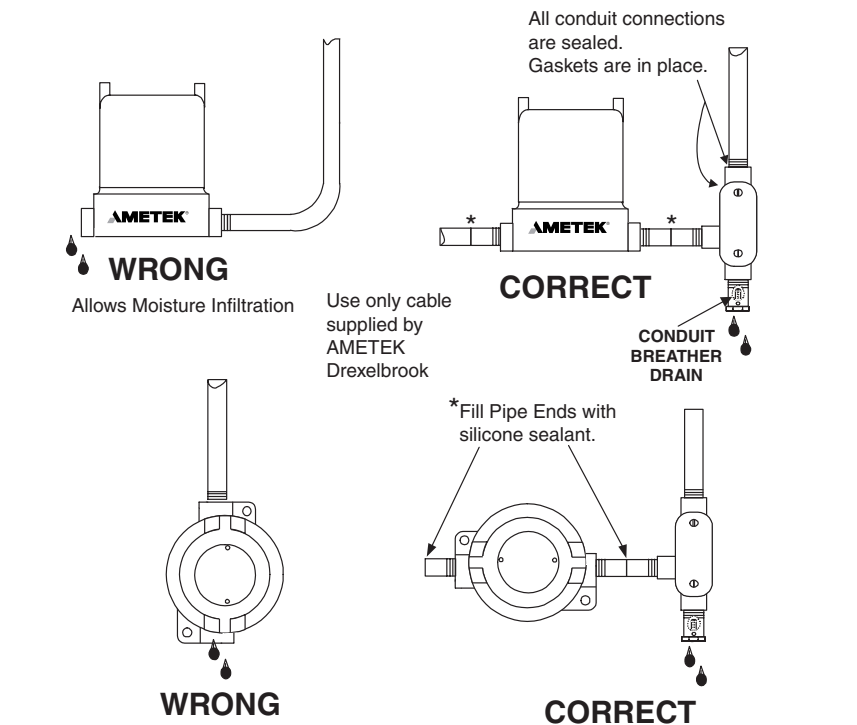
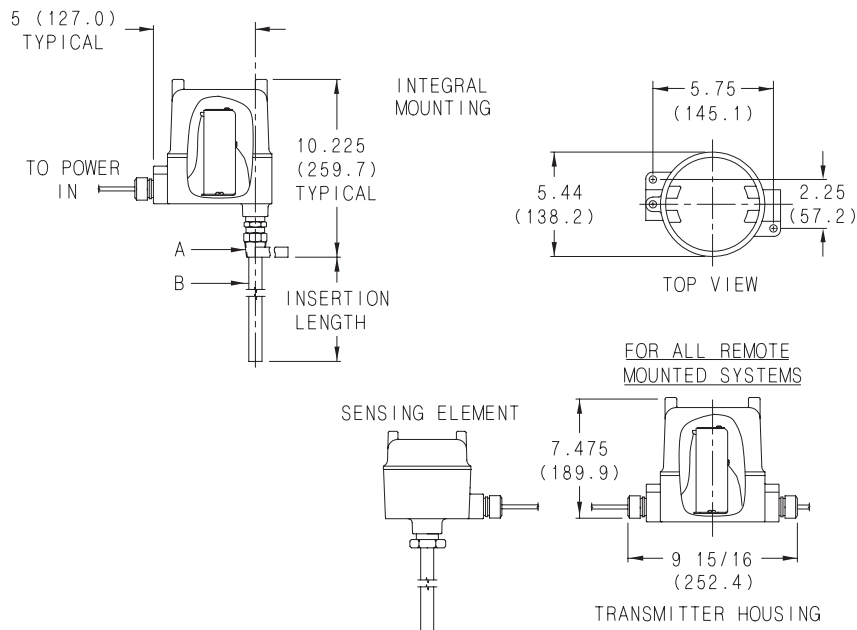


Figure 2-2  
Mounting Dimensions  
Inches (mm)



ALL CONDUIT CONNECTIONS AS 3/4" NPT

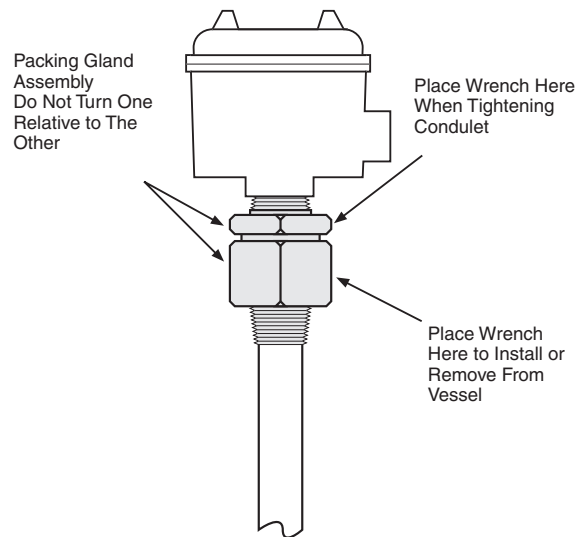
## **2.2 Mounting the Electronic Unit (Continued)**

The mounting location for the sensing element (probe) is often determined by whether there is a suitable location inside a vessel. An external side arm or stilling well can be considered.

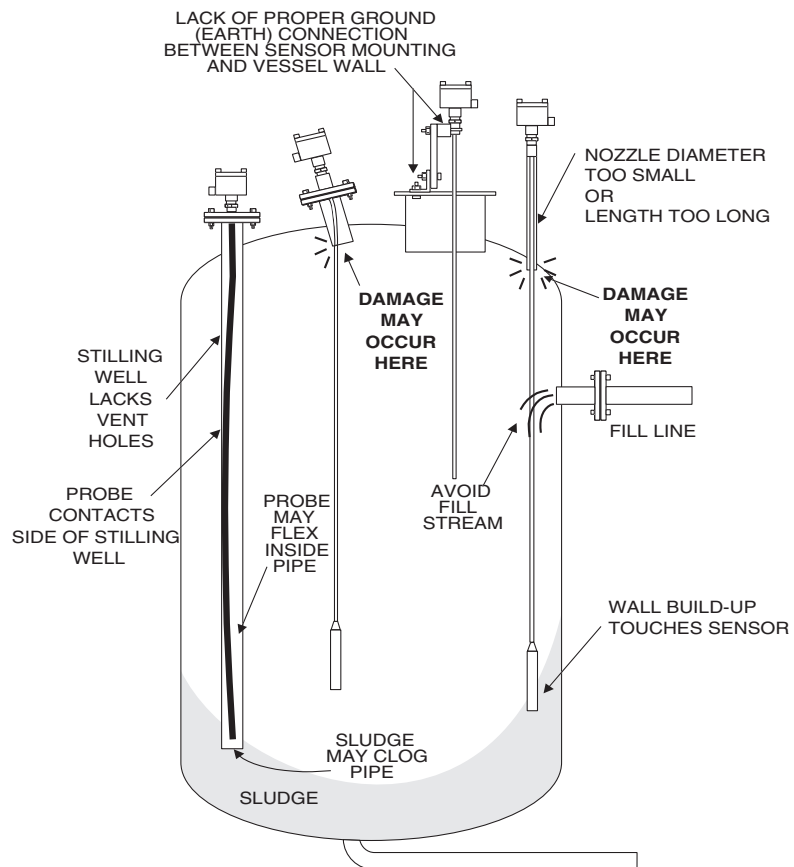
The following sensing element mounting and installation instructions should be followed so that the equipment will operate properly and accurately:

- A. In applications requiring an insulated sensing element, use particular care during installation. There is always the danger of puncturing the insulation, especially with the thin-walled probes.
- B. Sensing elements should be mounted in such a manner that they are not in the direct stream of a filling nozzle or chute. If this is not possible, a deflecting baffle should be installed between the probe and the fill.
- C. Do not take the sensing element apart or loosen the packing glands. Follow instructions in Figure 2-3.
- D. Avoid installing the sensing element with any of the common mistakes shown in Figure 2-4.
- E. If a stilling well is used, ensure that "vent" holes are large enough to allow free passage of both air and process material. Holes should be 5/8" or larger, 120° apart, every 2-3 feet along the length of the stilling well.
- F. Sensing elements that are mounted in agitated vessels usually require brackets and supports to control the position of the sensor during agitation. See Figure 2-5.
- G. For non-metallic vessels without Drexelbrook self-grounding sensing elements, choose one of the grounding recommendations shown in Figure 2-6.

## 2.2 Mounting the Electronic Unit (Continued)



**Figure 2-3**  
*Installing Sensing Element*

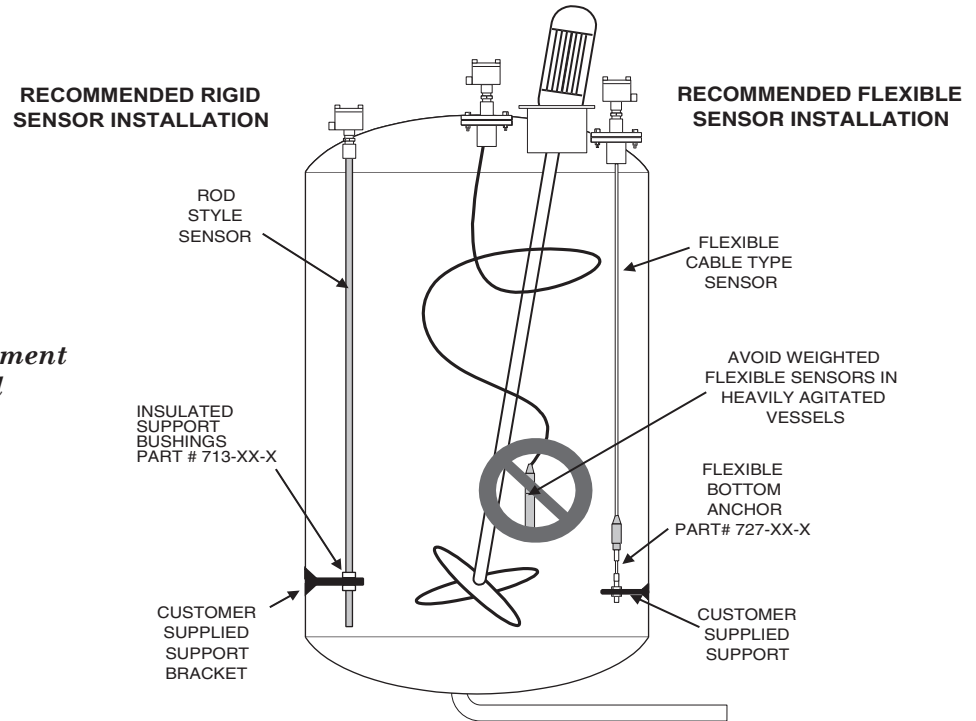


**Figure 2-4**  
*Common Installation Mistakes*



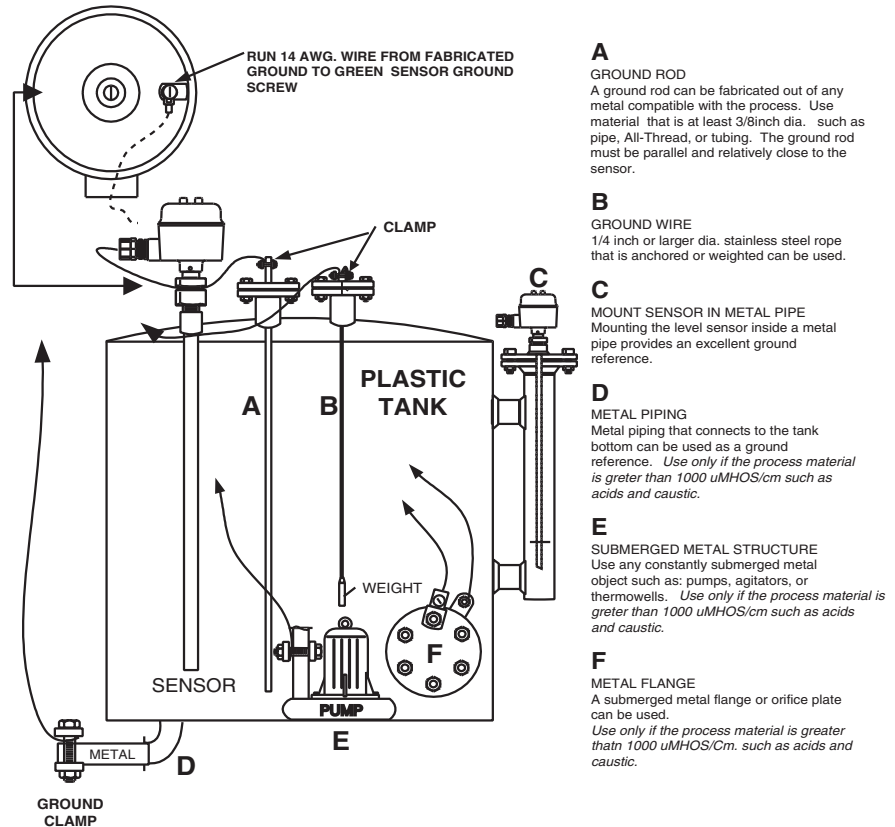
## 2.2 Mounting the Electronic Unit (Continued)

**Figure 2-5**  
*Installing Sensing Element in Agitated Vessel*



- If the vessel is non metallic see grounding sketch below. sensors with factory supplied concentric shield or ground rod do not need additional grounding.
- Measure ground continuity from housing ground screw to metal wall of vessel. A good ground will measure less than 5 ohms.

**Figure 2-6**  
*Providing Ground Reference\**  
*\*This is a sensing element ground reference and possibly different from an electrical power ground.*

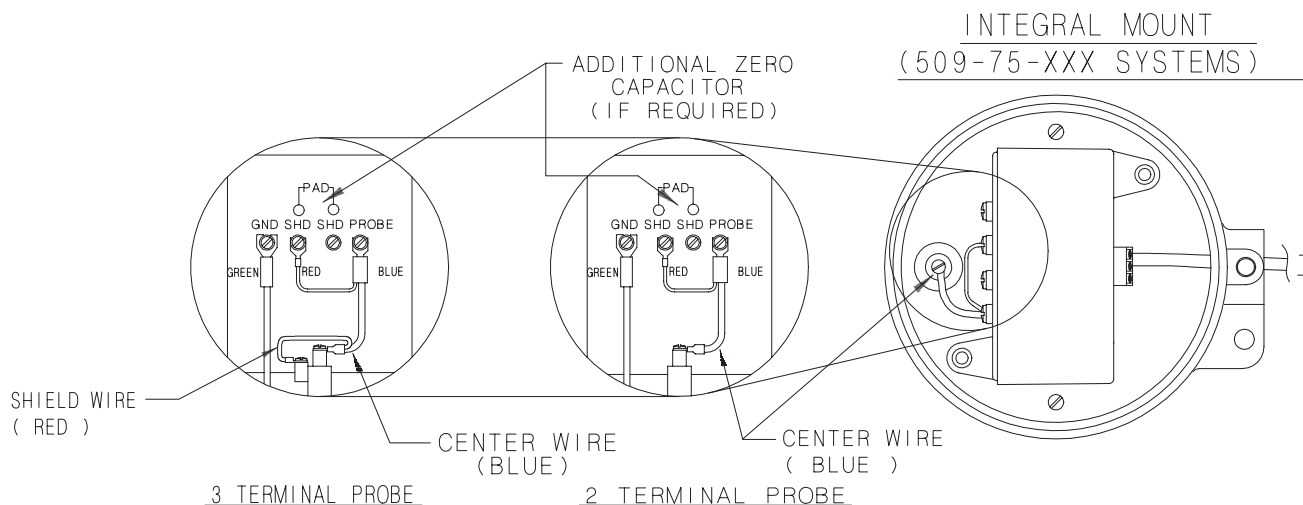


## 2.3 Wiring the Electronic Unit

Integral units are pre-wired at the factory. Figure 2-7 shows the wiring of the integral unit.

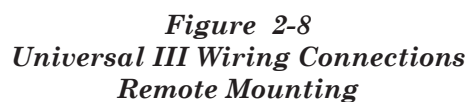
For remote units, the signal connections are made to the three-terminal block on the front of the chassis. Due to the low power consumption of the instrument, the wiring need only be light gauge (e.g. 20 AWG). Twisted shielded pair cables are recommended for lengths over 200 feet.

The cable from the sensing element is connected to the four-terminal strip on the back side of the instrument chassis. The cable connections are probe (PRB) or Center Wire (CW), ground (GND), and shield (SHD). See Figure 2-8 for wiring connections of the remote unit.



**Figure 2-7**  
**Wiring Connections Integral Mounting**

**Figure 2-8** Wiring Connections, Remote Mounting



## 2.4 Wiring the Sensing Element



### CAUTION !

Before using Intrinsic Safety Barriers, read manufacturer's instruction for barrier operation.

The 409-1000 has a built-in current limiter which holds the signal current to a maximum of 28 mA.

The cable connections to the sensing element are shown in Figure 2-9 and 2-10

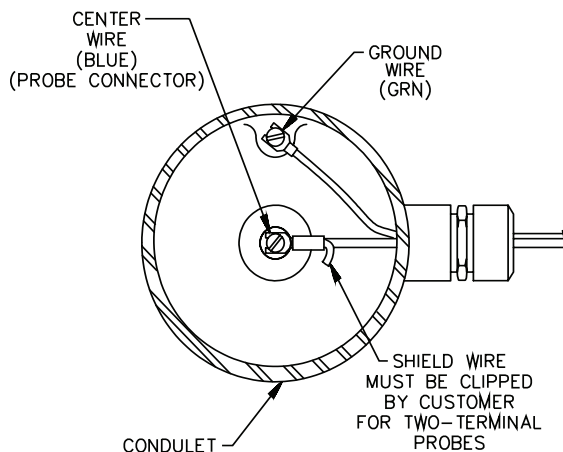
- Do not connect the cable to the sensing element until after the sensing element has been installed in the vessel and the conduit housing has been secured.
- If the sensing element does not have a shield connection, (the most common condition for a 2-terminal sensing element) **be sure to clip and /or tape the shield wire at the sensing element end of the cable only.** See Figure 2-9.



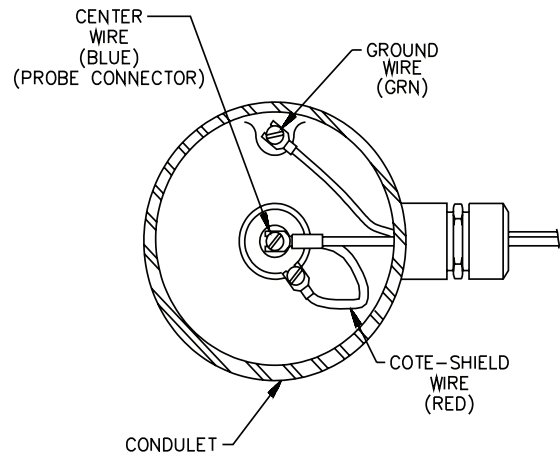
Only coaxial cables supplied by Drexelbrook should be used to connect the transmitter to the sensing element. Use of other cables can result in unstable performance.



Clipped Shield wire on two-wire versions must NOT touch housing.



**Figure 2-9**  
*Three-Terminal Cable Connections  
to Two-Terminal Sensing Element*



**Figure 2-10**  
*Three-Terminal Cable Connections  
to Three-Terminal Sensing Element*

## 2.5 Spark (Static Electricity) Protection

### Spark Protection for Integral Sensing Elements

If spark protection is supplied for an integral sensing element, use the following instructions for installing the spark protection.

- A. Attach the mounting link on the spark protector to the sensing element center connection screw.
- B. Connect the green wire from the spark protector to the housing/chassis mounting screw.
- C. Connect the center wire connector (Blue) of the spark protector to the "probe" connection on the transmitter.
- D. Connect the shield connector (Orange) of the spark protector to the shield (sh) connector on the transmitter.

### Spark Protection for Remote Sensing Elements

If spark protection is supplied for a remote sensing element, use the following instructions for installing the spark protection.

- A. Attach the mounting link on the spark protector to the sensing element center connection screw.
- B. Connect the green wire from the spark protector to the ground screw.
- C. Feed the coax cable into the conduit.
- D. Connect the coax cable center wire (**CW**) to the spark protector and the ground wire (**GND**) to the ground screw as shown in Figure 2-12.
- E. Connect the shield wire to the Cote-Shield terminal (**SH**).\*



For sensing elements that do not have shield connections, clip the shield wire as shown in Figure 2-9.

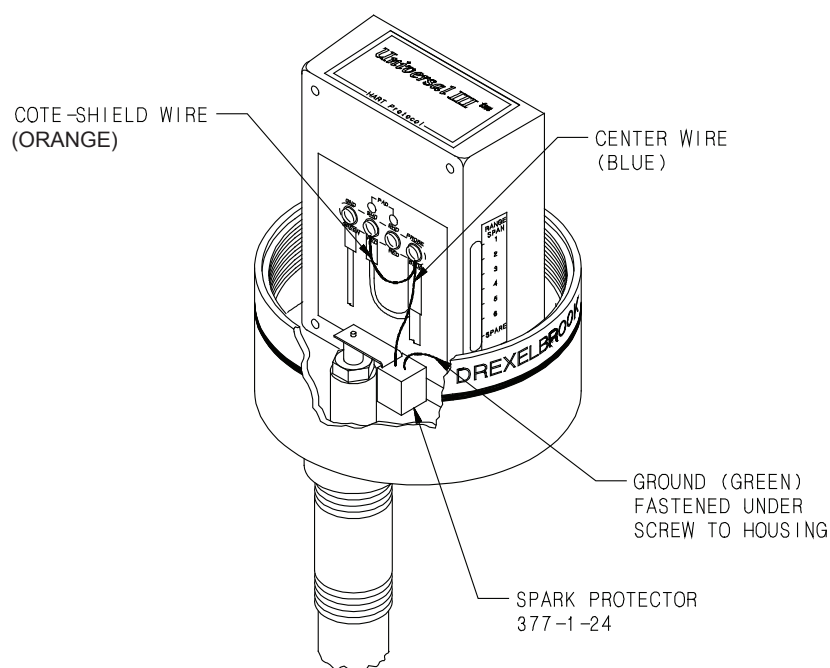


Make sure the transmitter has a ground attached either on sensing element side or loop side of the unit.

Unless the assembly is attached to a metallic vessel, chassis of transmitter is not grounded.

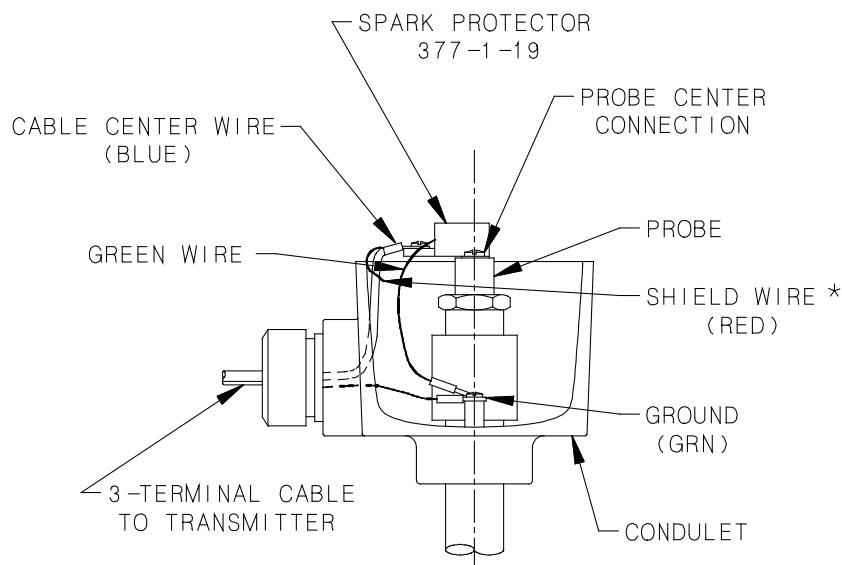
Clipped Shield wire on two-wire versions must NOT touch housing.

## 2.5 Spark (Static Electricity) Protection (Continued)



**Figure 2-11**  
**Spark Protection for Integral Sensing Elements**

**NOTICE**  
*Clipped Shield wire on two-wire versions must NOT touch housing.*

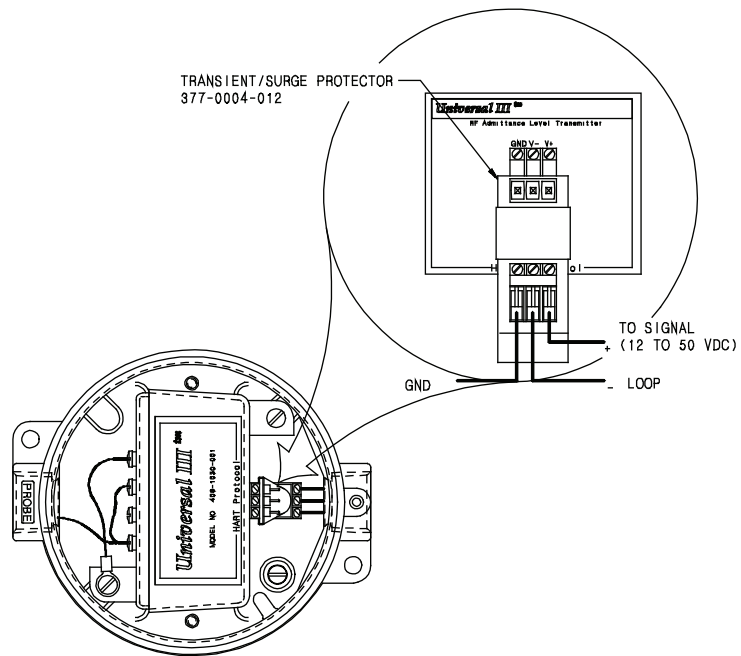


\* SHIELD MUST BE CLIPPED BY CUSTOMER FOR 2 TERMINAL SENSING ELEMENTS

**Figure 2-12**  
**Spark Protection for Remote Sensing Elements**

## 2.6 Surge Voltage (Lightning) Protection

Optional surge protection is sometimes supplied with transmitters that are expected to be exposed to surge voltages or surges due to lightning near the two-wire loop. A Drexelbrook Model 377-4-12 Surge Voltage Protection affords a great deal of protection to the transmitter but is not absolute in its protection against a very close lightning strike. Refer to **Figure 2-13** to properly connect the Surge Voltage Protection. Be sure that the transmitter housing is well connected to a good ground.



**Figure 2-13**  
Surge Voltage Protection

## 2.7 RFI (Radio Frequency Interference) Filters

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 the vessel is non-metallic, select, if possible, a shielded (concentric) sensor. If unsure about suitability, contact the Drexelbrook Applications department for a recommendation.
- For remotely-mounted electronic units connect the sensor to the electronic unit by placing the coaxial cable in grounded metal conduit. Integrally mounted electronic unit sensor connections are already shielded.
- Use Twisted Shielded Pair wiring for all loop wiring connections. Loop connection wiring should also be in grounded metallic conduit.
- Where possible, use of cast aluminum housings without windowed openings for the electronic unit is recommended. If local close-coupled indicators are used, install a loop filter between the indicator and the electronic unit.

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

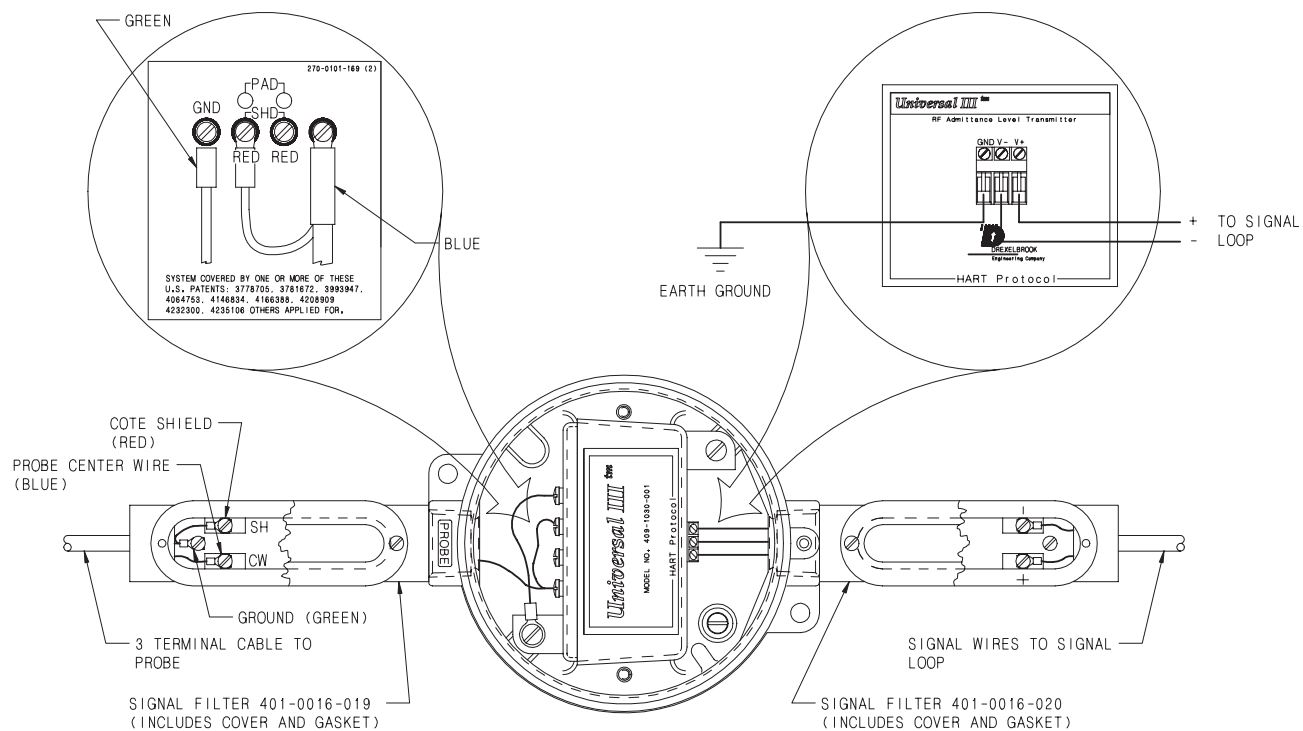
If the recommendations listed are followed, it is usually **not** necessary to add RFI filtering to protect against signal strengths of 10 Volts/ Meter or less. This degree of protection is usually sufficient to protect against walkie talkies that are used 3 feet (1M) or more from a typical electronic unit. If greater protection is required, or filters have already been provided, install RFI filters as shown in *Figure 2-14*.

### CE Mark Certification:

3-Terminal Coaxial Cable - Systems with remote mounted electronics require the use of a Probe RFI filter (only) if the sensing element is connected with 3-terminal coaxial cable, installed in accordance with figure 2-14, to maintain CE Mark certification.



## 2.7 RFI Filters (Continued)



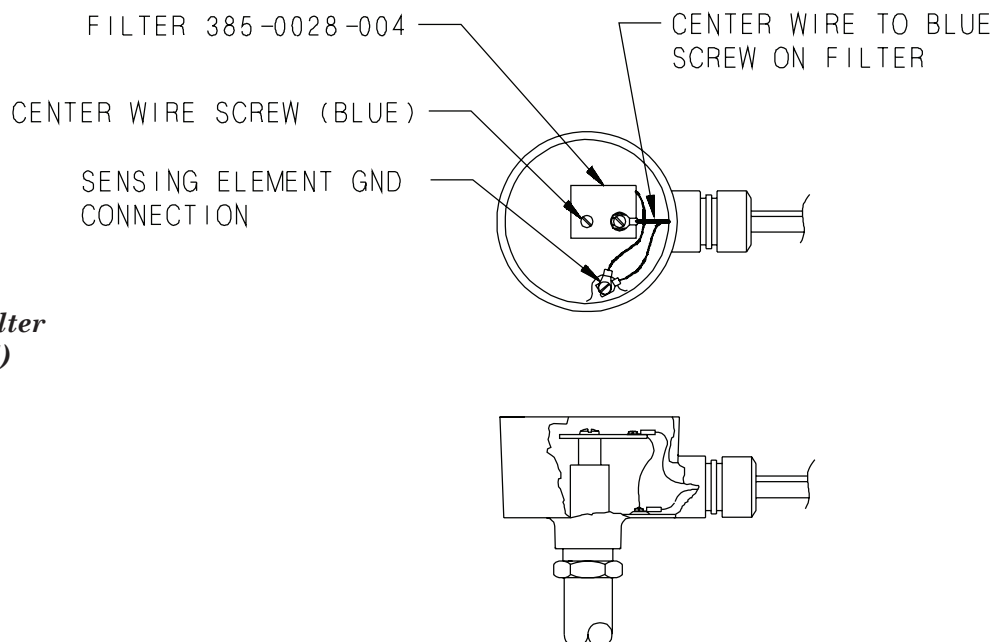
**Figure 2-14**  
**Radio Frequency Interference (RFI) Filters**

## 2.8 Electrostatic Filters

In applications such as desalters or treaters and other coalescers with electrostatic grids, it is customary for Drexelbrook to supply a special filter on the sensing element. The purpose of the filter is to remove voltage that may be imposed in the sensor from the high voltage grids. Some earlier applications have the filter located at the transmitter instead of the sensing element; either is acceptable.

Connect the electrostatic filter Drexelbrook Part Number 385-0028-004 as shown in **Figure 2-15**.

### *Typical Mounting For Typical Sensing Element*



**Figure 2-15**  
**Electrostatic Filter**  
**(385-0028-004)**

## 2.9 Digital Integral Meter

An optional digital integral meter (DIM) (401-44-1) can be used with the Universal III electronic unit for local digital loop 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.

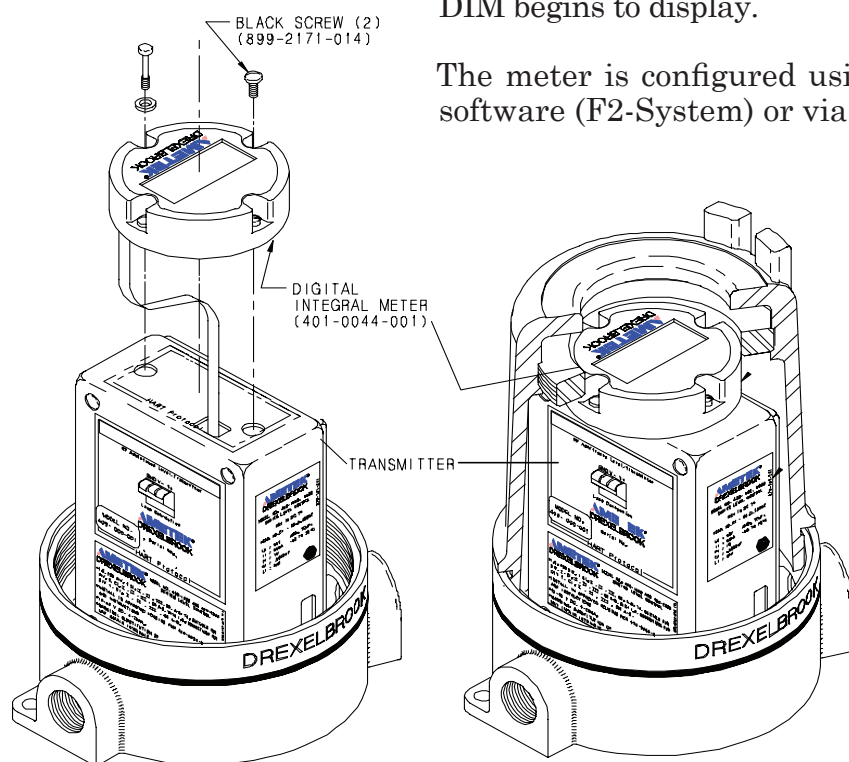
**Integral meter can be rotated 90°** to allow for proper viewing orientation:

- remove hold-down screws.
- remove black cover screws.
- move cover screws to original hold-down screw location.
- remount meter in new orientation.

The meter is not inserted into the 4-20 mA loop. It receives power and data directly from the Drexelbrook smart transmitter via attached mini ribbon cable. See Figure 2-16.

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.

The meter is configured using either the Drexelbrook PC software (F2-System) or via the Model 275 Calibrator.



**Figure 2-16**  
*Digital Meter in Housing with Viewport*



## **Section 3**

## Section 3: Configuration & Calibration with Drexelbrook PC Software

This section instructs the user how to use the Drexelbrook 401-700-20/40 Series PC calibrator software to configure and calibrate the Universal III (RF Admittance) Transmitter.

### 3.1 General Description

The 401-700-20/40 software package allows the use of any Windows® 9X/NT/2000/XP-based personal, laptop, or notebook computer to calibrate the HART® Protocol transmitter.

The PC software can be used in place of the Rosemount® 268 or 275 handheld calibrators used for multi-Process Variable (PV) transmitters.

### 3.2 Model Number

**4 0 1 - 0 7 0 0 - 0 2 X / 4 X**

2X= 1 PC Software Package includes:

RS232 Modem Assembly 401-0700-004 (*Figure 3.1*).

2X=2 PC Software Package includes:

Contents in 401-0700-021, HART® 6.0 (*DOS version*) on a 3½" Floppy Disk, and HARTWin™ version 2.1 or greater on a CD-ROM.

4X=1 PC Software Package includes:

USB Modem Assembly 401-0700-007(*Figure 3.1a*).

4X=2 PC Software Package includes:

Contents in 401-0700-41, Utilities and Drivers on a CD- ROM, and HARTWin™ version 2.3 or greater on a CD-ROM.

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

HART® 6.0 (*DOS version*) on a CD-ROM.

**4 0 1 - 0 7 0 0 - 0 3 1**

HARTWin™ version 2.X on a CD-ROM.

### 3.3 System Requirements

#### PC Requirements

Windows® 95, 98, ME, 2000, XP.

The USB modem is not compatible with Windows® 95, 98 First Edition, or NT. It is recommended that the software be installed on a hard drive with 20 megabytes or more of space available.

#### Input to Modem

RS232 or USB Port, from one of the COM serial ports (COM1, COM2, etc.). The PC provides operating power for the modem but not for the transmitter.

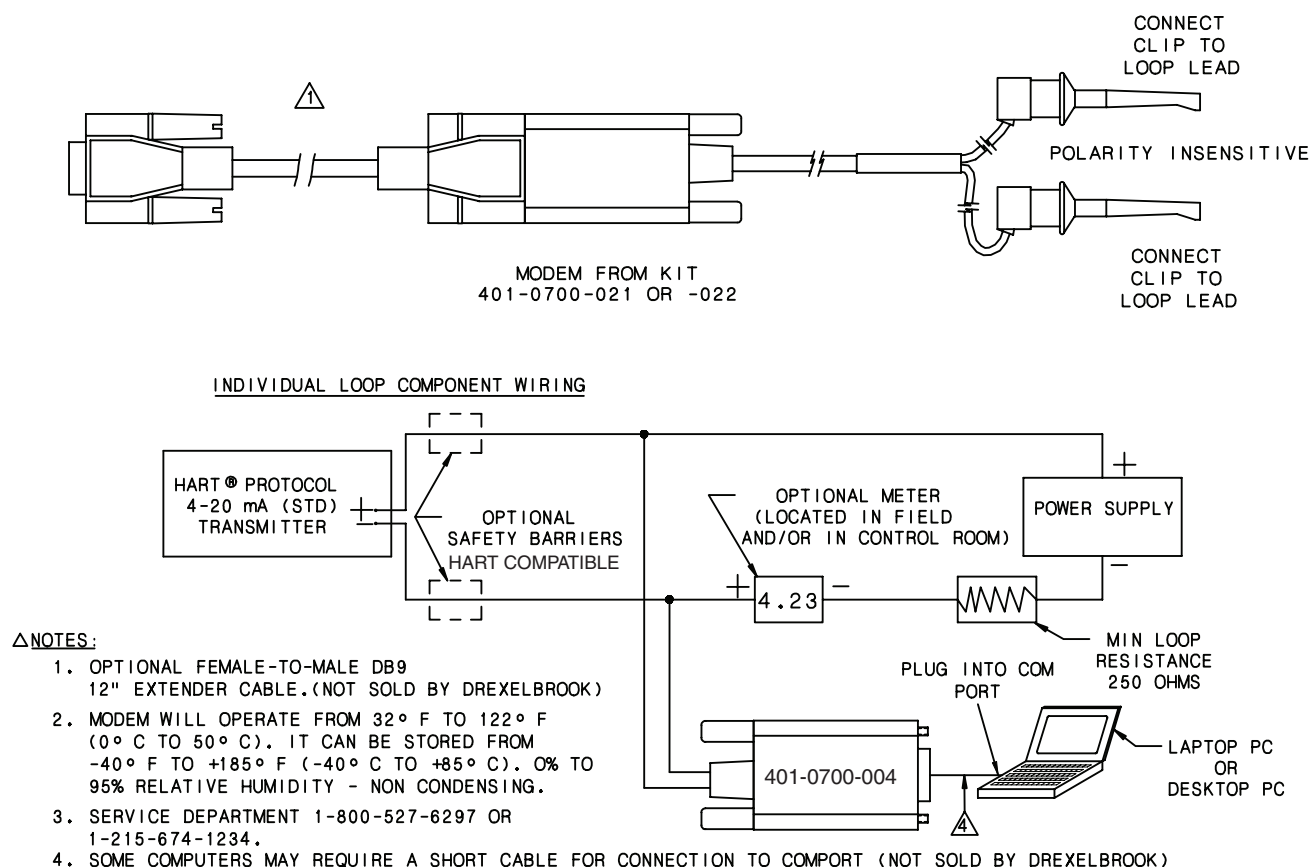
#### Output (to Transmitter being Calibrated)

4-20 mA in HART® Protocol.

### 3.4 Installing The RS232 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 RS232 Drexelbrook Modem 401-700-004 to one of the **COM** serial ports (**COM1**, **COM2**, etc.) of the computer.
- B. Connect the Modem's 4-20 loop connectors to the transmitter loop.
- C. Turn on the computer.



*Figure 3-1*  
*RS232 Modem Assembly & Loop Connection*

### 3.4.1 Installing The USB Modem

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

A. Turn on the computer

B. Install Modem Software:

It is highly recommended the USB drivers be installed **BEFORE** you plug in the modem.

Install the USB Drivers by inserting the Modem Installation Disk into CD Drive of the computer.

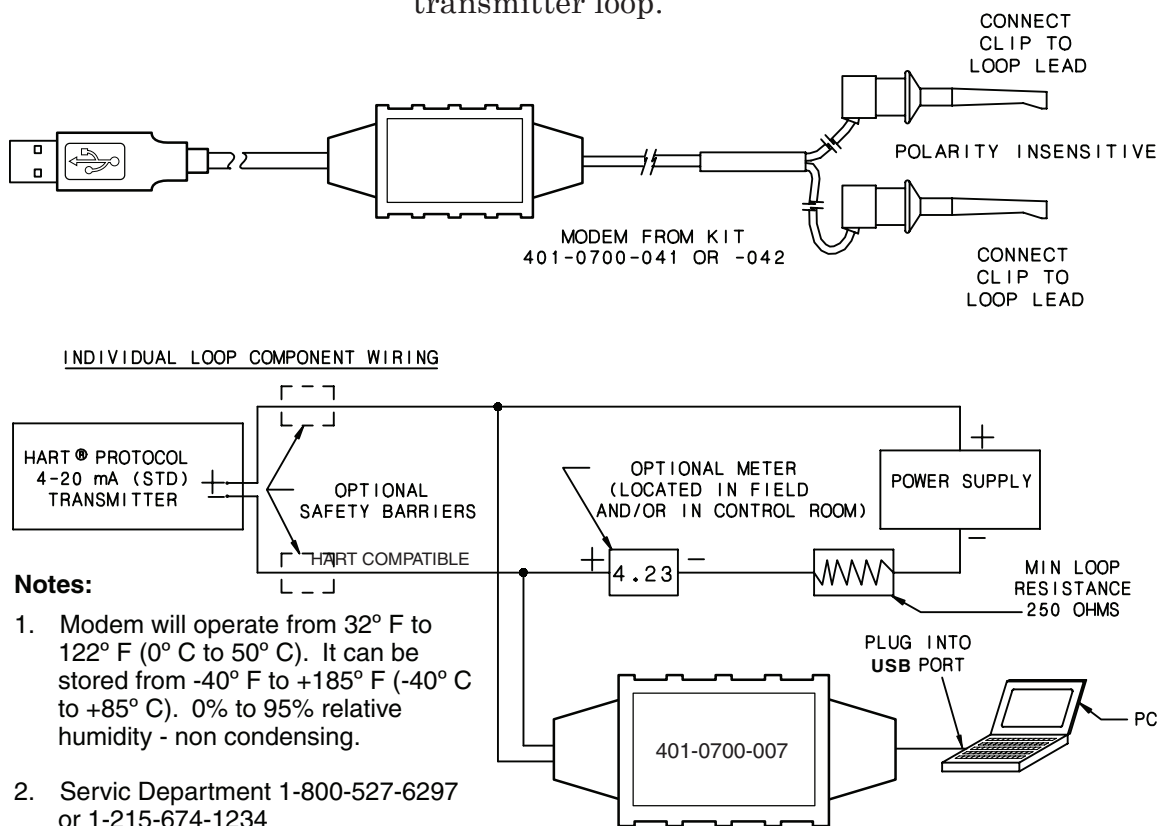
If program does not "Auto-Run", select "D:\setup" (where D is the letter representing the CD Drive)

Be Sure to Select the USB interface in the setup prompt.

Follow any "On-Screen" Instructions.

C. Connect the Drexelbrook Modem 401-700-007 to a **USB** port on the computer. With the USB drivers already installed, the computer will detect the modem and assign a COM PORT number.

D. Connect the Modem's 4-20 loop connectors to the transmitter loop.



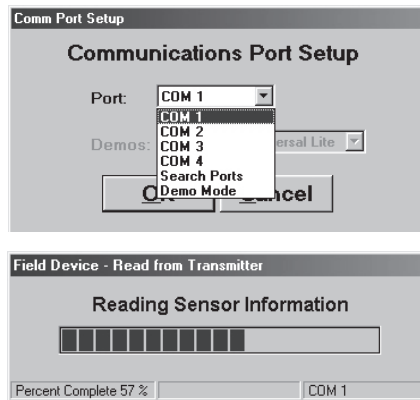
**Notes:**

1. 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.
2. Servis Department 1-800-527-6297 or 1-215-674-1234

**Figure 3-1a**  
**USB Modem Assembly & Loop Connection**



### 3.5 Install the Windows Version HARTWin Software on Hard Drive



**Figure 3-2**  
*Selecting COM ports during software installation*

- A. Place the 401-700-031 CD into the CD drive
- B. If program does not "Auto-Run", select "D:\setup" (where D is the letter representing the CD Drive).
- C. Follow "On-Screen" instructions in **Setup** to create program file.
- D. Once loaded, double click "HartWin" icon and the program should run under its own window.
- E. Select communication port [**Com 1, Com 2, etc.**] and then click "**OK.**" See **Figure 3-2**
- F. If you are not sure which communication port you are using (such as when first using a USB modem), select "Search Ports," then OK. The software automatically will seek out the correct one. In either case the software begins to communicate with the HART protocol transmitter and returns with a view (below) containing "name plate data," Tag ID and all default or existing configuration information. This is the same as if you clicked on the Read Transmitter function button.
- G. The next view, shown in **Figure 3-3**, appears automatically, displaying current transmitter database for calibration set-up for your selected Tag ID. The Scratch Pad will automatically show the last message (last user, last calibration, etc.) up to 32 characters. If this is a new transmitter, the Tag ID is user-defined. Serial number, transmitter software version, range, etc. is automatically entered from the "name plate data" embedded in the transmitter:

### 3.6 Description of Function Keys

**Figure 3-3** shows a PC calibration software menu screen. The following paragraphs describe the function buttons. The data fields are described in Section 3.7-Configuration.

#### **Read Transmitter [F3 on keyboard]**

Reads all pertinent data from the transmitter and displays it on the screen. The Read function also updates the real time window. Keep in mind that it takes several seconds to load the information from the transmitter. When the load is complete, the screen shows the database parameters, except any user-defined strapping table information. This command is also used when connecting to another transmitter.

### 3.6 Description of Function Keys (Continued)

#### Write to Transmitter [F5 on keyboard]

Sends new or edited configuration data to the transmitter. Data fields that have been edited but not sent to the transmitter are displayed in red.

#### Real Time View [F4 on keyboard]

Displays the real time values of level, capacity, distance, temperature, loop current, percentage, and status.

#### Point Calibration [F6 on keyboard]

Calibrates the HART® protocol transmitter using Point calibration. See Section 3.8 Calibration. Enter the low point and high point of level for an accurate calibration.

#### D/A Trim

Allows a field reference meter to be connected to the transmitter for adjusting transmitter output current. See Section 3.10.

#### Strapping Table

Displays the values of the input to level and output to volume in percent in a 21-point table. Allows points to be changed to accommodate irregularly shaped vessels. See Section 3.11.

#### Configure Meter

Configures the optional Digital Integral Meter (440-44-3) used for local indication. See Section 3.12.

#### True Level Calibration (grayed out)

This button is inactive for the Universal III Transmitter. It is for the extra features that come with the True Level model transmitter.

*Figure 3-3  
PC Software Menu Screen  
automatically communicates  
all "name plate data" from  
transmitter*

The screenshot shows the 'HART for Windows' software interface. At the top is a menu bar with 'File', 'Field Device', 'Options', and 'Help'. Below the menu bar is a row of buttons: 'Read Transmitter', 'Write to Transmitter', 'Real Time View', 'Point Calibration', 'D/A Trim', 'Strapping Table', 'Configure Meter', and 'True Level Calibration'. The main area is titled 'AMETEK Drexelbrook HART® Protocol Software for Windows® 9x/NT/2000/XP'. It contains several configuration fields:

- Tag-ID:** 12345678
- Serial Number:** 14096
- Scratch Pad:** (empty text field)
- Software Version:** 3.1
- Analog Loop Assign:** LEVEL (dropdown menu)
- Range Position:** 4
- Damping Time:** 0 sec
- Type:** 30

Below these are two main sections: 'Level Configuration' and 'Vessel Configuration'.

**Level Configuration:**

- Level Units:** feet (dropdown menu)
- Maximum Level:** 200.00 ft
- Level Type:** Standard
- LRV (4 mA):** 0.00 ft
- URV (20 mA):** 100.00 ft

**Vessel Configuration:**

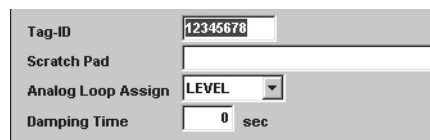
- Vessel Units:** gallons (dropdown menu)
- Maximum Capacity:** 1000.00 gal
- Vessel Type:** Vertical (dropdown menu)

At the bottom right is a 'Level Calibration' section:

- Lower Level:** 0.00 ft
- Lower Capacitance:** 50.00 pf
- Upper Level:** 10.00 ft
- Upper Capacitance:** 2000.00 pf

At the bottom left, there is a 'Status' field showing 'OK' and a 'Field device tag identifier' field.

## 3.7 Configuration



The image shows a software menu screen with the following fields:

Tag-ID	12345678
Scratch Pad	
Analog Loop Assign	LEVEL
Damping Time	0 sec

*Figure 3-4  
Configure Transmitter from  
Menu screen*

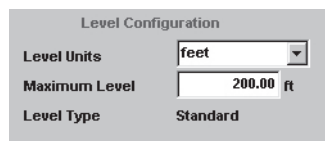
Refer to **Figure 3-3** PC Software Menu Screen.

Configuration involves downloading information to the HART protocol transmitter that is specific to the application and vessel that is being measured.

Calibration requires that application information and two points of level and/or capacitance be supplied to the transmitter from the calibration software.

- A. Begin configuration 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. Press Tab or Enter on your keyboard.
- B. Select **Level** or **Vessel** in the **Analog Loop Assign** selection box. Press Tab or Enter on your keyboard.
  - **Level configuration** sets the output to follow the level of the material being measured.
  - **Vessel configuration** sets the output to follow the strapped volume or weight in the vessel. For example, gallons in a horizontal vessel.
- C. Edit **Damping Time** from 0-90 seconds, if desired.
- D. Click on **Write to Transmitter**.
- E. Move to **Level Configuration** section of menu.

### 3.7.1 Level Configuration



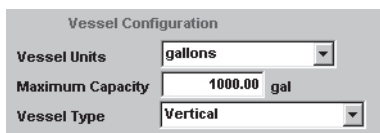
The image shows a 'Level Configuration' screen with the following fields:

Level Units	feet
Maximum Level	200.00 ft
Level Type	Standard

*Figure 3-5  
Level Configuration from  
Menu screen*

- A. Select **Level Units**. The default is feet. Choose the units that correspond to the level measurement.
- B. Edit the **Maximum Level** to agree with the actual tank height (not the length of the sensing element).
- C. Click on **Write to Transmitter** and move to the **Vessel Configuration** section of the menu.

### 3.7.2 Vessel Configuration

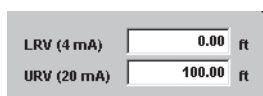


Vessel Configuration	
Vessel Units	gallons
Maximum Capacity	1000.00 gal
Vessel Type	Vertical

**Figure 3-6**  
*Vessel Configuration from Menu screen*

- A. Select **Vessel Units**. The default is gallons. Press Enter and choose the units that correspond to the vessel measurement. The units include both weight and volume outputs. Press Tab or Enter on your key board to continue.
- B. Edit the **Maximum Capacity** of the vessel. Enter the corresponding value of weight or volume equal to the **Maximum Level**. Enter 100 for percent if the weight or volume units are not known or needed. Press Tab or Enter on your keyboard to continue.
- C. Select **Vessel Type**. Available options include:
  - Vertical Tank (**VERTICAL**)
  - Horizontal cylinder with flat ends (**HRZCy/FL**)
  - Horizontal cylinder with dished ends (**HRZCy/Ds**)
  - Horizontal cylinder with hemispherical ends (**HRZCy/HM**)
  - Spherical (**SPHERE**)
  - The default is **Vertical**. Press Enter and choose the type of vessel.
- D. Click on **Write to Transmitter**.
- E. Move on to Range Values (**URV & LRV**) section of menu.

### 3.7.3 Lower and Upper Range Values (LRV and URV)



LRV (4 mA)	0.00	ft
URV (20 mA)	100.00	ft

**Figure 3-7**  
*LRV & URV Configuration from Menu screen*

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

- A. Edit **LRV** (Lower Range Value) to display the output you want to see when the transmitter generates 4 mA current. The default **LRV** is 0 feet.
- B. Edit **URV** (Upper Range Value) to display the output you want to see when the transmitter generates 20 mA current. The default **URV** is 100 feet for the Universal III.
- C. Click on **Write to Transmitter**. *Configuration is now complete.*

### 3.8 Calibration

There are two methods for calibrating the transmitter using the PC software:

**Point Calibration:** (menu button selection):

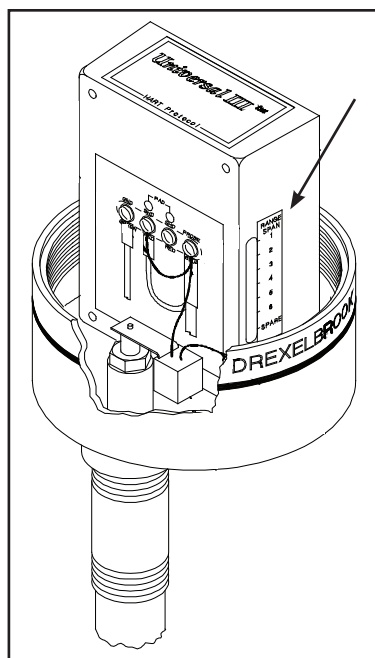
Uses the two known level points in the vessel for calibration. The further apart the two points are for the calibration the better the accuracy of the overall measurement. Always initiate the point calibration process by selecting the **Point Calibration** button on the PC menu screen and following the prompts in the pop-up window.

**Level Calibration:** See Figure 3-3 (lower right)

Uses capacitance values obtained from the AMETEK Drexelbrook Service department (or a previous calibration or identical application) for the zero and span calibration data. Call 1-800-527-6297. Please provide your DE purchase order number, transmitter serial number, vessel and application data to the Service Engineer. Level calibration is done using the **Level Calibration** data fields on the PC menu screen.



**May use both Point & Level Calibrations**



**Figure 3-9**  
**Range Span Jumpers**

It is permissible or sometimes even recommended that both methods be used in order to establish a calibration standard. For example, if the vessel was already filled before the calibration was attempted and it is difficult or impossible to lower the level to establish the second point, it would be best to use a calculated zero capacitance for the low point and actual level for the high point. While this wouldn't be as accurate as two known level points, it will be reasonably accurate until an actual low point calibration can be established. The Service department will help in calculating high or low capacitance values.

Because calibration involves determining two known points of capacitance, a span (or range) jumper 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. *See Fig. 3-9.*
- Each **Range Span** position on the Universal III advances the range in inches or feet to approximately five times the previous setting.

*See Table 3-1*

### Universal III Span Range Setting Chart Probe Length vs. Span Position Number / maximum pF

Jumper Position =	1	2	3	4	5	6
Maximum pF =	20	100	450	2000	10000	45000

SYSTEM #    SENSOR # MAXIMUM PROBE LENGTH IN FEET

#### CONDUCTING LIQUIDS:

509-75-X09	700-1-22	N/A	N/A	5.4	20	N/A	N/A
509-75-X25	700-5-54	N/A	N/A	9.2	40	200	920
509-75-X06	700-2-57	N/A	N/A	1.2	5.3	20	N/A
509-75-X13	700-5-18	N/A	N/A	1.4	6.25	31	140
509-75-X07	700-2-24	N/A	N/A	7.8	20	N/A	N/A
509-75-X05	700-2-37	N/A	N/A	N/A	N/A	4.1	14
509-77-X06	700-1-24	N/A	N/A	5.4	20	N/A	N/A
509-75-X30	700-1-62	N/A	N/A	5.4	20	N/A	N/A
509-75-724	700-5-29	N/A	N/A	N/A	4.2	21	95

#### INTERFACE APPLICATION:

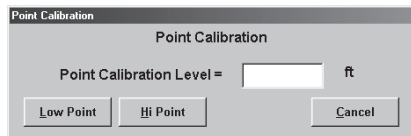
509-76-X06	700-2-57	N/A	N/A	1.2	5.3	20	N/A
509-76-X02	700-2-27	N/A	N/A	1.0	4.8	20	N/A
509-76-X04	700-2-37	N/A	N/A	N/A	N/A	4.0	14

#### INSULATING K = 1.5-5:

509-77-X06	700-1-24	N/A	2.7	12.5	20	N/A	N/A
509-77-X06	700-1-22	N/A	8.3	20	N/A	N/A	N/A
509-77-X06	700-5-54	N/A	8.0	37.5	166	N/A	N/A
509-77-X06	700-2-57	N/A	3.6	16.2	20	N/A	N/A
509-77-X06	700-5-18	N/A	3.8	17.1	76	N/A	N/A
509-77-X06	700-2-24	N/A	6.0	20	N/A	N/A	N/A
509-77-X06	700-2-27	N/A	5.0	20	N/A	N/A	N/A
509-77-X06	700-2-37	N/A	5.0	14	N/A	N/A	N/A

*Table 3-1  
Span Range Position for a number of common Sensing Elements*

### 3.8.1 Point Calibration



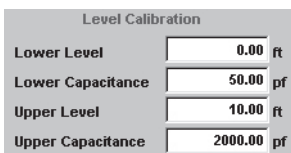
**Figure 3-10**  
*Point Calibration from Menu Screen*

The Point to Point method of calibration is the most accurate way to calibrate the transmitter with two level points. The high or low level must be known and should be held steady for accurate calibration. They may be any two points at more than 10% apart, and need not be the 4mA or 20 mA points.

The Point Calibration pop-up window is accessed by clicking on the menu "button" Point Calibration. Either a high point or a low point can be entered first.

- A. Type in current value as the high point of the two point calibration.
- B. Click on Hi Point or press Enter (or Tab) on the keyboard. High point calibration is now complete.
- C. Move level in vessel a minimum of 10%.
- D. Type in that value for Low Point of the two point calibration.
- E. Click on Low Point or press Enter (or Tab) on keyboard. Low point calibration is now complete.

### 3.8.2 Level Calibration



**Figure 3-11**  
*Level Calibration area of Menu Screen*

Level calibration uses zero and span capacitance values as the calibration data. These values can be obtained from the AMETEK Drexelbrook Service department (or from a previous calibration or identical application). Please be prepared when you call (1-800-527-6297) with the purchase order number and the serial number of the transmitter.

- A. Go to Level Calibration area of the menu.
- B. Enter Lower Level value. Press Tab or Enter.
- C. Enter Lower Capacitance value. Press Tab or Enter.
- D. Enter Upper Level value. Press Tab or Enter.
- E. Enter Upper Capacitance value. Press Tab or Enter.
- F. Click on Write to Transmitter.

### 3.8.3 Application Example

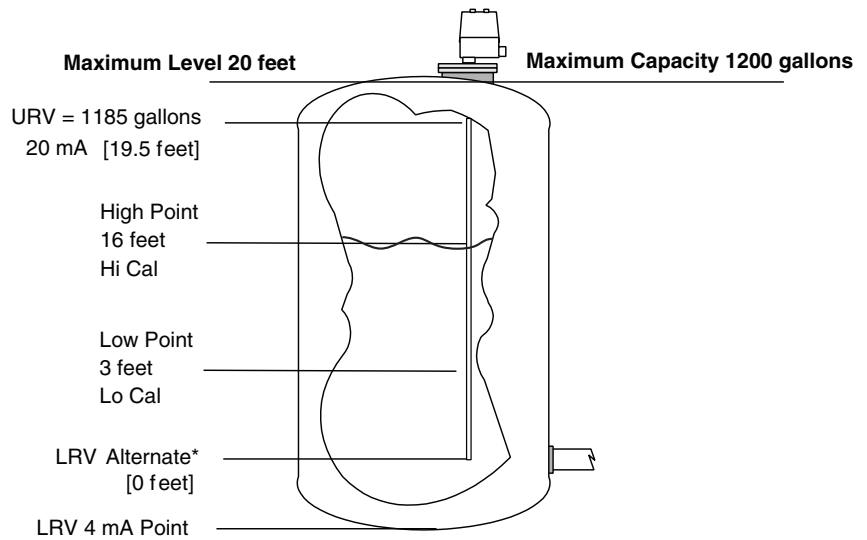
Example of an application using the PC software.  
(Application Data)

- Vertical Tank
- No Damping
- Caustic or Acid Material in Tank Sensing Element: 700-5-54, Model Code: 74 (See Section 1.4)
- Span Range Switch factory set to 4
- Maximum Capacity of Vessel = 1200 gallons
- Maximum Size of Vessel = 20 feet
- 4 mA (LRV) = 0 gallons
- 20 mA (URV) = 1185 gallons [19.5 feet]
- Point Calibration done using two known level points:
- Lo Cal = 3 feet [selected level]
- Hi Cal = 16 feet [current level]



### 3.8.3 Application Example (Continued)

**Figure 3-12**  
*Application Example Diagram*



\*LRV may either reference the bottom of the vessel, bottom of the sensor, or an elevated point on the sensor.

**Figure 3-13**  
*PC Software Menu Screen  
View of Application Example*

**HART for Windows**

File Field Device Options Help

Read Transmitter Write to Transmitter Real Time View Point Calibration D/A Trim Strapping Table Configure Meter True Level Calibration

AMETEK Drexelbrook HART® Protocol Software for Windows® 9x/NT/2000/XP

Tag-ID: 12345678 Serial Number: 14096

Scratch Pad: CAL BY RSM Software Version: 3.1

Analog Loop Assign: LEVEL Range Position: 4

Damping Time: 0 sec Type: 30

**Level Configuration**

Level Units: feet

Maximum Level: 20.00 ft

Level Type: Standard

LRV (4 mA): 0.00 ft

URV (20 mA): 19.50 ft

**Vessel Configuration**

Vessel Units: gallons

Maximum Capacity: 1200.00 gal

Vessel Type: Vertical

**Level Calibration**

Lower Level: 3.00 ft

Lower Capacitance: 200.00 pf

Upper Level: 16.00 ft

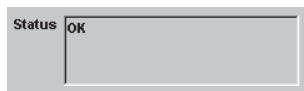
Upper Capacitance: 1000.00 pf

Status: OK

Lower Range Value where loop equals 4 mA or 0% out



### 3.9 PC Status Messages



*Figure 3-13a  
PC Software Menu Screen  
View of Main Menu*

#### Status Message: SPAN TOO SMALL

Difference between URV and LRV is less than 10% of range.

**Example:** For 0 to 10 foot calibration points: LRV=3.0 feet and URV=3.8 feet. When calibration points are too close together, overall accuracy of calibration is adversely affected.

**Action:** The calibration points should be farther apart.

#### Calibration Status Message: RAISE SPAN JUMPER

Based on LRV, URV, and capacitance calibration data, the estimated 100% capacitance exceeds selected range by greater than 10%.

**Example:** A unit in Range 4 (2000 pF) projects maximum capacitance equal to 2500 pF. Error message is displayed.

**Action:** Raise Range jumper (Section 3.8, Table 3-1) to position 5 for this example.

#### Calibration Status Message: LOWER SPAN JUMPER

Based on LRV, URV, and capacitance calibration data, the estimated 100% capacitance value is less than 10% of the maximum pF for the range below the selected range.

**Example:** A unit in Range Span 4 (2000 pF) projects maximum capacitance equal to 400 pF.

**Action:** Lower Range jumper (Section 3.8, Table 3-1) to position 3 (Max. pF of 450 pF) for this example.

#### Real-time Status Message: UNDERRANGE

Present capacitance/milliamper value is less than -5% of range.

**Examples:** Center wire connection is broken. Sensing element is not operating. An elevated Zero is used and actual level is below 4mA point. Vessel has lost its RF ground reference.

**Action:** Check connections and ground. Recalibrate if this level is in operational range of process.

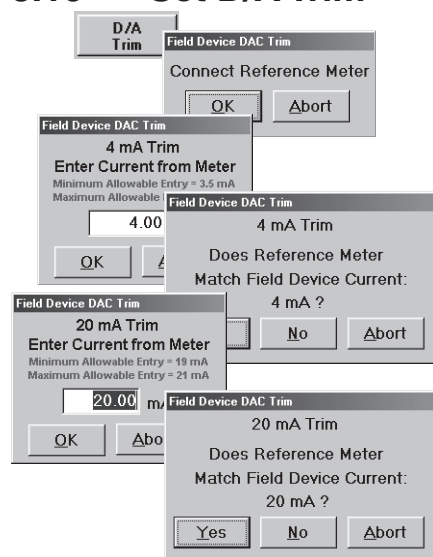
#### Real-time Status Message: OVERRANGE

Present capacitance/ milliamp value over 105% of system span.

**Examples:** Actual level exceeds span point on sensing element. Cut in sensing element insulation or shorted coax.

**Action:** Check sensing element and coax. Re-calibrate if this level is in operational range of process.

### 3.10 Set D/A Trim



**Figure 3-14**  
**Setting D/A Trim Menu Screen**  
**"Pop-Ups"**

**D/A Trim is NOT a calibration! This is a pre calibrated alignment to precision factory settings and is rarely in need of change. The procedure is intended only as a slight "meter" adjustment to a known external reference.**

The Digital to Analog (D/A) Trim adjusts the transmitter mA (current) output. Since the smart transmitter performs a digital to analog conversion, there may be a discrepancy in the 4-20 mA output loop as measured with a reliable external milliampere meter.

For example: perhaps after calibration you observe that the tank is empty and a hand-held mA meter reads only 3.94 mA, while the Real Time View in the PC Menu shows 4.00 mA. By adjusting the D/A trim, you may digitally manipulate the output current to equal 4.00. You may also wish to adjust the high end to 20.00 mA.

To make these adjustments, click on **D/A Trim** on the PC software Menu Screen and follow the pop-up window instructions:

### 3.11 Strapping Table

The strapping table is a 2-point to 21-point table used by the Universal III to cause the output current to follow a specified relationship to the level. There are certain strapping tables that are already built in to the transmitter software. These are: Linear (vertical tank); Horizontal Tank with flat ends; Horizontal Tank with dished ends; Horizontal Tank with hemispherical ends; and Spherical Tank. These predefined tables are automatically created by selections made with Vessel Configuration assignments during Configuration procedure in Section 3.7.2, and viewed by clicking the **Strapping Table** "button" on the Main menu.

If the output-to-level relationship is not defined by one of these tables, you may create a table in the Strapping Table program. To create a non-linear relationship, you will need at least 3 points and may use as many as 21 points. A 21-point table will define the relationship with more accuracy. A common example for a simple table would be a Cone Bottom Vertical tank which would require 3 points—the bottom, straight-side break point, and the top. On the other hand, an open channel flow application could benefit from using all 21 available points.

### 3.11 Strapping Table (Continued)

- A. Plan your table by filling out table 3-2. You may use the first column which lists every 5% between 0 and 100%, or you may fill in your own values in column 2.
- B. Fill out column 3 with output values corresponding to those listed in column 1 or 2.
- C. "Click" on **Strapping Table** button to access table:
- D. Enter the values you calculated into the screen view presented.
- E. "Click" on **Write Strapping Table**.
- F. "Click" on **Exit** when completed.

*Table 3-2  
Universal III  
Strapping Table*

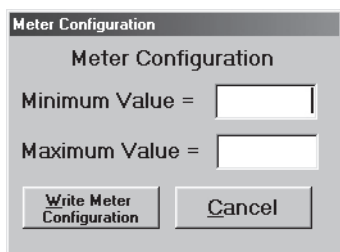
Point Number	Level Standard Preset Values % Level	Level Optional Values % Level	Output Value In Selected Units
1.	0		
2.	5		
3.	10		
4.	15		
5.	20		
6.	25		
7.	30		
8.	35		
9.	40		
10.	45		
11.	50		
12.	55		
13.	60		
14.	65		
15.	70		
16.	75		
17.	80		
18.	85		
19.	90		
20.	95		
21.	100		

*Figure 3-15  
Menu Screen Transforms to  
Strapping Table*



By clicking on **Last Read Values**, this view may also be used to review existing strapping tables previously entered.

### 3.12 Digital Integral Meter Configuration



**Figure 3-16**  
*Configure Meter Pop-up from Menu Screen; values relate to LRV & URV*

The optional Digital Integral Meter (DIM)(401-44-3) is used for local display. It can be viewed through a glass viewport in the transmitter housing cover. **See Figure 2-16**

The meter can be configured to read any engineering units, e.g. 4-20 mA, gallons, inches, feet, etc. Status messages are also displayed on the meter. Refer to Section 2.9 for meter installation.

To configure the meter, "Click" on **Configure Meter** in menu screen for the pop-up;

**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:**

Minimum Value = 0.00

Maximum Value = 100.00

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

Minimum Value = LRV

Maximum Value = URV

**To set the meter display range equal to percent of level:**

Minimum Value = 0

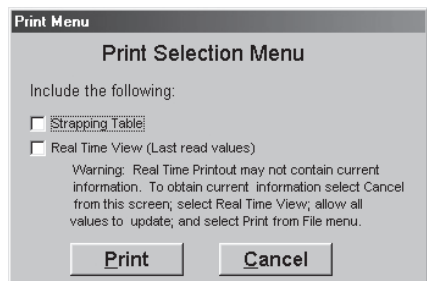
Maximum Value = 100

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 upon return of power.

**If the display becomes distorted:**

- Remove power from the smart transmitter,
- Wait one minute,
- Reapply power to restart the meter.

### 3.13 Save/Print Entries



**Figure 3-17**  
*Print Pop-up from Menu*

In addition to your own convenience, many regulatory agencies are requiring a record of the values being used during certain processes. All of the values developed in this configuration and calibration procedure may be saved to be reloaded into another (or replacement) transmitter. All of the values may likewise be printed out as hard copy, including the Serial Number, transmitter software version, Tag ID, Scratch Pad, Level and Vessel Configurations, Level Calibration, all of the Real Time View numbers, and all of the Strapping Table entries.

### 3.13 Save/Print Entries (Continued)

Pop-up screens come from selections in the **FILE** pull down at the top left of the PC menu Screen.

Copies are saved in both .slt file and .txt files.

The .slt file will download into a transmitter through the **OPEN** command. The text file may be printed out, or reformatted.

**PRINT** command provides a pre-formatted hard copy.

### 3.14 Validation

More and more industries are requiring formal validation of their processes for their customers as well as for various government regulatory agencies. The Universal III Transmitter has this capability built in.

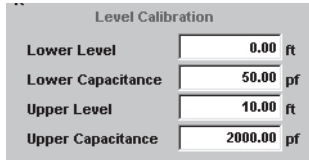
#### 3.14.1 Validation Design Concept

Smart RF Continuous Level systems derive their input information from a sensing element that provides a capacitance value to the RF Transmitter. The RF Transmitter output signal is derived from this capacitance value, based on the capacitance span of the transmitter during initial calibration.

If the RF Transmitter's minimum and maximum capacitance values are known, and remain unchanged, the effects of a specific capacitance value within this range can be accurately predicted. If a known capacitance (which can be NIST-traceable) within this range produces repeatable results and the minimum and maximum values remain unchanged the RF Level system can be assumed to be operating correctly.

With a known capacitance input, the output signal would not be repeatable if the calibration information is altered, or if the RF transmitter was not operating within specifications. Repeatable calibration information can be maintained through the use of the Save/Print capability built into the Universal III Transmitter.

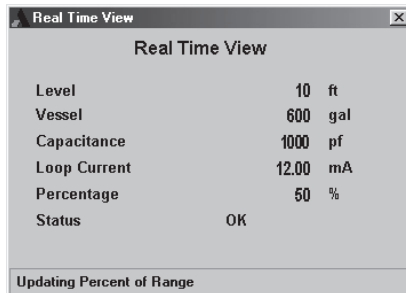
### 3.14.2 Validation Procedures



Level Calibration	
Lower Level	0.00 ft
Lower Capacitance	50.00 pf
Upper Level	10.00 ft
Upper Capacitance	2000.00 pf

**Figure 3-18**  
**Capacitance on Menu Screen**

- A. Drexelbrook Laptop software must be used. Connect the laptop to the smart level transmitter signal loop to be validated and start the software according to the instructions provided at the beginning of this Section.
- B. At the Main configuration screen observe the Level Calibration, Lower Capacitance, and Upper Capacitance values and the Lower Level and Upper Level values. Select an NPO Capacitor (which can be NIST traceable, if desired or required) that falls somewhere mid-range. Example: See Fig. 3-18. If Lower Capacitance is 50pF and Upper Capacitance is 2000pF, that corresponds to a Lower Level and Upper Level of 0-10 feet. Select an NPO Capacitor of approximately 1000pF. [Drexelbrook 401-6-8 Capacitor Substitute Box may also be used; it is traceable to NIST].
- C. Connect the NPO capacitor selected from the last step to the Probe and Ground connections at the transmitter (with coaxial cable from sensing element disconnected).



Real Time View	
Level	10 ft
Vessel	600 gal
Capacitance	1000 pf
Loop Current	12.00 mA
Percentage	50 %
Status	OK

Updating Percent of Range

**Figure 3-19**  
**Real Time View Pop-up from Menu Screen**

- D. Select Real Time View on the PC software Menu Screen (F4 on your keyboard) See Fig. 3-19. The display should show the Capacitance as the value of the NPO Capacitor (within the capacitors tolerance), and the LEVEL should display close to the mid-range of the Lower and Upper Level from the Level Calibration field. The Loop Current and the Percentage will also reflect the values that are generated by the NPO Capacitor. Add to the scratch pad of the Menu Screen the value of the NPO capacitor that you used. If desired, this information can be printed out for file or record purposes. Mark or Tag this capacitor\* to correspond to this specific transmitter. Put the capacitor in a safe location for use in subsequent testing and validation.
- E. By placing the same exact capacitor\* on the RF transmitter's Probe and Ground terminals and observing the signal output generated by this capacitor, it can be verified that the transmitter is operating properly and that the calibration information is the same as during the initial set up.



Every capacitor manufactured will generate a slightly different capacitance value within its specified tolerance. By marking the capacitor and using only this capacitor for testing and validating the AMETEK Drexelbrook Universal III Transmitter, the system should produce repeatable results within transmitter specifications.

### 3.14.3 Validation Results

*See Fig. 3-20.*

If the information that is shown (or printed) matches the initial readings within system specifications, then it can be verified that the calibration and configuration is as originally set. It can also be verified that the transmitter's response falls within acceptable tolerances. The system has passed validation tests. Using the Save/Print feature built into the transmitter allows the ability to comply with the record-keeping needed for many processes by regulatory agencies.

AMETEK Drexelbrook

205 Keith Valley Road

Horsham, PA 19044

Telephone: 215-674-1234

FAX: 215-674-2731

Service: 800-527-6297

Tag-ID:LT 101

Scratch PAD:1000 pf NPO validation capacitor

Analog Loop Assign:LEVEL

Damping Time:0 sec.

Serial Number:1172

Software Version:3.1

Range Position:4

Type:30

Level Configuration

Level Units:feet

Maximum Level:10.00 ft

Level Type:Standard

Vessel Configuration

Vessel Units:gallons

Maximum Capacity:1200.00 gal

Vessel Type:Vertical

LRV (4mA):0.00 ft

URV (20 mA):10.00ft

Level Calibration

Lower Level:0 ft

Upper Level:10 ft

Lower Capacitance:50 pf

Upper Capacitance:2000 pf

Real Time View

Level:10 ft

Vessel:600 gal

Capacitance:1000 pF

Loop Current:12.00 mA

Percentage:50 %

Status:OK

Strapping Table

Vessel Type:Vertical

Number of Points:21

In

Level

Percent

Out

Volume

Percent

0.00

0.00

0.00

0.00

1.00

5.00

60.00

5.00

2.00

10.00

120.00

10.00

3.00

15.00

180.00

15.00

4.00

20.00

240.00

20.00

5.00

25.00

300.00

25.00

6.00

30.00

360.00

30.00

7.00

35.00

420.00

35.00

8.00

40.00

480.00

40.00

9.00

45.00

540.00

45.00

10.00

50.00

600.00

50.00

11.00

55.00

660.00

55.00

12.00

60.00

720.00

60.00

13.00

65.00

780.00

65.00

14.00

70.00

840.00

70.00

15.00

75.00

900.00

75.00

16.00

80.00

960.00

80.00

17.00

85.00

1020.00

85.00

18.00

90.00

1080.00

90.00

19.00

95.00

1140.00

95.00

20.00

100.00

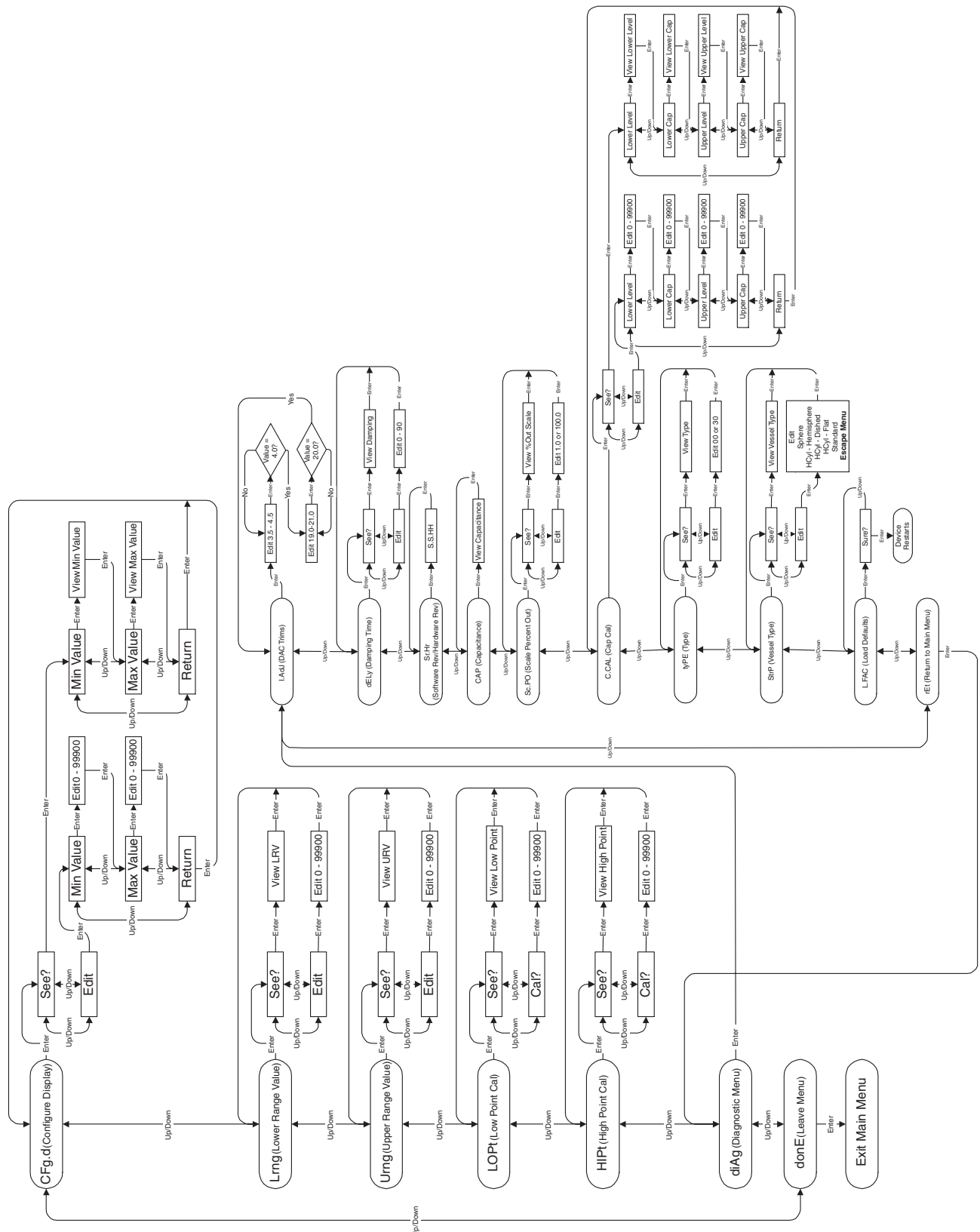
1200.00

100.00

**Figure 3-20**  
*Typical Printout of Transmitter Data*



### 3.15 Calibration & Configuration via 401-44-3 Display/Keypad





## **Section 4**

## **Section 4: Configuration and Calibration Using the Rosemount™ Model 275 Communicator with a Drexelbrook Device Description**

### **4.1 Drexelbrook Device Description**

The Drexelbrook Device Description for the Rosemount 275 handheld calibrator makes it easy to calibrate a Universal III. The device description software is stored in the memory module (located in the back portion) of the calibrator.

To determine if your Model 275 Handheld calibrator has the Drexelbrook Device Description loaded, 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 lists all the Manufacturers in alphabetical order.
- 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.

**Section 5** describes configuration of the Universal III transmitter with a Rosemount 275 handheld calibrator without a device description.

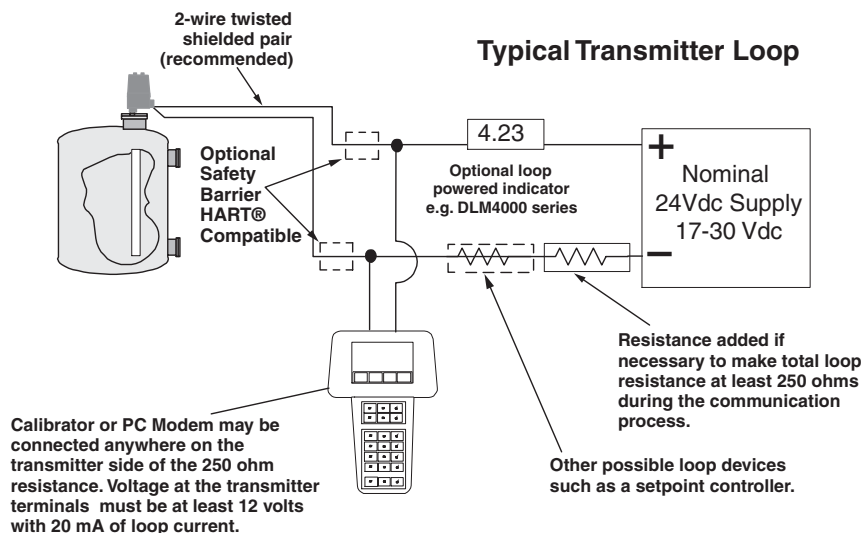
### **4.2 Start-up**

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

1. Connect the Rosemount Model 275 (Shown in Fig. 4-1).
2. Turn on the Calibrator and look for the ONLINE screen to appear. ONLINE means that the 275 Calibrator has recognized the Universal III and is ready for Configuration and Calibration.
3. You must start the process by doing the Configuration first-- followed by Calibration. There are also instructions for configuring the Strapping Tables and for doing a D/A Trim to make the loop output agree with a calibration standard for loop current.

## 4.2 Start-up (Continued)

*Figure 4-1*  
*Typical Transmitter Loop*



## 4.3 Configuration

Following is the keystroke sequence for Configuration 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. If current loop assign is Level and is correct, go to next screen and select Exit. Proceed to 4.3 Calibration.

If Vessel configuration is to be selected, choose Vessel, go back to Config screen and select **Vessel Config**. Edit all values as done for Level Config. Select **Exit** and proceed to 4.4 Calibration.



## 4.4 Calibration

There are two methods of calibrating the Universal III transmitter: **Point Calibration** or **Capacitance Calibration**.

Point calibration uses the actual level in your vessel for calibration. The further apart the two points are for the calibration, then the better the accuracy of the overall measurement.



Capacitance calibration uses values obtained from the Drexelbrook Service department (or a previous calibration or identical application) for the zero and span calibration data. Call 1-800-527-6297 for assistance. Please provide the purchase order number, transmitter serial number and application information to the Service Engineer.

It is permissible or sometimes even recommended that both methods be used in order to establish a calibration standard. For example, if the vessel was already filled before the calibration was attempted and it is difficult or impossible to lower the level to establish the second point, it would be best to use a calculated zero capacitance for the low point and actual level for the high point. While this wouldn't be as accurate as two known level points, it will be reasonably accurate until an actual low point can be established. The Service department will help in calculating high or low capacitance values.

### 4.4.1 Point Calibration

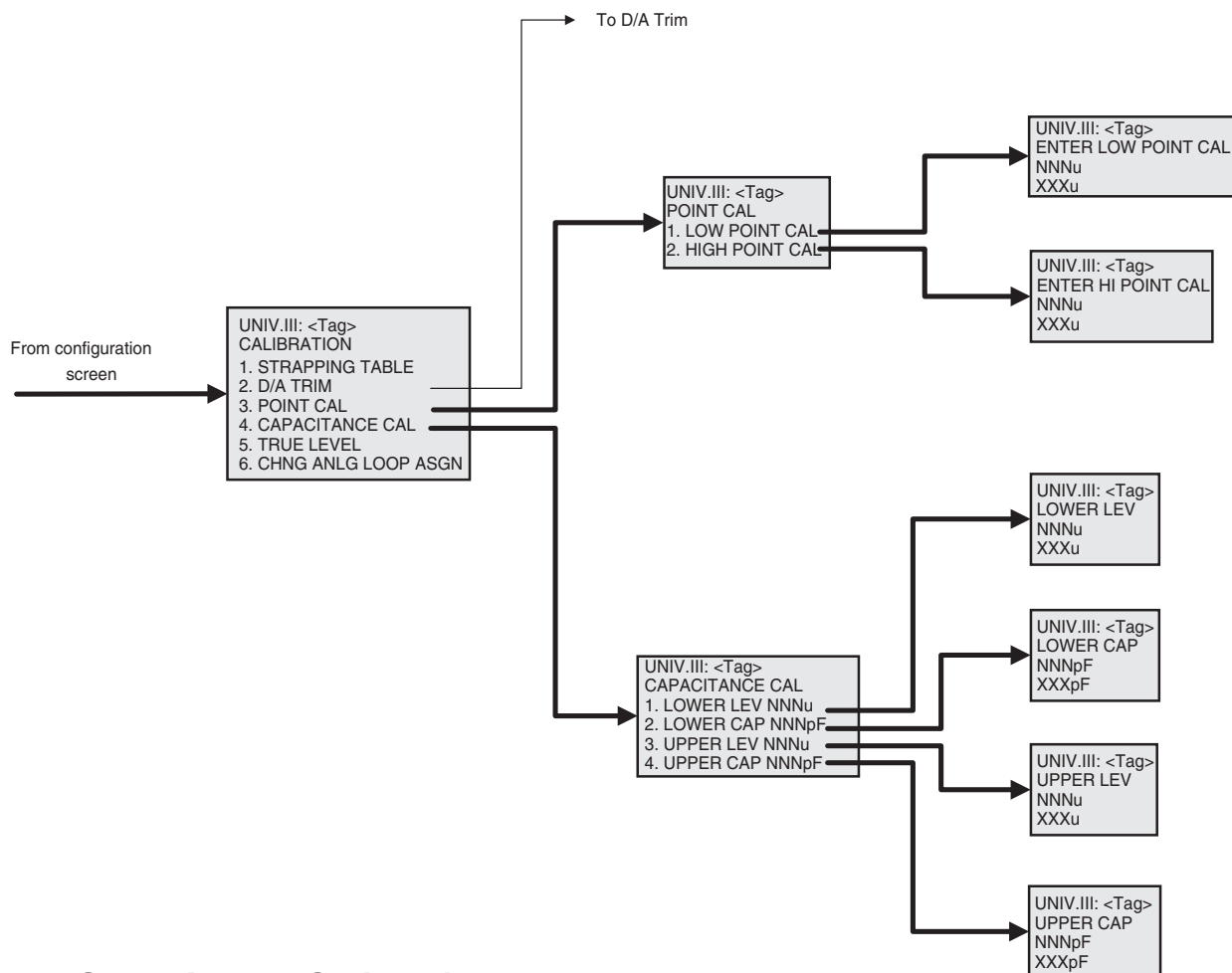
Following is the keystroke sequence for Point Calibration using the Model 275 Calibrator.

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.

**Exit**—Calibration is complete.

### 4.4.1 Point Calibration (Continued)



### 4.4.2 Capacitance Calibration



Capacitance calibration uses zero and span capacitance values as the calibration data. These values can be obtained from the Drexelbrook Service department (or a previous calibration or identical application). Call 1-800-527-6297 for assistance. Please provide your DE purchase order number, transmitter serial number, and application information to the Service Engineer.

Following is the keystroke sequence for Capacitance Calibration using the Model 275 Calibrator.

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

Select **Capacitance Cal**—select either **Lower Level** or **Upper Level** depending on whether the next value will be higher or lower for the second point—edit capacitance value and level as a pair—return to Capacitance Cal screen.

**Exit**—Calibration is complete.

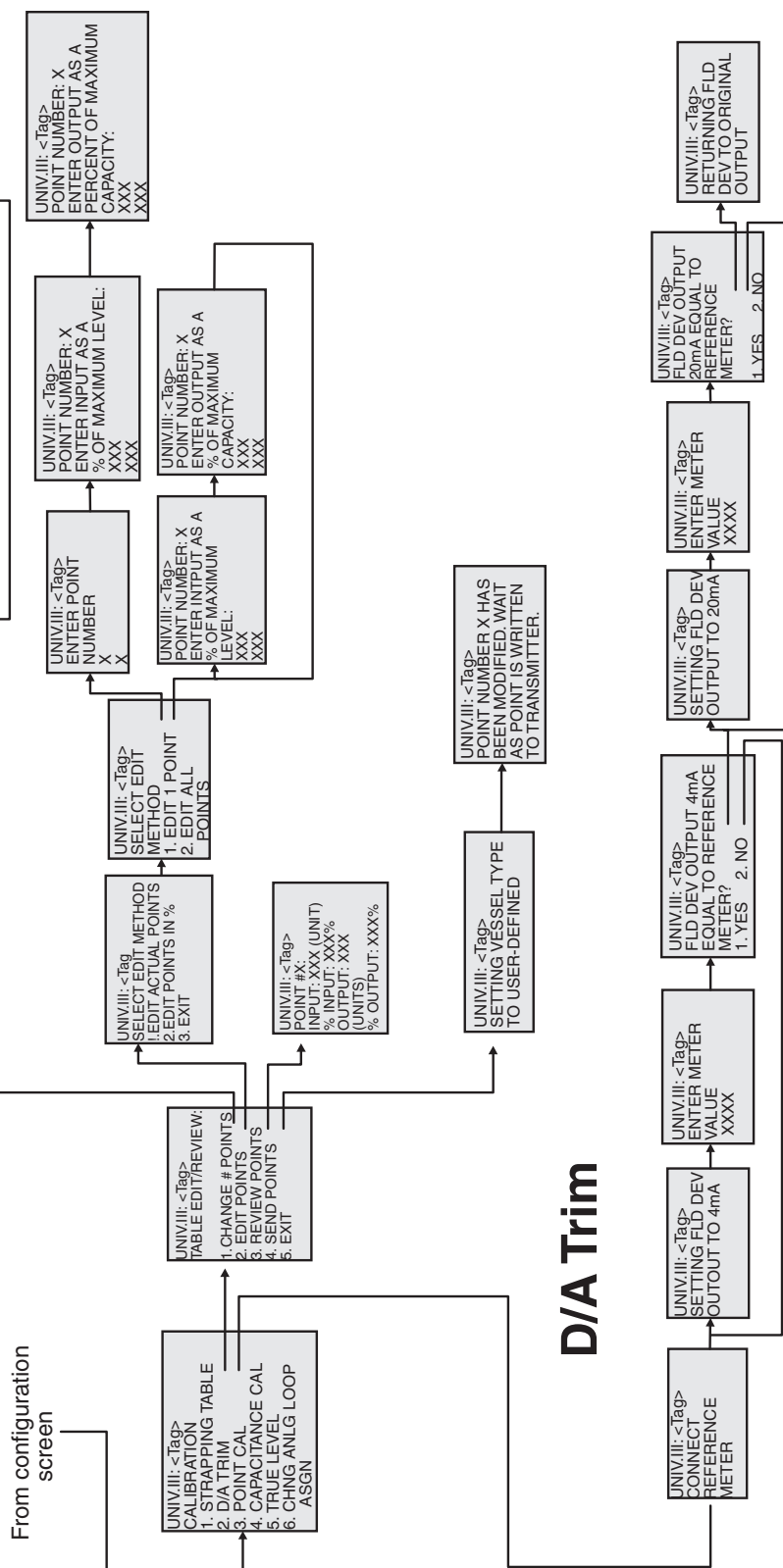
## 4.4.3 D/A Trim

Refer to the D/A Trim diagram for the D/A Trim sequence and Strapping Table configuration.



*D/A Trim is NOT a calibration! This is a pre-calibrated alignment to precision factory settings and is rarely in need of change. The procedure is intended only as a slight "meter" adjustment to a known external reference.*

## Strapping Table



#### 4.4.4 Strapping Table

The strapping table is a 2-point to 21-point table used by the Universal III to cause output current to follow specified relationship to level. There are certain strapping tables that are already built in to the transmitter software. These are: Linear (vertical tank); Horizontal Tank with flat ends; Horizontal Tank with dished ends; Horizontal Tank with hemispherical ends; and Spherical Tank. These predefined tables are automatically created by selections made with Vessel Config assignment during Configuration procedure in Section 4.3.

If output-to-level relationship is not defined by one of these tables, you may create a table in Strapping Table program. To create a non-linear relationship, you will need at least 3 points and may use as many as 21 points. A 21-point table will define relationship to about a 0.1% accuracy. Common example for a simple table would be Cone Bottom Vertical tank which would require 3 points—bottom, straight-side break point, and top. Open channel flow application, however, could benefit from using all 21 available points.

- Plan your table by filling out form below. You may use first column which lists every 5% between 0 and 100%, or you may fill in your own values in column 2.
- Fill out column 3 with output values corresponding to those listed in column 1 or 2.

Point Number	Level Standard Preset Values % Level	Level Optional Values % Level	Output Value In Selected Units
1.	0		
2.	5		
3.	10		
4.	15		
5.	20		
6.	25		
7.	30		
8.	35		
9.	40		
10.	45		
11.	50		
12.	55		
13.	60		
14.	65		
15.	70		
16.	75		
17.	80		
18.	85		
19.	90		
20.	95		
21.	100		



## **Section 5**

## Section 5: Configuration and Calibration Using the Rosemount™ Model 275 Communicator without a Drexelbrook Device Description

The Model 275 Communicator can be used to enter and download configuration/ calibration values to the Universal III transmitter.

### 5.1 Range / Span Control

Definitions:

- **LRV** - Lower Range Value of control loop.
- **LSL** - Lower Sensor Limit related to minimum level point.
- **PV** - Process Variable; level value from transmitter.
- **SV** - Secondary Variable; volume or weight, based on PV.
- **URV** - Upper Range Value of control loop.
- **USL** - Upper Sensor Limit related to maximum level point.

The first step in configuration is to identify the span range position of the instrument. There is a jumper on the back of the electronics chassis: Range Span See Fig. 5-1. The Range Span provides continuous adjustment of the change in capacitance required to produce full scale current. Each Range Span position advances the range in inches or feet to approximately five times the previous setting. Table 5-1 gives the range span position for a number of common sensing elements and range of measurement.

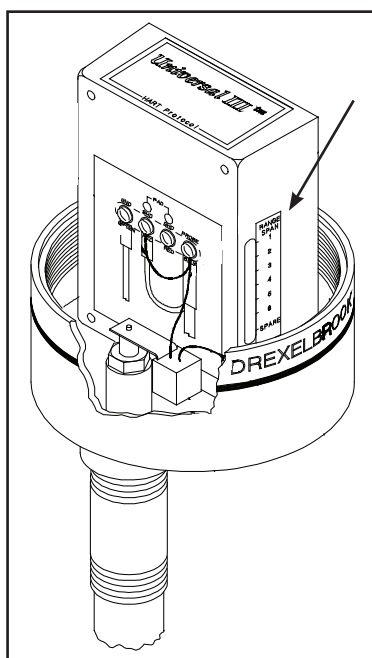


Figure 5-1  
Range Span Jumpers

Table 5-1  
Probe Length vs. Span Position Number / maximum pF

Jumper Position =		1	2	3	4	5	6
Maximum pF =		20	100	450	2000	10000	45000
SYSTEM #	SENSOR #	MAXIMUM PROBE LENGTH IN FEET					
CONDUCTING LIQUIDS:							
509-75-X09	700-1-22	N/A	N/A	5.4	20	N/A	N/A
509-75-X25	700-5-54	N/A	N/A	9.2	40	200	920
509-75-X06	700-2-57	N/A	N/A	1.2	5.3	20	N/A
509-75-X13	700-5-18	N/A	N/A	1.4	6.25	31	140
509-75-X07	700-2-24	N/A	N/A	7.8	20	N/A	N/A
509-75-X05	700-2-37	N/A	N/A	N/A	N/A	4.1	14
509-77-X06	700-1-24	N/A	N/A	5.4	20	N/A	N/A
509-75-X30	700-1-62	N/A	N/A	5.4	20	N/A	N/A
509-75-724	700-5-29	N/A	N/A	N/A	4.2	21	95
INTERFACE APPLICATION:							
509-76-X06	700-2-57	N/A	N/A	1.2	5.3	20	N/A
509-76-X02	700-2-27	N/A	N/A	1.0	4.8	20	N/A
509-76-X04	700-2-37	N/A	N/A	N/A	N/A	4.0	14
INSULATING K = 1.5-5:							
509-77-X06	700-1-24	N/A	2.7	12.5	20	N/A	N/A
509-77-X06	700-1-22	N/A	8.3	20	N/A	N/A	N/A
509-77-X06	700-5-54	N/A	8.0	37.5	166	N/A	N/A
509-77-X06	700-2-57	N/A	3.6	16.2	20	N/A	N/A
509-77-X06	700-5-18	N/A	3.8	17.1	76	N/A	N/A
509-77-X06	700-2-24	N/A	6.0	20	N/A	N/A	N/A
509-77-X06	700-2-27	N/A	5.0	20	N/A	N/A	N/A
509-77-X06	700-2-37	N/A	5.0	14	N/A	N/A	N/A

## 5.2 Rules & Conventions of HART Configuration Software (Model 275)

To become familiar with the operation of the Model 275 Communicator, it is best to review the Operating Manual that comes with the unit. This paragraph reviews some of the basic characteristics of the Model 275 configuration/calibration software. The following pages show the decision tree menus.

**Arrow Keys:** Use the arrow keys to move through the software menus. An arrow at the beginning of the menu item indicates the next progressive step.

**Alphanumeric Keys:** Use the alphanumeric keys to enter data. Data fields are characterized by a blinking cursor.

**Function Keys:** The function keys, F1 through F4, indicate the specific actions that are available to complete the software function. The action words that appear above each key change as you move through the menus and select the software task.

**Heart Symbol:** When a ♥ appears in the upper right corner of the screen, communication is occurring between the communicator and the transmitter.

## 5.3 Tag ID

To name or identify the transmitter, use the 8-character Tag ID. The Tag ID is entered or changed in the following menus.

- a) select the ONLINE MAIN menu
- b) ⇒1 DEVICE SETUP ⇒ ↓ ↓
- c) ⇒3 BASIC SETUP ⇒
- d) ⇒1 TAG ⇒
- e) change (use alphanumeric keys) Tag ID
- f) F4 ENTER
- g) F2 SEND
- h) F4 OK
- i) F4 OK

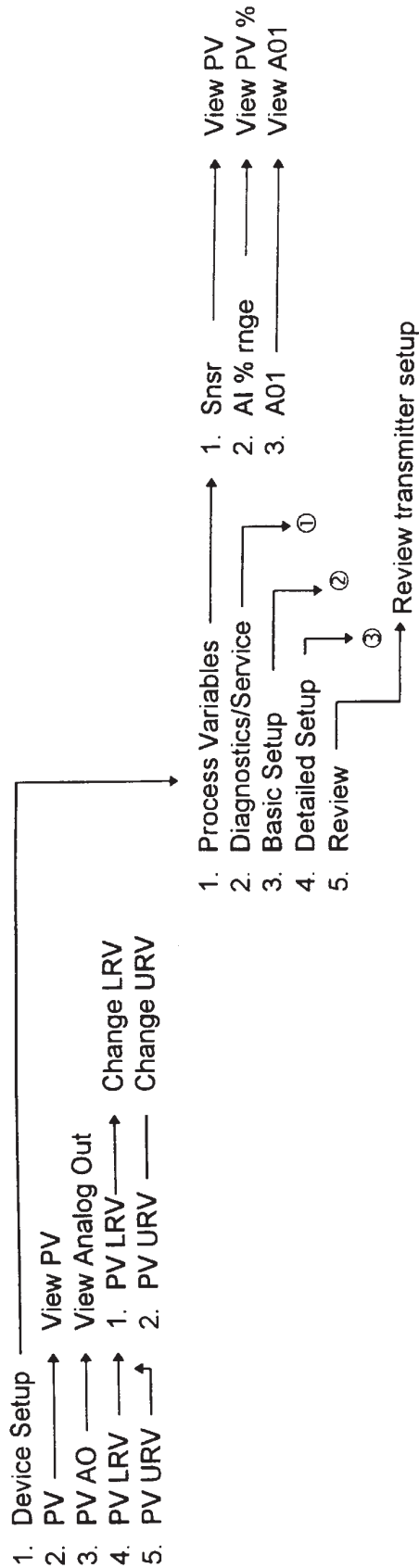
or:

- a) select the ONLINE MAIN menu
- b) ⇒1 DEVICE SETUP ⇒ ↓ ↓
- c) ⇒3 BASIC SETUP ⇒ ↓ ↓ ↓
- d) ⇒4 DEVICE INFORMATION ⇒ ↓ ↓ ↓
- e) ⇒4 TAG ⇒
- f) change (use alphanumeric keys) Tag ID
- g) F4 ENTER
- h) F2 SEND
- i) F4 OK
- j) F4 OK
- k) F3 HOME

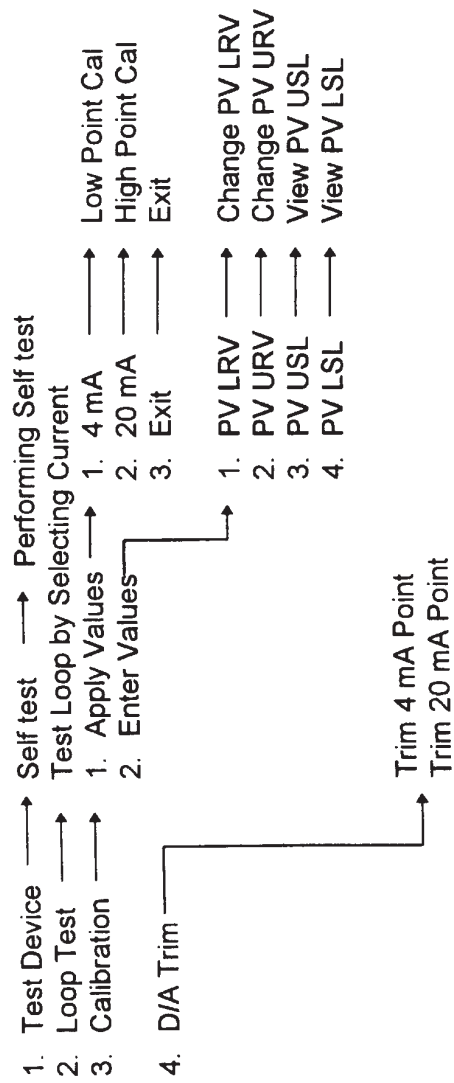
## 5.4 Set Up Procedures

### Rosemount 275 Hart Communicator

#### MAIN ONLINE

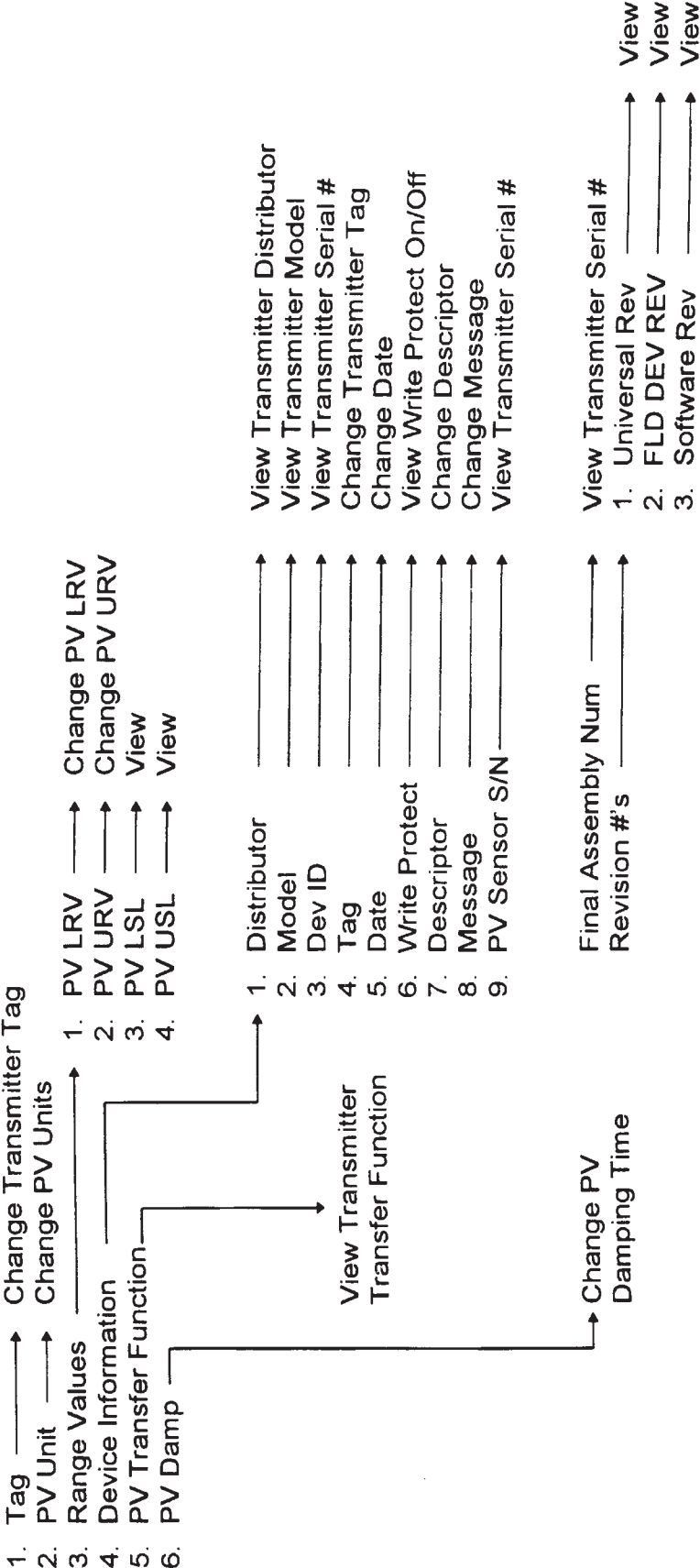


#### ① DIAGNOSTICS/SERVICE



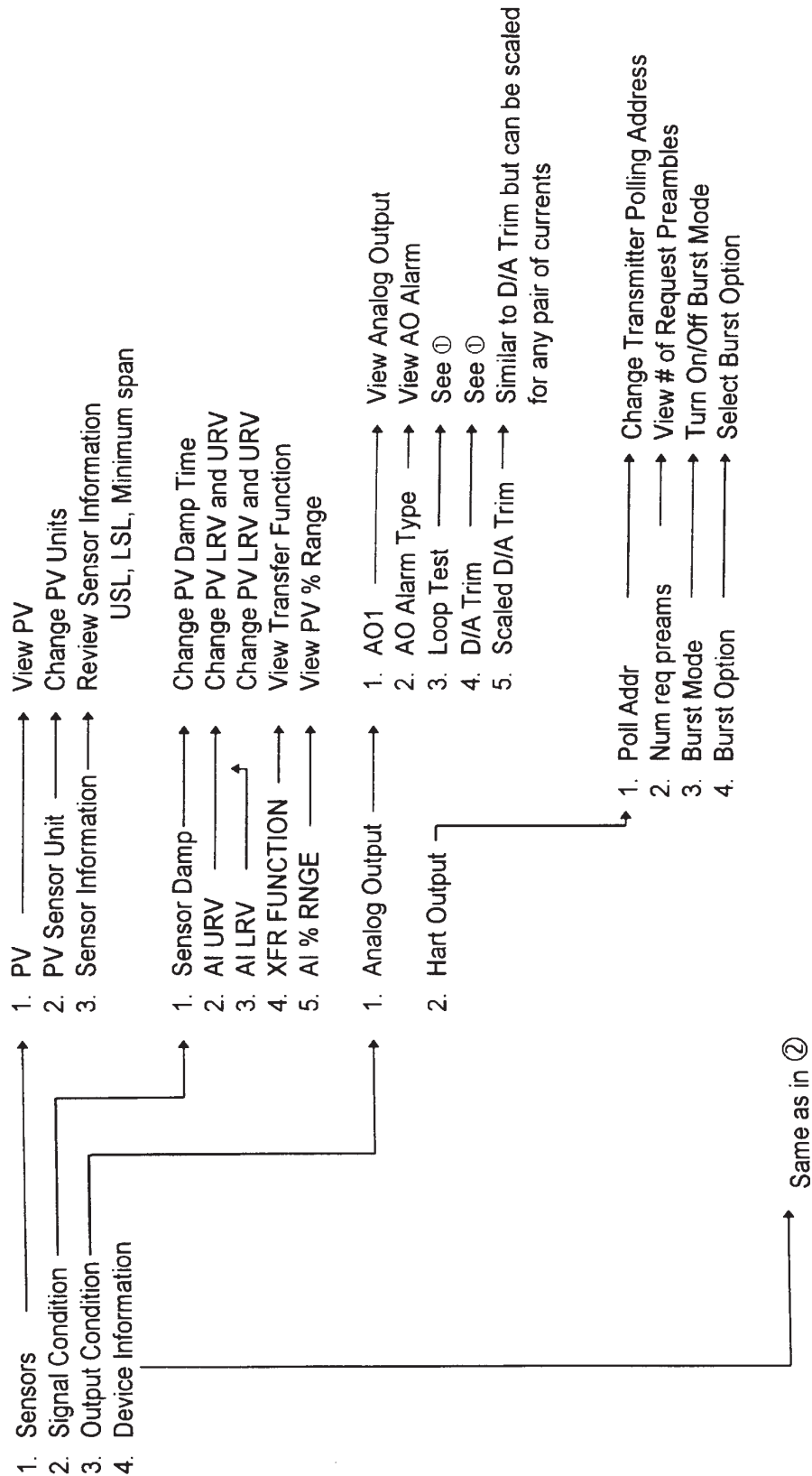
5.4 Set Up Procedures (Continued)

② BASIC SETUP



## 5.4 Set Up Procedures (Continued)

### ③ DETAILED SETUP



## 5.5 Reading Input and Output

Within the Model 275 configuration, there are several different menus that allow you to view the Process Variable (PV) and the Analog Output (AO1).

View PV Input:

- a) select the ONLINE MAIN menu ↓
- b) ⇒1 DEVICE SETUP ⇒ ↓ ↓ ↓
- c) ⇒4 DETAILED SETUP ⇒
- d) ⇒1 SENSORS ⇒
- e) ⇒1 PV ⇒
- f) view Process Variable ♥
- g) EXIT F4
- h) HOME F3

or:

- a) select the ONLINE MAIN menu ↓
- b) ⇒2 PV ⇒
- c) view Process Variable ♥
- d) F4 EXIT
- e) ⇒2 PV ↓
- f) ⇒3 PV AO
- g) view Analog Output ♥
- h) F4 EXIT

or:

- a) select the ONLINE MAIN menu
- b) ⇒1 DEVICE SETUP
- c) ⇒1 PROCESS VARIABLES
- d) ⇒1 SNSR ⇒
- e) view Process Variable ♥
- f) F4 EXIT
- g) ⇒1 SNSR ↓
- h) ⇒2 AI % RANGE ⇒
- i) view PV% ♥
- j) F4 EXIT
- k) ⇒2 AI % RANGE ↓
- l) ⇒3 AO1 ⇒
- m) view Analog Output ♥
- n) EXIT F4
- o) HOME F3

## 5.6 Calibration Using Actual Tank Level

When calibrating using a handheld without a device description, tank level **must be moved**. Calibration is a two-step process. A low point calibration and high point calibration are required. Calibration points do not have to be an empty tank or a full tank. (example: low point performed at 20% and high point performed at 80 % will work). You also may perform high point cal before low point cal.

From main screen go to:

- 1 Device setup
- 2 Diag/Service
- 3 Calibration
- 4 Enter values

You now have four choices:

- 1 PV LRV
- 2 PV URV
- 3 PV USL
- 4 PV LSL

Choose **PV LRV** if your vessel currently has a low level.

Choose **PV URV** if your vessel currently has a high level.

Edit the displayed value to equal the actual tank level, then:

- ENTER
- SEND
- OK
- OK
- ⇐
- 1 Apply values
- OK

You now have two choices:

- 1 4mA
- 2 20 mA

Choose 20mA if performing a high point calibration.

Choose 4mA if performing a low point calibration.

Continue:OK

- ENTER
- 3 EXIT
- OK
- HOME

Observe on the home screen that your **PV URV** or **PV LRV** value has been changed by the calibration procedure. You must manually change these values back. Re-enter your desired **PV URV** and **PV LRV** at this time.

This completes the first calibration point of the two-step process. For the second point, change the level in your tank and repeat the entire above procedure.



## 5.7 Bench Calibration (if needed)

When performing a bench calibration tank level will be simulated using a Drexelbrook 401-6-8 C-box. Calibration is a two-step process. A low point calibration and high point calibration are required

Hook up a Drexelbrook C-Box in place of the sensing element. Dial up the capacitance value that corresponds to an empty tank. For specific information on how to wire and use the C-box calibrator see the instructions that came with the calibrator.

From main screen go to:

- 1 Device setup
- 2 Diag/Service
- 3 Calibration
- 4 Enter values

You now have four choices

- 1 PV LRV
- 2 PV URV
- 3 PV USL
- 4 PV LSL

Choose **PV LRV** if performing a low point calibration.

Choose **PV URV** if performing a high point calibration.

Edit the displayed value to equal the actual tank level, then:

ENTER  
SEND  
OK  
OK  
←  
1 Apply values  
OK

You now have two choices:

- 1 4mA
- 2 20mA

Choose **20mA** if performing a high point calibration.

Choose **4 mA** if performing a low point calibration.

Continue:OK

ENTER  
3 EXIT  
OK  
HOME

Observe on the home screen that your **PV URV** or **PV LRV** value has been changed by the calibration procedure. You must manually change these values back. Re-enter your desired **PV URV** and **PV LRV** at this time.

This completes the first calibration point of the two-step process. Change the value on the C-box to correspond to the Picofarads of a full tank and repeat the entire above procedure for a high point calibration.

## 5.7.1 Bench Calibration Information Sheet

Company \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_  
 Customer P.O. Number \_\_\_\_\_ Item \_\_\_\_\_ DE# \_\_\_\_\_ Tag No. \_\_\_\_\_  
 Filled out by: \_\_\_\_\_ Date \_\_\_\_\_ Phone \_\_\_\_\_ Fax \_\_\_\_\_

### Material being Measured - Fill out any known information

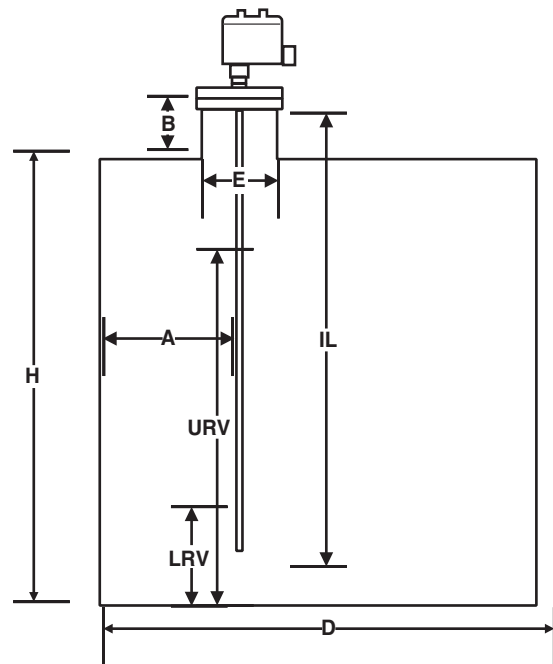
Name of Material: \_\_\_\_\_ ☐ Level Measurement ☐ Interface Measurement  
 Dielectric Constant: (K) \_\_\_\_\_  
 Conductivity: (g) \_\_\_\_\_ Vessel Shape ☐ Vertical Cylinder  
 Other: \_\_\_\_\_ ☐ Horizontal Cylinder  
☐ Other \_\_\_\_\_

### Installation Details

☐ NPT Thread Mount  
☐ Flange Mount- if flange mount  
     B = \_\_\_\_\_ inches  
     E = \_\_\_\_\_  
 A = \_\_\_\_\_ inches  
 H = \_\_\_\_\_ inches  
 D = \_\_\_\_\_ inches  
 H = \_\_\_\_\_ inches  
 IL = \_\_\_\_\_ inches

Unless specified otherwise, calibration values of zero and span capacitances will be based on 4-20 mA being over the entire range of 'H'. If other values are desired specify LRV and URV in inches.

LRV = \_\_\_\_\_ inches  
 URV = \_\_\_\_\_ inches



### Calculations by Drexelbrook

LRV \_\_\_\_\_ Calculated Zero Capacitance \_\_\_\_\_ pF  
 URV \_\_\_\_\_ Calculated Span Capacitance \_\_\_\_\_ pF  
 Calculated by: \_\_\_\_\_ Date \_\_\_\_\_

Phone 800-527-6297  
 Fax 215-443-5117

5.8 Point Calibration

- Equipment Required:
- Universal III HART® Smart Transmitter
  - Model 275 HART® Calibrator
  - 24V Power source
  - Approximately 250 ohm total loop resistance
  - Two known process levels applied to the probe

This procedure uses an example of a point calibration for full-scale (20mA) = 35 ft. and zero (4mA) = 1.5 ft.

5.8.1 Fine Tuning Calibration

When a known level is available that is closer to an endpoint than a previous calibration point, it may be used as a new calibration point to increase accuracy. This is done in the following steps: **Enter the Upper Calibration Point** and/ or **Enter the Lower Calibration Point** with the new known level applied.

The order of execution between the upper and lower calibration procedures does not matter. They can be done at different times.



The procedure **Set Up Zero and Full Scale Limits** must be performed to set up the vessel zero and full-scale limits sometime prior to performing a point calibration. This informs the Universal III of the tank level limits and only needs to be performed once for a given installation.

5.8.2 Selecting Engineering Units

The examples in this procedure use the default units of feet. For other units, use the following procedure:

- A. Connect the handheld communicator to the 4-20 mA loop per Figure 4-1.
- B. Power the loop and proceed with following steps.

<u>Action</u>	<u>View</u>	<u>Function</u>
1/0	Online (Generic)	Power On
1	Device Setup	Select Device Setup
3	Basic Setup	Select Basic Setup
4	PV Snsr unit	Select PV Units
↑ & ↓	Available Units	Use the arrow keys to scroll through the available units and press [ENTER] when the desired unit is displayed.
[ENTER]	Basic Setup	Select highlighted unit
Home	Online (Generic)	Desired units are selected

## 5.9 Handheld Calibrator Error Messages

### **Error Message: Applied Process Too High**

The applied process at 100% exceeds the capacitance range setting by at least 5% of span.

**Example:** URV = 10 ft., Applied Process = 12 ft. will generate this error.

**Action:** The Span Select Jumper Must Be Raised.  
This allows the process output at 100% to be within the range of the span range capacitance.

### **Error Message: Span Too Small**

The difference between the URV and LRV is less than 10% of the range.

**Example:** For 0 to 10 ft. calibration points: LRV = 3.0 ft., URV = 3.8 ft. will generate this error.

**Action:** The Calibration Points Should Be Farther Apart.  
When the calibration points are too close together, the overall accuracy of the calibration is adversely affected.

### **Error Message: Upper Range Value Too High**

The process capacitance at 100% exceeds the present capacitance range jumper setting.

**Example:** For 0 to 10 ft. calibration: span select jumper = 100 pF, point cal. LRV = 0 ft. @ 10 pF, URV = 7 ft. @ 90 pF generates this error because the process would be 124 pF @ 10 ft.

**Action:** The Span Select Jumper Must Be Raised.  
This allows the process output at 100% to be within the range of the span range capacitance.

**NOTE:** Respond to the prompt which is displayed immediately after the error message that reads "Restore Device Value?" with <N>.

### **Error Message: Upper Range Value Too Low**

The Full scale projected from the entered URV and LRV is less than 5% of the present capacitance range jumper setting.

**Example:** For 0 to 50 ft. calibration: span select jumper = 1000 pF, LRV = 0 ft. @ 10 pF, URV = 40 ft. @ 80 pF generates this error.

**Action:** The Span Select Jumper Must Be Lowered.  
This allows the URV-LRV span to be greater than 5% of the capacitance range jumper setting.

**NOTE:** Respond to the prompt which is displayed immediately after the error message that reads "Restore Device Value?" with <N>.

## **Section 6**

## Section 6: Troubleshooting

Problem/Symptom	Tests in order of probability	Reference Section(s)	Comments
Rosemount 268 or 275 Calibrator gives error message that no device was found	Check calibrator connections Check for 250 $\Omega$ resistance (min.) Check voltage at transmitter Check transmitter	6.2 and 6.3 6.6	Often a result of loop connection problems
Rosemount 275 Calibrator gives error message that device could not be identified	Check calibrator connections Check for 250 $\Omega$ resistance (min.) Check voltage at transmitter Check transmitter	6.2 and 6.3 6.6	Often a result of loop connection problems
Can't communicate with transmitter using Drexelbrook PC Software	Check calibrator connections Check for 250 $\Omega$ resistance (min.) Check voltage at transmitter Check transmitter Try another modem	6.2 and 6.5 6.6	Often a result of loop connection problems
0 mA output all the time (no measurable output current at any time)	Check voltage at transmitter Check polarity of loop Test Transmitter	6.2 (6.3, 6.4, or 6.5) 6.6	Probable loop problem Faulty connection in loop
More than 20 mA output all the time (output current always exceeds 20 mA)	Check for moisture in head of sensor Test Sensing Element Test Transmitter Check Calibration	6.7 6.6 Section(s) 3, 4, and 5	
Output drifts (output accuracy varies slowly over time...e.g. hours or days)	Test transmitter without sensing element (drift test) Verify proper sensing element ground reference	6.6 Fig. 2-6	
Output erratic - (output jumps around noticeably in terms of seconds or minutes)	Test Transmitter Check process level Check for Static Discharge Check for radio interference	6.6 6.9 6.10	Erratic readings often show actual process conditions. Look for bubbles or stratification, etc.
Output intermittent (output jumps quickly usually between >0mA and some "on scale" value)	Check Signal Loop Connections	6.7 6.8	Intermittent Loop Connection
Inaccurate readings (Level readings are incorrect compared to actual known level)	Check calibration Test transmitter Check method of comparison	Section(s) 3, 4, and 5 6.6	Have you verified actual level? (At times even sight gauges can be misleading.)
Reading does not change with level	Check cables Check sensing element Test Transmitter	6.8 6.7 6.6	Be sure that level is really changing. Possible plugged or unvented stilling well.
Output goes in opposite direction from level change	Check calibration	Section(s) 3, 4, and 5	Probable high point cal/low point cal reversal or inverted interface application.
<b>Application-related Problems</b>	<b>Comments</b>		
Product Bridging	When process material fills what was originally airspace between the sensor and a nozzle or the vessel, it no longer behaves like a coating. It measures like actual level. Contact Drexelbrook.		
Corrosion of metal parts	TFE and stainless steel in the sensor's pressure seal have widely different coefficients of expansion that sometimes permit pressure leaks to occur. Re-torquing the packing assembly can usually fix the problem. Contact the Service department for the proper torque values and procedure.		

Table 6-1 Problem / Symptom Chart

## 6.1 Identifying a Problem/Symptom



Use **Table 6-1** as a guide to find and correct a problem when it occurs. Most problems are not related to transmitter 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 24-hour Service Hot line at 1-800-527-6297 or 215-674-1234. You may also E-mail us at the Internet address: [drexelbrook.service@ametek.com](mailto:drexelbrook.service@ametek.com). Further service information may be found at our World Wide Web address [www.drexelbrook.com](http://www.drexelbrook.com).

When you contact us, be prepared to give the service person as much information as you can about the model numbers, application requirements, and the materials being measured. At the end of this section, a form is available to organize the information that will help us resolve the problem. Prior to your call, a copy of the completed form can be faxed directly to the Service department at (215) 443-5117.

### 6.1.2 Integral Digital Meter Display (401-0044-003) Error Codes

Error Message	Description	Probable Cause	Corrective Action
<b>Err 1</b>	EEPROM Failure / Checksum Error	Transmitter Failure	Restore Factory Defaults See Section 3.15
<b>Err 2</b>	Not Used		
<b>Err 3</b>	Analog to Digital Converter Response Failure	Transmitter Error	Contact Factory Service 1-800-527-6297
<b>Err4</b>	Probe Value too High	Probe Resistance to Ground too Low	Check for Electrical Short See Section 6.7 & 6.8

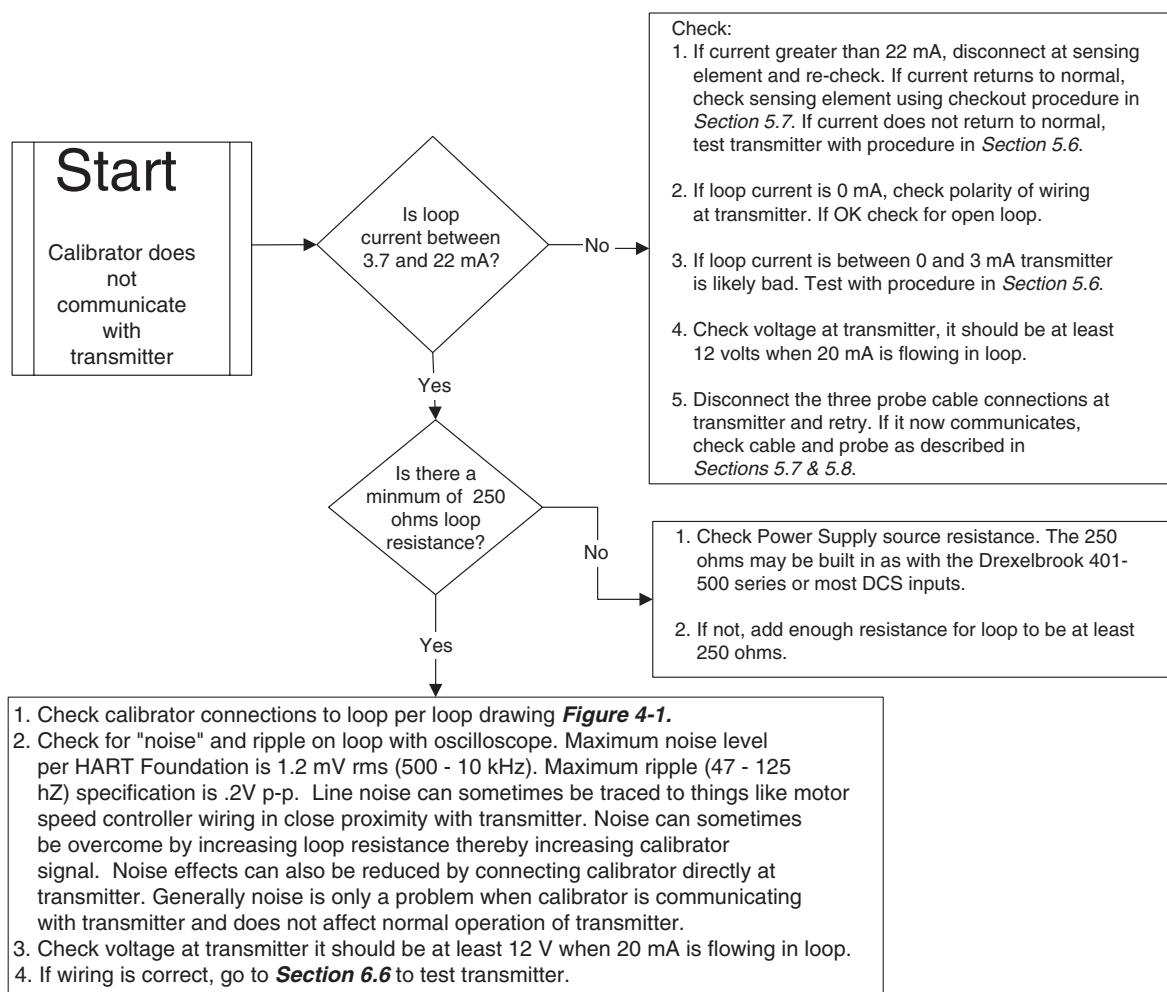
## 6.2 Troubleshooting Loop Connection

Specific transmitter loop connections will vary from installation to installation but in general will be connected in a similar manner to typical transmitter loop in **Figure 4-1**. 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 transmitter when a loop current of 20 mA is flowing.

### 6.3 Rosemount Mod. 268 or 275 Calibrator cannot identify or find device

If the Rosemount 268 or 275 calibrator (generic) gives error message that no device description was found, use the following flowchart to troubleshoot.



### 6.4 Rosemount Mod. 275 with device description cannot identify or find device

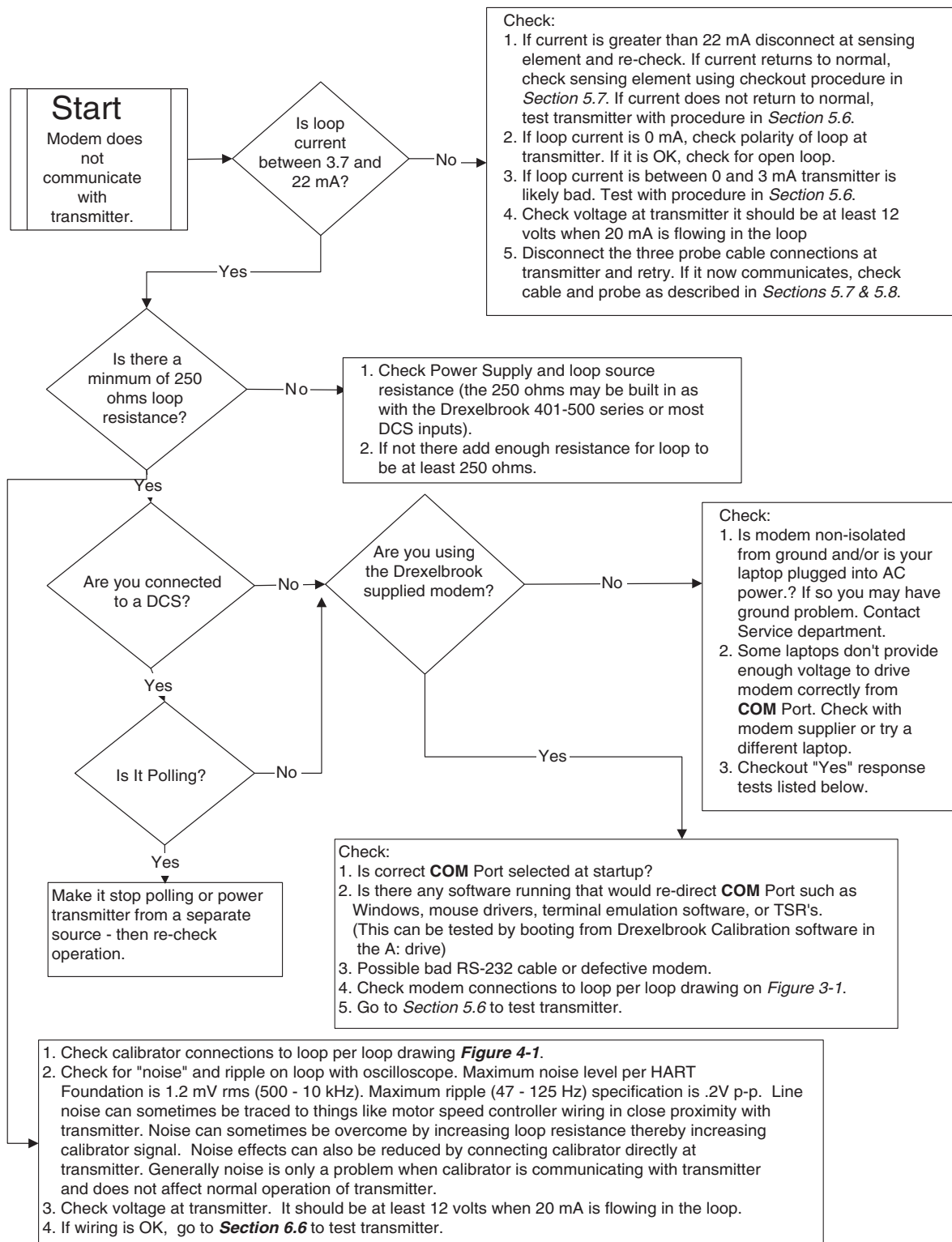
This condition may be the result of trying to calibrate a transmitter with software less than version 3.0 (transmitters shipped prior to approximately January 1997). There are two options you can use to identify the device and delete the error message.

**Option 1** - Configure the transmitter as a "generic" device per the instructions in this manual.

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



## 6.5 Transmitter does not communicate with Drexelbrook PC software



## 6.6 Troubleshooting Transmitter

*Always Install to Local Codes / Requirements / Directives as Mandated by the Authority Having Jurisdiction*

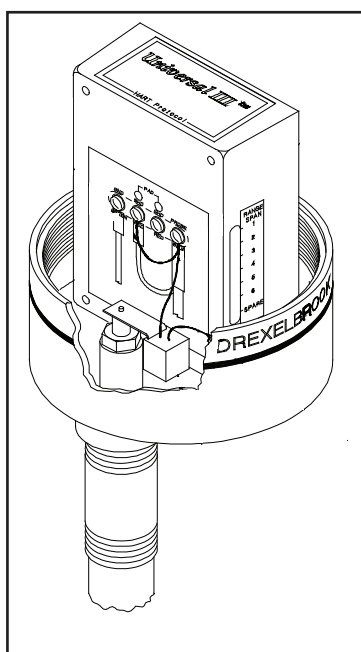
**Install Per  
420-0004-203-ID**



**WARNING:**  
*Substitution of Components May Impair Intrinsic Safety.*



**WARNING:**  
*To Prevent Ignition of Flammable or Combustible Atmospheres, disconnect Power Before Servicing.*



**Figure 6-1**

To troubleshoot the transmitter, use one of the following tests, depending on the device used with your calibration.

Some of the following tests require 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 you need a C-box. Fixed temperature stable capacitors (NPO types) can often be found at many electronic supply houses.

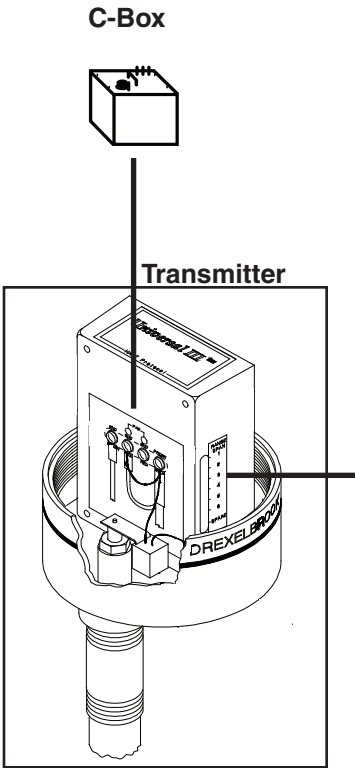
### TRANSMITTER TEST - Using a PC or 275 Handheld with device Description

1. Determine the span range currently selected on the electronic unit. **See Figure 6-2**
2. Using the MAX pF values listed in **Figure 6-3**, 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 transmitter's probe terminals.
4. Place capacitor on transmitter from **PROBE** to **GND** (ground) terminals See **Figure 6-1**.
- 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 **Rosemount 275 handheld** 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.

6.6 Troubleshooting Transmitter (Continued)

TRANSMITTER TEST - Using a 268 or 275 Handheld 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.** See *Figure 6-2*
- 3. Adjust C-box capacitance until 20 mA is achieved. Record value.
- 4. Using *Figure 6-3*, 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.
- 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 not accurate, contact the Service department at 1-800-527-6297 for further assistance.



SPAN RANGE	JUMPER POSITION					
	1	2	3	4	5	6
MAX pF	20	100	450	2000	10000	45000

Figure 6-3  
Span Range Capacitance Values

6.6.1 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. In most cases, no drift will be found in the transmitter.

## 6.6.1 Transmitter Drift Test (Continued)

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 further instructions regarding repair or replacement.

## 6.7 Troubleshooting Sensing Element

**Troubleshooting sensing element requires 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.



**CAUTION:** *Sensing element is intrinsically safe. Therefore, when using this product, it is recommended that all service activity comply with appropriate guidelines.*



**Remove sensing element from vessel to a safe area. Test outlined in steps 1 and 2 can be performed in a metal test vessel filled with high conductivity water. Depending on locality, tap water may not be suitable. If not, a spoonful of table salt may work.**

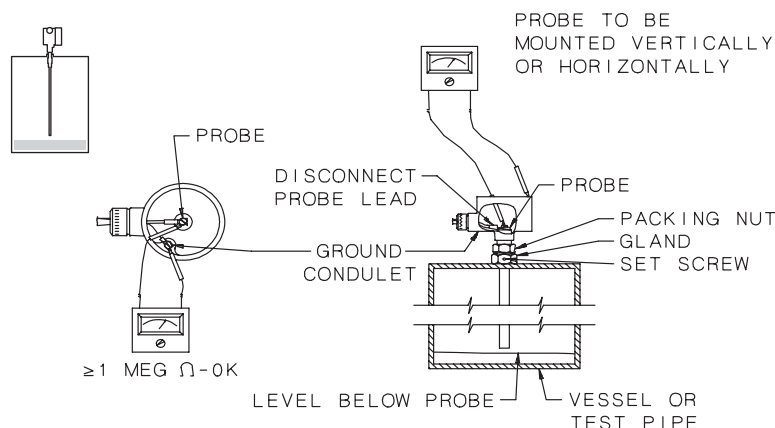
In the following tests, if it is not possible to raise or lower level in vessel, sensing element may be suspended in a metal pipe or other container that is filled with conductive water (see above note) and connected to grounded sensing element conduit. If container is not metallic, then a ground wire or rod is needed to be placed into the water and referenced to sensing element conduit or mounting devices.

## 6.7 Troubleshooting Sensing Element (Continued)

### Testing the Sensing Element - Step 1 (Figure 6-5)

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

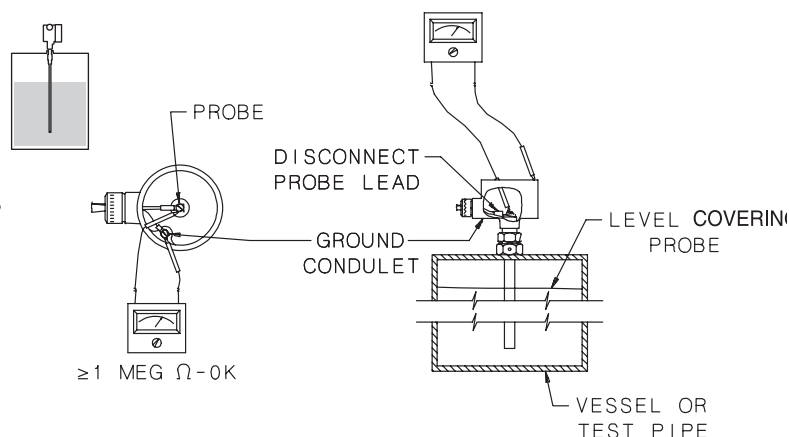
**Figure 6-5**  
*Sensing Element Testing,  
Material Below  
the Sensing Element*



### Testing the Sensing Element - Step 2 (Figure 6-6)

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. Consult the Service department for further assistance.

**Figure 6-6**  
*Sensing Element Testing,  
Material Covering  
the Sensing Element*



## 6.8 Troubleshooting Coaxial Cable

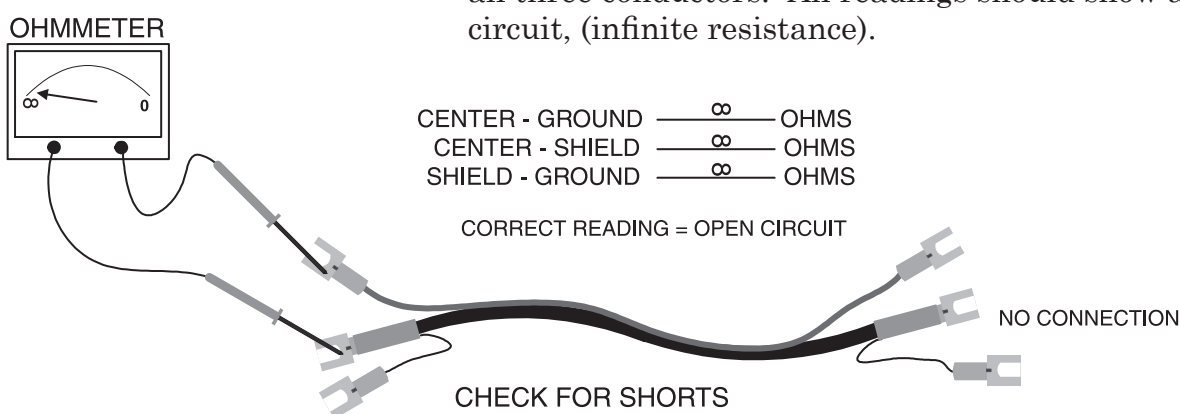


If there is water or other conductive material in the conduit it can change the electrical properties of the coax cable and cause the system to perform poorly. Moisture in the

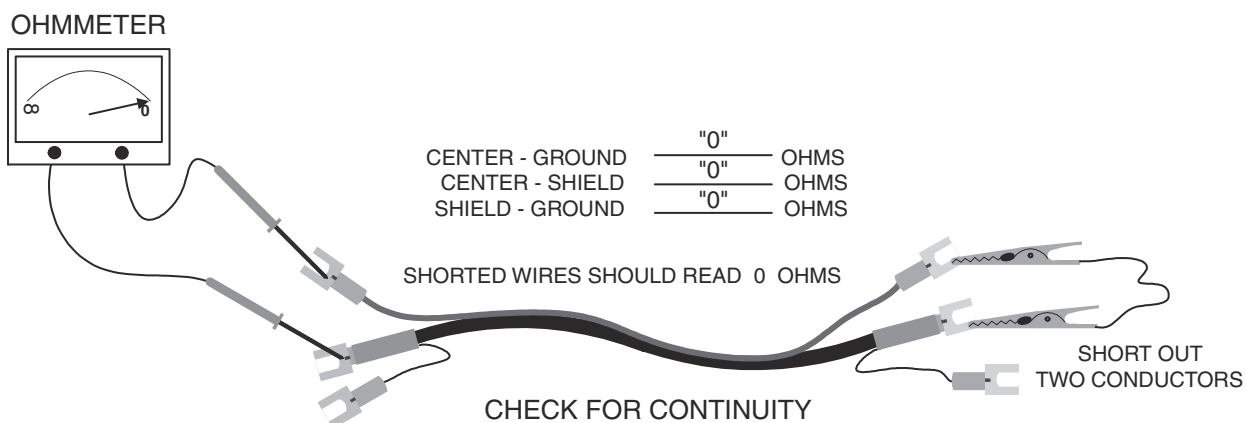
## 6.8 Troubleshooting Coaxial Cable (Continued)

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.



## 6.9 Static Electricity

Static electricity can cause the 4-20 mA output to appear to jump around in an erratic fashion with a time period of few seconds. Applications that are prone to static electricity include insulating liquids that may be agitated or pumped and granulars that may be air-conveyed at high rates of speed. Conductive liquids and conductive granulars tend not to generate static electricity. In addition to causing erratic readings, static electricity can cause instrument failure. If you ever get a static shock from a sensing element, you need spark protection. (See section 2.5)

Drexelbrook normally supplies static electricity discharge devices (spark protectors) with its sensing elements that are going to be used in these types of applications. If you need a spark protector, contact the Drexelbrook Service department.

## 6.10 Radio Frequency Interference

All Drexelbrook transmitters have a significant amount of RFI protection built in. There are situations, however, where the standard protection is inadequate. RFI filters are available to provide additional protection for both the sensor and the 4-20 mA loop from unusually difficult sources of interference. Proper grounding and careful attention to installation practices can usually make them unnecessary. Some recommended installation practices include:

1. Use twisted shielded cable for the 4-20 mA loop.
2. Use grounded metal conduit for all entrances to the transmitter housing.
3. Ground the transmitter housing to a good earth ground.
4. Use concentric shield sensors in non-metallic vessels.

If RFI continues to be a problem, contact the Drexelbrook service department for the proper filters and assistance.

## 6.11 Factory Assistance

AMETEK Drexelbrook can answer any questions about your level measurement system.

For Technical Support: 1-800-527-6297

All other inquiries: Call Customer Service at 1-800-553-9092 (US and Canada) , or + 215-674-1234 (International).





## **6.11 Factory Assistance (Continued)**

If you require assistance and attempts to locate the problem have failed:

- Contact your local Drexelbrook representative,
- For Technical Assistance call toll-free:  
1-800-527-6297 (US and Canada) or + 215-674-1234 (International),
- FAX: + 215-443-5117,
- E-mail: [drexelbrook.service@ametek.com](mailto:drexelbrook.service@ametek.com)

**Please provide the following information:**

- Instrument Model Number
- Sensing Element Model Number and Length
- Original Purchase Order
- Material being measured
  - Temperature
  - Pressure
  - Agitation
- Brief description of the problem
- Checkout procedures that have failed

## **6.12 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.

## **6.13 Customer Training**

Periodically, AMETEK 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 AMETEK Drexelbrook, attention: Communications/ Training Group, or call direct + 215-674-1234.



## 6.14 Return Equipment

**Any equipment being returned for repair or credit must be pre-approved 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 to which the sensing element has been exposed MUST accompany any repair.
- It is your responsibility to fully disclose all chemicals and decontaminate the sensing element.

To obtain a return authorization (RA#), contact the Service department at 1-800-527-6297 (US and Canada) or + 215-674-1234 (International).

**Please provide the following information:**

- Model Number of Return Equipment
- Serial Number
- Original Purchase Order Number
- Process Materials to which equipment has been exposed
- MSDS sheets for any hazardous materials
- Billing Address
- Shipping Address
- Purchase Order No. 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 19044-1499

COD shipments will not be accepted.

## 6.15 Universal III Troubleshooting Guide

AMETEK Drexelbrook  
Universal III Troubleshooting Guide  
Service Department (800) 527-6297 FAX (215) 443-5117

Service Dept. Contact \_\_\_\_\_

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

Provide as much of the following information as possible. **All** of the information is available from the Drexelbrook Calibration Software, or from a Rosemount Model 275 with Drexelbrook Device Description (DD) installed. Information with an asterisk is available from a Rosemount 268 or 275 in the Generic mode.

AMETEK Drexelbrook HART® Protocol Software Version \_\_\_\_\_

\*Tag ID \_\_\_\_\_ \*Serial Number \_\_\_\_\_  
\*Scratch Pad \_\_\_\_\_ Software Version \_\_\_\_\_  
Analog Loop Assign \_\_\_\_\_ Range Position \_\_\_\_\_  
\*Damping Time \_\_\_\_\_ Type (00/30) \_\_\_\_\_

### Level Configuration

Level Units \_\_\_\_\_  
Maximum Level \_\_\_\_\_  
Level Type \_\_\_\_\_

\*LRV (4mA) \_\_\_\_\_  
\*URV (20mA) \_\_\_\_\_

### Vessel Configuration

Vessel Units \_\_\_\_\_  
Maximum Capacity \_\_\_\_\_  
Vessel Type \_\_\_\_\_

### True Level Reference

Lower Reference Cap. \_\_\_\_\_  
Upper Reference Cap. \_\_\_\_\_  
  
Status: \_\_\_\_\_

### Capacitance Calibration

Lower Level \_\_\_\_\_  
Lower Capacitance \_\_\_\_\_  
Upper Level \_\_\_\_\_  
Upper Capacitance \_\_\_\_\_

### Vessel Sketch



Show principal tank dimensions, including vessel construction, mounting location, nozzle, LRV, URV, present level, etc.

### Press F4 For Real-Time View

Level \_\_\_\_\_  
Vessel \_\_\_\_\_  
Capacitance \_\_\_\_\_  
Reference \_\_\_\_\_  
Loop Current \_\_\_\_\_  
Percentage \_\_\_\_\_  
Status \_\_\_\_\_

Detailed description of problem: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## **Section 7**

## Section 7: Specifications

### 7.1 Transmitter 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

#### Accuracy

- $\pm 0.25\%$  of range. Accuracy includes the combined effects of linearity, hysteresis, and repeatability. It refers to the transmitter only and is measured at reference conditions of 25 degrees C  $\pm 1^\circ$ , 10-55% R.H. and 24  $\pm 1.2$  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

- $\pm 1\%$  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.



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.*

## 7.1 Transmitter Specifications (Continued)

### 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

- 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. Nonincendive for Class I Groups A, B, C, and D; Class II Groups E, F, and G, Class III, (Div. 2).

### Sensing Element Cable Length

- 100 feet maximum.

## 7.2 Coaxial Cable Specifications

### Sensing Element Cable Length

150 feet maximum.

### General Purpose 380-XXX-12

.51" (13mm) OD at largest point,  
160°F (70°C) temperature limit.

### Composite Cable 380-XXX-18

#### (first 10 feet high temperature)

.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.

## **Section 8:      Normal Maintenance**

### **8.1   Viewport Cleaning**

The viewport (if supplied) is made of Borosilicate glass and can be cleaned with any common glass cleaning product (e.g.: Windex™, Isopropyl alcohol, etc.) that is suitable for the Class and Division rating of the specific system installation.

## **Section 9**

# Section 9: Drawings

## 9.1 FM / CSA APPROVAL DRAWINGS

440-115-184 (2) NO. 420-0004-029-CD SHT 1 OF 4

• NO CHANGE IN PART OR VENDOR OF PART ALLOWED WITHOUT PRIOR APPROVAL OF FM.

**DIV. 2 LOOP**

**HAZARDOUS (CLASSIFIED) AREA**  
CLASS I, II, III, DIVISION 1  
GROUPS A, B, C, D, E, F, G

700 SERIES SENSING ELEMENT

LEVEL 0-1  
COMP 0-1  
SHD 0-1  
GND 0-1

SENSING ELEMENT AND CABLE ARE INTRINSICALLY SAFE FOR CLASS I GROUPS A, B, C, D CLASS II GROUPS E, F, G, CLASS III.

MODEL NUMBER OF APPROVED SENSING ELEMENTS SHOWN ON SHEETS 1-4 AS INTRINSICALLY SAFE:

70a-bcde-fgh-i-o

a = 0-4  
b = 0-9, BLANK  
c = 0-9, BLANK  
d = 0-9, BLANK  
e = 0-9  
f = 0-9, BLANK  
g = 0-9, BLANK  
h = 0-9  
i = 14 CHARACTER EXPANDED NUMBERING SYSTEM, DOES NOT AFFECT SAFETY.

NOTES:  
1. SEAL FITTINGS SUPPLIED ARE "WEATHER RESISTANT." THEY ARE NOT CERTIFIED AS "EXPLOSIONPROOF" (XP) OR "FLAMEPROOF" (D). REPLACE WITH APPROPRIATE SEAL FITTINGS AS REQUIRED.  
2. ALWAYS INSTALL TO NEC® AND/OR LOCAL CODES/REQUIREMENTS/DIRECTIVES AS MANDATED BY THE AUTHORITY HAVING JURISDICTION.

**HAZARDOUS (CLASSIFIED) AREA**  
CLASS I, II, III, DIVISION 2 GROUPS A, B, C, D, F, G

OPTIONAL DISPLAY 401-0044-001

AMETEK DREXELBROOK 409-1000/2000 SERIES TRANSMITTER

LEVEL 0-1  
SHD/COMP 0-1  
SHD 0-1  
GND 0-1

380 SERIES CABLE  
MAXIMUM LENGTH SEE NOTE 4

OPTIONAL INTEGRAL SENSING ELEMENT (700 SERIES)

OPTIONAL DISPLAY 401-0044-001

FM/CSA ENTITY APPROVED BARRIER

250Ω MIN. SERIES RESISTOR REQUIRED FOR COMMUNICATION.

24VDC POWER SOURCE

POWER SOURCE MAY NOT USE OR GENERATE MORE THAN 250 VAC.

NON-HAZARDOUS AREA

NOTES:  
1. 377-0001-019 SPARK PROTECTOR MAY BE CONNECTED TO ANY PROBE ON SHEETS 1-4.  
2. APPROVED BARRIER MUST BE INSTALLED IN ACCORDANCE WITH ENTITY REQUIREMENTS AS STATED ON PAGE 3.  
3. 250 Ω SERIES RESISTANCE MIN. IS REQUIRED FOR COMMUNICATIONS AND CAN BE INCLUDED IN THE BARRIER.  
4. MAX CABLE LENGTH 409-1000 150 FT (46m) 409-2000 50 FT (15m)  
5. WHEN OPTIONAL RFI FILTERS P/N 401-0016-019, P/N 401-0016-020, OR P/N 01-0016-023 IS INSTALLED, MAX CABLE LENGTH 409-1000 127 FT. (39m) 409-2000 27 FT. (8m)

MODEL NUMBERS OF CERTIFIED TRANSMITTERS SHOWN ON PAGES 1 TO 3:

409-20a0-b0c-de mod f  
a = SENSITIVITY, 0 OR 5  
b = APPROVAL, 0, F, C OR K  
c = ENCLOSURE, 4, 6, 8, 9, C, D  
d = 0 OR BLANK  
e = 0 OR BLANK  
f = METER, 9100-038, 9100-039, 9100-042, OR BLANK

409-10a0-bcd-ef mod g  
a = PHASING 0 OR 3  
b = APPROVAL, 0, F, C OR K  
c = FREQUENCY, 0, 1  
d = ENCLOSURE, 4, 6, 8, 9, C, D  
e = 0, A, OR BLANK  
f = 0, A-P OR BLANK  
g = METER, 9100-037, 9100-039, 9100-038, OR BLANK

NOTES:  
1. SEAL FITTINGS SUPPLIED ARE "WEATHER RESISTANT." THEY ARE NOT CERTIFIED AS "EXPLOSIONPROOF" (XP) OR "FLAMEPROOF" (D). REPLACE WITH APPROPRIATE SEAL FITTINGS AS REQUIRED.  
2. ALWAYS INSTALL TO NEC® AND/OR LOCAL CODES/REQUIREMENTS/DIRECTIVES AS MANDATED BY THE AUTHORITY HAVING JURISDICTION.

**HAZARDOUS (CLASSIFIED) AREA**  
CLASS I, II, III, DIVISION 2 GROUPS A, B, C, D, F, G

OPTIONAL DISPLAY 401-0044-001

AMETEK DREXELBROOK 409-1000/2000 SERIES TRANSMITTER

LEVEL 0-1  
SHD/COMP 0-1  
SHD 0-1  
GND 0-1

380 SERIES CABLE  
MAXIMUM LENGTH SEE NOTE 4

OPTIONAL INTEGRAL SENSING ELEMENT (700 SERIES)

OPTIONAL DISPLAY 401-0044-001

FM/CSA ENTITY APPROVED BARRIER

250Ω MIN. SERIES RESISTOR REQUIRED FOR COMMUNICATION.

24VDC POWER SOURCE

POWER SOURCE MAY NOT USE OR GENERATE MORE THAN 250 VAC.

NON-HAZARDOUS AREA

NOTES:  
1. 377-0001-019 SPARK PROTECTOR MAY BE CONNECTED TO ANY PROBE ON SHEETS 1-4.  
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d = 0 OR BLANK  
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f = METER, 9100-038, 9100-039, 9100-042, OR BLANK

409-10a0-bcd-ef mod g  
a = PHASING 0 OR 3  
b = APPROVAL, 0, F, C OR K  
c = FREQUENCY, 0, 1  
d = ENCLOSURE, 4, 6, 8, 9, C, D  
e = 0, A, OR BLANK  
f = 0, A-P OR BLANK  
g = METER, 9100-037, 9100-039, 9100-038, OR BLANK

NOTES:  
1. SEAL FITTINGS SUPPLIED ARE "WEATHER RESISTANT." THEY ARE NOT CERTIFIED AS "EXPLOSIONPROOF" (XP) OR "FLAMEPROOF" (D). REPLACE WITH APPROPRIATE SEAL FITTINGS AS REQUIRED.  
2. ALWAYS INSTALL TO NEC® AND/OR LOCAL CODES/REQUIREMENTS/DIRECTIVES AS MANDATED BY THE AUTHORITY HAVING JURISDICTION.

• APPROVED DRAWING •  
CHANGES TO THIS DRAWING REQUIRE AGENCY APPROVAL PER 440-0015-003

☒ FM ☒ CSA ☐ KEMA

☐ 420-0004-039 ☐ 420-0004-138

**AMETEK®**  
**DREXELBROOK**

205 KEITH VALLEY RD  
HORSHAM, PA 19044-9986

215-674-1234  
FAX 215-674-2731

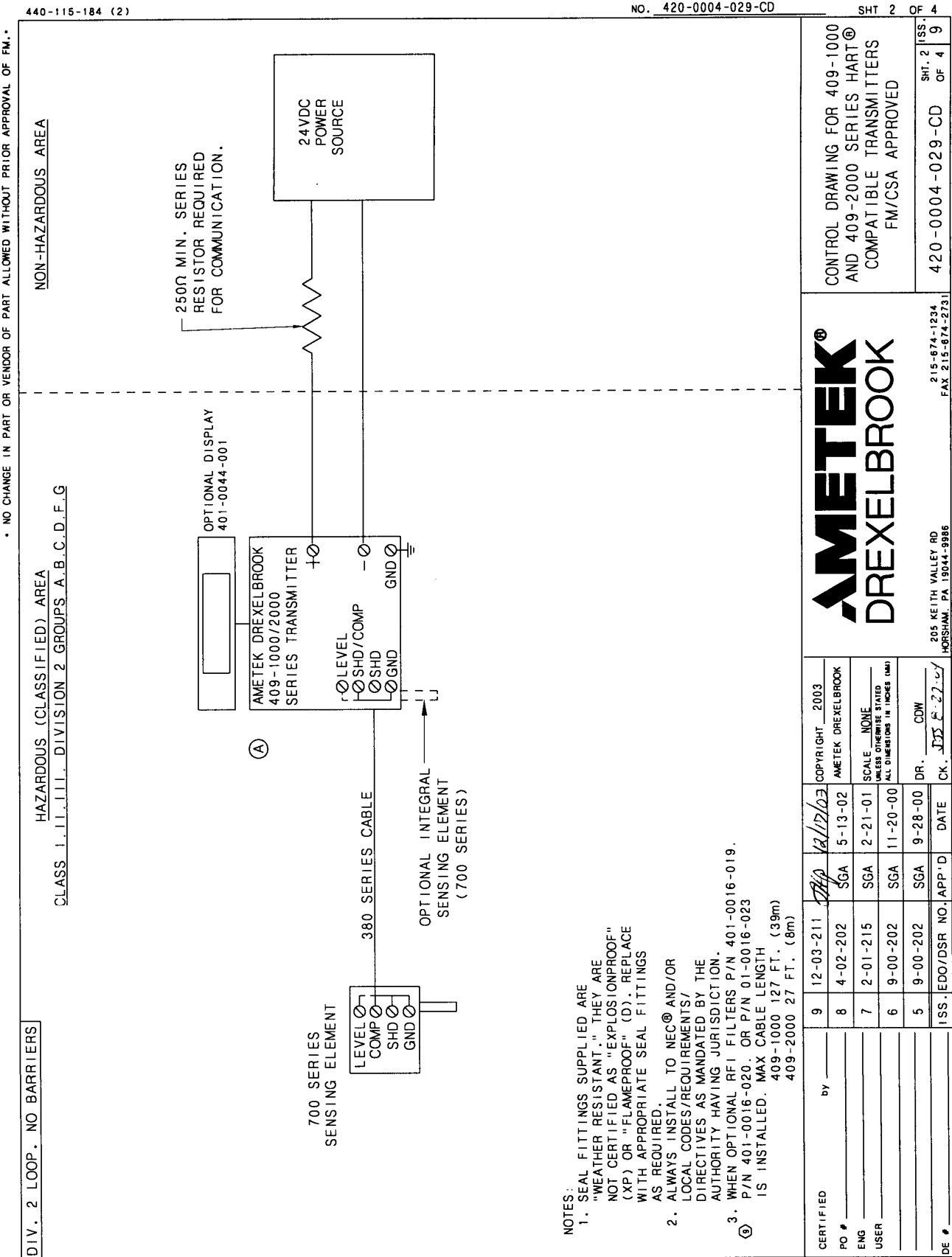
CONTROL DRAWING FOR 409-1000 AND 409-2000 SERIES HART® COMPATIBLE TRANSMITTERS FM/CSA APPROVED

ISS. 1 OF 4  
420-0004-029-CD

CERTIFIED	by	9	12-03-211	12/17/23	COPYRIGHT, 2003
PO #		8	4-02-202	SGA	AMETEK DREXELBROOK
ENG		7	2-01-215	SGA	SCALE NONE
USER		6	9-00-202	SGA	UNLESS OTHERWISE STATED ALL DIMENSIONS IN INCHES (MM)
ISS. EDO/DSR NO. APP'D		5	9-00-202	SGA	DR. CDW
DATE					OK. 12/17/23



9.1 FM / CSA APPROVAL DRAWINGS (Continued)



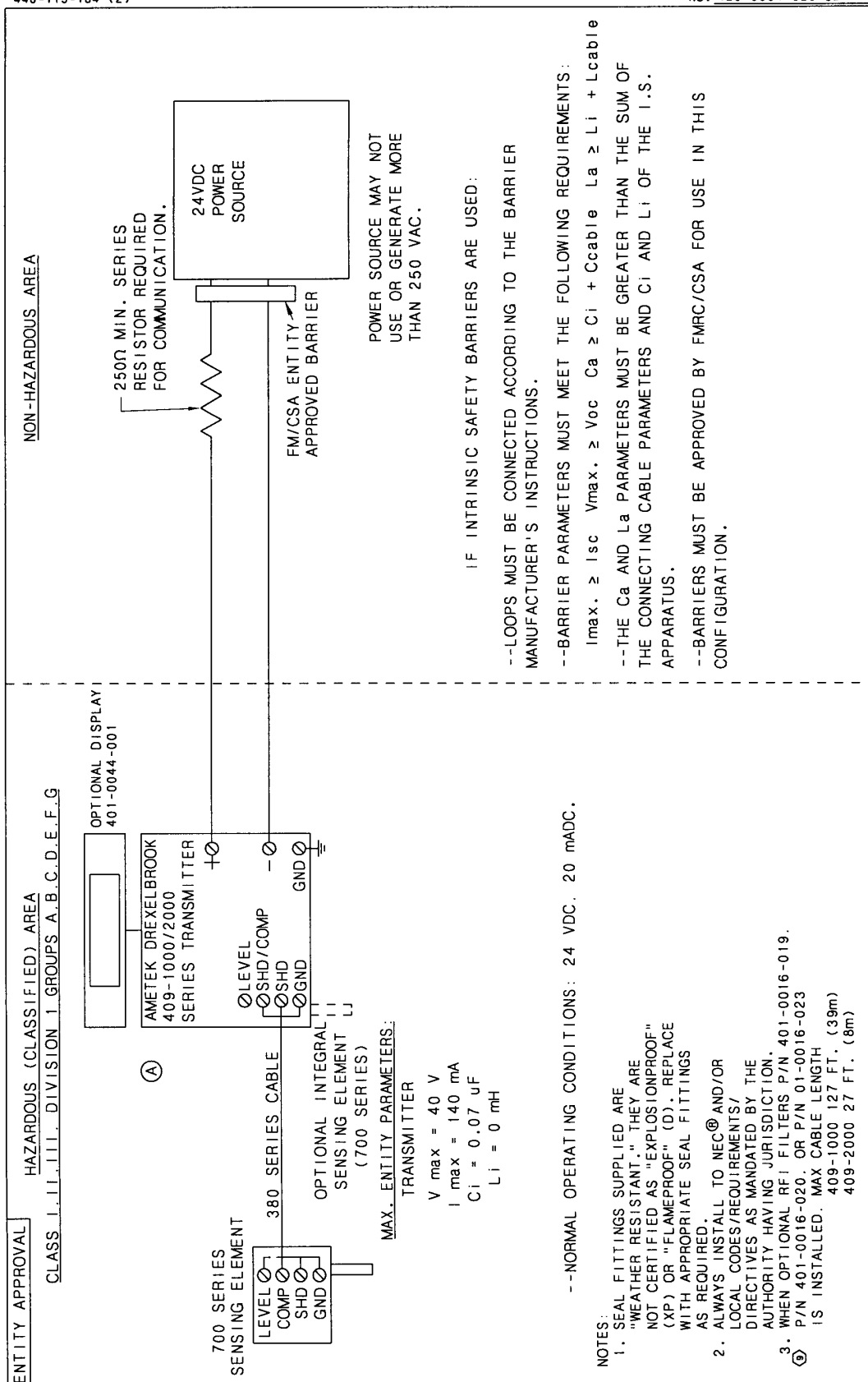
## 9.1 FM / CSA APPROVAL DRAWINGS (Continued)

440-115-184 (2)

NO. 420-0004-029-CD

SHT 3 OF 4

NO CHANGE IN PART OR VENDOR OF PART ALLOWED WITHOUT PRIOR APPROVAL OF FM.\*



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PO #		8	4-02-202	DATE	5-13-02	AMETEK DREXELBROOK	
ENG		7	2-01-215	DATE	4-21-01	SCALE	NONE
USER		6	9-00-202	DATE	11-20-00	UNLESS OTHERWISE STATED ALL DIMENSIONS IN INCHES (MM)	
		5	9-00-202	DATE	9-28-00	DR.	CDW
		ISS.	ENC/DSB. NO.	APP'D	DATE	OK 08-27-04	

CONTROL DRAWING FOR 409-1000  
AND 409-2000 SERIES HART®  
COMPATIBLE TRANSMITTERS  
FM/CSA APPROVED

215-874-1234  
205 KEITH VALLEY RD.

**AMETEK®**  
**DREXELBROOK**

SHT. 3 OF 4  
420 0004-029-CD

9.1 FM / CSA APPROVAL DRAWINGS (Continued)

440-115-184 (2)

NO. 420-0004-029-CD

SHT 4 OF 4

EXPLOSIONPROOF INSTALLATION

HAZARDOUS (CLASSIFIED) AREA

CLASS I, II, III, DIVISION 1 GROUPS A, B, C, D, E, F, G

NON-HAZARDOUS AREA

700 SERIES SENSING ELEMENT

LEVEL, COM, SHD, GND

CONDUIT SEAL

CONDUIT

CONDUIT SEAL

CONDUIT

CONDUIT SEAL

24VDC POWER SUPPLY

FM/CSA ENTITY APPROVED BARRIER

250Ω MIN. SERIES RESISTOR REQUIRED FOR COMMUNICATION.

EXPLOSIONPROOF FOR CLASS I GROUPS A, B, C, D AND DUST-IGNITIONPROOF FOR CLASS II AND III GROUPS E, F, AND G.

POWER SOURCE MAY NOT USE OR GENERATE MORE THAN 250 VAC

380 SERIES CABLE: SEE SHEET 1, NOTE 4

SEE PAGE 1 FOR LIST OF APPROVED SENSING ELEMENT.

MODEL NUMBERS OF CERTIFIED TRANSMITTERS SHOWN ON PAGE 4:

409-10a0-bcd-ef mod g  
a = PHASING 0 OR 3  
b = APPROVAL, 0, F, C OR K  
c = FREQUENCY, 0.1  
d = ENCLOSURE, 4, 6, 8, 9, C, D  
e = 0, A OR BLANK  
f = 0, A-P OR BLANK  
g = METER, 9100-037, 9100-039, 9100-038, OR BLANK

409-20a0-b0cde mod f  
a = SENSITIVITY, 0 OR 5  
b = APPROVAL, 0, F, C OR K  
c = ENCLOSURE, 4, 6, 8, 9, C, D  
d = 0, OR BLANK  
e = 0, OR BLANK  
f = METER, 9100-038, 9100-039, 9100-042, OR BLANK

NOTES:

1. CONDUIT SEALS MUST BE WITHIN 2 INCHES (50mm) OF TRANSMITTER HOUSING.

2. SEAL FITTINGS SUPPLIED ARE "WEATHER RESISTANT." THEY ARE NOT CERTIFIED AS "EXPLOSIONPROOF" (XP) OR "FLAMEPROOF" (D). REPLACE WITH APPROPRIATE SEAL FITTINGS AS REQUIRED.

3. ALWAYS INSTALL TO NEC® AND/OR LOCAL CODES/REQUIREMENTS/DIRECTIVES AS MANDATED BY THE AUTHORITY HAVING JURISDICTION.

4. WHEN OPTIONAL RFI FILTERS P/N 401-0016-019, P/N 401-0016-020, OR P/N 01-0016-023 IS INSTALLED, MAX CABLE LENGTH 409-1000 127 FT. (39m) 409-2000 27 FT. (8m)

NOTE: AN FM/CSA BARRIER MUST BE USED THAT HAS THE ENTITY AS STATED ON PAGE 3.

CONTROL DRAWING FOR 409-1000 AND 409-2000 SERIES HART® COMPATIBLE TRANSMITTERS FM/CSA APPROVED

420-0004-029-CD

SHT. 4 OF 4

ISS 9

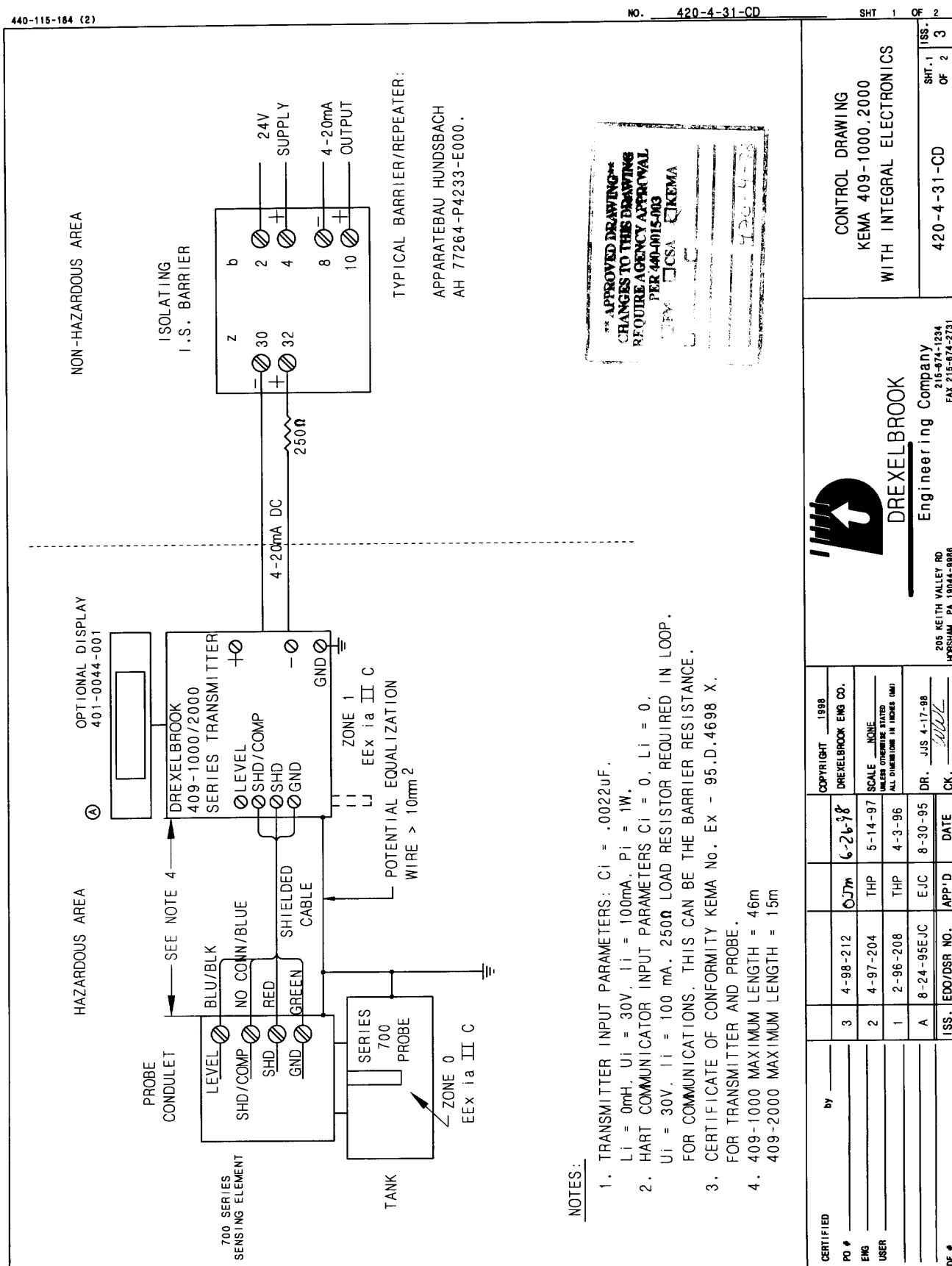
**METEK®**  
**DREXELBROOK**

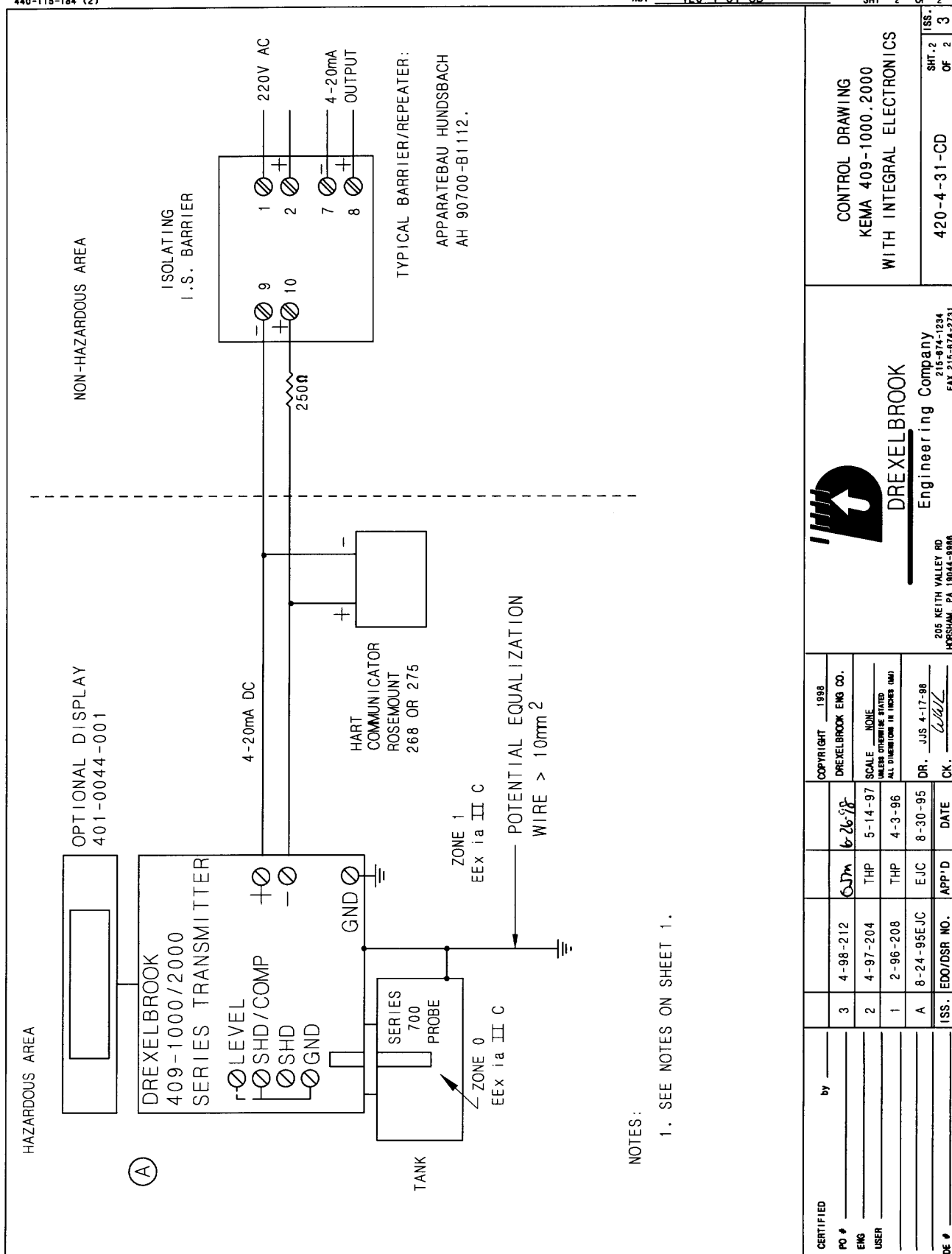
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FAX 215-674-2731

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PO #		8	4-02-202	SGA	5-13-02	AMETEK DREXELBROOK
ENG		7	2-01-215	SGA	2-21-01	SCALE NONE
USER		6	9-00-202	SGA	11-20-00	UNLESS OTHERWISE STATED, ALL DIMENSIONS IN INCHES (MM)
ISS.	EDO/DSR	NO.	APP'D	DATE	DR.	CK.
DE #		5	9-00-202	SGA	9-28-00	CDW

## 9.2 KEMA APPROVAL DRAWINGS











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