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# Installation and Operating Instructions

Series CM3  
Cut Monitor  
with HART® Protocol  
using 409-1000 Electronics

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Series CM3  
Cut Monitor  
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using 409-1000 Electronics

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## Table of Contents

<b>SECTION 1 INTRODUCTION</b> .....	<b>1</b>
1.1 Description .....	1
1.2 Models Available .....	1
<b>SECTION 2 INSTALLATION</b> .....	<b>5</b>
2.1 Unpacking .....	5
2.2 Mounting the Electronic Unit.....	5
2.3 Mounting the Sensing Element.....	10
2.4 Wiring the Electronic Unit .....	13
2.5 Wiring the Sensing Element (Remote Electronic Units).....	15
2.6 Surge Voltage (Lightning Protection) .....	16
2.7 RFI (Radio Frequency Interference) .....	16
<b>SECTION 3 OPERATION</b> .....	<b>18</b>
3.1 General Description .....	18
3.2 PC Software Model Number .....	18
3.3 PC Software Specifications .....	19
3.4 Installing the Modem .....	19
3.5 Installing the Software on the Hard Drive.....	20
3.5.1 Running PC Software from the Hard Drive as a DOS Program .....	20
3.5.2 Running PC Software from the Hard Drive in Windows 95®.....	21
3.6 Description of the Function Keys .....	22
3.7 Using the PC Software Menu .....	24
<b>SECTION 4 CALIBRATION</b> .....	<b>25</b>
4.1 Checking Calibration Data .....	25
4.2 Trimming Factory Calibration .....	26
4.3 Recalibration.....	27
<b>SECTION 5 SERVICE</b> .....	<b>28</b>
5.1 Telephone Assistance .....	28
5.2 Equipment Return.....	28
5.3 Field Service .....	29
5.4 Customer Training .....	29
<b>SECTION 6 SPECIFICATIONS</b> .....	<b>30</b>
6.1 Specifications for the Electronic Unit .....	30
6.2 Specifications for Coaxial Cable .....	31



**SECTION 1  
INTRODUCTION**

The instructions in this manual are for the Drexelbrook CM3 Series Cut Monitor used for measurement of water-in-oil (B.S.&W.) applications.

**1.1 Description**

Each Drexelbrook CM3 Cut Monitor 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 when the sensing element is mounted remotely from the electronic unit.

The CM3 Cut Monitor is a smart capacitance-to-current device. A change in oil composition produces a capacitance change that results in a change of signal current.

**1.2 Models Available**

The CM3 model number is 509-0277-X0X. The electronic unit model number is 409-1000. The sensing element model number is 700-20X-5X.

**5 0 9 - 0 2 7 7 - X 0 X** CM3 Cut Monitor

|  
|  
**Sensing Element  
Reference Number:  
See Table 1-1**

**Package:**  
7 = Remote  
9 = Integral

**4 0 9 - 1 0 0 0 - X 0 X** Universal III Electronic Unit

**Agency Approvals:**  
F = FM  
C = CSA  
K = KEMA

**Housing:**  
6 = Remote Nema 4X  
Explosionproof  
with Drexelcote  
8 = Integral Nema 4X  
Explosionproof  
with Drexelcote

**Modification 91-38:**  
Adds local indicator  
(standard for remote  
electronics)

# CM3 Series Cut Monitor with Universal III™ Transmitter

Sensing Element Reference	Application	Sensing Element Model Number	Standard Material of Construction	OD and Standard Mounting	Insertion Length
509-0277-					
X0A	1 inch pipe	700-201-51	316 SS with with TFE seals and insulators	Rod ¼" OD ¾" NPT	18.7 inches
X0B	2 inch pipe	700-201-52	316 SS with with TFE seals and insulators	Rod ¼" OD ¾" NPT	28.1 inches
X0C	3 inch pipe	700-202-53	316 SS with with TFE seals and insulators	Rod ½" OD 1" NPT	29 inches
X0D	4 inch pipe	700-202-54	316 SS with with TFE seals and insulators	Rod ½" OD 1" NPT	32.1 inches
X0E	6 inch pipe	700-202-56	316 SS with with TFE seals and insulators	Rod ½" OD 1" NPT	38.4 inches
X0F	8 inch or or larger pipe	700-201-58	316 SS with with TFE seals and insulators	Concentric shield 1.66" OD 4"/150# RF flange mount	37 inches standard (varies with nozzle length)
X0G	in-tank sensing element	700-201-59	316 SS with with TFE seals and insulators	Perforated concentric shield 1.66" OD 2"/150# RF flange mount	27 inches standard (varies with nozzle length)

**Table 1-1**  
**Sensing Element**  
**Model Numbering**



### 1.2 Models Available (cont.)

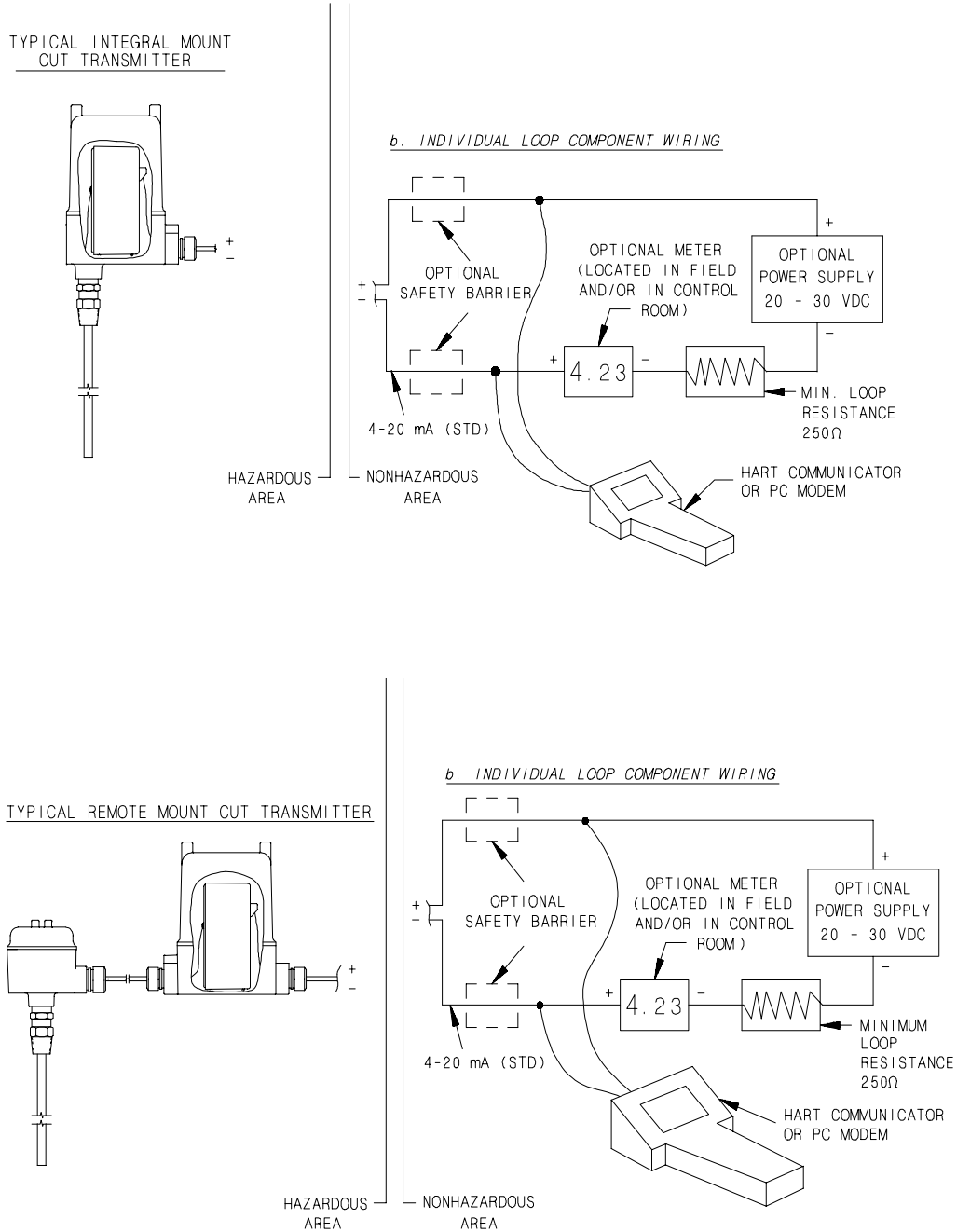
The standard electronic unit (409-1000-X0X) is mounted in an explosionproof housing that meets the following classifications:

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

The remote electronic unit and sensing element are connected by a three-terminal coaxial cable (380-0xx-12).

- The xx in the model number indicates the length of the cable in feet.
- Maximum length is 25 feet.
- Shorter lengths are available.
- Cable can also be purchased in bulk lengths with termination kits.

# CM3 Series Cut Monitor with Universal III™ Transmitter



**Figure 1-1**  
**HART® Universal III™ Transmitter**  
**in Two-Wire Loop**

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.

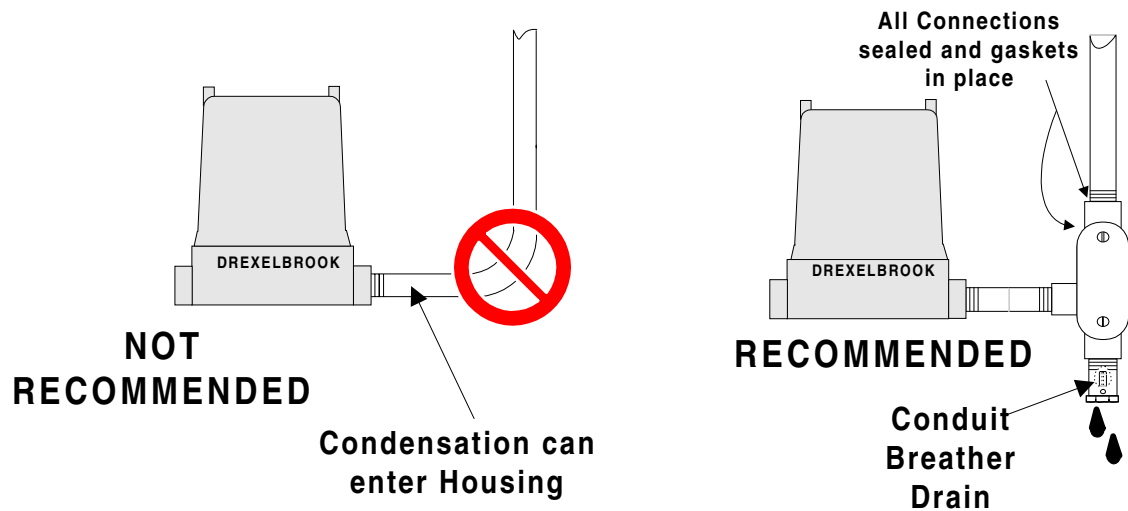
2.2 Mounting the Electronic Unit

The integral electronic unit is mounted with the sensing element. The remote electronic unit is 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°F and 185°F (-40°C and 85°C).

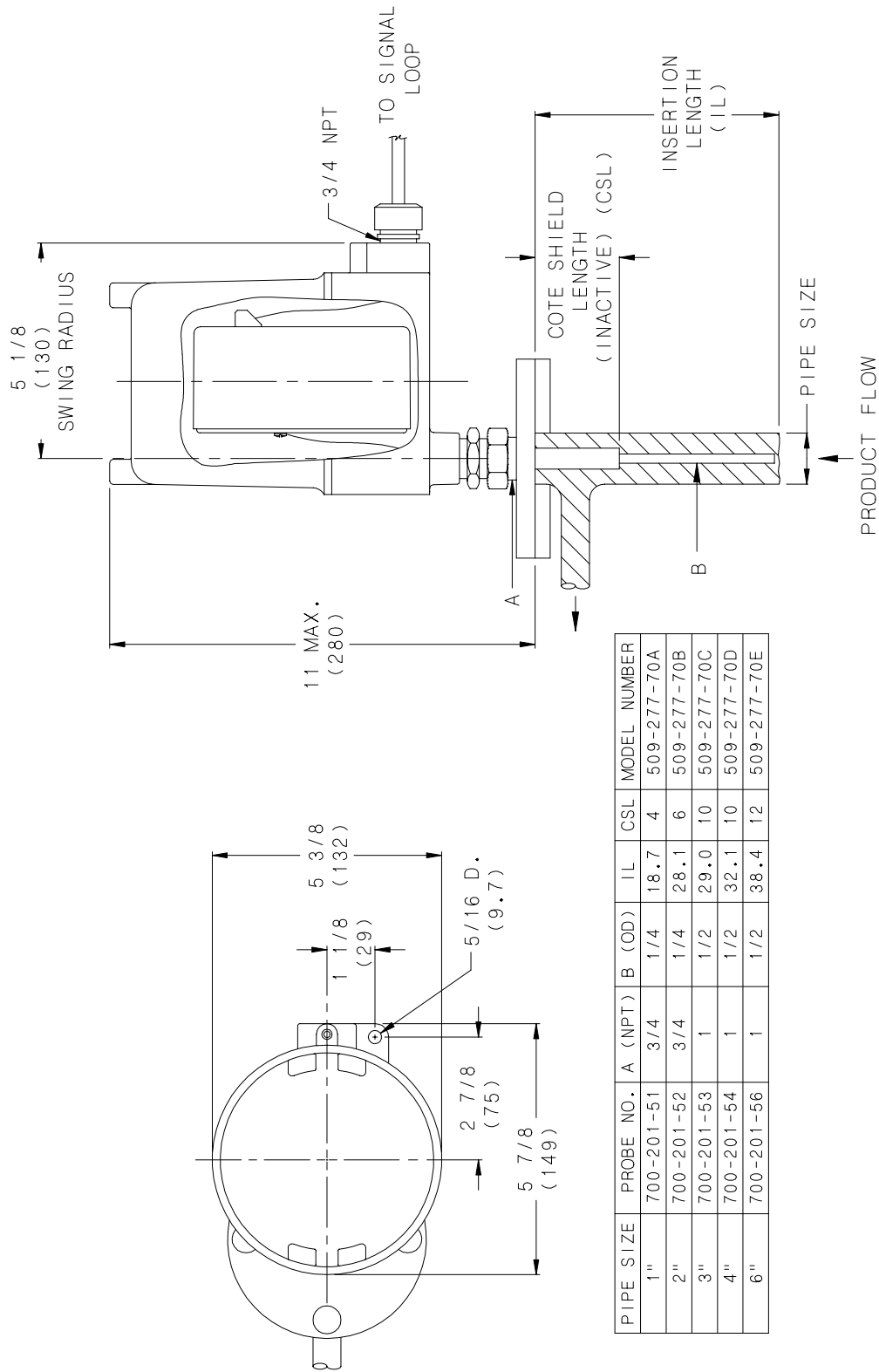
**NOTE**

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.

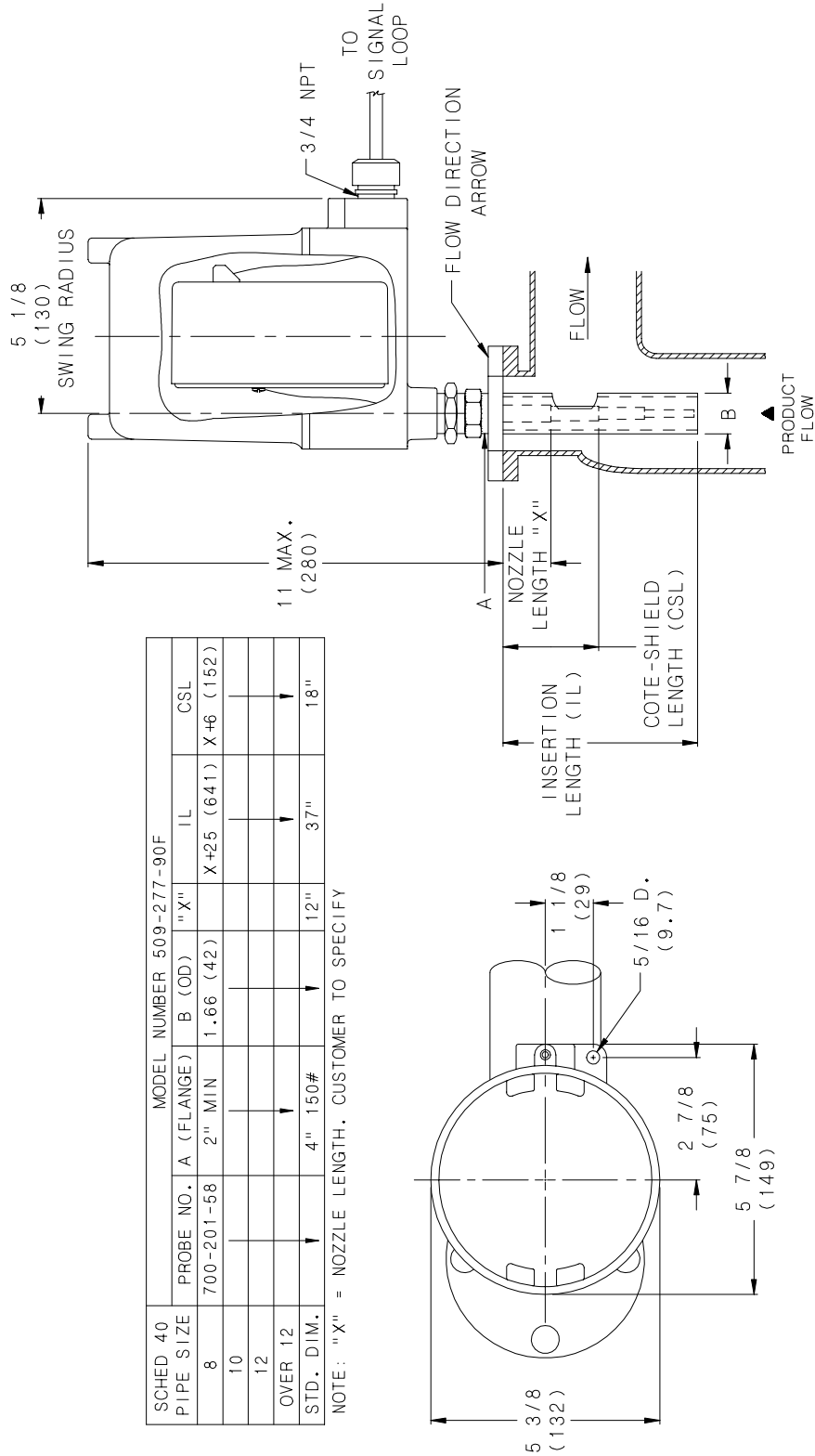
Figure 2-1 shows the recommended conduit installation. See Figures 2-2 through 2-5 for mounting dimensions.



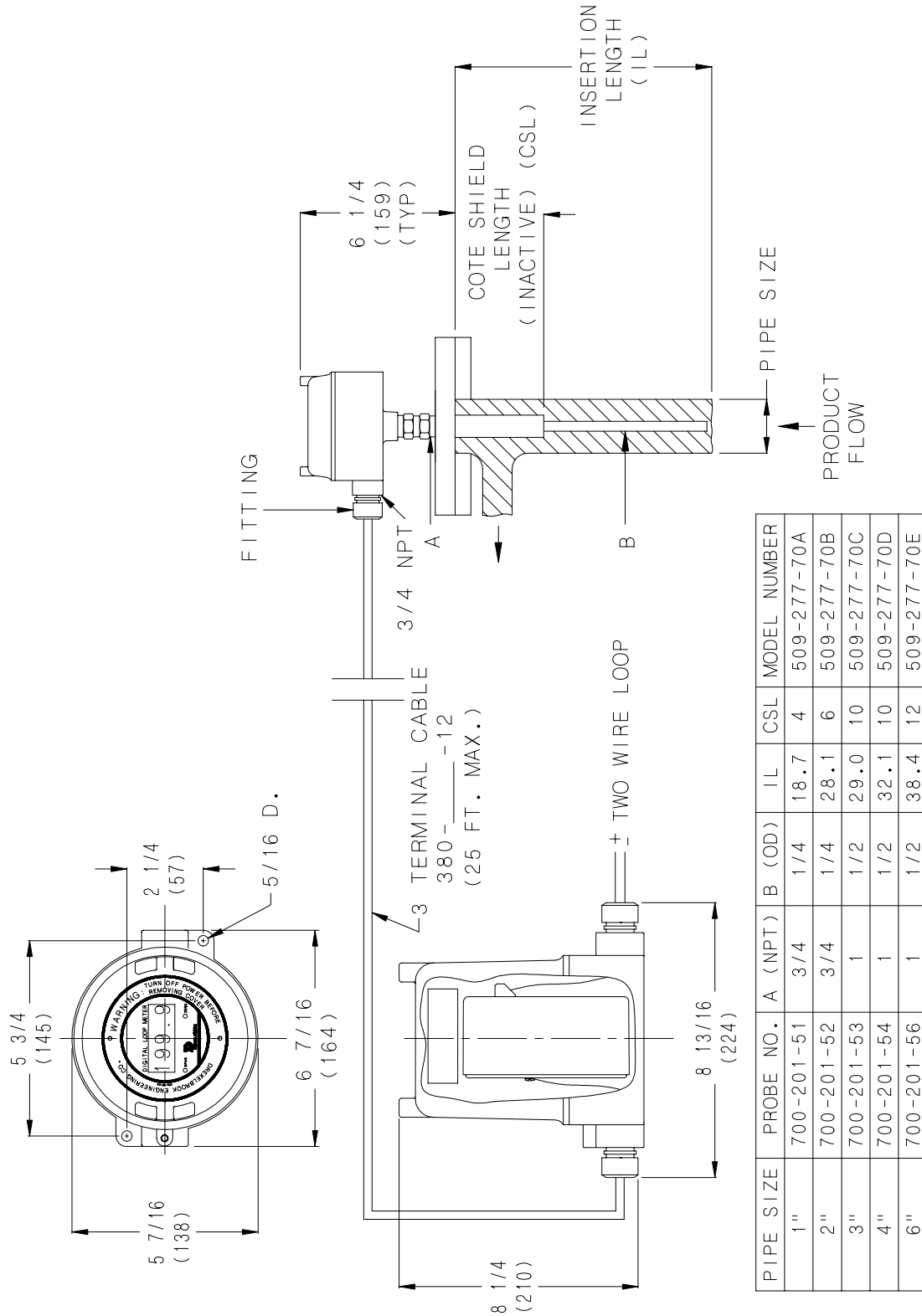
*Figure 2-1  
Recommended Conduit Connection*



**Figure 2-2**  
**Mounting Dimensions**  
**Integral Electronics**  
**1" through 6" Pipe Size**



**Figure 2-3**  
**Mounting Dimensions**  
**Integral Electronics**  
**Greater than 8" Pipe Size**



**Figure 2-4**  
**Mounting Dimensions**  
**Remote Electronics**  
**1" through 6" Pipe Size**

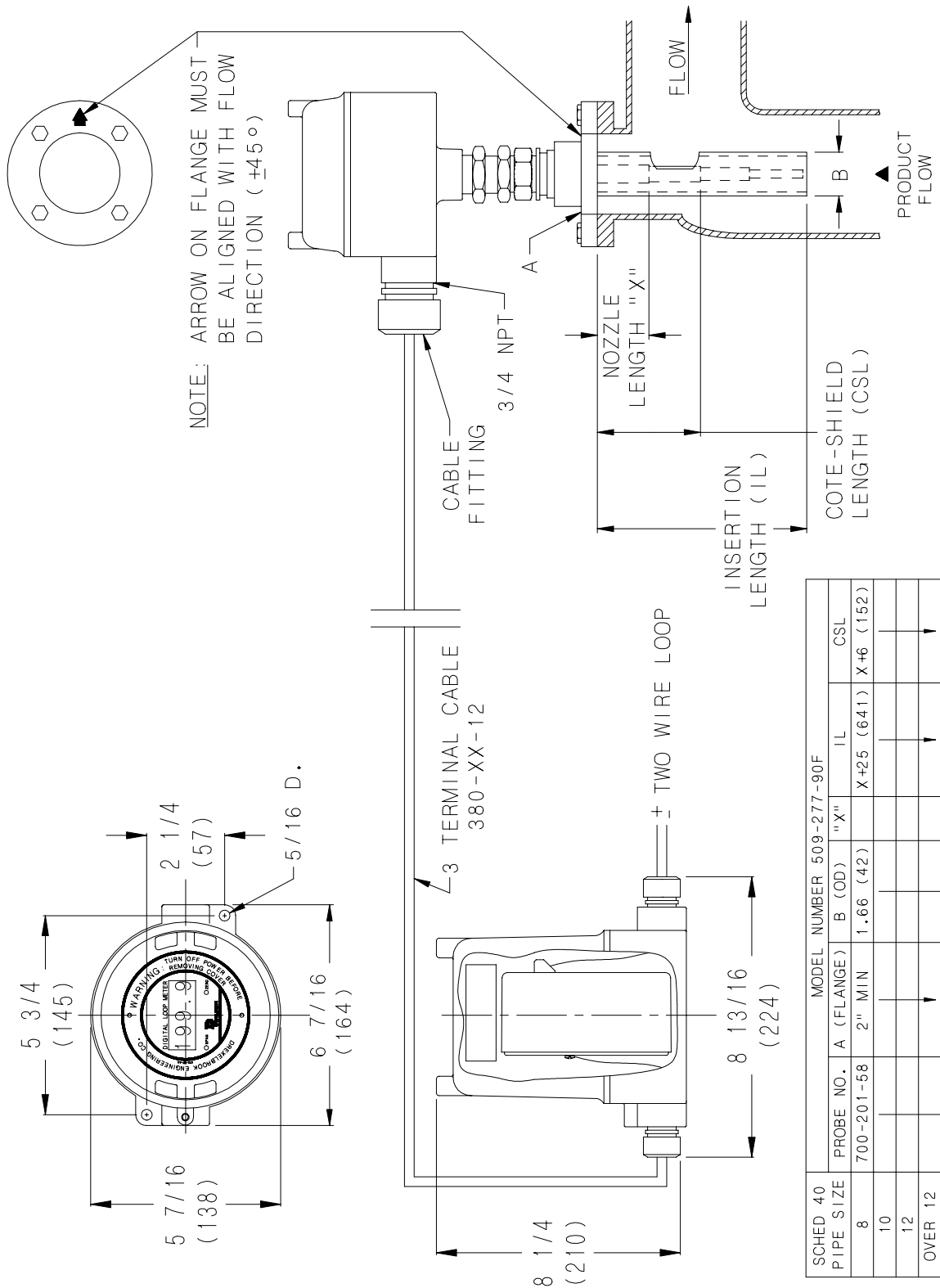
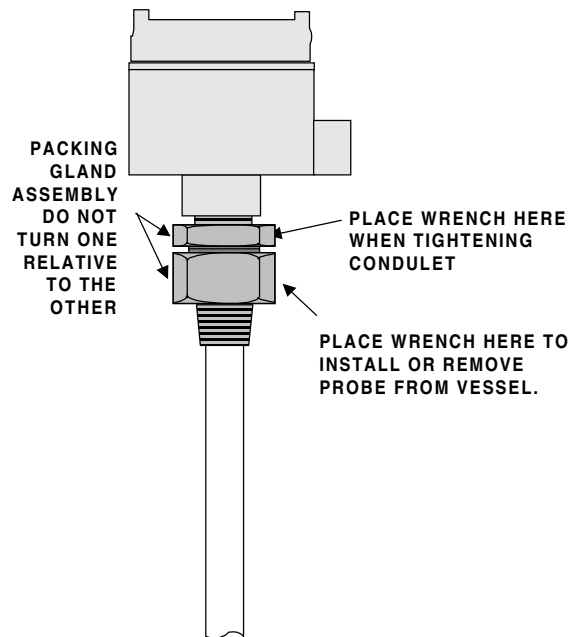


Figure 2-5  
 Mounting Dimensions  
 Remote Electronics  
 Greater than 8" Pipe Size

## 2.3 Mounting the Sensing Element

Use the following mounting and installation instructions so that the sensing element will operate properly and accurately:

- a. The sensing element should be mounted in a section of pipe as close to the center and as parallel to the pipe as possible. Factory calibration assumes mounting on the pipe centerline and in the correct size pipe (see Figure 2-2).
- b. Vertical mounting, with the tip down, is preferred, but not essential.
- c. Gas bubbles **must** be excluded from the active area by maintaining pressure and, if necessary, a degasser upstream from the sensing element. Gas bubbles (whether from natural gas, air or steam) invalidate the accuracy of the transmitter.
- d. For **in-tank mounting** installations, the standard length of the cote shield section is eight inches. If the nozzle is longer than six inches, a non-standard cote shield length should be used.
- e. **Do not take the sensing element apart or loosen the packing glands.** Follow instructions in Figure 2-6.

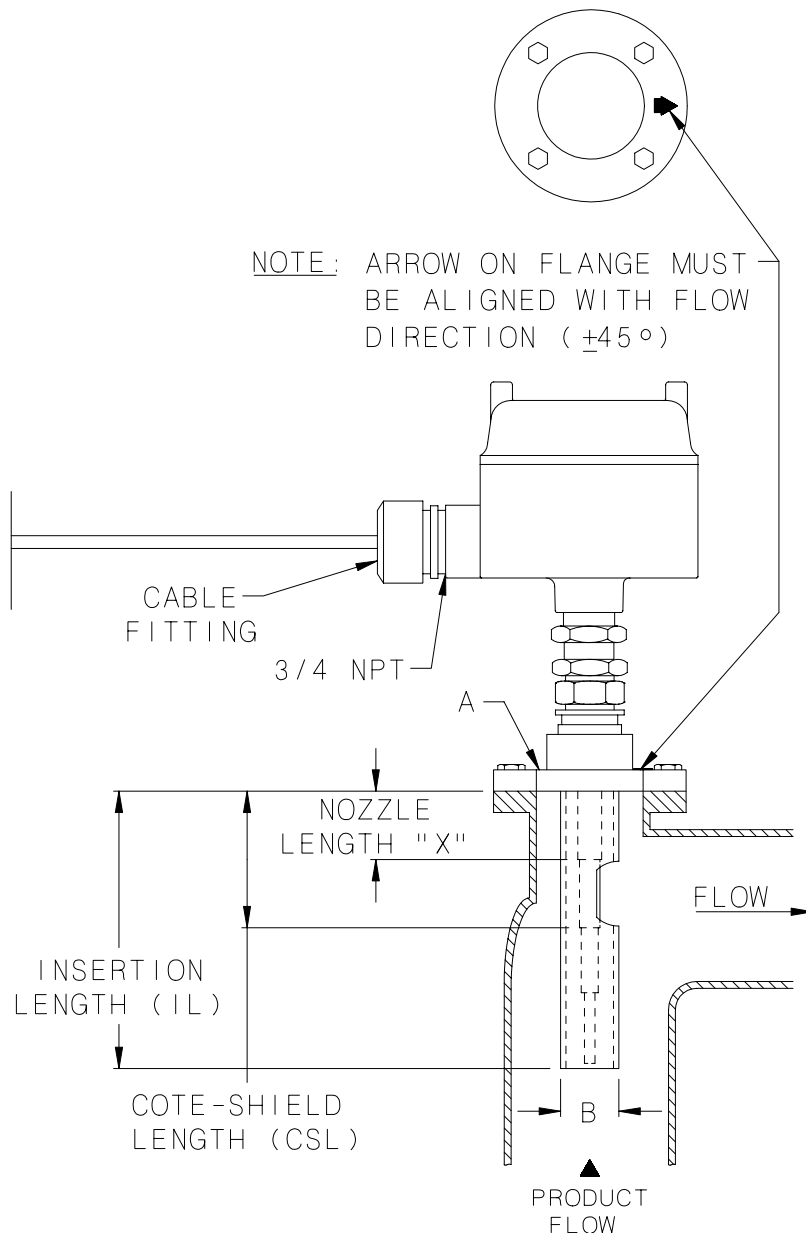


*Figure 2-6  
Installing the Sensing Element*



2.3 Mounting the Sensing Element (cont.)

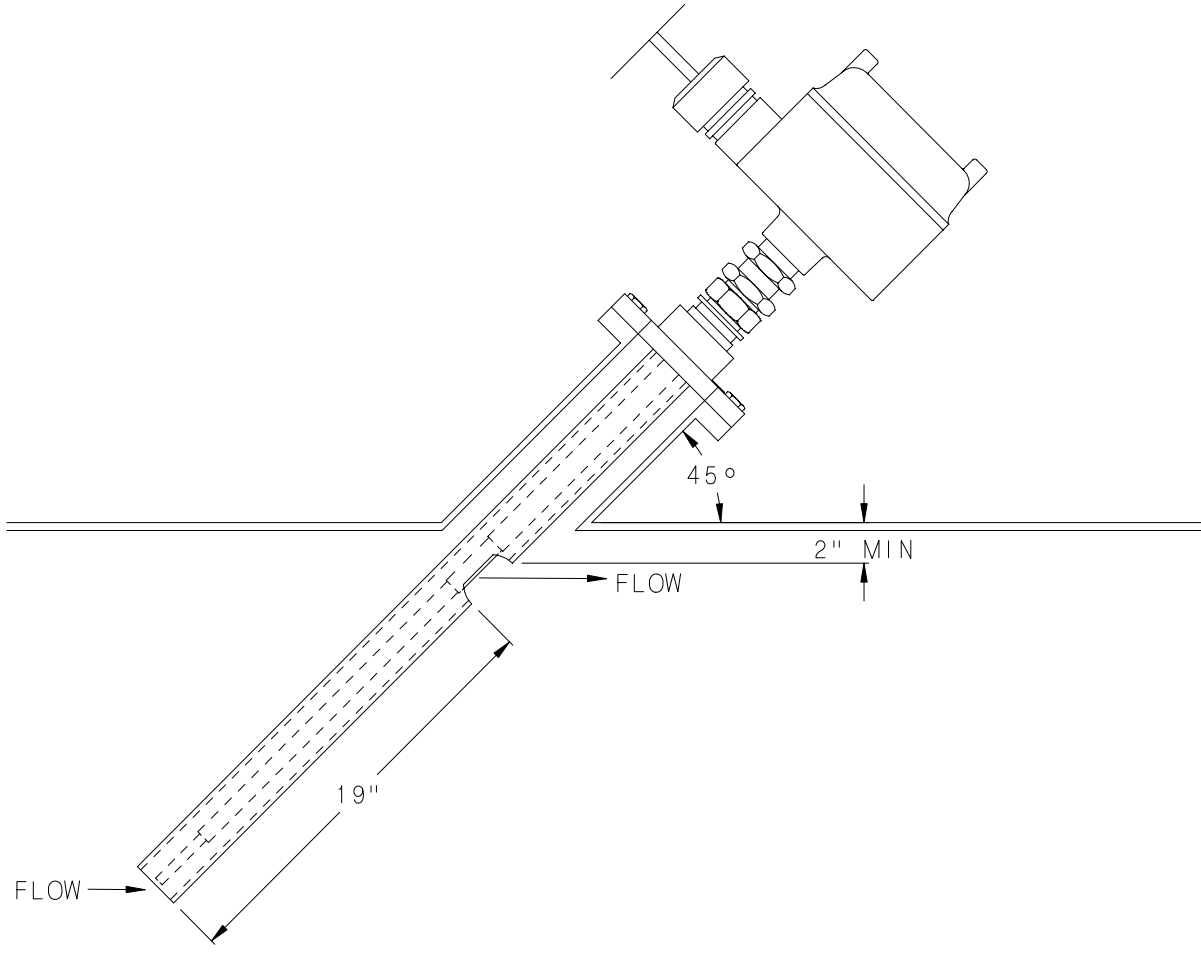
- e. In large pipe installations (greater than eight inches), the length of the cote shield section must be long enough (i.e. length of nozzle short enough) that the cutout in the concentric tube is in the actual flow of oil. See Figure 2-7.



*Figure 2-7  
Installation in a  
Large Pipe (greater than eight inches)*

## 2.3 Mounting the Sensing Element (cont.)

- f. For large pipes with no bends (18 inch and larger), it is possible to mount the sensing element at a 45 degree angle to provide sufficient flow through the shield of the sensing element. See Figure 2-8.



**Figure 2-8**  
*Installation in a Pipe 18 inches or larger*

2.4 Wiring the Electronic Unit

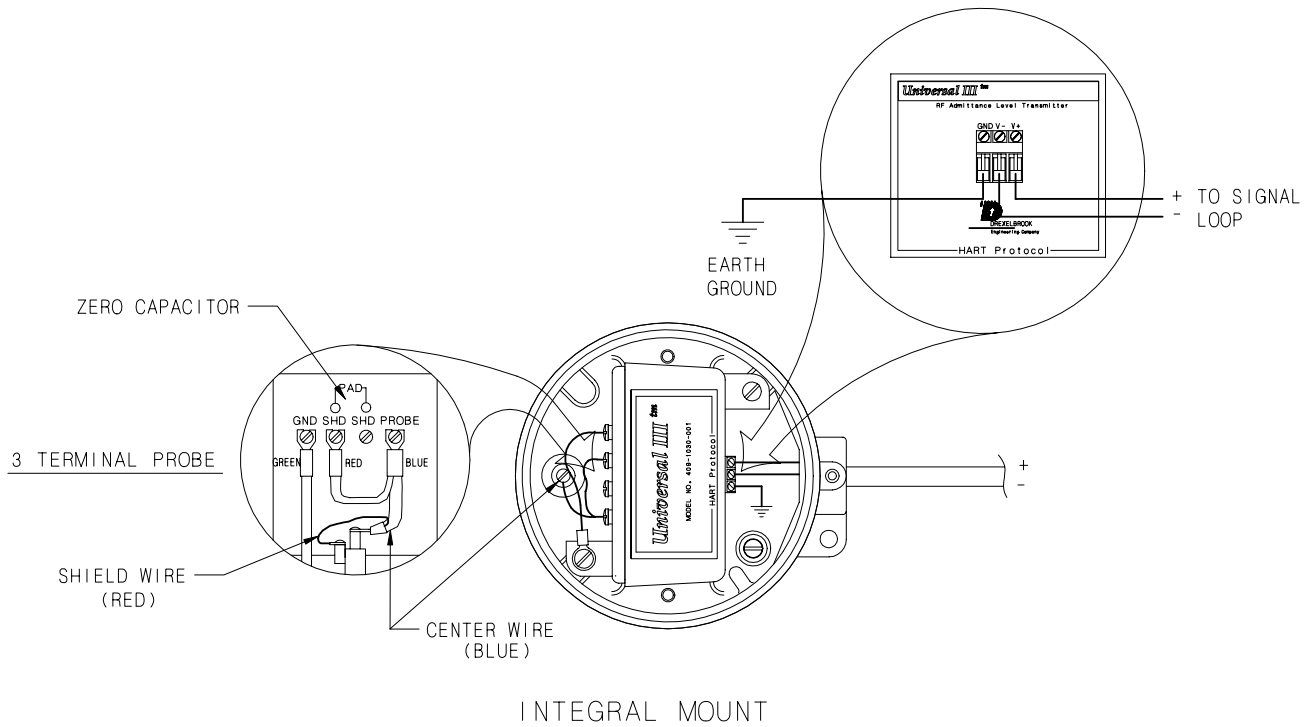
**CAUTION**

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

**CAUTION**

If welding anywhere on the piping or connected tanks, physically remove all connections from the electronic unit and remove the unit from its housing.

Integral units are prewired at the factory. Figure 2-9 shows the wiring of the integral unit.

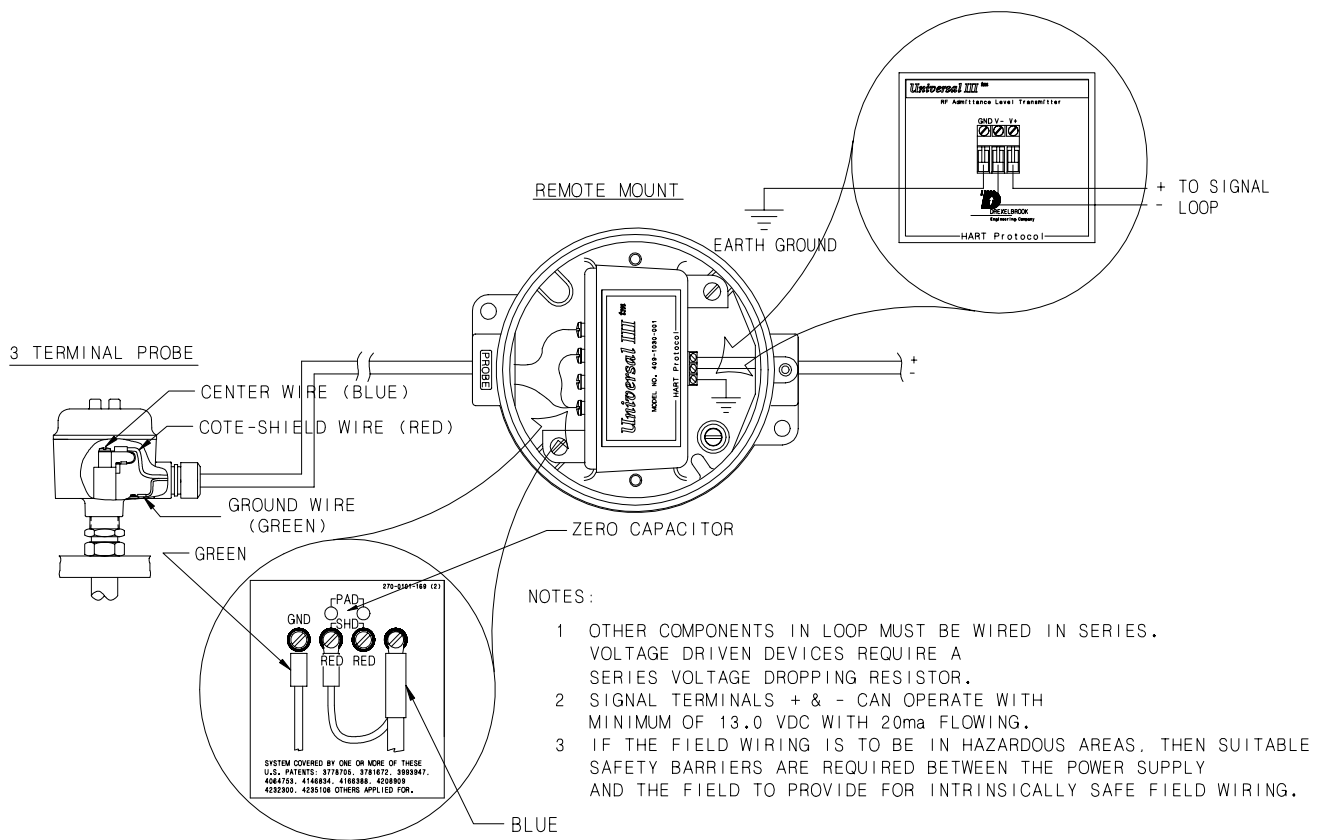


**Figure 2-9**  
**CM3 Wiring Connections**  
**(Integral Mounting)**

## 2.4 Wiring the Electronic 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 required.

The cable from the sensing element is connected to the four-terminal group on the back side of the instrument chassis. The cable connections are probe (Prb or Center Wire), ground (Gnd), and shield (Shd). See Figure 2-10



**Figure 2-10**  
**CM3 Wiring Connections**  
**(Remote Mounting)**

## 2.5 Wiring the Sensing Element (Remote Electronic Units)

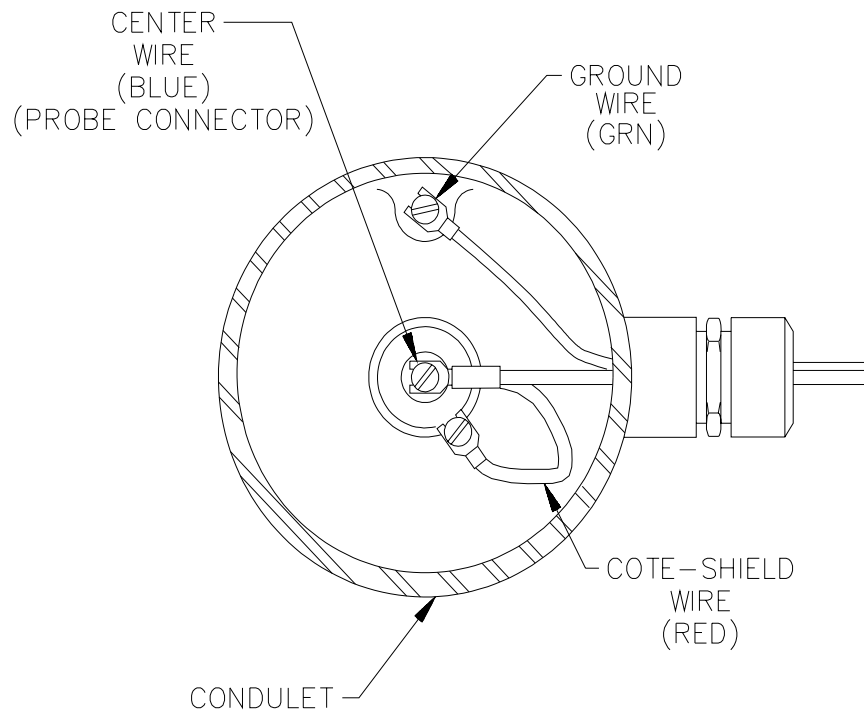
Only coaxial cables supplied by AMETEK Drexelbrook should be used to connect the transmitter to the sensing element. Use of other cables can result in unstable calibration.

To prevent problems with radio frequency interference, the cable should be run in metallic conduit if walkie-talkies or variable speed drives are located within 25 feet of the electronic unit.

The cable connections to the sensing element are shown in Figure 2-12.

### **NOTE**

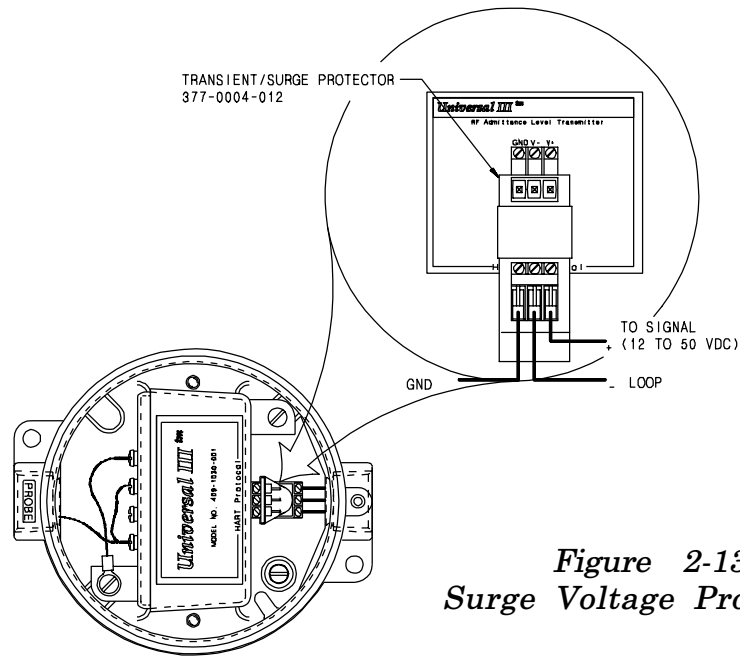
Do not connect the cable to the sensing element until after the sensing element has been installed in the vessel and the conduit housing has been secured.



**Figure 2-12**  
**Three-Terminal Cable Connections**  
**to Three-Terminal Sensing Element**

## 2.6 Surge Voltage (Lightning) Protection

Optional surge protection is sometimes supplied with transmitters that are expected to be exposed to surges or lightning on the two-wire loop. A Drexelbrook model 377-4-12 Surge Voltage Protector provides 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 Protector. In addition to surge voltage protection, connect the transmitter housing to a good ground.



*Figure 2-13  
Surge Voltage Protection*

## 2.7 RFI (Radio Frequency Interference)

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.
- For remote electronic units, connect the sensing element to the electronic unit by placing the coaxial cable in grounded metal conduit. (Integrally mounted electronic unit connections are already shielded.)
- Use twisted, shielded-pair wiring for all loop wiring connections. Loop connection wiring should also be in grounded metallic conduit.

### 2.7 RFI (Radio Frequency Interference) (cont.)

- Do not run power wiring in the same conduit with signal cables
- Ground the electronic unit and housing with a minimum of 14 gauge wire to a good earth ground. Make sure that conduits entering and leaving the housing have a good electrical ground connection to the housing.

The RFI recommendations listed above provide a degree of protection that is usually sufficient to protect against walkie-talkies used 3 feet (1M) or more from a typical electronic unit.

# CM3 Series Cut Monitor with Universal III™ Transmitter

## SECTION 3 COMMUNICATION WITH DREXELBROOK PC SOFTWARE

This section instructs the user how to use the Drexelbrook 401-700-20 Series PC software to calibrate the Universal III transmitter.

### 3.1 General Description

The 401-700-20 software package allows the use of any DOS or Windows®-based personal computer to interface with the CM3 HART® protocol transmitter.

A PC and Drexelbrook software can be used in place of the Rosemount® handheld calibrator used for multi-PV transmitters.

### 3.2 PC Software Model Number

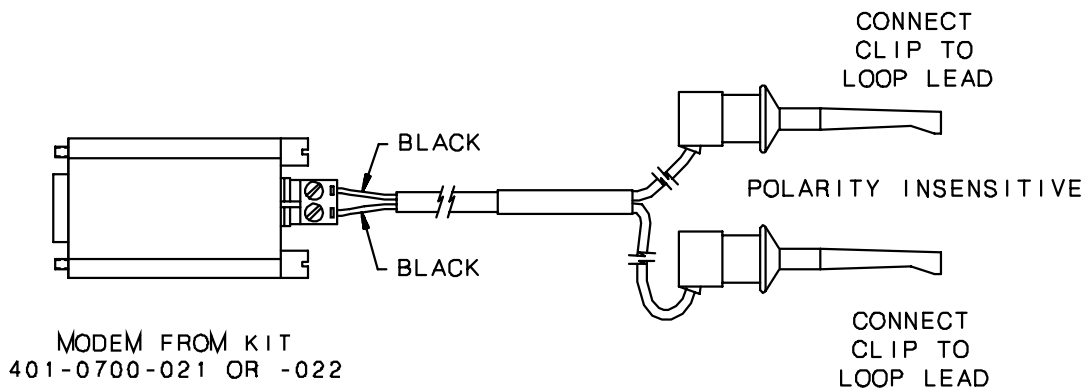
4 0 1 - 0 7 0 0 - 0 2 X

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

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

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

PC Software 3½-inch disk only.



*Figure 3-1  
Modem Assembly*



3.3 PC Software Specifications

—PC Requirements

8088 DOS-based PC or higher using DOS version 3.1 or higher. While it is possible to operate from the 1.44 megabyte floppy disk furnished with the 401-700-20 package, it is recommended that the software be installed on a hard drive with 0.5 megabytes or more of space available.

—Input to Modem

RS232 from the COM1 serial port. The PC provides operating power for the modem but not for the transmitter.

—Cable (included with Modem)

5-foot modem to transmitter loop connection

3.4 Installing the Modem

Refer to Figure 3-2 for a connection diagram and use the following procedure to install the hardware that is necessary to run the PC software.

- a. Connect the Drexelbrook Modem 401-700-002 to the COM1 serial port of the computer.
- b. Connect the 4-20 loop connectors to the transmitter loop. Modem is polarity insensitive.
- c. Connect the loop wires to the modem.
- d. Turn on the computer.

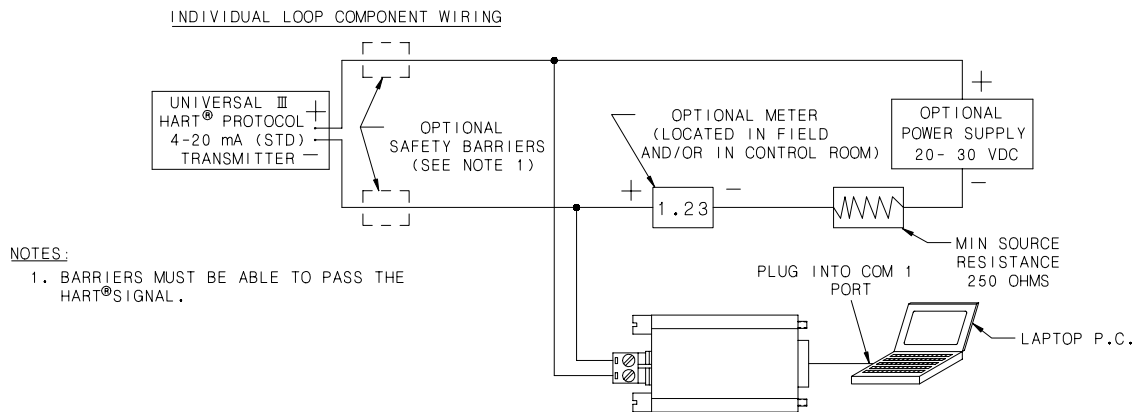


Figure 3-2  
Connecting the Modem

### 3.5 Installing the Software on the Hard Drive

#### *NOTE*

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

#### *NOTE*

The PC software is a DOS-based program. It cannot be installed directly from Windows 3.1® or Windows 95®.

- a. If you are using Windows®, go to the MS DOS prompt to install the PC software.
- b. Place the 401-700-006 software disk into the drive (usually drive a:).
- c. At the `c:>` prompt, type `a: install`. The program will create a directory on the hard drive called **HART60** and place the program file there.
- d. At this point, the software is loaded onto the hard drive, you can:
  - run the software from the DOS mode, or
  - create a program icon (or shortcut) and run the software in Windows®.

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

To run the PC software from DOS:

- a. Type `cd:\HART60`
- b. Type `HART60`

## 3.5.2 Running PC Software from the Hard Drive in Windows 95®

To run the PC software from Windows 95:

- a. Click the **Start** button, and then point to **Settings**.
- b. Click **Taskbar**, and then click the **Start Menu Programs** tab.
- c. Click **Add** and type c:\hart60\hart60.exe
- d. Click **Next**, and then double-click the **Programs** menu where Hart60 is to appear.
- e. Choose a name and icon and then click **Finish** and **OK**.

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



- f. Double click on the DE LOGO icon and the HART program should run under a window.
- g. The software starts communicating with the HART protocol transmitter and returns with Tag ID and all existing configuration information. Press **F1** at any time for on-line Help.

### **NOTE**

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

- h. Press **F3** to read the HART Protocol transmitter's present database. It takes several seconds to upload the information in the transmitter. When the upload is complete, the screen shows the transmitter's data-base parameters.

3.6 Description of the Function Keys      Figure 3-3 shows a PC software menu display and the following paragraphs describe the data fields.

```
F2 Sys F3 Read F4 View F5 Write F6 Pt.CAL F7 Cm F8 File F9 Exit
Drexelbrook Engineering Co. HART Protocol Software Ver. 6.0 (c)1999

Tag-ID.....CM-101                Serial # 109
Scratch Pad.....Calibrated 1/99   Software Ver.--
Analog Loop Assign...Level        Range Pos. 4
Damping Time.....0 Sec            Type XX

      LEVEL CONFIGURATION                VESSEL CONFIGURATION
Level Units.....cm                Vessel Units.....gallons
Maximum Level.....8 cm            Maximum Capacity.....1000 gal
Level Type.....Standard           Vessel Type.....Vertical

      LRV ( 4 mA ).....0 cm
      URV ( 20 mA ).....5 cm

      LEVEL CALIBRATION
Status: * Demo *                Lower Level.....1.87 cm
                                Upper Level.....4.90 cm
                                Lower Capacitance....43.15 pF
                                Upper Capacitance....47.90 pF

                                01-27-1999 15:17:31

Save data file to disk
F1 Help
```

Figure 3-3  
PC Software Menu Display

**NOTE**

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

F1 HELP  
Accesses Help menu and Screens

F2 SYS  
Accesses and configures System information.

## 3.6 Description of the Function Keys (cont.)

Service: Access toll-free service phone number.  
Print: Print configuration screen.  
Other items are not applicable.

### **F3 READ (receive transmitter data)**

Reads all pertinent data from the transmitter and displays it on the screen. The Tag-ID is displayed in the communication window. Once the tag is read and a valid HART protocol transmitter is detected, you may use the **ESC** key to abort the interrogation if this is not the correct transmitter loop. However, if an incomplete upload has occurred, the data not received will have a question mark (?) next to its data field. The **READ** function also updates the real-time window level, vessel, capacitance, current and status after completing loading the data.

### **F4 VIEW (monitor transmitter data)**

Displays the real-time values of cut, sensor capacitance in pF, loop current, and percent of range from the Universal III transmitter. If the transmitter status is anything other than OK, a detailed status message is displayed. Use the **ESC** key to abort the PV update.

### **F5 WRITE (send data to transmitter)**

Sends new or edited configuration data to the transmitter. Data that has been edited but not sent to the transmitter has an asterisk next to its data field.

### **F6 PT. CAL (point calibration)**

Calibrates the Universal III transmitter using Point calibration with two actual composition points. The high and low water percentage must be known.

### **F7 CM**

Selects the Communication Port: COM1.

### **F8 FILE**

This function loads or saves the data on the screen to a PC disk file with an .SLT and .TXT file extension.

### **F9 EXIT**

Exit PC software.

### 3.7 Using the PC Software Menu

All Drexelbrook CM3 Series Cut Monitor instruments are configured and calibrated at the factory.

Two of the data fields in the menu can be changed to identify the instrument specifically for the application. To make an entry in these data fields, position the cursor and type over the existing entry.

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

Press **F5 Write**.

Other data fields on the menu relate to the cut monitor measurement. These data fields should not be changed unless instructed by a factory service engineer.

- The **Analog Loop Assignment** is made at the factory according to the desired range set by the coarse span jumper on the side of the electronic unit. The jumper is set at the factory. **Do not change the factory setting.**
- For a cut monitor application, **Level Units** data field represents % Water Units, measured in **cm** (cut measurement).
- **Maximum Level** is factory set to coincide with the range set by the coarse span jumper. **Do not change the factory setting.**
- For a cut monitor application, the **LRV** (4 mA) corresponds to dry oil or 0% water (0.00 cm).
- For a cut monitor application, the **URV** corresponds to the full scale water percentage (e.g. 10.00 cm on the 10% water range).

## SECTION 4 CALIBRATION

All Drexelbrook CM3 Series Cut Monitor instruments are calibrated at the factory according to:

- size of pipe, and
- density of oil specified.

Specific factors could cause the factory calibration to be less accurate than is required. For example,

- a. Pipe I.D. is smaller than nominal size (Sched. 80, 160, or extra heavy pipe)
- b. Sensing element is not centered (parallel to axis) in pipe. This condition causes higher (never lower) readings.
- c. Oil may be heavier (higher readings) or lighter (lower readings) than expected.
- d. Major temperature deviations.

**Do not change the factory calibration** without obtaining data that indicates a calibration change is necessary.

If the output reading is low because of gas, steam, or air in the stream, then **no** amount of calibration will produce satisfactory performance. Eliminate the gas problem, or consult the factory at 1-800-527-6297. Once the gas is gone, a legitimate calibration check can be made.

### 4.1 Checking Calibration Data

The following equipment is required to check the calibration of a cut monitor application and record sample data:

- A centrifuge (or other API-approved standard) to sample BS&W content.
- If the stream temperature is greater than 150°F (65°C), a sampling bomb with a minimum capacity of 500 ml.
- Temperature stabilization bath.

## 4.1 Checking Calibration Data (cont.)

To record the sample, proceed as follows:

- a. With a personal computer connected to the loop, (as detailed in section 3.3), use key **F4** to display **Real-time View**. As sample is taken, record the
  - output value (cm) and
  - capacitance value (pF).

Generally, these two values should be recorded at one or more different levels of water content (wetter or dryer).

- b. If stream temperature is greater than 150°F (65°C), use the sampling bomb to take the sample and stabilize the temperature at 150°F before attempting to spin the sample in the centrifuge.

Compare spin results to the output readings to determine if calibration needs to be trimmed.

- If the deviation is less than 1.5% water, proceed to section 4.2 *Trimming Calibration*.
- If the deviation is greater than 1.5% water, proceed to section 4.3 *Recalibration*.

## 4.2 Trimming Factory Calibration

Use the following procedure to trim (fine tune) the factory calibration.

- a. On the Menu display of the PC software, move the cursor to the **LEVEL CALIBRATION** submenu.
- b. Enter the deviation amount plus the present real-time value for **Lower Level** (zero calibration value). Press **Enter**.

For example, if the sampled output was .85% lower than the spin reading; and the present real-time value is 1.02 cm; enter 1.87 cm for **Lower Level**.

- c. Enter the deviation amount plus the present real-time value for **Upper Level** (fullscale calibration value). Press **Enter**.

Using the same example, if the present real-time value is 10.05 cm; enter 10.90 cm for **Upper Level**.



## 4.3 Recalibration

If the sample data recorded in section 4.1 *Checking the Calibration Data*, has a deviation greater than 1.5% water:

- a. Record sample data and obtain the deviations at the high and low ends of the range--at least half of the span apart.

For example, on a 0-1% range, the readings should differ by at least 0.50 cm. On a 0-50% range, the readings should differ by at least 25.00 cm.

- b. Graph the results of cm readings against actual cut at those readings.
- c. Determine from the graph, the deviation values at the zero and full scale points.
- d. On the Menu display of the PC software, move the cursor to the **LEVEL CALIBRATION** submenu.
- e. Enter the deviation amount plus the present real-time for **Lower Level** (zero calibration value). Press **Enter**.

For example, if the sampled output was .85% lower than the spin reading; and the present real-time value is 1.02 cm; enter 1.87 cm for **Lower Level**.

- f. Enter the deviation amount plus the present real-time value for **Upper Level** (fullscale calibration value). Press **Enter**.

Using the same example, if the present real-time value is 10.05 cm; enter 10.90 cm for **Upper Level**.

If assistance is required, call the factory at 1-800-527-6297.

**SECTION 5  
SERVICE**

**5.1 Telephone  
Assistance**

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

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

Instrument Model # \_\_\_\_\_  
P.O. # \_\_\_\_\_  
Date \_\_\_\_\_  
Insertion Length \_\_\_\_\_  
Application \_\_\_\_\_  
Material being measured \_\_\_\_\_  
Temperature \_\_\_\_\_  
Pressure \_\_\_\_\_  
Agitation \_\_\_\_\_  
Brief description of the problem \_\_\_\_\_  
Checkout procedures that failed \_\_\_\_\_

**5.2 Equipment  
Return**

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

Reason for Return \_\_\_\_\_  
Return Authorization # \_\_\_\_\_  
Person to contact at your company \_\_\_\_\_  
“Ship To” address \_\_\_\_\_

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

To keep the paperwork in order, you must include a purchase order with returned equipment, even though it may be coming back for warranty repair. You will not be charged if the equipment is covered under warranty.

Please return your equipment with freight charges pre-paid. We regret that we cannot accept collect shipments. Drexelbrook usually has exchange units available for faster turnaround of repair orders. If you prefer your own unit repaired rather than exchanged, please mark clearly on the return unit, “Do Not Exchange”.

Spare instruments are generally in factory stock. If the application is critical, a spare chassis should be kept on hand.

### 5.3 Field Service

Trained field servicemen are available on a time-plus-expense basis to assist in start-ups, diagnosing difficult application problems, or in-plant training of personnel. Contact the service department for further details.

### 5.4 Customer Training

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

SECTION 6  
SPECIFICATIONS

6.1 Specifications for  
Electronic Unit

—*Power Requirement*

20 to 30 Vdc

Minimum of 12 Vdc at 20 mA at transmitter terminals

—*Input Range*

409-1000: 1.0 to 45,000 pF

—*Output Range*

4-20 mA

—*Accuracy*

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

—*Load Resistance*

Maximum Load Resistance = 750 ohms

Minimum Load Resistance = 250 ohms

—*Temperature Effect*

±1% of range per 50°F (30°C)

—*Supply Voltage Effect*

< 0.1% from 12 to 30 Vdc

—*Effect of Load Resistance*

< 0.1% for full resistance range at 24 Vdc supply.

—*Response to Step Change*

1 second standard (to 90% of final value);

0-90 seconds available with delay

—*Ambient Temperature*

-40°F to +185°F (-40°C to 85°C)

6.1 Specifications for  
Electronic Unit

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

6.2 Specifications for  
Coaxial Cable

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

—*Sensing Element Cable Length*  
150 feet maximum

## TERMS AND CONDITIONS OF SALE

**GENERAL:** ALL ORDERS ARE SUBJECT TO THE FOLLOWING TERMS AND CONDITIONS. ANY ACCEPTANCE OF BUYER FOR ANY GOODS OR SERVICES IS CONDITIONED UPON THESE TERMS AND CONDITIONS, AND SELLER OBJECTS TO ANY ADDITIONAL OR DIFFERENT TERMS PROPOSED BY BUYER IN ANY DOCUMENT, WHICH SHALL NOT BE BINDING UPON SELLER. No salesman or other party is authorized to bind the AMETEK DREXELBROOK Division of AMETEK, Inc. (hereinafter "Seller") by any agreement, warranty, statement, promise, or understanding not herein expressed, and no modifications shall be binding on Seller unless the same are in writing and signed by an executive officer of Seller or his or her duly authorized representative. Verbal orders shall not be executed until written notification has been received and acknowledged by Seller.

**QUOTATIONS:** Written quotations are valid for thirty (30) days unless otherwise stated. Verbal quotations expire the same day they are made.

**PRICES:** All prices and terms are subject to change without notice. Buyer-requested changes to its order ("Orders"), including those affecting the identity, scope and delivery of the goods or services, must be documented in writing and are subject to Seller's prior approval and adjustments in price, schedule and other affected terms and conditions. Orders requiring certified test data in excess of commercial requirements, are subject to a special charge.

**ORDER ACCEPTANCE:** All Orders are subject to final approval and acceptance by Seller at its office located at 205 Keith Valley Road, Horsham, Pennsylvania 19044.

**TERMS OF PAYMENT:** Seller's standard terms of payment for Buyers who qualify for credit are net thirty (30) days from date of invoice. All invoices must be paid in United States dollars.

**CREDIT:** Seller reserves the right at any time to revoke any credit extended to Buyer or otherwise modify terms of payment if Buyer fails to pay for any shipments when due or if in Seller's opinion there is a material adverse change in Buyer's financial condition. Seller may, at its option, cancel any accepted Order if Buyer fails to pay any invoices when due.

**DELIVERY:** Shipments are F.O.B place of manufacture ("Shipping Point") and the Buyer shall pay all freight, transportation, shipping, duties, fees, handling, insurance, storage, demurrage, or similar charges from Shipping Point. Delivery of goods to common carrier shall constitute delivery and passing of title to the Buyer, and all risk of loss or damage in transit shall be borne by Buyer. Any claims or losses for damage or destruction after such delivery shall be the responsibility of Buyer.

Seller reserves the right to make delivery in installments which shall be separately invoiced and paid for when due, without regard to subsequent deliveries. Delay in delivery of any installment shall not relieve Buyer of its obligation to accept remaining deliveries.

Acknowledged shipping dates are approximate only and based on prompt receipt of all necessary information from Buyer and Buyer's compliance with terms of payment.

**TAXES:** All sales, excise and similar taxes which Seller may be required to pay or collect with respect to the goods and/or services covered by any Order, shall be for the account of the Buyer except as otherwise provided by law or unless specifically stated otherwise by Seller in writing.

**TERMINATION AND HOLD ORDERS:** No Order may be terminated by Buyer except upon written request by Buyer and approval by Seller, and if said request is approved by Seller, under the following conditions: (1) Buyer agrees to accept delivery of all of the units completed by Seller through the workday on which Seller receives the written termination request; (2) Buyer agrees to pay to Seller all direct costs and expenses applicable to the portion of the Order that is incomplete.

### WARRANTY:

A. **Hardware:** Seller warrants its goods against defects in materials and workmanship under normal use and service for one (1) year from the date of invoice.

B. **Software and Firmware:** Unless otherwise specified, Seller warrants for a period of one (1) year from date of invoice that standard software or firmware, when used with Seller specified hardware, shall perform in accordance with Seller's published specifications. Seller makes no representation or warranty, expressed or implied, that the operation of the software or firmware shall be uninterrupted or error-free, or that functions contained therein shall meet or satisfy the Buyer's intended use or requirements.

C. **Services:** Seller warrants that services, including engineering and custom application, whether provided on a fixed cost or time and material basis, shall be performed in accordance with generally accepted industry practices.

D. **Remedies:** Seller's liability under this section is restricted to replacing, repairing, or issuing credit (at Seller's option) for any returned goods and only under the following conditions: (1) Seller must be promptly notified, in writing, as soon as possible after the defects have been noted by the Buyer, but not later than (1) year from date of invoice from Seller; (2) The defective goods are to be returned to the place of manufacture, shipping charges prepaid by the Buyer; (3) Seller's inspection shall disclose to its satisfaction that the goods were defective in materials or workmanship at the time of shipment; (4) Any warranty service (consisting of time, travel and expenses related to such services) performed other than at Seller's factory, shall be at Buyer's expense.

E. **Repaired/Reconditioned Goods:** As to out-of-warranty goods which Seller has repaired or reconditioned, Seller warrants for a period of sixty (60) days from date of its invoice only new components replaced in the most recent repair/reconditioning.

F. **Returns and Adjustments:** No goods may be returned unless authorized in advance by Seller and then only upon such conditions to which Seller may agree. Buyer must obtain an RMA (Return Material Authorization) number from Seller prior to any return shipment and such RMA number must appear on the shipping label and packing slip. Buyer shall be responsible for the returned goods until such time as Seller receives the same at its plant and for all charges for packing, inspection, shipping, transportation, or insurance associated with returned goods. In the event that credit for returned goods is granted, it shall be at the lesser of the then current prices or the original purchase price. Claims for shortage or incorrect material must be made within five (5) days after receipt of shipment.

**ALL OTHER WARRANTIES, FOR ANY OF SELLER'S GOODS OR SERVICES, WHETHER ORAL, WRITTEN, EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE ARE EXCLUDED.**

**INTELLECTUAL PROPERTY:** Seller's sale of goods or provision of related documentation or other materials to Buyer shall not transfer any intellectual property rights to Buyer unless Seller specifically agrees to do so in writing. Seller shall retain ownership of all applicable patents, trademarks, copyrights and other intellectual property rights. Buyer shall not use, copy or transfer any such items in violation of Seller's intellectual property rights or applicable law, or for any purposes other than that for which the items were furnished.

Seller shall defend any lawsuit brought against the Buyer based on a claim that the design or construction of the goods sold hereunder by Seller infringe any United States or Canadian Patent, Copyright or Mask Work Registration, provided that Buyer promptly notifies Seller of such claim in writing and further provided that, at Seller's expense, (1) Buyer gives Seller the sole right to defend or control the defense of the suit or proceeding, including settlement, and (2) Buyer provides all necessary information and assistance for that defense. In the event of a charge of infringement, Seller's obligation under the agreement shall be fulfilled if Seller, at its option and expense, either (i) settles such claim; (ii) procures for Buyer the right to continue using such goods; (iii) replaces or modifies goods to avoid infringement; or (iv) accepts the return of any infringing goods and refunds their purchase price; or (v) defends against such claim.

If Buyer furnishes specifications or designs to Seller, the obligations of Seller set forth above shall not apply to goods made by Seller using such specifications or designs, and Buyer shall defend, indemnify and hold Seller harmless against any third party claims for infringement which arise out of Seller's use of specifications or designs furnished by Buyer.

**SOFTWARE LICENSE:** If goods purchased hereunder include software ("Software"), Buyer may use the Software only as part of the goods. Buyer may not use, copy, or transfer any of the Software except as may be permitted under the applicable License Agreement provided with the goods. Buyer's right to use, copy or transfer the Software shall terminate upon termination of Buyer's right to use the goods.

**PACKAGING/WEIGHTS AND DIMENSIONS:** Buyer specified packing or marking may be subject to additional charges not otherwise included in the price of the goods. Published weights and dimensions are estimates or approximate only and are not warranted.

**FORCE MAJEURE:** Seller shall not be responsible for delays in delivery or any failure to deliver due to causes beyond Seller's control, including but not limited to the following items: acts of God, war, terrorism, mobilization, civil commotion, riots, embargoes, domestic or foreign governmental regulations or orders, governmental priorities, port congestion, acts of the Buyer, its agents or employees, fires, floods, strikes, lockouts and other labor difficulties, shortages of or inability to obtain shipping space or transportation, inability to secure fuel, supplies or power at current prices or on account of shortages thereof, or due to limitations imposed by the extent of availability of Seller's normal manufacturing facilities.

If a delay excused per the above extends for more than ninety (90) days and the parties have not agreed upon a revised basis for continuing providing the goods or services at the end of the delay, including adjustment of the price, then Buyer, upon thirty (30) days' prior written notice to Seller may terminate the Order with respect to the unexecuted portion of the goods or services, whereupon Buyer shall promptly pay Seller its reasonable termination charges upon submission of Seller's invoices thereof.

**LIMITATION OF LIABILITY:** Seller's liability for any claim of any kind, except infringement of intellectual property rights, shall not exceed the purchase price of any goods or services which give rise to the claim. **SELLER SHALL IN NO EVENT BE LIABLE FOR BUYER'S MANUFACTURING COSTS, LOST PROFITS, LOSS OF USE OF THE GOODS OR SERVICES, COST OF CAPITAL, COST OF SUBSTITUTE GOODS, FACILITIES, SERVICES OR REPLACEMENT POWER, DOWNTIME COSTS, CLAIMS OF BUYER'S CUSTOMERS FOR DAMAGES, OR OTHER SPECIAL, PROXIMATE, INCIDENTAL, INDIRECT, EXEMPLARY OR CONSEQUENTIAL DAMAGES.** Any action against Seller must be brought within eighteen (18) months after the cause of action accrues. These disclaimers and limitations of liability shall apply regardless of the form of action, whether in contract, tort or otherwise, and further shall extend to the benefit of Seller's vendors, appointed distributors and other authorized resellers as third-party beneficiaries.

**PROHIBITION FOR HAZARDOUS USE:** Goods sold hereunder generally are not intended for application in and shall not be used by Buyer in the construction or operation of a nuclear installation or in connection with the use or handling of nuclear material, or for any hazardous activity or critical application, where failure of a single component could cause substantial harm to persons or property, unless the goods have been specifically approved for such a use or application. Seller disclaims all liability for any loss or damage resulting from such unauthorized use and Buyer shall defend, indemnify and hold harmless the Seller against any such liability, whether as a result of breach of contract, warranty, tort (regardless of the degree of fault or negligence), strict liability or otherwise.

**EXPORT CONTROL:** Buyer shall comply with all export control laws and regulations of the United States, and all sales hereunder are subject to those laws and regulations. Seller shall not be named as shipper or exporter of record for any goods sold hereunder unless specifically agreed to in writing by Seller. At Seller's request, Buyer shall furnish Seller with end-user and end-user information to determine export license applicability. Buyer warrants, in accordance with U.S. Export Law, that goods sold hereunder shall not be destined for facilities or activities involving nuclear, chemical or biological weapons, or related missile delivery systems in named prohibited regions or countries.

**GOVERNING LAW:** Seller intends to comply with all laws applicable to its performance under any order. All matters relating to interpretation and effect of these terms and any authorized changes, modifications or amendments thereto shall be governed by the laws of the Commonwealth of Pennsylvania. No government contract regulations or clauses shall apply to the goods or services, this agreement, or act to bind Seller unless specifically agreed to by Seller in writing.

**NON-WAIVER BY SELLER:** Waiver by Seller of a breach of any of these terms and conditions shall not be construed as a waiver of any other breach.

**SEVERABILITY AND ENTIRE AGREEMENT:** If any provision of these terms and conditions is unenforceable, the remaining terms shall nonetheless continue in full force and effect. This writing, together with any other terms and conditions Seller specifically agrees to in writing, constitutes the entire terms and conditions of sale between Buyer and Seller and supercedes any and all prior discussions, and negotiations on its subject matter.



**AMETEK<sup>®</sup>**  
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