DREXELBROOK®

A Leader in Level Measurement

Installation and Operating Instructions

For the

Universal V™ CM Model with Temperature Compensation

2-Wire, 4-20 mA, Water Cut Monitor
with HART® Protocol

For Assistance Call 215-674-1234

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LEVEL MEASUREMENT SOLUTIONS

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Universal V™ CM Model

with Temperature Compensation

2-Wire, 4-20 mA
Water Cut Monitor
with HART® Protocol

DREXELBROOK®
An ISO 9001 Certified Company

AMETEK®
LEVEL MEASUREMENT SOLUTIONS

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Section 1: Introduction

1.1 System Description

The instructions in this manual are for the AMETEK Drexelbrook Universal V CM Water Cut Monitor with Temperature Compensation for measurement of the percentage of water in oil. Each AMETEK Drexelbrook Universal V CM with Temperature Compensation system consists of a two-wire, 4-20 mA electronic unit and a 700 series sensing element. Communication with the device is done by either an onboard keypad or with a laptop via HART® protocol and AMETEK Drexelbrook HRTWin Software.

AMETEK Drexelbrook has been measuring water cut with capacitive technology for over 40 years. Using capacitance to measure water cut is widely successful because of the large difference between the dielectric constants of oil ($k \approx 2.3$) and water ($k \approx 80$). The sensing element and the pipe wall form the necessary two plates of the concentric capacitor. The system electronics transmit a radio frequency voltage to the sensing element that measures changes in capacitance. As the amount of water in the flowing oil increases, the net dielectric of the fluid increases causing the capacitance to increase. The electronics then computes the relationship between capacitance change and water cut.

It is termed a two-wire transmitter because the same two wires that are used to power the unit also indicate the change in Cut (4-20 mA).

1.2 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.

1 .3 Model Numbering

Technology
- **V** Universal V

Measurement Type / Frequency and Phasing
- **T0** Water Cut Monitor with Temperature Compensation Electronics

Digital Protocols
- **1** HART®

Future Use
- **0** Future Use

Approvals
- **0** Unapproved
- **1** FM/FMc IS
- **2** FM/FMc XP
- **3** ATEX ia
- **4** ATEX d
- **5** IECEx ia
- **6** IECEx d

Electrical Connection
- **0** 3/4" NPT without external ground lug
- **1** M20 with external ground equipotential bonding
- **2** 3/4" with external groundequipotential bonding

Surge / Noise Suppression
- **0** No additional filtering required
- **1** Signal RFI (Integral)

Integral / Remote options
- **0** Integral configuration

Dual seal option
- **0** Without Dual Seal option

Sensing Element Code
- **201** 700-1202-401 Perma-Seal™, Pipe < 8" 200 psi @ 450ºF
- **202** 700-1202-402 Perma-Seal™, Pipe < 8" 1000 psi @ 250ºF
- **203** 700-1202-411 Perma-Seal™, In Tank Perforated Concentric 200 psi @ 450°F
- **204** 700-1202-412 Perma-Seal™, In Tank Perforated Concentric 1000 psi @ 250°F
- **205** 700-1202-421 Perma-Seal™, Pipe 8" and > 200 psi @ 450ºF
- **206** 700-1202-422 Perma-Seal™, Pipe 8" and > 1000 psi @ 250°F

Cut Monitor Software
- **0** None
- **A** Light Oil -- 0 - 1%
- **B** Light Oil -- 0 - 5%
- **C** Light Oil -- 0 - 10%
- **D** Light Oil -- 0 - 30%
- **F** Heavy Oil -- 0 - 1%
- **G** Heavy Oil -- 0 - 5%
- **H** Heavy Oil -- 0 - 10%
- **I** Heavy Oil -- 0 - 30%

1 .3 Model Numbering (Continued)

Process gland wetted part (X)

B 316/316L SS

Process connection (XX)

A0	3/4" NPT	
FA	2" 150# RF	Carbon Steel
FB	2" 150# RF	316/316L Stainless Steel
GA	2" 300# RF	Carbon Steel
GB	2" 300# RF	316/316L Stainless Steel
IA	3" 150# RF	Carbon Steel
IB	3" 150# RF	316/316L Stainless Steel
JA	3" 300# RF	Carbon Steel
JB	3" 300# RF	316/316L Stainless Steel
KA	4" 150# RF	Carbon Steel
KB	4" 150# RF	316/316L Stainless Steel
LA	4" 300# RF	Carbon Steel
LB	4" 300# RF	316/316L Stainless Steel
XX*	Many more options available upon request (ASME/ANSI, DIN)	

Insertion Length in MM

XXXXXX Length of the probe in millimeters from process connection to the bottom of the probe. Ranges from 13.875" to 39.275" (352.425mm to 997.585mm) I.L. depending on pipe size and sensing element - Refer to pipe size look up table

Cote-Shield™ Length in MM

XXXXXX Length of the Cote-Shield in millimeters. Typical 3.5", 6" or 10" (88.9mm, 152.4mm, 254 mm) depending on pipe size and sensing element- Refer to pipe size look up table

Inactive Length in MM

XXXXXX Length of the inactive part of the probe that is not measured. This option does not apply to Cut Monitors

Inactive Material

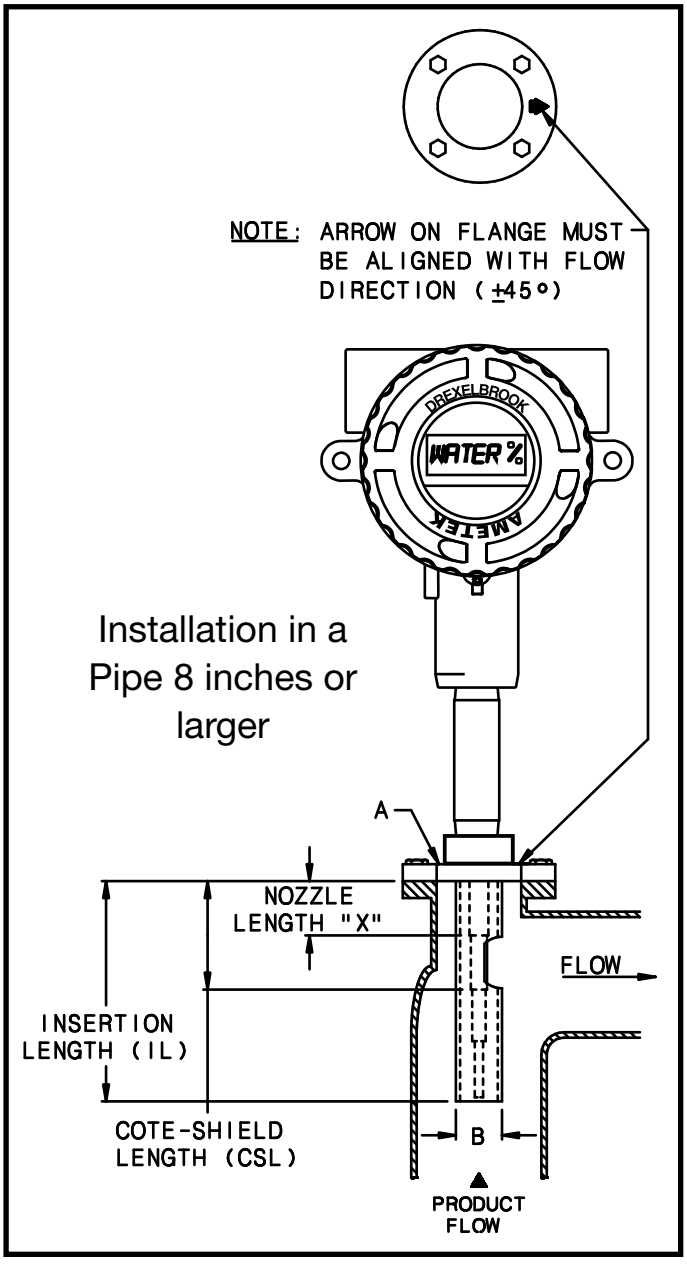
N Not Applicable to Cut Monitors

Section 2: Installation

2.1 Installation Guide

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

- 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 center line and in the correct size pipe.
- Vertical mounting, with the tip down, is preferred, but not essential.
- 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) decrease the accuracy of the measurement.
- Do not take the sensing element apart or loosen the packing glands.
- 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.
- For large pipes with no bends (18 inch and larger), consult the factory.



2.2 Installation Considerations

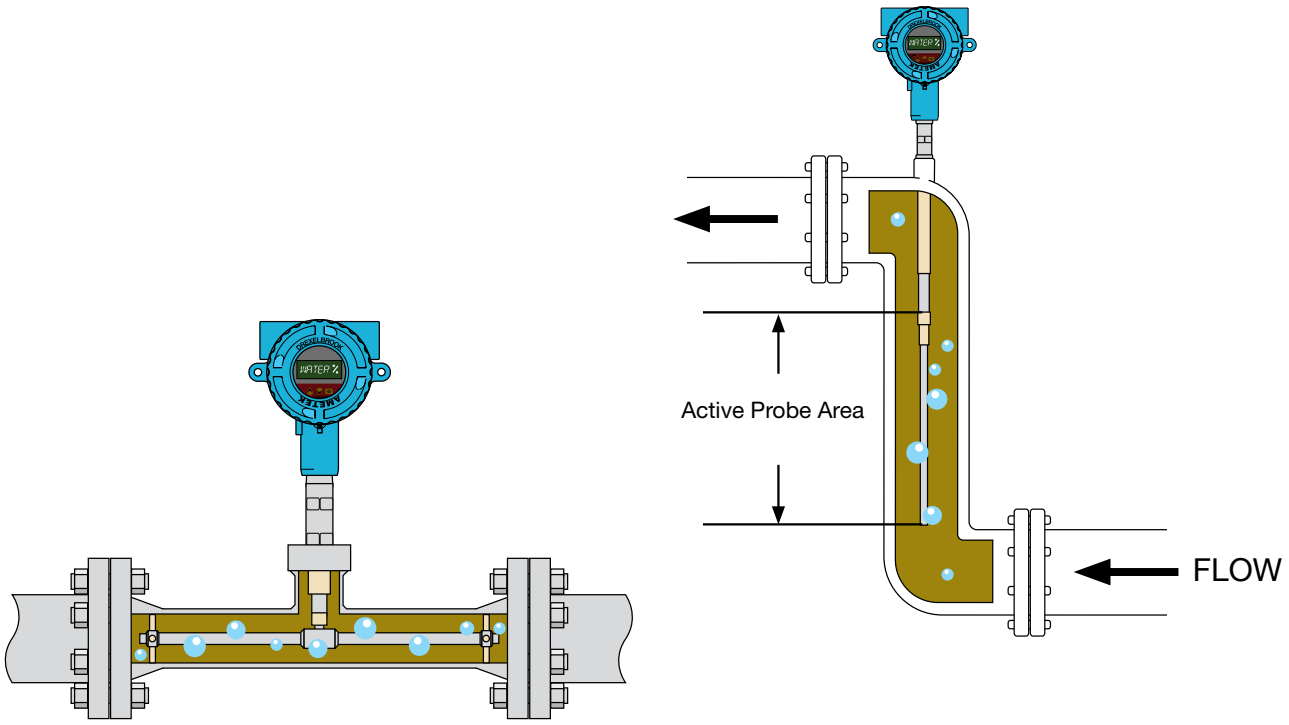
The sensing element must be mounted at an existing or created, 90 degree bend in the pipe. It can be installed through a tee or a weld-o-let to a 90 degree elbow. The vertically downward mounting attitude is preferred for ease of inspection or cleaning, since draining of the pipe is not required. Regardless, the probe will function in any attitude, as long as the pipe is completely full in the active probe area. **See the figure below** for ideal installation orientation.

The probe is active from its tip to the end of the Cote-Shield element. In the area of the Cote-Shield, it is completely inactive.

In all cases, the presence of gas bubbles, whether from air, petroleum vapor, steam, or natural gas, will reduce accuracy, producing lower readings. One of the most common causes of gas bubbles is abrupt pressure drops in high temperature streams, which can allow water and light ends to flash.

An in-line mixer just upstream of the Cut Monitor is highly recommended for streams which go above 10% water cut. Accuracy is based on uniform, oil-continuous emulsion, so any unplanned separation will cause errors.

All instruments are factory calibrated. If calibration trimming is required, it may be done through the Keypad or with AMETEK Drexelbrook PC software. The proprietary software allows temperature calibration trimming with one reading and sample. The Real-time View window is useful for observing transmitter function and troubleshooting.



Suggested Installation

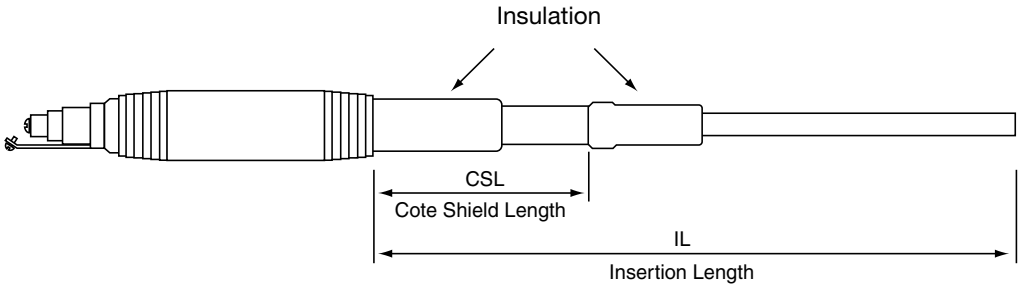
2.3 Sensing Element Insertion and Active Lengths

The Cut Monitor sensing element varies with pipe size. The larger the pipe diameter size, the longer the sensing element active length must be. The Cote-Shield length is sized so the Cote-Shield is fully extended into the fluid beyond nozzles and elbows. Below are some standard sensor dimensions.

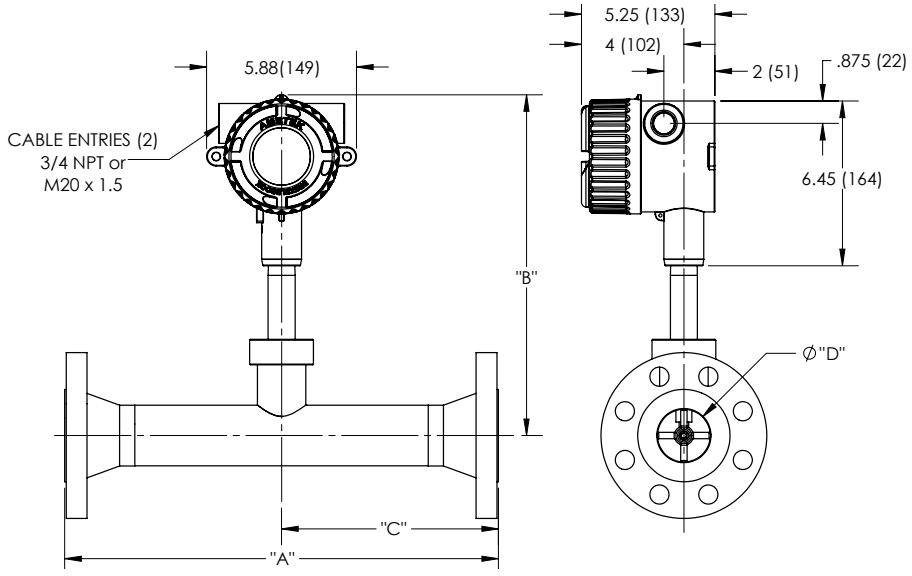
700-1202-4XX Series Sensing Elements		
Pipe Size	**Cote-Shield Length**	**Insertion Length**
2"	6"	23.75"
2"	10"	27.75"
3"	6"	28"
3"	10"	32"
4"	6"	31.125"
4"	10"	35.125"

Pipe Size	Cote-Shield Length	Insertion Length
6"	6"	35.375"
6"	10"	39.375"
8" and >	10"	25.5"
In Tank	3.5"	19"
In Tank	6"	21.5"
In Tank	10"	25.5"

Sensing Element Dimensions



Size	Dimension "A"	Dimension "B"	Dimension "C"	Dimension "D"	Flange
2 inch	17.0" (432)	13.4" (340)	8.5" (216)	2.125" (54)	150#/300#
3 inch	32.0" (813)	13.9" (353)	19.0" (429)	3.125" (79)	150#/300#
4 inch	32.0" (813)	14.3" (363)	21.8" (554)	4.625"(117)	150#/300#



2.4 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 and 167 °F (-40 and 75 °C).

NOTICE

When installing the 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"**

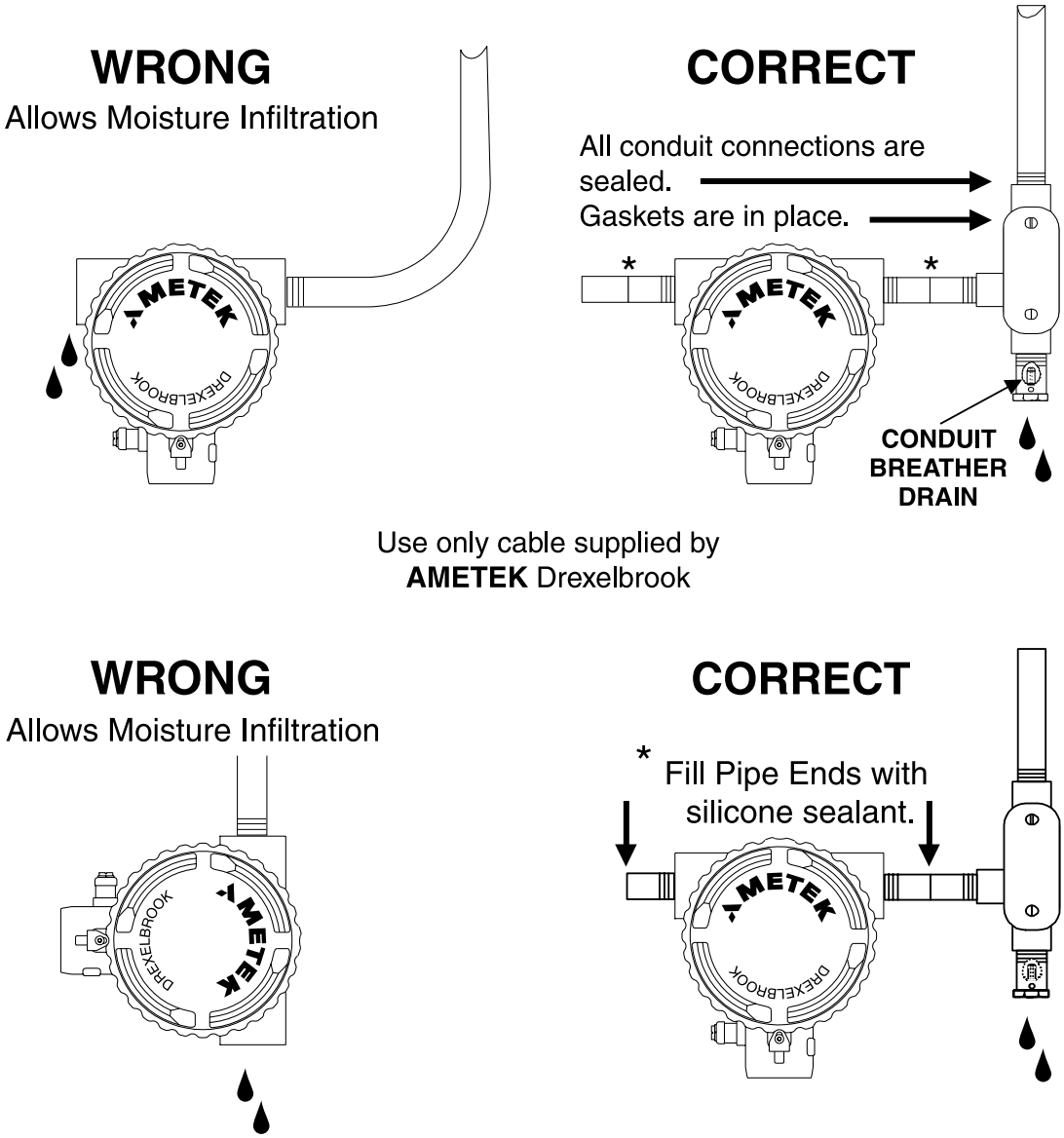
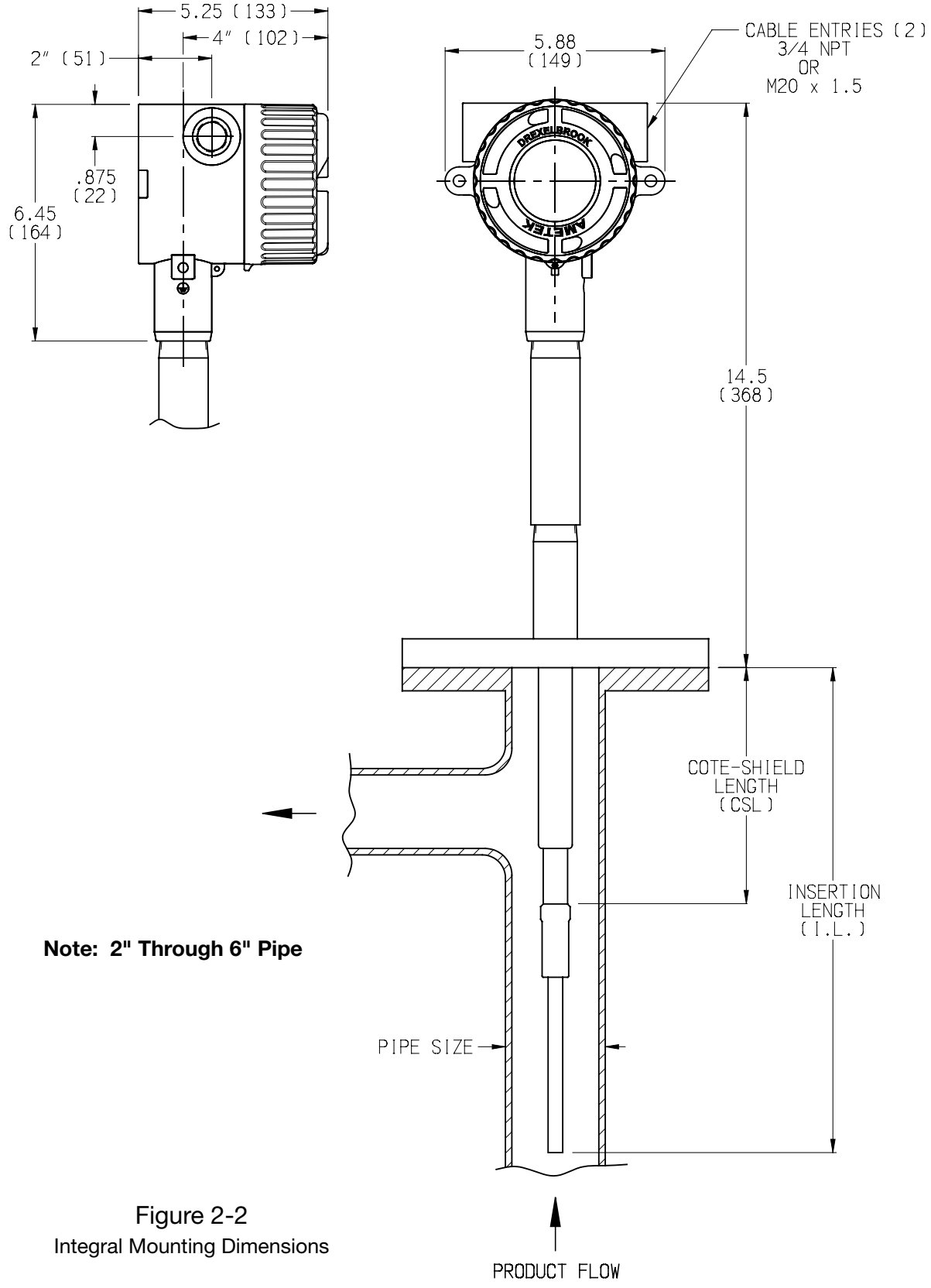


Figure 2-1
Recommended Conduit Installation

2.4 Mounting the Electronic Unit (Continued)

Integral System Mounting



Note: 2" Through 6" Pipe

Figure 2-2
Integral Mounting Dimensions

2.5 Wiring the Electronic Unit

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). Shielded twisted pair cables are recommended.

Integral units are pre-wired to the sensing element at the factory. **"Figure 2-4"** shows the wiring of the integral unit.

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

The Universal V CM with Temperature Compensation has a built-in current limiter which holds the signal current to a maximum of 28 mA.

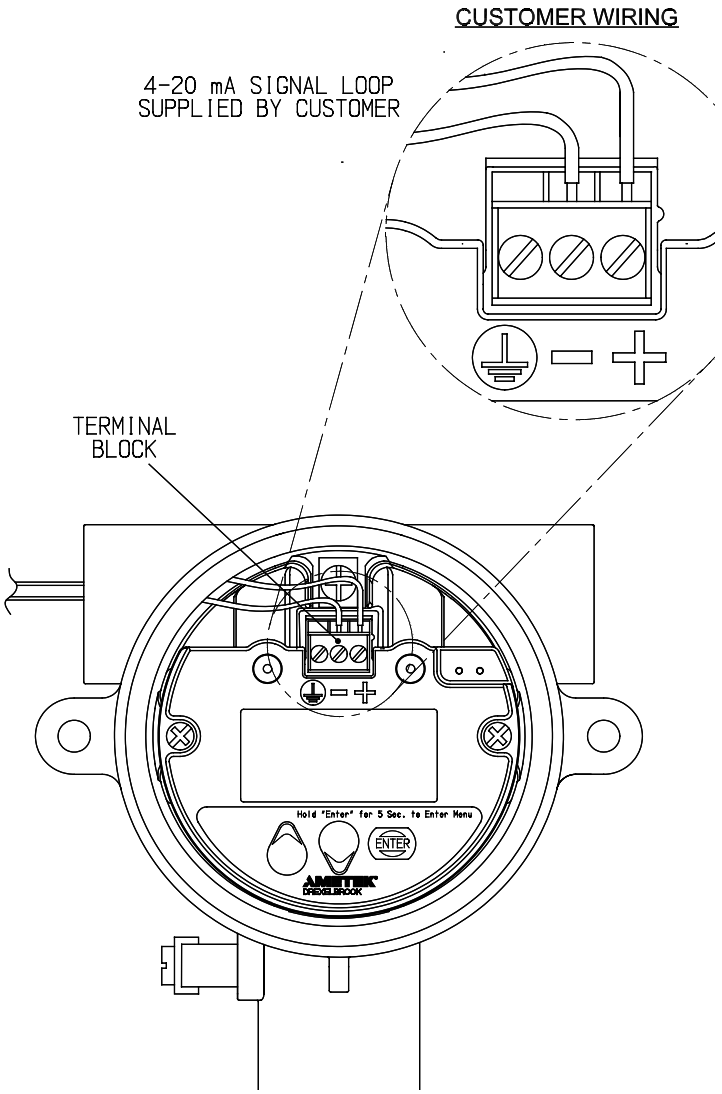


Figure 2-3
Universal V CM with Temperature Compensation
Wiring Connections

2.6 Wiring the Sensing Element

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

Integral System Sensing Element Wiring

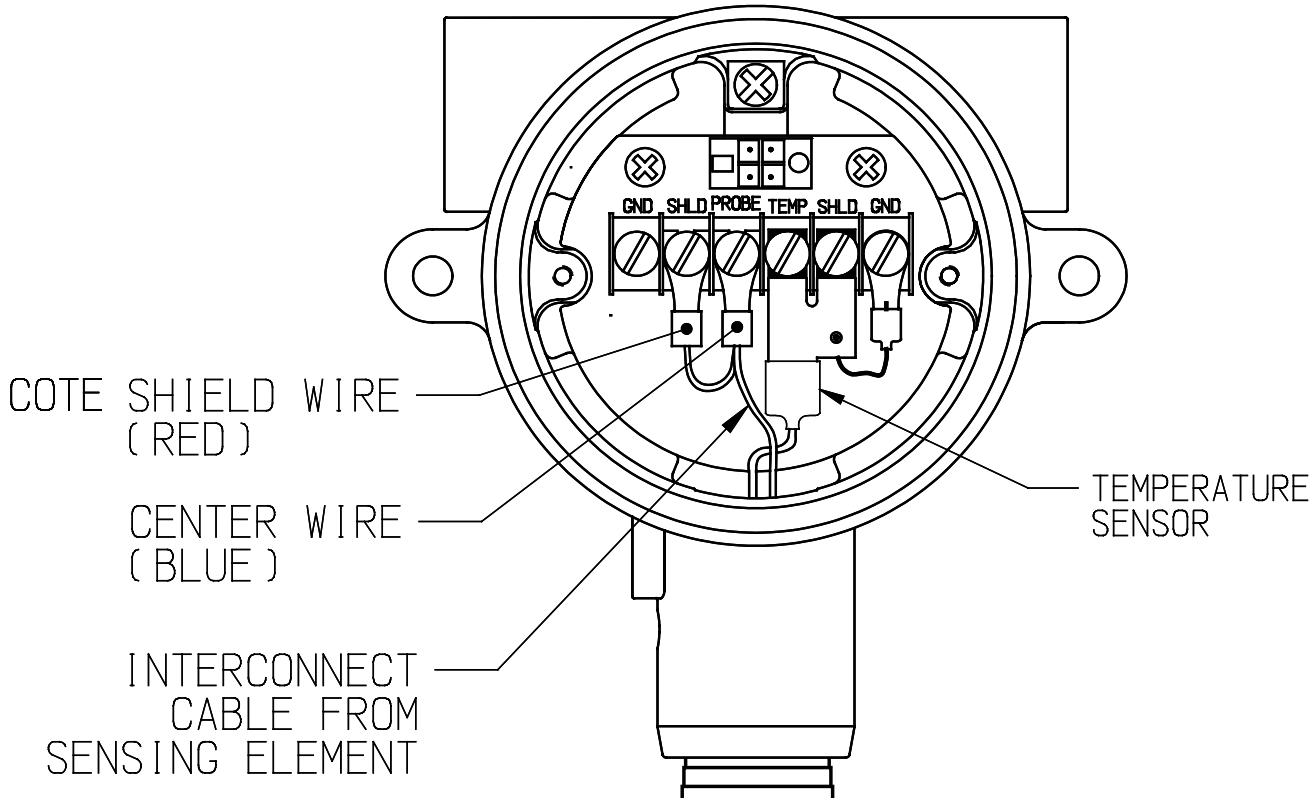


Figure 2-4
Universal V CM with Temperature Compensation
Wiring Connections Integral Mounting

2.7 Surge Voltage (Lightning) Protection

Optional surge protection can be 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 401-0016-028 Signal Filter Assembly affords additional protection to the transmitter but is not absolute in its protection against a very close lightning strike. Refer to **"Figure 2-5"** to properly connect the Signal Filter Assembly. You must insure the transmitter housing is well connected to an earth ground.

2.8 RFI (Radio Frequency Interference) Filters

When installing the Universal V 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 two-way radios may pass.
- Use Shielded Twisted Pair wiring for all loop wiring. Loop wiring should also be in grounded metallic conduit.
- 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 two-way radios 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 2-5"**.

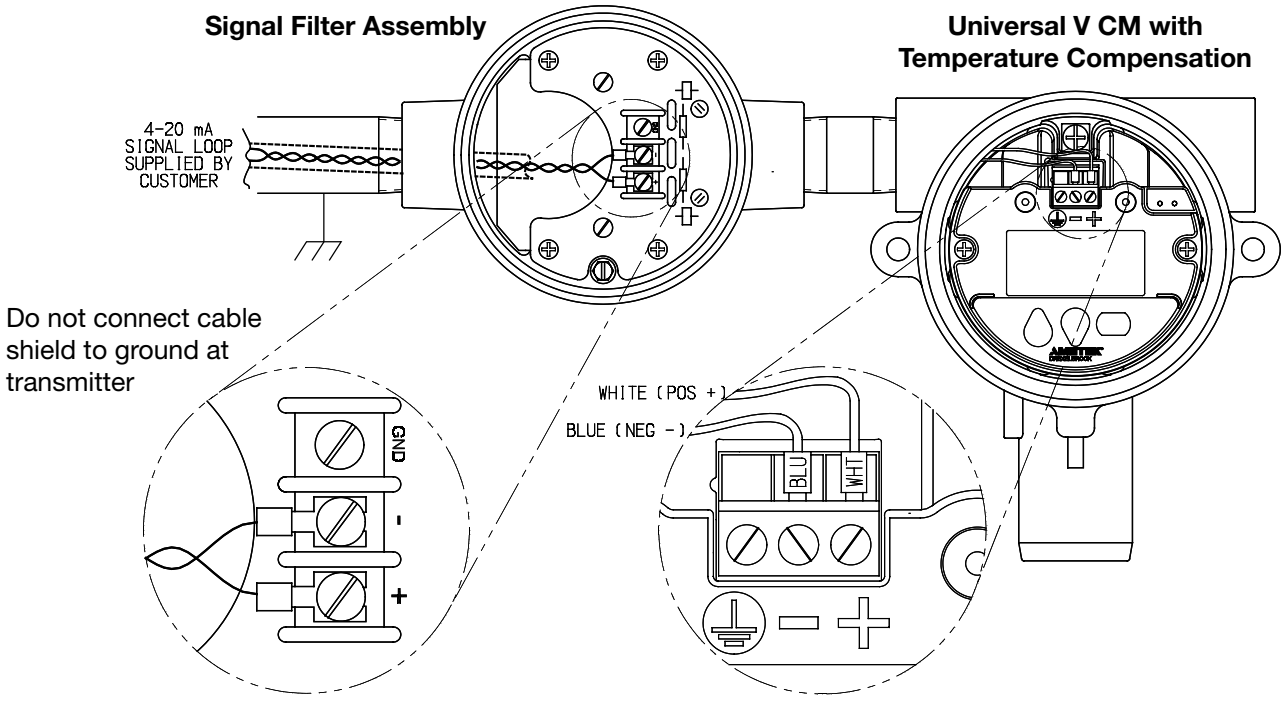


Figure 2-5
Signal Radio Frequency Interference (RFI) Filters / Surge Protection
Part # 401-0016-028

Section 3: Configuration & Calibration with HRTWin Software

This section instructs the user how to use the AMETEK Drexelbrook PC Calibrator Software to configure and calibrate the Universal V CM with Temperature Compensation (RF Admittance) Transmitter.

3.1 Installing The USB Modem

HART® Modems are available from third party vendors.
Refer to directions supplied by modem manufacturer.

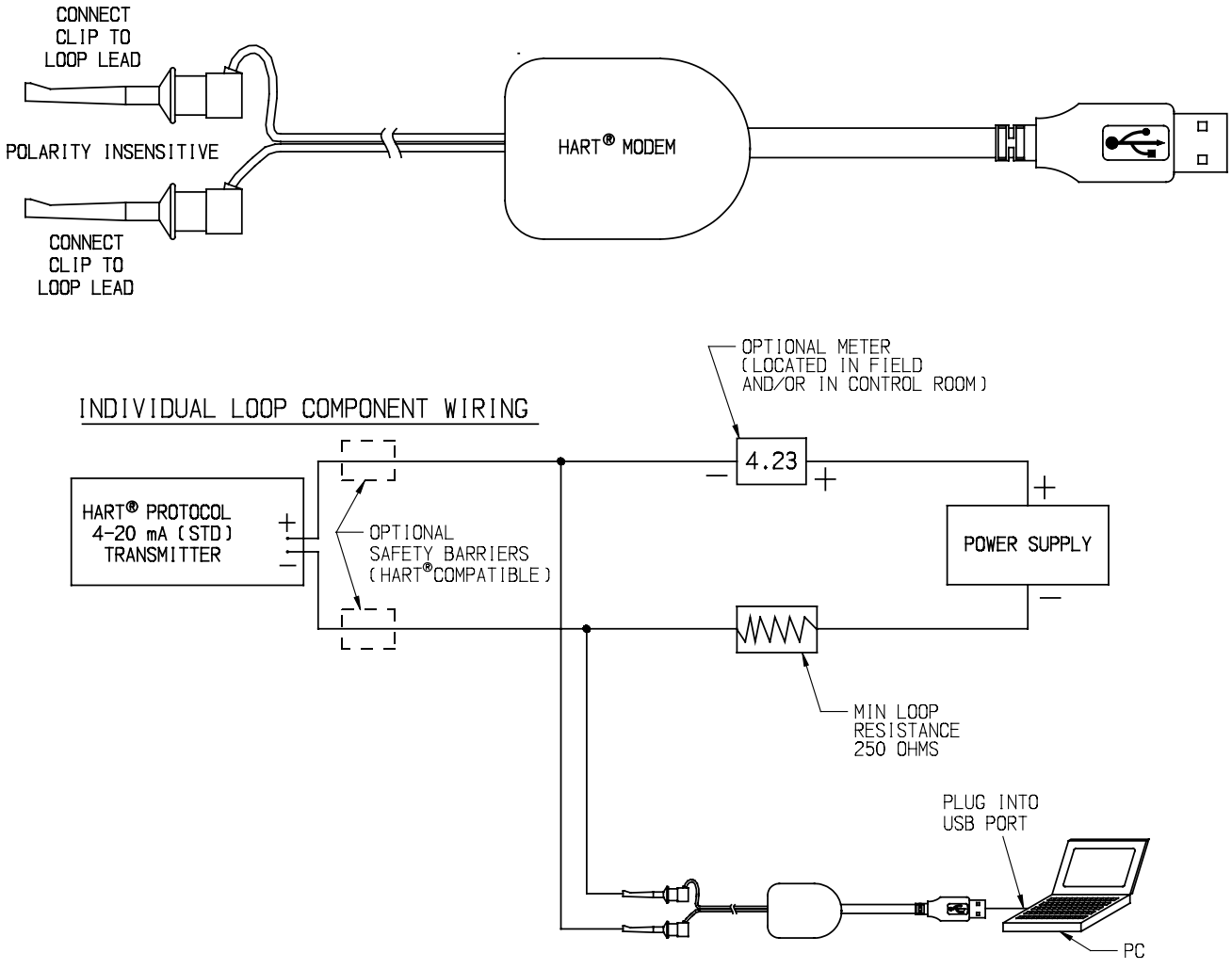


Figure 3-1
USB Modem Assembly & Loop Connection
Part # 401-0700-062 - Modem Only
Part # 401-0700-063 - Modem & HRTWin Software

3.2 Install the Windows Version HRTWin™ Software

Installation is quite simple.

A. Download the software from www.drexelbrook.com - Services and Support - Software Downloads. HRTWin version 9.3 or higher is required

B. If program does not "Auto-Run", select the location where the file was saved and run the set-up program manually.

C. Follow "On-Screen" instructions in Setup to create program file.

3.2.1 Configuration using HARTWin

A. Once loaded, double click "HRTWin" icon and the program will run under its own window.

B. Select communication port [Com 1, Com 2, etc.] and then click “OK.” **"Figure 3-2"**.

C. 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.

D. 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:

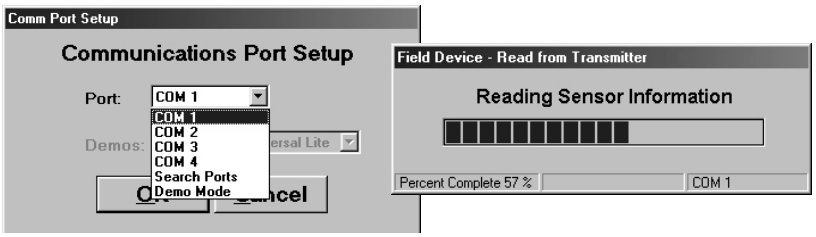


Figure 3-2
Selecting COM ports during software installation

3.2.1 Configuration using HARTWin (Continued)

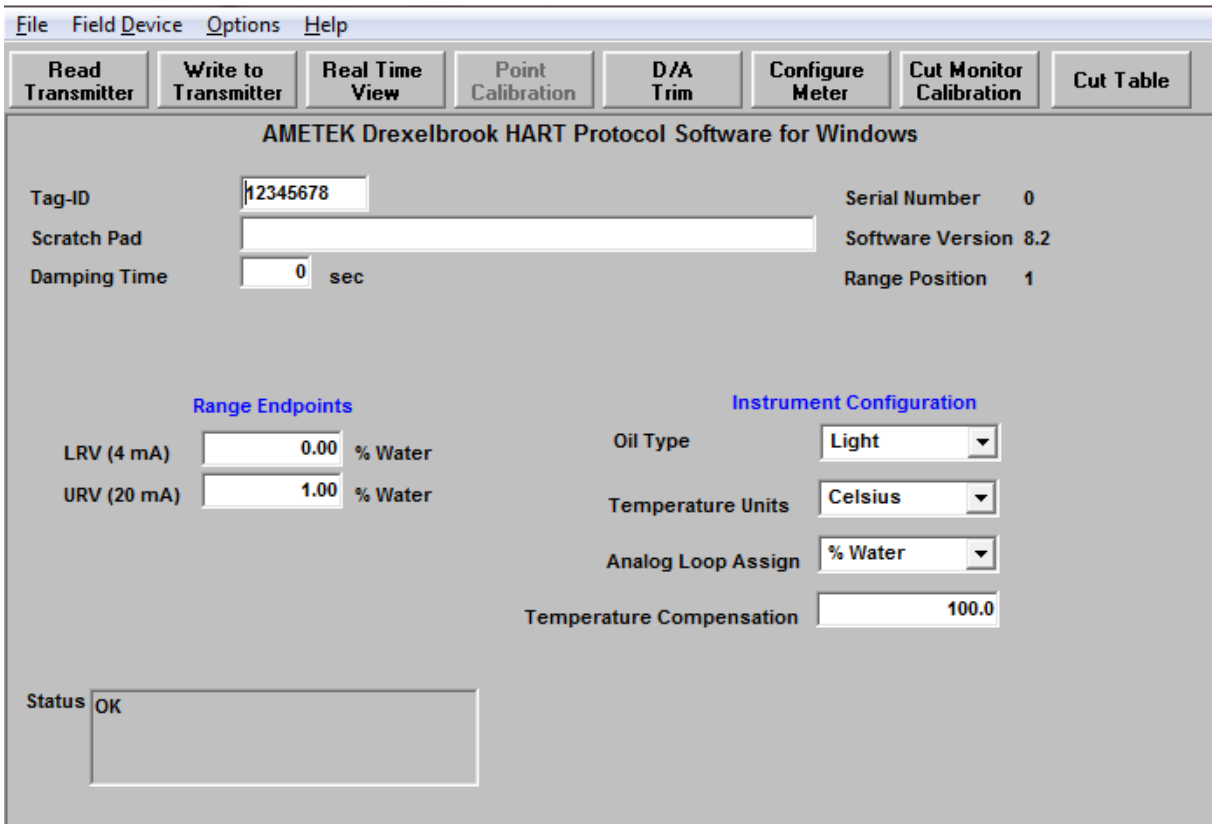


Figure 3-3
PC Software Menu Screen automatically communicates all "name plate data" from transmitter

3.3 Description of Function Keys

The following paragraphs describe the function buttons. The data fields are described in **Section "3.4 Configuration"**.

Read Transmitter [F3 on keyboard]
Reads data from the transmitter and displays it on the screen. The Read function also updates the real time window. It takes several seconds to load the information from the transmitter. When the load is complete, the screen shows the database parameters. This command is also used when connecting to another transmitter.

Real Time View [F4 on keyboard]
Displays the real time values of temperature, water cut, capacitance, loop current, % range, and status.

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.

D/A Trim
Allows a field reference meter to be connected to the transmitter for adjusting transmitter output current. **See "3.6 Set D/A Trim"**.

Cut Table
Displays the values of the input (pF) vs. output (% water) in a table of 11-points.

Configure Meter
Configures the Integrated Display (440-44-3) used for local indication.

Cut Monitor Calibration
Used to adjust calibration to specific oil and temperature that the transmitter monitors. **See "3.5.1 Calibration Trim Using HRTWin Software"**

Figure 3-4
HRTWin Tool Bar

3.4 Configuration

Configuration involves defining the measurement parameters and downloading this information to the HART protocol transmitter.

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

C. Verify range endpoints are correct. If URV must be changed to >30% water please consult factory.

D. Verify oil type is correct. Light Oil is selected for API Gravity ≥ 25 and Heavy Oil is selected for API Gravity < 25.

E. Select desired Temperature units, Celsius or Fahrenheit.

F. Analog Loop assignment - Allows the 4-20mA loop to reflect either % water cut or temperature. Changing this will automatically change LRV and URV. During normal operation this should be set to % water.

D. Click on Write to Transmitter.

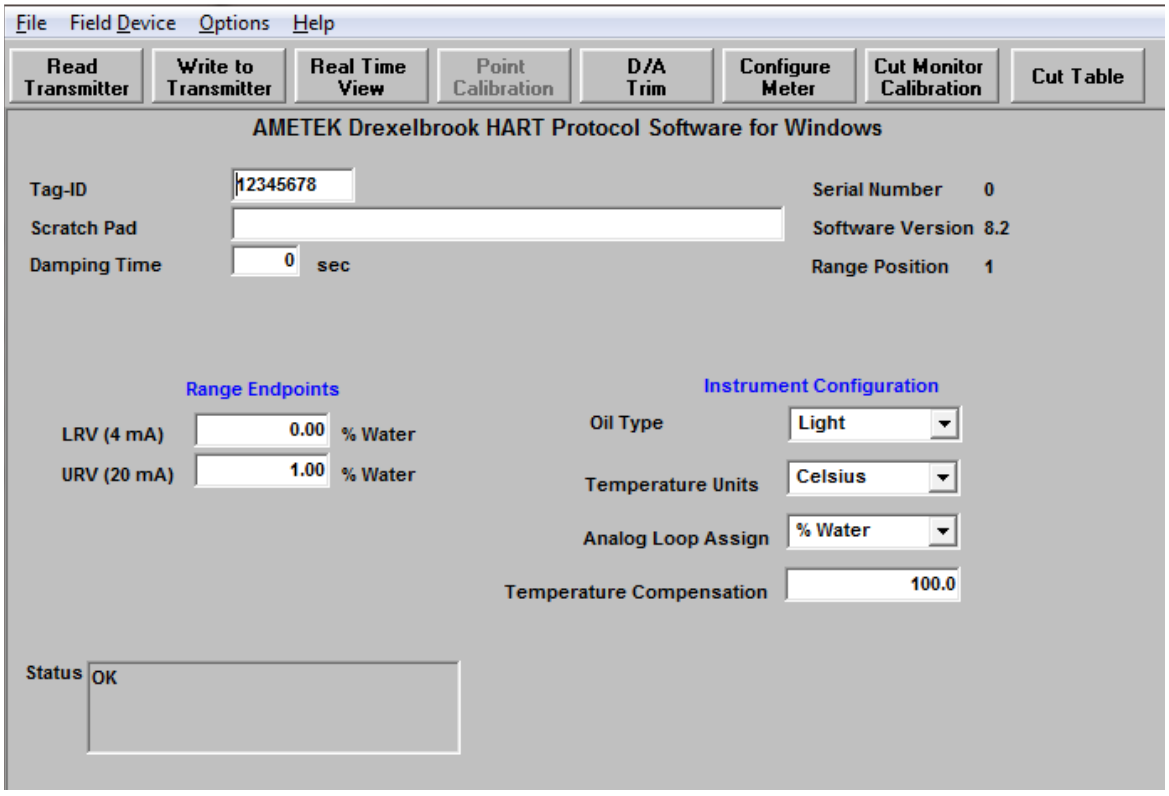


Figure 3-5
HRTWin Main Screen

3.5 Calibration

All Drexelbrook Universal V CM Water Cut Monitor instruments are calibrated at the factory according to:

- Size of pipe, and
- Density of oil

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 (Schedule. 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.

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. Consult the factory at 1-215-674-1234.

To perform an accurate calibration, you must confirm no gas is present and make a measurement of the water content using suitable methods.

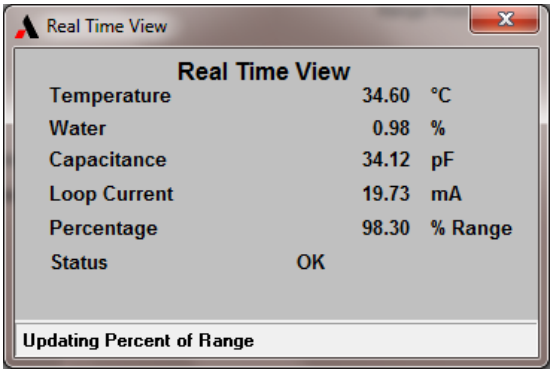


Figure 3-6
RTV Window

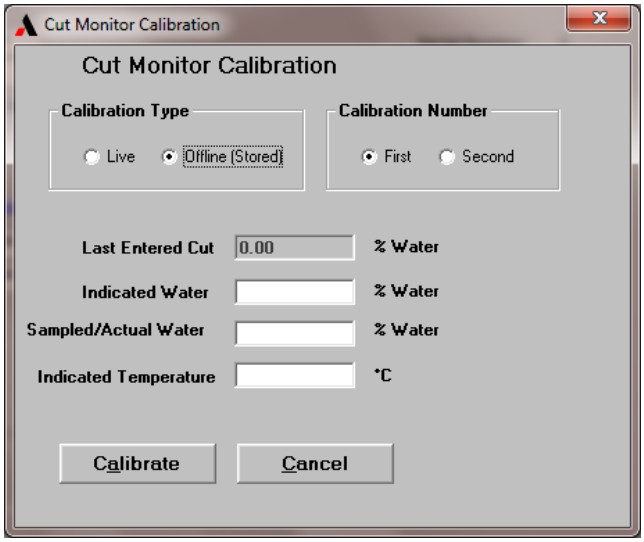


Figure 3-7
Calibration Window

ATTENTION: Equipment accuracy and calibration is dependant on the quality of the sample.

3.5.1 Calibration Trim Using HRTWin Software

A. Two calibration methods are available.
   a. Live Calibration is used when the calibration can be completed before the water cut or temperature reading can change.
   b. "Offline" (Stored) Calibration is used when these values may change between taking the sample and entering the water cut value measured.

B. Calibration Number:
   a. First is used for an initial sample and adjusts the value based solely on the water content.
   b. Second is performed at a different temperature and will automatically adjust the Temperature Compensation Value. The minimum temperature change for the second calibration is 10 °C (18 °F).

C. Temperature Compensation Value: Determines the amount of adjustment made to the water cut due to temperature. Minimum value of 0 provides no compensation. Higher values to a maximum of 10,000 increases compensation. This value can be manually edited in the main HRTWin screen.

D. If the measured sample differs from the original value by more than 2.5% water, another iteration may be required. If possible monitor the performance with the new calibration for a few days before performing a second calibration.

E. Calibration Procedures:
   a. Live Calibration Method
      i. Take a sample of the fluid as close to the probe as possible.
      ii. After determining the actual water percentage enter this value in the sample enter this value in the Sample/Actual Water box.
      iii. Note: Last Entered Cut is a **read only** value from a previous calibration if applicable.
      iv. Click on Calibrate.

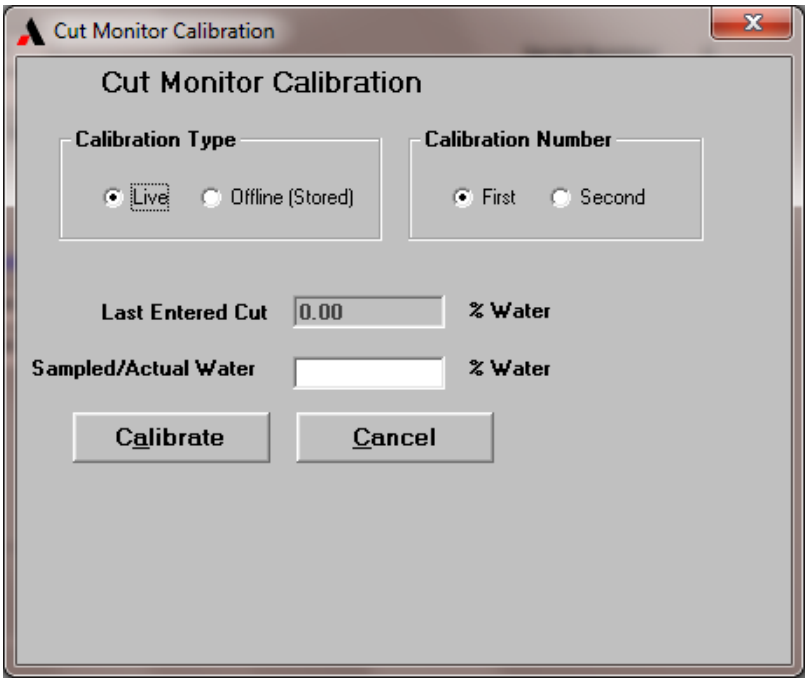


Figure 3-8
Live Calibration

3.5.1 Calibration Trim Using HRTWin Software (Continued)

b. Stored Calibration Method
   i. Open the "Real Time View" screen.
   ii. Allow oil to flow for several minutes and reading to stabilize prior to calibration to insure a representative sample. Take a sample of the fluid as close to the probe as possible.
   iii. As the sample is being taken record the Water Cut value and temperature from the Real Time View.
   iv. Close the "Real Time View" screen and open the "Cut Monitor Calibration"
   v. Enter the Water Cut value recorded in the Indicated Water box and the temperature recorded in the Indicated Temperature box.
   vi. After determining the actual water percentage, enter this value in the Sample/Actual Water box.
   vii. Note: Last Entered Cut is a read only value from a previous calibration if applicable.
   viii. Click on Calibrate.

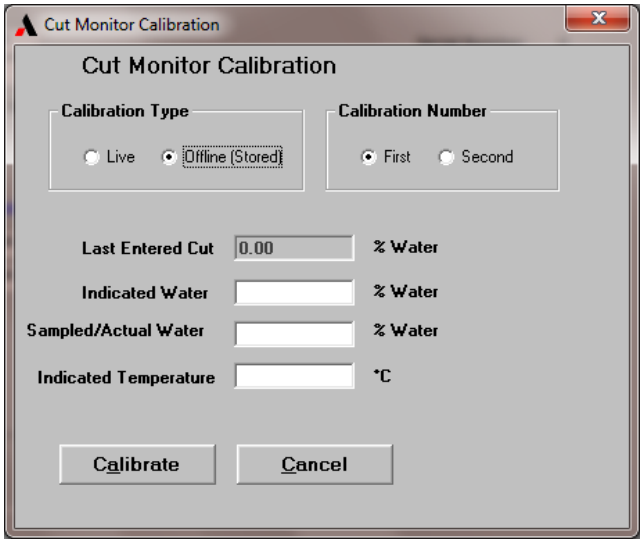


Figure 3-9
Standard Calibration

3.5.2 Temperature Compensation and Oil Type Settings

The Oil Type selection is set at the factory (based on data submitted with the order) to Light or Heavy Oil. The Oil Type selection sets the default parameters of the unit.

If a user performs a calibration to obtain more accurate readings, the Oil Type field will change to Custom to indicate the default settings have changed.

The Temperature Compensation is used to offset the effect of temperature on the dielectric of oil, in order to produce an accurate cut reading. The higher the value, the greater the compensation effect. Please consult the factory for suggested settings.

3.6 Set D/A Trim

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 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.

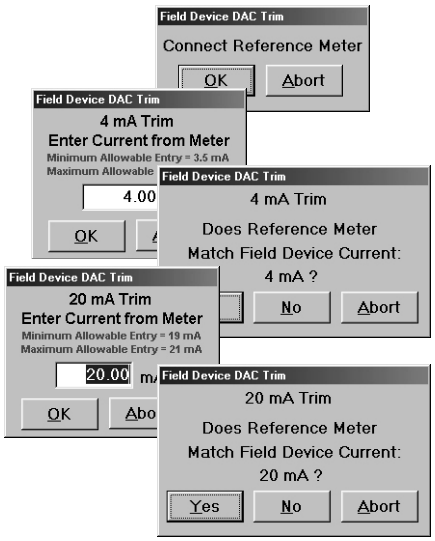


Figure 3-10
Setting D/A Trim Menu Screen Windows

3.7 Save/Print Entries

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, Instrument Calibration, all of the Real Time View numbers, and all of the Cut Table entries.

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

Copies are saved as both a Text (.txt) and a Universal V CM with Temperature Compensation file (.cmt) files.

The .cmt 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.

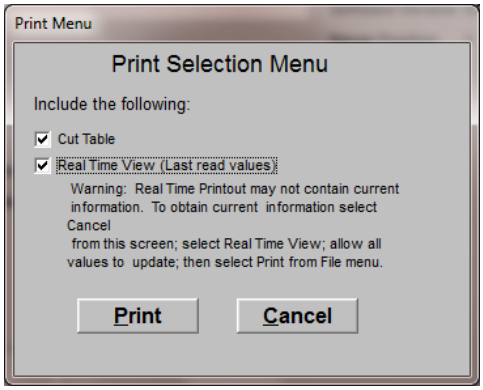
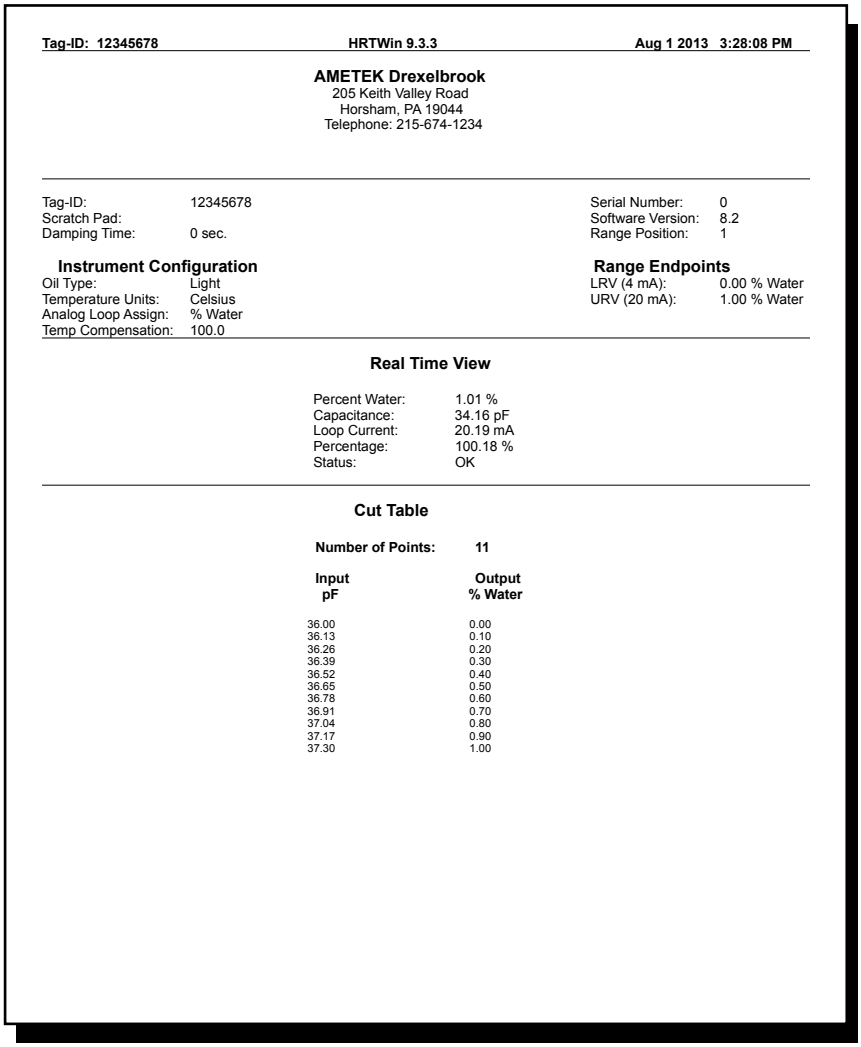


Figure 3-11
Print Pop-up from Menu



Tag-ID: 12345678 HRTWin 9.3.3 Aug 1 2013 3:28:08 PM

AMETEK Drexelbrook
205 Keith Valley Road
Horsham, PA 19044
Telephone: 215-674-1234

Tag-ID:	12345678	Serial Number:	0
Scratch Pad:		Software Version:	8.2
Damping Time:	0 sec.	Range Position:	1

Instrument Configuration

Oil Type:	Light
Temperature Units:	Celsius
Analog Loop Assign:	% Water
Temp Compensation:	100.0

Range Endpoints

LRV (4 mA):	0.00 % Water
URV (20 mA):	1.00 % Water

Real Time View

Percent Water:	1.01 %
Capacitance:	34.16 pF
Loop Current:	20.19 mA
Percentage:	100.18 %
Status:	OK

Cut Table

Number of Points: 11

Input pF	Output % Water
36.00	0.00
36.13	0.10
36.26	0.20
36.39	0.30
36.52	0.40
36.65	0.50
36.78	0.60
36.91	0.70
37.04	0.80
37.17	0.90
37.30	1.00

3.8 Calibration & Configuration via Display/Keypad

3.8.1 Navigation of the Display/Keypad

- To enter the Configuration Menu press and Hold the "Enter" Button for approximately 5 seconds.
- Use the "Up" and "Down" Buttons to scroll through the available menu selections.
    - Reference Flow Chart and Menu Function Table
- Press "Enter" to access sub-menu items.
- Use the "Up" and "Down" Buttons to adjust settings.
  Settings that can be adjusted will be "flashing".
- Press "Enter" to accept the adjustment...Or...
- Press and Hold the "Enter" Button for approximately 5 seconds to exit to the previous menu level.
- Continue to Hold the "Enter" Button to exit the menu and return to the main display.

3.8.2 Configuration

- Verify Oil Type, Fct. 1.01 is correct. If a previous calibration has been performed this will display “Custom”. Do not change from Custom.
- Verify Temperature units are correct, Fct. 1.02.
- Verify Lower Range Value is correct, Fct. 4.02
- Verify Upper Range Value is correct, Fct. 4.03

3.8.3 Calibration

- *Note: Calibration of the temperature compensation requires a second calibration at a minimum change in temperature of 10°C (18°F).*
- *Note: If the measured sample differs from the original value by more than 2.5% water, another iteration may be required.*
- *Note: Calibration must be performed when oil is flowing. Allow oil to flow for several minutes and reading to stabilize prior to calibration to insure a representative sample.*

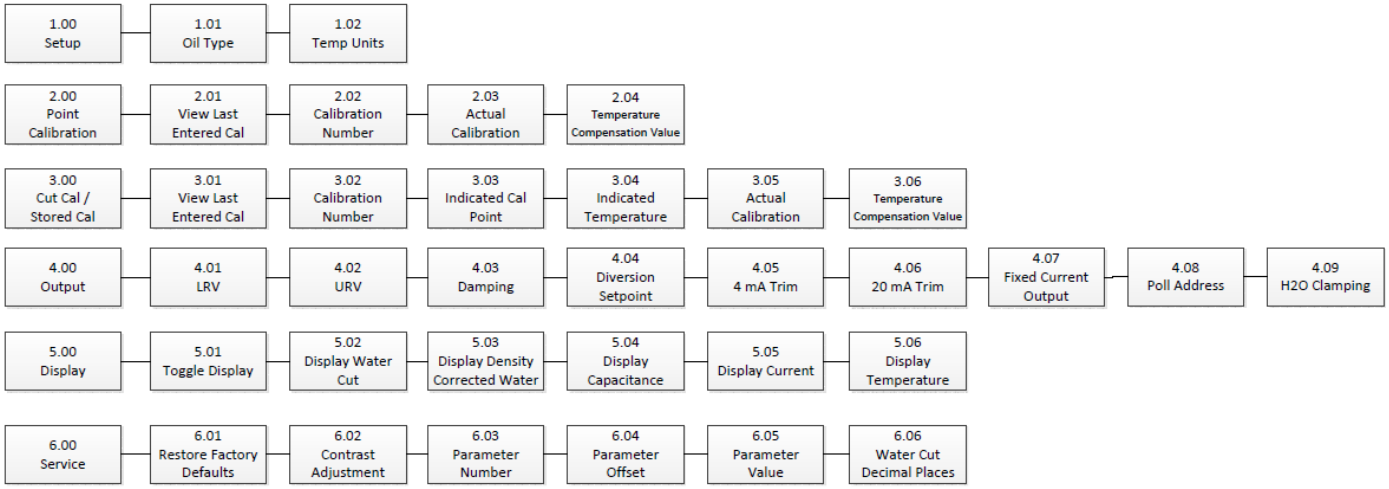
Note: Oil must be free of entrained gas prior to calibration..

- Point Cal, FCT 2.00 (preferred calibration method). This method is used when a sample can be tested for water content on site with a minimum delay.
    - Verify Calibration number is correct, FCT 2.02
    - Take a sample of the fluid as close to the probe as possible and determine water content
    - Enter the actual water cut reading from sample in Actual Calibration Fct. 2.03
- Offline / Stored Cal, FCT 3.00. This method is used when a change in water content is expected between sampling oil and entering data.
    - Take a sample of the fluid as close to the probe as possible. As the sample is being taken record the Water Cut value and Temperature from the Display.
    - Determine water content of sample.
    - Edit Water Cut Clamping, Fct 4.09 to Disable.
    - Verify Calibration number is correct, FCT 3.02.
    - Enter the water cut reading captured at the time of taking the sample in Indicated Calibration Point, Fct. 3.03.
    - Enter the temperature reading captured at the time of taking the sample in Indicated Temperature, Fct 3.04.

3.8 Calibration & Configuration via Display/Keypad (Continued)

- Enter the actual water cut reading from the sample in **Actual calibration, Fct 3.05**

Flow Chart



Menu Function (Display Abbreviation)	Values (Display Abbreviation)	Description
Fct 1.00 Setup (SETUP)		
Fct 1.01 Oil Type (OIL TYP)	CUSTOM LIGHT (Default) HEAVY	Light Oil is defined as oil with API ≥ 25. Heavy Oil is defined as oil with API < 25.
Fct 1.02 (T UNITS) Temperature Units	Celsius (Default) Fahrenheit	Selects units for view and entering temperature related data
Fct 2.00 Point Cal (PT CAL)		Used when a sample can be evaluated on the spot, and results entered when the same temperature and cut condtions apply
Fct 2.01 View Last Entered Calibration (LST CAL)	Value of last cut entered for calibration-READ ONLY	User can view the last % cut entered
Fct 2.02 Calibration Number (CAL NUM)	FIRST (Default) SECOND	User selects which type of cut or calibration they are performing. A FIRST calibration is used when the first cut is available. A Second calibration may be performed at a different temperature to automatically adjust the temperature compensation number. A 10 °C or greater change is recommended between first and second calibrations.
Fct 2.03 Actual calibration (ACT CAL)	Water cut % from actual cut % 0.0 (Default)	Enter the actual water cut reading verified by another method of water cut measurement.
Fct 2.04 Temperature Compensation value (TMP CMP)	Indicates or allows changes to the current Temperature Compensation value. 1000.0 (Default)	The Temperature Compensation value determines the amount of adjustment made to the water cut due to temperature. A value of 0 will provide no compensation, and higher values provide more compensation. User can enter a value themselves, or perform a 2nd calibration to have this value automatically computed.
Fct 3.00 Offline / Stored Cal (CUT CAL)		Used when cal data is obtained remotely, or entered when the conditions have changed since the sample was taken. Indicated % water cut and temp must be recorded when sample is taken. (Note: This menu is disable when H20 CLIP is ENABLED)
Fct 3.01 View Last Entered Calibration (LST CAL)	Value of last cut entered for calibration-READ ONLY	User can view the last % cut entered

3.8 Calibration & Configuration via Display/Keypad (Continued)

Menu Function (Display Abbreviation)	Values (Display Abbreviation)	Description
Fct 3.02 Calibration Number (CAL NUM)	FIRST (Default) SECOND	User selects which type of cut or calibration they are performing. A FIRST calibration is used when the first cut is available. A SECOND calibration may be performed at a different temperature to automatically adjust the temperature compensation number. A 10 °C or greater change is recommended between first and second calibrations.
Fct 3.03 Indicated Calibration Point (IND CAL)	% Water 0.0 (Default)	Enter the water cut reading captured at the time of taking the sample for calibration measurement
Fct 3.04 Indicated Temperature (IND Temp)	Temperature in degrees C or F 0.0 (Default)	Enter the temperature reading captured at the time of taking the sample for calibration measurement
Fct 3.05 Actual calibration (ACT CAL)	Water cut % from actual cut % 0.0 (Default)	Enter the actual water cut reading verified by another method of water cut measurement.
Fct 3.06 Temperature Compensation value (TMP CMP)	Indicates or allows changes to the current Temperature Compensation value 1000.0 (Default)	The Temperature Compensation value determines the amount of adjustment made to the water cut due to temperature. A value of 0 will provide no compensation, and higher values provide more compensation. User can enter a value themselves, or perform a 2nd calibration to have this value automatically computed.
Fct 4.00 Output (OUTPUT)		Configure the output from the unit including LRV, URV, damping and fixed output
Fct 4.01 Loop Assignment/Variable (VRBLE)	H2O CUT (Water Cut) TEMP (Temperature)	Select the variable to scale the 4-20 mA output loop. Normally this is set to H2O CUT. Temperature can be selected for diagnostic purposes.
Fct 4.02 Lower Range Value (LRV)	0.0 (Default)	Enter the lower range value in % water equivalent to 4mA output
Fct 4.03 Upper Range Value (URV)	1.0 (Default)	Enter the upper range value in % water equivalent to 20mA output
Fct 4.04 Damping in Seconds (DAMPING)	0.0 (Default)	Enter damping in seconds to delay and filter (software RC filter) the output in case of rapid water cut variations
Fct 4.05 4mA Trim (TRIM 4)	4.00 (Default)	Use this menu to calibrate the 4 mA output which is not common practice. Requires calibrated meter to measure actual current output
Fct 4.06 20mA Trim (TRIM 20)	20.00 (Default)	Use this menu to calibrate the 20 mA output which is not common practice. Requires calibrated meter to measure actual current output
Fct 4.07 Fixed Output (LOCK mA)	0.00 (Default)	Use this menu to fix the output to a certain mA value regardless of the measurement. Enter the value in mA. The output will stay at this value until exiting the menu of if display times out in approximately. 30 seconds
Fct 4.08 Polling Address (POLL)	0 (Default)	Enter the Polling Address to be used on the HART loop. Each device on the loop must have a unique Polling Address. Change only for multi-drop configuration
Fct 4.09 Water Cut Clamping (H2O CLP)	ENABLE (Default)	Clamps the indicated water cut to values of 0.0% and above
Fct 5.00 Display (DISPLAY)		Setup the parameter(s) to be displayed on the unit during operation
Fct 5.01 Toggle the display (TOGGLE?)	NO (Default)	Toggle between enabled parameters. YES or NO

3.8 Calibration & Configuration via Display/Keypad (Continued)

Menu Function (Display Abbreviation)	Values (Display Abbreviation)	Description
Fct 5.02 Water Cut (H2O)	ENABLE (Default)	Enable or disable water cut measurement display
Fct 5.03 Density Corrected Water Cut (DC H2O)	ENABLE (Default)	Enable or disable the automatic display of the density corrected water cut ONLY when connected to a DCM.
Fct 5.04 Capacitance (CAP)	ENABLE (Default)	Enable or disable capacitance measurement in pF
Fct 5.05 Calculated current (4-20)	DISABLE (Default)	Enable or disable the calculated current output
Fct 5.06 Temperature (TEMP)	ENABLE (Default)	Enable or disable temperature display
Fct 6.00 Service (SERVICE)		Use this menu for troubleshooting and service
Fct 6.01 Restore factory default (RST FAC)	NO (Default)	Select YES to restore factory default in which case all parameters will be replaced with factory default setting. Restoring the factory default will initiate this message on the display '"Init PA".
Fct 6.02 Contrast (CONTRST)	0 (Default)	0 is the highest contrast. 20 is the lowest contrast
Fct 6.03 Parameter Number (PAR NUM)	0	0 to 65535. Contact factory
Fct 6.03 Parameter Number (PAR NUM)	0	0 to 65535. Contact factory
Fct 6.04 Parameter Offset (PAR OFS)	0	Contact factory
Fct 6.05 Parameter Value (PAR VAL)	44	Contact factory
Fct 6.06 Select Decimal Value (H20 DEC)	0 1 2 (Default)	Allows the user to select the number of decimal places displayed for % water

3.9 HART® – Multi-drop Mode

All AMETEK Drexelbrook HART protocol transmitters default to a polling address of "0".

In order to put the transmitter in the "Multi-drop" mode, the polling address must be changed from "0".

A polling address of "1 – 15" is acceptable under "HART revision 5". The transmitter will set the output to a fixed current of "6 mA". All Multi-drop transmitters are placed in parallel on the Loop.

Section 4: Specifications

4.1 Transmitter Specifications

Technology
RF Admittance / Capacitance

Supply Voltage
16–30VDC, 2-wire loop powered

Ouput/Digital Protocol
4-20mA, HART

Compatible with HART®

Accuracy and Resolution

Water Cut Range	Nominal Water Cut Variance*	Water Cut Resolution**
0 to 1%	+/- 0.03	0.0002
0 to 5%	+/- 0.04	0.0009
0 to 10%	+/- 0.04	0.0009
0 to 30%	+/- 0.12	0.0030

Above 30% - Consult Factory

* The measurement accuracy of an inline, dynamic water cut measurement is dependent upon many process variables including: oil dielectric consistency, fluid velocity at the sample point, mounting geometry and homogeneity of the oil/water emulsion. The values above represent nominal water cut measurement variances for a properly installed sensor under consistent measurement point conditions.

** The smallest water cut step that the instrument can resolve

Load Resistance
363 Ohms @ 24 VDC

636 Ohms @ 30 VDC

Minimum 250 Ohms for HART Communications

Ambient Temperature
-40 to 75 °C (-40 to 167 °F)

Process Temperature (Sensing Element)
Up to 204 °C (400 °F) - TRansmitter will compensate for the effects of temperature when the water in liquid state (Eg 0 °C to 100 °C at ambient pressure)

Process Pressure (Sensing Element)
Up 69 bar (1,000 psi), probe dependent

Process Connection (Sensing Element)
NPT, ANSI, and more upon request

Response Time
350 msec nominal (no damping applied)

1-90 seconds programmable damping time

Supply Voltage Effect
0.2% of full scale max

Start-Up Time
< 12 seconds

Configuration and Calibration
Standard LCD display and keypad are built-in

HRTWIN™ PC-based software (free download)

Emission and Surge Protection
Compliant with IEC6100-4.2, 3, 4, 6, 8

Compliant with CISPR11 Group I, Class B

Approvals
Intrinsically Safe (IS)

Explosion Proof (XP)

FM, FMc

ATEX, IECEx

Section 5: Normal Maintenance

5.1 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 6: Hazardous Location Approval Supplementary Installation & Operating Instructions

6.1 General Safety Information

This document contains installation instructions for potentially explosive atmosphere applications.

The Universal V series of transmitters are approved for use in hazardous locations when properly installed. Control drawings detailing installation guidelines are available in ***Section 8***.

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

The aluminum enclosure must be protected from mechanical friction and impact that could cause ignition capable sparks.

The use of the external ground is optional for Zones installation. See Section 2 of the manual for installation and wiring.

6.1.2 Warning

- Installation, Start-Up, and Service should only be performed by personnel trained in explosive atmosphere installations.
- Substitution of Components May Impair Intrinsic Safety.

6.1.3 Device Description

The Universal V CM Water Cut Monitor with Temperature Compensation. Measurements are displayed via remote communications or an integrated display screen.

6.1.4 Electrical connection

WARNING! Read the following information carefully.

- Live Maintenance should only be carried out by Skilled Personnel trained in explosion protection methods.
- Test Equipment used to perform "Live Maintenance" must be certified to use in the associated hazardous area.

Intrinsically Safe Installations

When the Universal V Series is installed as an intrinsically safe device per the agency control drawings, the housing cover may be safely opened. For system configuration, remove the view port housing cover to access the display keypad for local system configuration.

Explosionproof or Flameproof Installations

No Live maintenance is permitted.
Disconnect power to the device and check that the atmosphere is clear of hazardous substances.

6.1.5 Commissioning

Start-up checklist

Do not connect power until you have gone through the checklist below

1. Are the wetted components (gasket, flange and sensing element) resistant to the corrosive properties of the tank product?

2. Does the information given on the nameplate correspond with the application?

3. Ex i applications: Are you using an intrinsic barrier within the correct parameters?

4. Did you install cable entries of the correct internal diameter so that there is a good seal around the cable? Are the cable glands suitably certified per the application and the hazardous area parameters?

5. Do not use the earth terminal in the wiring compartment: use the equipotential bonding system.

6.2 The Compartment Cover

Viewport Cleaning: The viewport 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.

6.2.1 Opening the cover

Procedure

1. Unscrew cover stop, if applicable
2. Unscrew terminal compartment cover

6.2.2 Closing the cover

Warning: Ex d [ia] applications
Check that the terminal compartment cover is screwed tight and the cover stop (if applicable) is fastened tightly to the cover.

6.3 Specific Conditions of Use

1. CONSULT THE MANUFACTURER IF DIMENSIONAL INFORMATION ON THE FLAMEPROOF JOINTS IS NECESSARY.

2. IN LOCATIONS REQUIRING EPL Ga OR Da EQUIPMENT, CARE MUST BE TAKEN WHEN INSTALLING THE ALUMINUM ENCLOSURE, THAT EVEN IN THE EVENT OF RARE INCIDENTS, AN IGNITION SOURCE DUE TO IMPACT OR FRICTION BETWEEN THE ENCLOSURE AND IRON/STEEL IS EXCLUDED.

3. THE ENCLOSURE CONTAINS NON-METALLIC ENCLOSURE PARTS. TO PREVENT THE RISK OF ELECTROSTATIC SPARKING, THE NONMETALLIC SURFACE SHOULD BE CLEANED WITH A DAMP CLOTH.

Section 7: Troubleshooting

Problem/Symptom	Tests in order of probability	Reference Section(s)	Comments
Can't communicate with transmitter using Drexelbrook PC Software	Check modem connections Check for 250 Ω resistance (min.) in the loop. Check voltage at transmitter Try another modem Power from a battery source	7.2 and 7.3	Often a result of loop connection problems or output current > 20 mA
0 mA output all the time (no measurable output current at any time)	Check voltage at transmitter Check polarity of loop	7.2	Probable loop problem. Faulty connection in loop
More than 20 mA output all the time	Check for moisture in housing Check transmitter Verify sensing element wiring is correct Test Sensing Element Check Calibration	 7.4 7.6	
Output drifts (output accuracy varies slowly over time…e.g. hours or days)	Test transmitter without sensing element (drift test)	7.5	
Output erratic - (output jumps around noticeably in terms of seconds or minutes)	Check probe and cable Check for radio interference Check for noise on loop	7.6 7.7	Erratic readings often show actual process conditions. Look for bubbles or stratification, etc.
Output intermittent (output jumps quickly usually between >4mA and some "on scale" value	Check signal loop connections Possible water slug	7.2	Intermittent Loop Connection
Inaccurate readings (% water readings are incorrect compared to sample)	Check calibration Check method of comparison	3	
Reading does not change with level	Check cables Check sensing element	7.6	Verify % water reading.
Output goes in opposite direction from level change	Check LRV/URV	3	Probable LRV/URV reversal.
Application related problems	**Comments**		
Gas bubbles	The presence of gas bubbles will decrease the dielectric constant of the liquid and therefore the reading. Bubbles must be eliminated for proper operation. Situations that can result in pressure drops, such as changing pipe diameters, should be avoided.		
Separation of oil and water	A homogeneous mixture is required for proper operation. Consider using an upstream mixer if separation is suspected.		

Table 7-1 Problem / Symptom Chart

7.1 Identifying a Problem/Symptom

Use Table 7-1 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 technical support at 630-723-6730. You may also E-mail us at fieldservice.magnetrol@ametek.com. Further service information may be found at ametek-measurement.com.

When you contact us, be prepared to give the service person as much information as you can about the model numbers, serial numbers, application requirements, and the materials being measured.

7.2 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 2-3**. When troubleshooting the loop connection, verify the following items.

1. Loop devices are wired in series.

2. There is at least 250 ohms total loop resistance for HART communications.

3. There is at least 16 VDC available for the transmitter when a loop current of 20 mA is flowing.

4. The open circuit voltage does not exceed 30 VDC

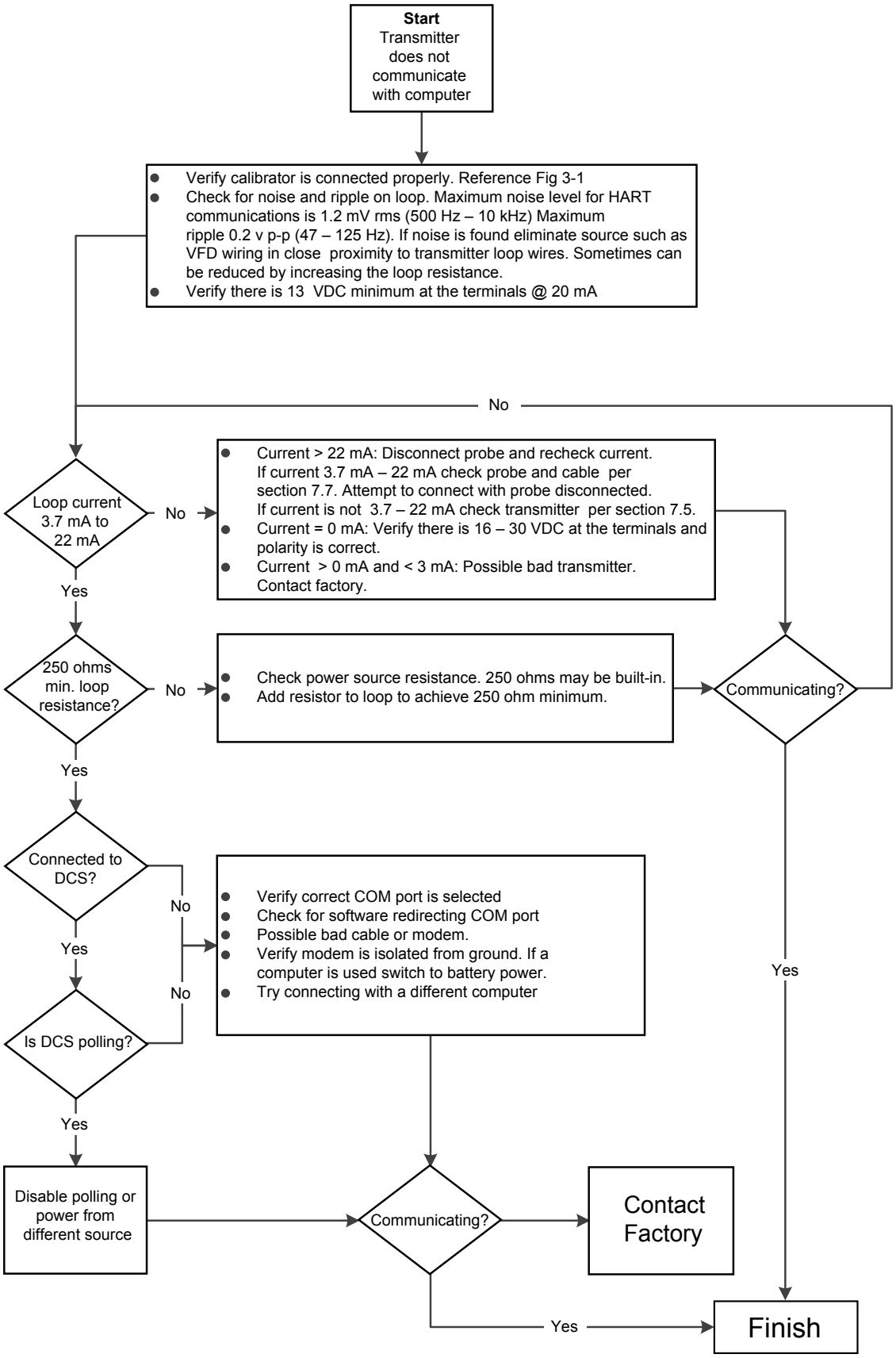
5. Power the unit from a portable source. 3 – 9 volt batteries in series will produce 27 VDC

7.3 Radio Frequency interference

All Drexelbrook transmitters have a significant amount of RFI protection built in. However, there are situations where the standard protection is inadequate. RFI filters are available to provide additional protection for 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 are referenced in Section 2.

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

7.4 Transmitter Does Not Communicate with HRTWin Software



7.5 Transmitter Function Test

If the unit is reading an incorrect value it is necessary perform the following steps to test the transmitter.

1. Verify the transmitter power is correct **See Section 2.5**.

2. Remove the transmitter from the housing. Read the capacitance and temperature via the integrated display or HRTWin with the transmitter separated from the probe connection board. A functioning transmitter will display:

   a. Capacitance 4 pF (approximately)
   b. Temperature 179 °C or 354 °F (approximately)

7.6 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.

1. Disconnect the coaxial cable and the Temperature Sensor Circuit Board from the transmitter terminals.

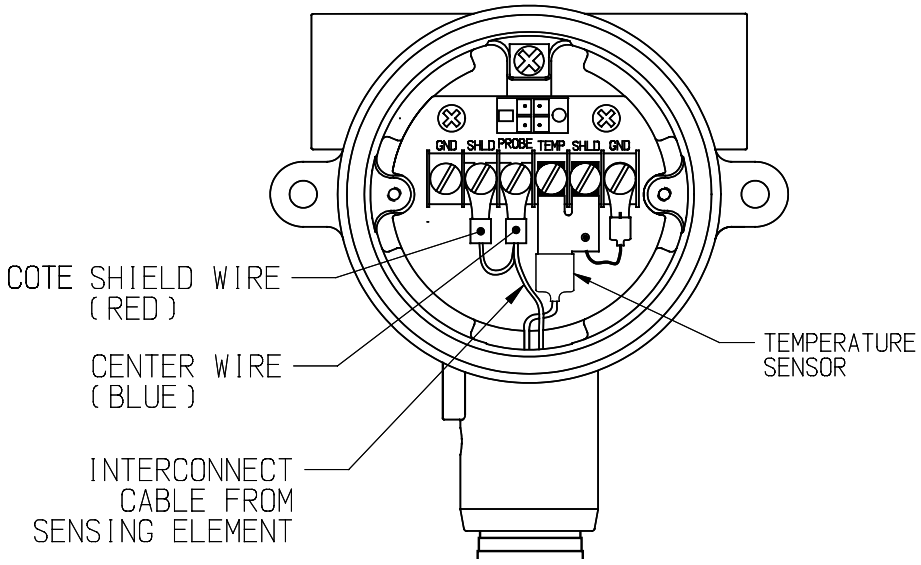
2. Without changing any data stored in the transmitter;

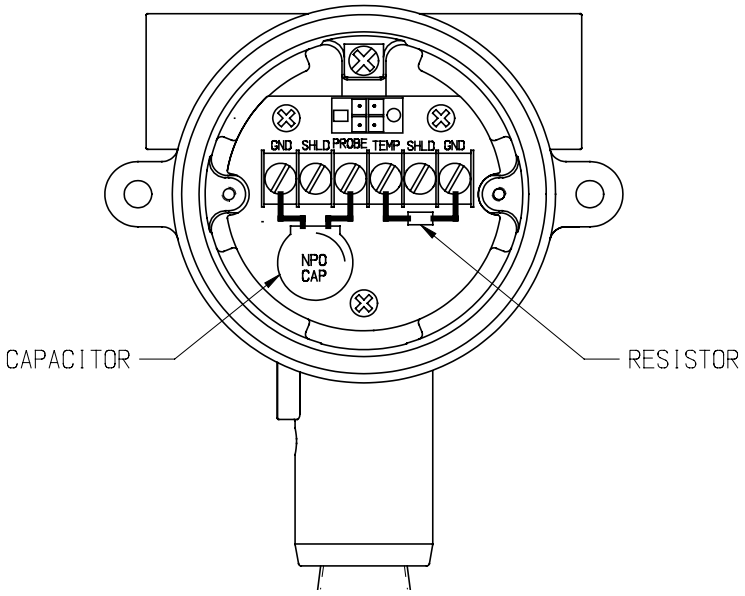
   A. Connect a Drexelbrook capacitance substitution box (401-0006-008) or an NPO test capacitor from the "PROBE" terminal to the **Left** "GND" terminal on the transmitter "Figure 7-1" on page 38. (Select a capacitance value that produces between 4 and 20 mA of loop current.)

   B. Connect a 1200 Ω resistor from the "TEMP" terminal to **Right** GND terminal.

3. Observe the loop current See "Figure 7-2" on page 39 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.

7.6 Transmitter Drift Test (Continued)





Electronic unit removed to access sensing element board terminal block. Sensing element wires removed.

Figure 7-1

7.6 Transmitter Drift Test (Continued)

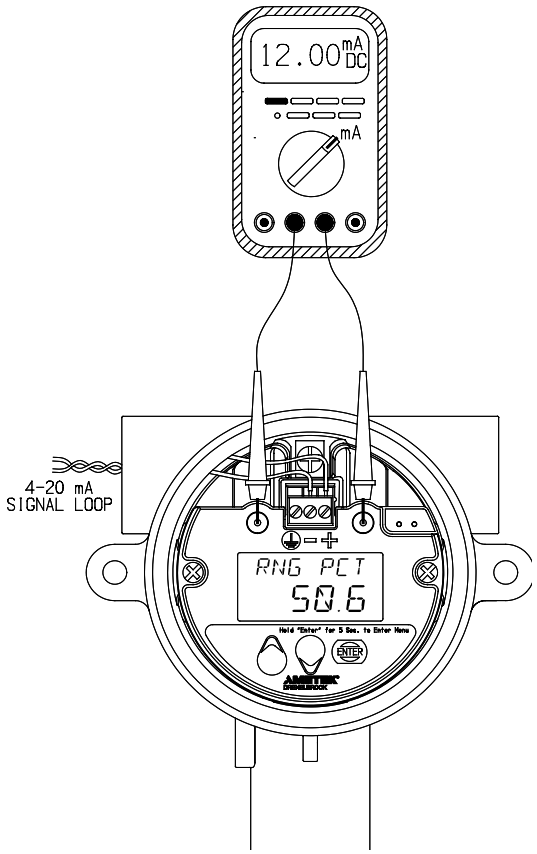


Figure 7-2

7.7 Testing the Temperature Sensor

1. Verify the temperature is reading correctly using the integrated display or HRTWin.

2. If temperature is incorrect remove temperature sensor connections in the housing. Refer to "Figure 7-3" on page 41.

3. Measure the resistance between TEMP & GND wires.

4. Resistance should be 1000 Ω @ 0 °C (32 °F), 1078 Ω @ 20 °C (68 °F) or 1385 Ω @ 100 °C (212 °F). Consult factory for other temperatures.

7.8 Testing the Sensing Element

1. With the sensing element installed normally, remove electronic unit from housing.

2. Disconnect sensing element interconnect cable in the housing, red and blue wires. Reference "Figure 7-3" on page 41.

3. Use an analog ohmmeter that is set to the highest resistance scale. Measure the resistances of: Center Wire (PROBE) to the Cote Shield Wire (SHLD), Center Wire to Housing, and Cote Shield Wire to Housing. Record values in "Table 7-2"
4. Remove the sensing element and repeat resistance measurements with the sensing element external to the vessel.

   a. A good sensing element should measure an open circuit ($\infty\ \Omega$) on all resistance tests.

   b. If resistance values were low on the first test and increased to an open circuit when removed the resistance was installation related. The most common cause is the sensing element is touching the pipe.

   c. If after removal the sensing element still shows resistance between terminals of less than 1M ohms, the sensor is damaged Contact the factory for recommendations.

5. Change the meter to the lowest resistance scale. Measure the resistance of: Center Wire to Center Rod and Cote Shield Wire to Cote Shield Element .

a. All resistances should be less than 10 Ohms. Higher resistances indicate a damaged cable.

Sensing Element Installed

Center Wire to Cote Shield Wire	_____ Ω
Center Wire to Housing	_____ Ω
Cote Shield Wire to Housing	_____ Ω

Sensing Element Removed

Center Wire to Center Rod	_____ Ω
Cote Shield Wire to Cote Shield Element	_____ Ω
Center Wire to Housing	_____ Ω
Cote Shield Wire to Housing	_____ Ω
Center Wire to Cote Shield Wire	_____ Ω

Table 7-2

7.8 Testing the Sensing Element - RF Admittance (Continued)

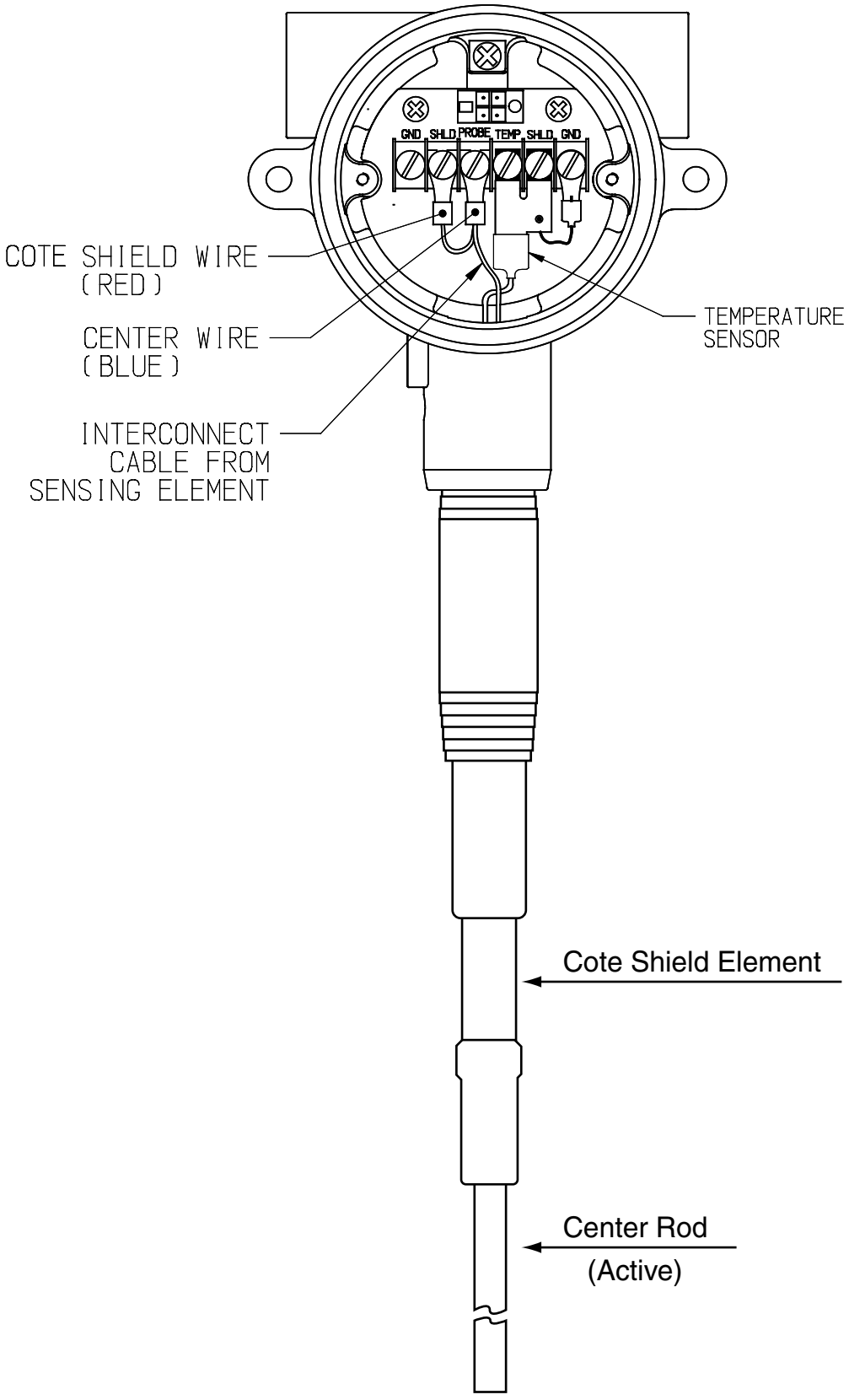


Figure 7-3

7.9 Status Messages

The Universal V CM has two types of error conditions, critical and non-critical. Critical error conditions cause device to go to a fault state loop current and scroll a message across the display. Non-critical error conditions allow the unit to continue normal operations, but scroll a message across the display to indicate to the user the nature of the non-critical faults. Most non-critical errors are the result of a transient condition affecting a very small number of readings and are not indicative of a failure but informational only.

Critical Errors

Below is a list of all the critical errors that can occur in the U-V Cut Monitor:

Error Message:	**SENSOR CRITICAL SHIELD ERROR**
Cause:	The preamp has failed to take a shield reading for 10 consecutive attempts.
Action:	Contact factory
Error Message:	**SENSOR CRITICAL PROBE ERROR**
Cause:	The preamp has failed to take a probe reading for 10 consecutive attempts. Most likely cause is a capacitance reading above the calibrated range
Action:	Perform sensing element and cable tests in troubleshooting section. Verify calibration and configuration parameters are set correctly. Contact factory
Error Message:	**SENSOR CRITICAL REF CAP ERROR**
Cause:	The preamp has failed to take a reference cap reading for 10 consecutive attempts.
Action:	Contact factory
Error Message:	**SENSOR CRITICAL COMM ERROR**
Cause:	The output module has failed to communicate with the preamp for 20 consecutive readings.
Action:	Contact factory.
Error Message:	**SENSOR STACK OVERFLOW**
Cause:	An error has occurred during operation that corrupted the SRAM.
Action:	Contact factory.
Error Message:	**SENSOR FLASH CKSM ERROR**
Cause:	The preamp failed the checksum test on power-up.
Action:	The unit needs to be replaced. Contact factory.
Error Message:	**SENSOR SPI ERROR**
Cause:	Preamp could not communicate with A2D through SPI bus.
Action:	Contact factory.
Error Message:	**SENSOR INVALID PROFILE**
Cause:	An invalid profile has been downloaded to the preamp.
Action:	Contact factory.
Error Message:	**POWER UP FAILURE**
Cause:	The output module failed to download all startup parameters to the preamp.
Action:	Cycle power to the system to attempt power-up procedure again. Contact factory

7.9 Status Messages (Continued)

Error Message:	**FLASH CKSM ERROR**
Cause:	The output module failed the checksum test on power-up.
Action:	The unit needs to be replaced. Contact factory.
Error Message:	**STACK OVERFLOW**
Cause:	An error occurred during operation that corrupted the SRAM.
Action:	Contact factory.
Error Message:	**FORCED RANGE MODE**
Cause:	The output module is in forced range mode because of HART command 215.
Action:	Contact factory.
Error Message:	**CALIBRATION SETUP ERROR**
Cause:	Calibration parameters produce calculated max capacitance above max range Incorrect configuration or calibration entry
Action:	Review calibration and configuration data Contact factory
Error Message:	**BEYOND MAX CAP ERROR**
Cause:	Live capacitance has exceed the max capacitance of the unit Probe or sensing element shorted
Action:	Review calibration and configuration data Perform sensing element and cable tests per section 5.5 and 5.6 Contact factory
Error Message:	**SENSOR CRITICAL RTD LOW RESISTANCE**
Cause:	Temperature sensor is below the temperature range for compensation.
Action:	Setting “Temperature Compensation” parameter to 0 will turn off temperature compensation changing this to a noncritical error and allowing temporary operation. Verify temperature is within compensation limits. Contact factory.
Error Message:	**SENSOR CRITICAL RTD HIGH RESISTANCE**
Cause:	Temperature sensor is above the temperature range for compensation.
Action:	Setting “Temperature Compensation” parameter to 0 will turn off temperature compensation changing this to a noncritical error and allowing temporary operation. Verify temperature is within compensation limits. Contact factory.

7.9 Status Messages (Continued)

Noncritical Errors

The following is a list of all the non critical error messages that could be displayed on the U-V Cut Monitor:

Error Message:	**SENSOR NONCRITICAL SHIELD ERROR**
Cause:	The preamp encountered an error when attempting to take a shield reading.
Action:	If error persists, contact factory.
Error Message:	**SENSOR NONCRITICAL PROBE ERROR**
Cause:	The preamp encountered an error when attempting to take a probe reading.
Action:	If error persists see actions for SENSOR CRITICAL PROBE ERROR.
Error Message:	**SENSOR NONCRITICAL REF CAP ERROR**
Cause:	The preamp encountered an error when attempting to take a ref cap reading.
Action:	If error persists, contact factory.
Error Message:	**SENSOR NONCRITICAL LEVEL VALID ERROR**
Cause:	The preamp encountered an error when attempting to take a test cap reading.
Action:	If error persists, contact factory.
Error Message:	**SENSOR NONCRITICAL COMM ERROR**
Cause:	Communication between the output module and the preamp are intermittently timing out.
Action:	If error persists, contact factory.
Error Message:	**FIXED CURRENT MODE SET**
Cause:	The output module is in fixed current mode because of HART command 40.
Action:	Consult factory.
Error Message:	**OVERRANGE**
Cause:	% range is over 105%, Level > URV, Cable shield open circuit, Cable or sensing element shorted
Action:	Verify level is within specified operating range, Perform sensing element and cable tests per, Contact factory
Error Message:	**UNDERRANGE**
Cause:	% range is under -5 %, Level < LRV, Cable or sensing element open circuit
Action:	Verify oil does not have gas bubbles, Perform sensing element and cable tests, Contact factory
Error Message	**INVALID CAP**
Cause:	Unit has calculated a negative capacitance
Action:	Verify the sensing element is fully covered in oil, Verify sensing element is connected properly, Perform sensing element and cable tests
Error Message	**SENSOR NONCRITICAL RTD LOW RESISTANCE**
Cause:	Temperature sensor is below the temperature range for compensation and temperature compensation is disabled.
Action:	Verify temperature is within compensation limits, Contact factory.
Error Message	**SENSOR NONCRITICAL RTD HIGH RESISTANCE**
Cause:	Temperature sensor is above the temperature range for compensation and temperature compensation is disabled.
Action:	Verify temperature is within compensation limits, Contact factory.

7.10 Factory Assistance

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

For Technical Support and Customer Assistance: + 215-674-1234
E-mail: fieldservice.magnetrol@ametek.com

Please complete the troubleshooting guide, section 7.14, and include any checkout procedures performed with the results.

7.11 Field Service

Trained field service engineers 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.

7.12 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.

7.13 Return Equipment

Any equipment being returned for evaluation 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 + 215-674-1234.

Please provide the following information:

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

Please include a purchase order even if the returned unit 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.

7.14 Universal V Cut Monitor Troubleshooting Guide

AMETEK Drexelbrook
Universal V™ CM Model with Temperature Compensation
Troubleshooting Guide
Service Department (215) 674-1234

Service Dept. Contact_____

Customer Name_____ Company_____ City/State_____

Phone #_____ Fax #_____ Email_____

Electronic Unit Model #_____ Serial #_____

Sensing Element Model #_____ Serial #_____ Insertion Length_____ Cote Shield Length_____

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. Information with an asterisk is available from the display.

AMETEK Drexelbrook HRTWin Protocol Software Version _____

Tag ID _____ Serial Number _____

Scratch Pad _____ Software Version _____

*Damping Time_____ Span Range _____

Range Endpoints

*LRV (4mA)_____

*URV (20mA)_____

Press F4 for Real-Time View

*Temperature_____

*Water % _____

*Capacitance _____

*Loop Current _____

*Percentage _____

*Status _____

Instrument Configuration

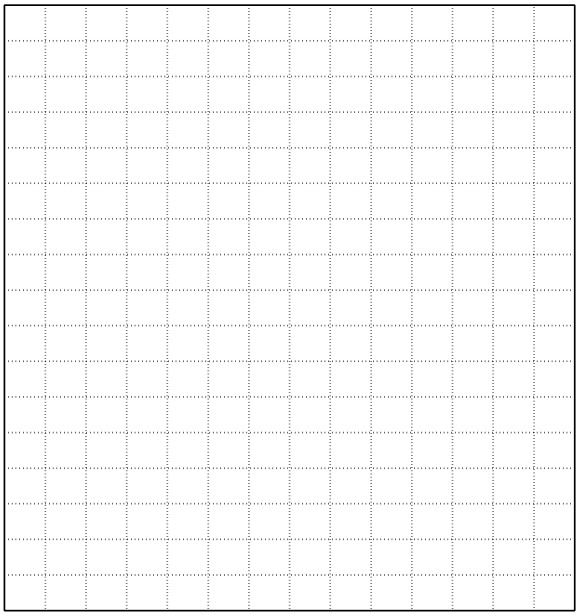
*Oil Type _____

*Temperature Units _____

*Analog Loop Assign. _____

*Temperature Compensation _____

Vessel Sketch

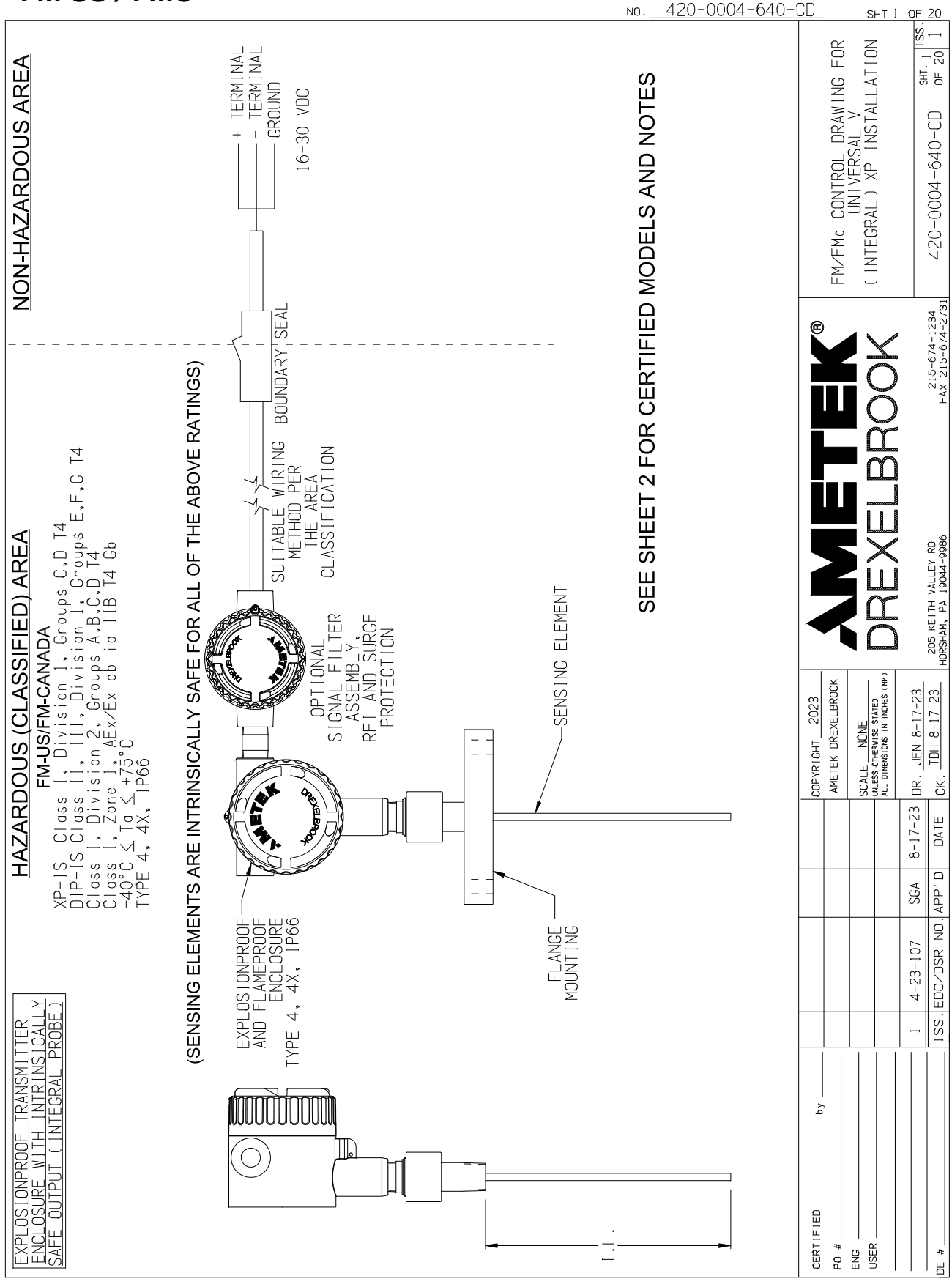


Show principal tank dimensions, including vessel construction, mounting location, nozzle, LRV, URV, present level, etc.

Detailed description of problem:_____

Section 8: Control Drawings

8.1 FM US / FMC



NOTES FOR PAGE 1:

1. THE INSTALLATION SHALL COMPLY WITH THE RELEVANT REQUIREMENTS OF THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE® (ANSI/NFPA 70) AND THE CANADIAN ELECTRICAL CODE (C22.1) AS APPLICABLE.
2. NO REVISION TO DRAWING WITHOUT PRIOR FM APPROVAL.
3. UNUSED OPENINGS MUST BE PROPERLY SEALED TO MAINTAIN ENCLOSURE ENVIRONMENTAL AND/OR HAZARDOUS LOCATION RATINGS.
4. FOR USE IN AMBIENT TEMPERATURES ABOVE 50°C, INSTALLATION WIRING SHOULD BE RATED TO 90°C OR GREATER.
5. A SEAL IS REQUIRED WITHIN 50MM OF THE ENCLOSURE.

CERTIFIED MODELS

Vab102cd00ef

a = TYPE P, L, C, T OR M
b = FREQUENCY AND PHASING 0, 1, 2, 3
c = ENTRIES 0, 2
d = SURGE/NOISE SUPRESSION 0, 1
e = SENSING ELEMENT: R11, R12, R13, R14, R15, 201, 202, 203, 204, 205, 206, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 502, 503, 504, 505, 506, 507, 508, 510, 511, 512, S12, S13, S14, S16, S18 S42, S43, S44, S46, S48
f = 24 CHARACTER NUMBERING SYSTEM THAT DOES NOT AFFECT SAFETY

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USER						
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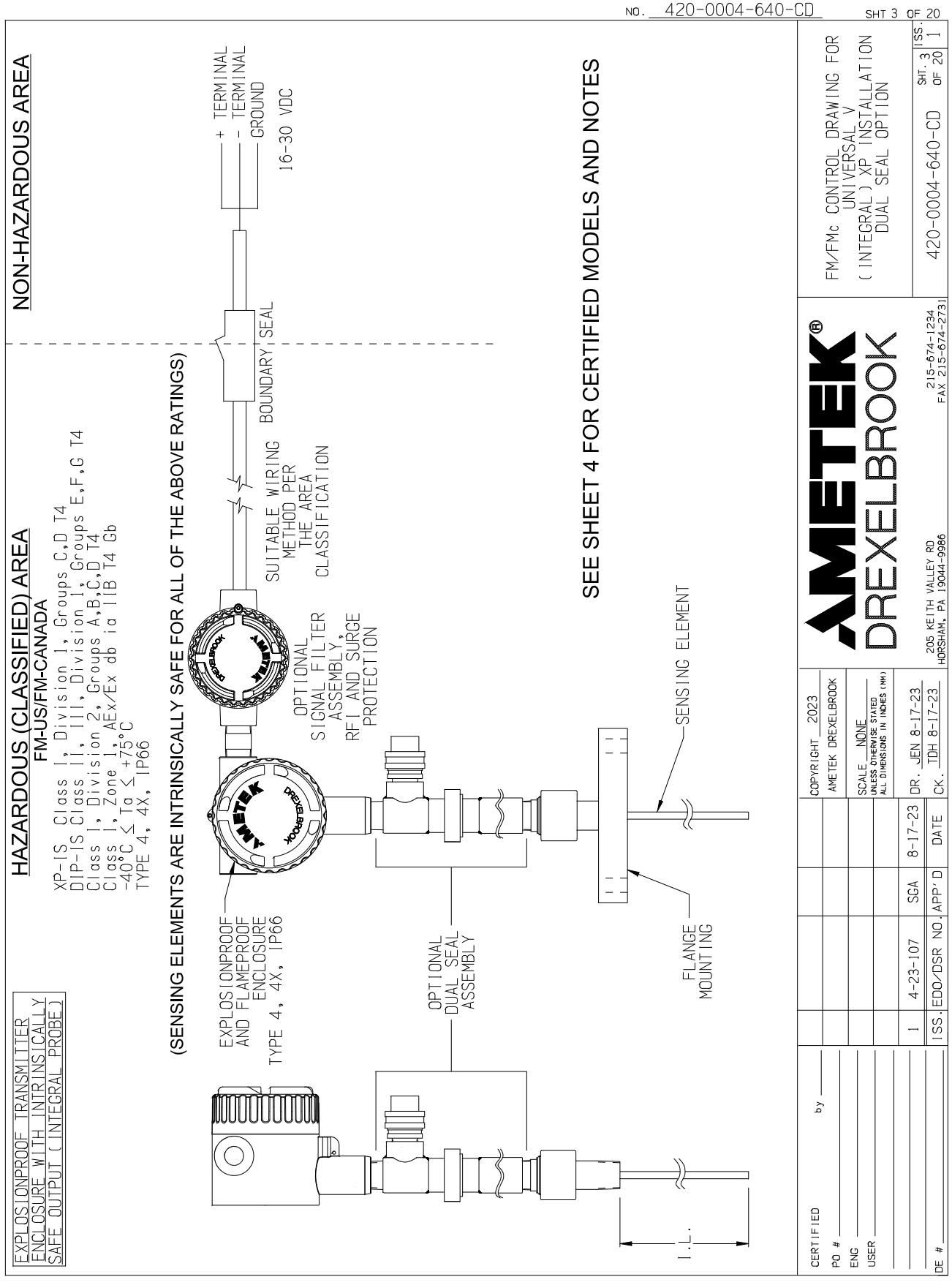
420-0004-640-CD SHT. 2 OF 20 ISS. 1

NO. 420-0004-640-CD SHT 2 OF 20

8.1 FM US / FMC (Continued)



NOTES FOR PAGE 3:

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c = ENTRIES 0, 2
d = SURGE/NOISE SUPRESSION 0, 1
e = SENSING ELEMENT: 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 201, 202, 203, 204, 205, 206, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, S02, S03, S04, S06, S08

f = 24 CHARACTER NUMBERING SYSTEM THAT DOES NOT AFFECT SAFETY

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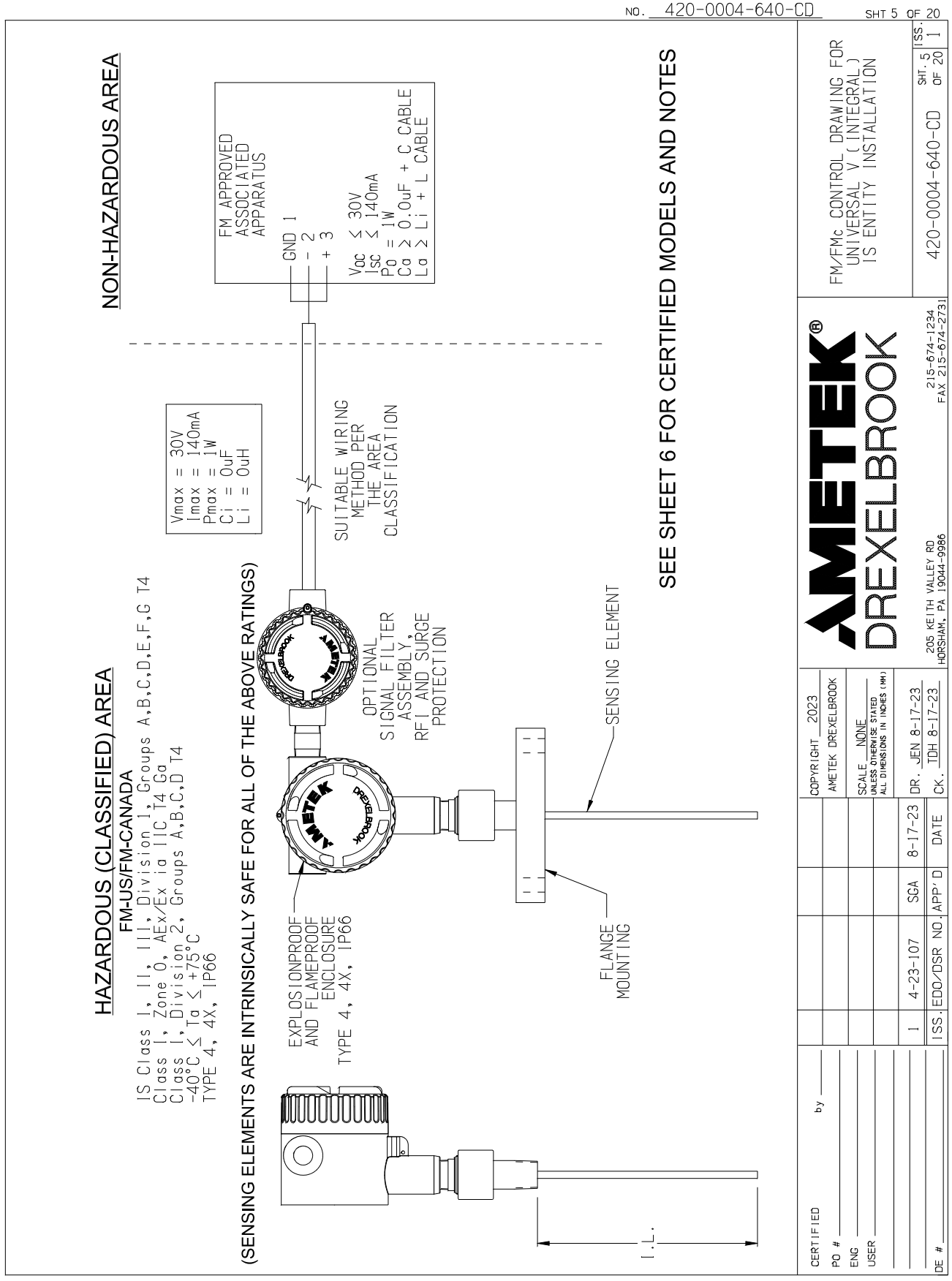
8.1 FM US / FMC (Continued)



NOTES FOR PAGE 5:

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2. NO REVISION TO DRAWING WITHOUT PRIOR FM APPROVAL.
3. CONTROL EQUIPMENT CONNECTED TO ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.
4. ASSOCIATED APPARATUS MANUFACTURER'S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.
5. DUST-TIGHT BOUNDARY SEAL MUST BE USED WHEN INSTALLED IN CLASS II AND CLASS III ENVIRONMENTS.
6. WARNING - SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.
7. UNUSED OPENINGS MUST BE PROPERLY SEALED TO MAINTAIN ENCLOSURE ENVIRONMENTAL AND/OR HAZARDOUS LOCATION RATINGS.
8. FOR USE IN AMBIENT TEMPERATURES ABOVE 50°C, INSTALLATION WIRING SHOULD BE RATED TO 90°C OR GREATER.

CERTIFIED MODELS

Vab101cd00ef

a = TYPE P, L, C, T OR M
b = FREQUENCY AND PHASING 0, 1, 2, 3
c = ENTRIES 0, 2
d = SURGE/NOISE SUPRESSION 0, 1
e = SENSING ELEMENT: R00, R01, R02, R03, R04, R05, 201, 202, 203, 204, 205, 206, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 601, 603, 604, 605, 606, 607, 608, 609, 610, 611, 613, 703, 705, 706, 708, 709, 713, 714, 715, 722, S12, S13, S14, S16, S18, S42, S43, S44, S46, S48, ZZZ*
f = 24 CHARACTER NUMBERING SYSTEM THAT DOES NOT AFFECT SAFETY

ZZZ* = SPECIAL SENSING ELEMENT
700- ANY 7 DIGIT NUMERIC COMBINATION

NOTES:

1. MAXIMUM PROCESS TEMPERATURE 290°C
2. MAXIMUM SENSOR CAPACITANCE < 1uF
3. MAXIMUM INSERTION LENGTH ***RIGID SENSOR*** 30 FEET (9.144 METERS)
4. MAXIMUM INSERTION LENGTH ***FLEXIBLE SENSOR*** 2000 FEET (609.6 METERS)
5. SENSING ELEMENT ENCLOSURE IP66 (IP RATING DOES NOT APPLY TO SPECIAL SENSORS SUPPLIED WITHOUT A 285- SERIES SENSING ELEMENT ENCLOSURE).

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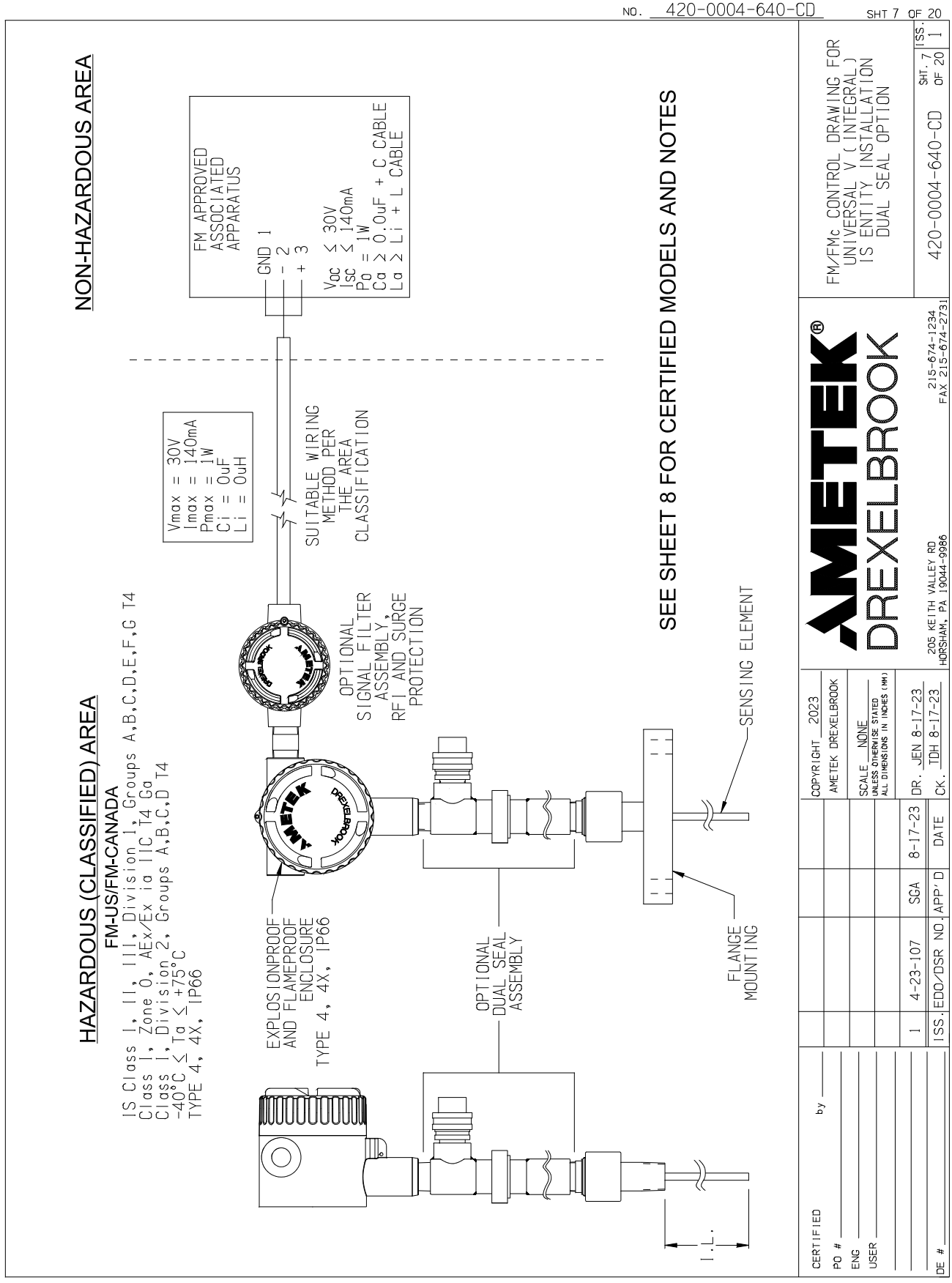
8.1 FM US / FMC (Continued)



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5. DUST-TIGHT BOUNDARY SEAL MUST BE USED WHEN INSTALLED IN CLASS II AND CLASS III ENVIRONMENTS.
6. WARNING - SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.
7. UNUSED OPENINGS MUST BE PROPERLY SEALED TO MAINTAIN ENCLOSURE ENVIRONMENTAL AND/OR HAZARDOUS LOCATION RATINGS.
8. FOR USE IN AMBIENT TEMPERATURES ABOVE 50°C, INSTALLATION WIRING SHOULD BE RATED TO 90°C OR GREATER.

CERTIFIED MODELS

Vab101cd01ef

a = TYPE P, L, C, T OR M
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c = ENTRIES 0, 2
d = SURGE/NOISE SUPRESSION 0, 1
e = SENSING ELEMENT: 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 201, 202, 203, 204, 205, 206, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 601, 603, 604, 605, 606, 607, 608, 609, 610, 611, 613, S02, S03, S04, S06, S08
f = 24 CHARACTER NUMBERING SYSTEM THAT DOES NOT AFFECT SAFETY

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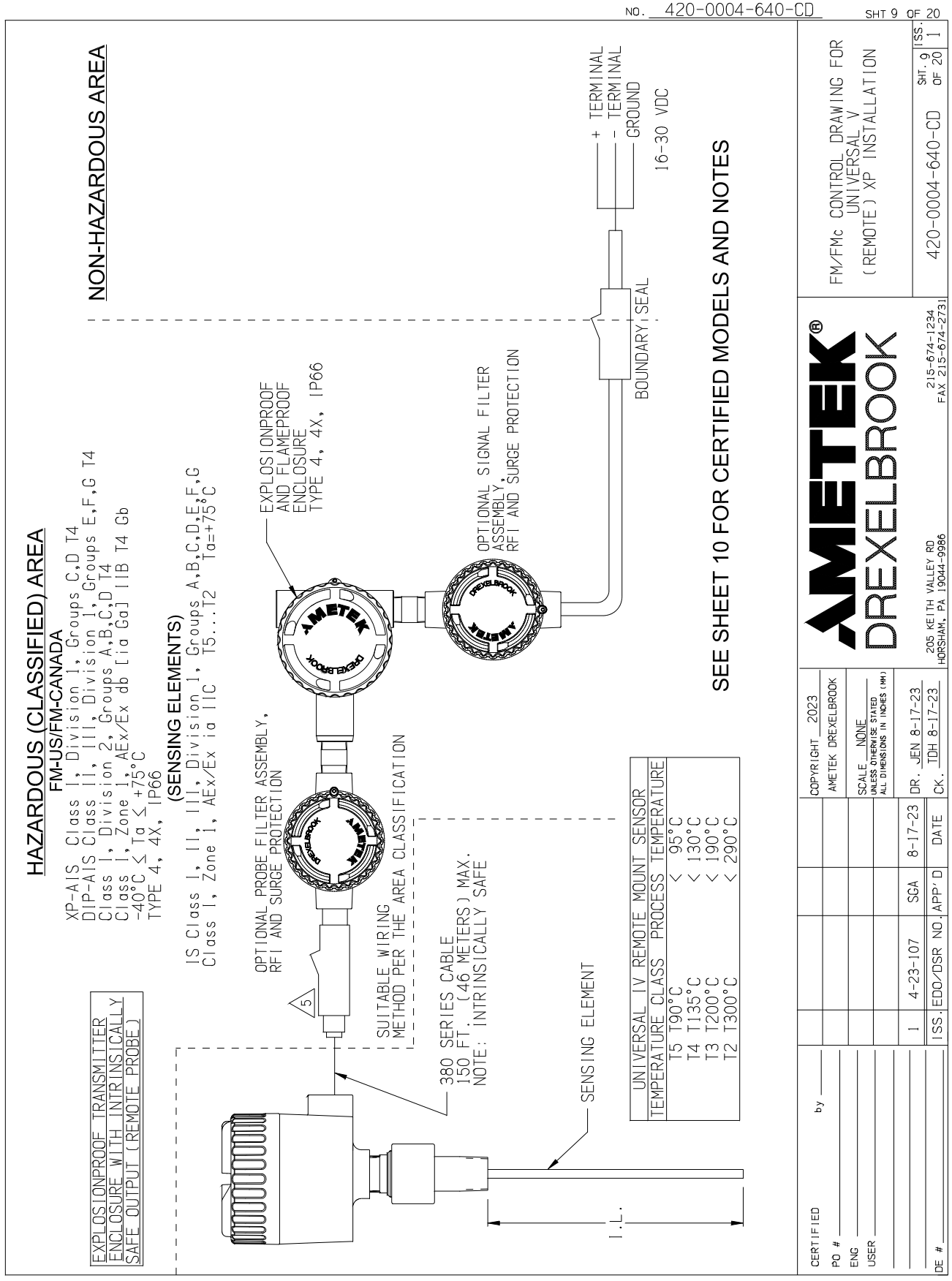
8.1 FM US / FMC (Continued)



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2. NO REVISION TO DRAWING WITHOUT PRIOR FM APPROVAL.
3. UNUSED OPENINGS MUST BE PROPERLY SEALED TO MAINTAIN ENCLOSURE ENVIRONMENTAL AND/OR HAZARDOUS LOCATION RATINGS.
4. OPTIONAL FILTERS 401-0016-030 AND 401-0016-031 MAY BE INSTALLED IN SENSOR ENCLOSURE.
5. CONDUIT SEAL REQUIRED SUITABLE FOR THE APPLICATION WHEN OPTIONAL PROBE FILTER IS NOT INSTALLED.
6. FOR USE IN AMBIENT TEMPERATURES ABOVE 50°C, INSTALLATION WIRING SHOULD BE RATED TO 90°C OR GREATER.
7. A SEAL IS REQUIRED WITHIN 50MM OF THE ENCLOSURE.

CERTIFIED MODELS

Vab102cde0fg

a = TYPE P, L, OR C.
b = FREQUENCY AND PHASING 0, 1, 2, 3
c = ENTRIES 0, 2
d = SURGE/NOISE SUPRESSION 0, 1, 2, 3, 4, 5, 6, 7, D
e = CABLE OPTIONS 1,2,3,4,5,6,7,8,9,A,B,C,D,E,F,G,H,J,K,L,M,N,P,R,S,Z
f = SENSING ELEMENT: R09, 000, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 513, 601, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, S02, S03, S04, S06, S08, ZZZ*
g = 24 CHARACTER NUMBERING SYSTEM THAT DOES NOT AFFECT SAFETY

ZZZ* = SPECIAL SENSING ELEMENT
700- ANY 7 DIGIT NUMERIC COMBINATION

NOTES:
1. MAXIMUM PROCESS TEMPERATURE 290°C
2. MAXIMUM SENSOR CAPACITANCE < 1uF
3. MAXIMUM INSERTION LENGTH ***RIGID SENSOR*** 30 FEET (9.144 METERS)
4. MAXIMUM INSERTION LENGTH ***FLEXIBLE SENSOR*** 2000 FEET (609.6 METERS)
5. SENSING ELEMENT ENCLOSURE IP66 (IP RATING DOES NOT APPLY TO SPECIAL SENSORS SUPPLIED WITHOUT A 285- SERIES SENSING ELEMENT ENCLOSURE).

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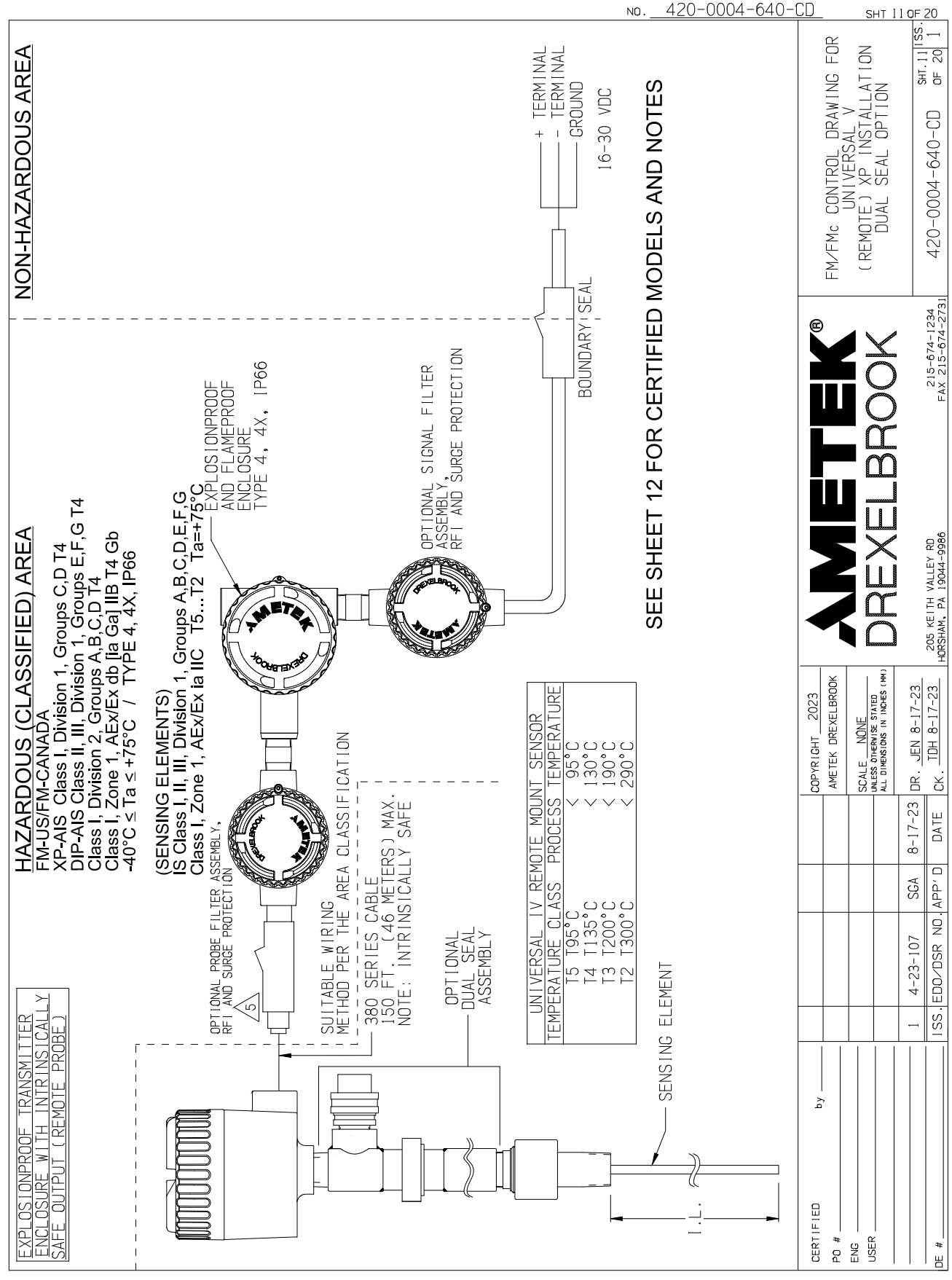
8.1 FM US / FMC (Continued)



NOTES FOR PAGE 11:

1. THE INSTALLATION SHALL COMPLY WITH THE RELEVANT REQUIREMENTS OF THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE® (ANSI/NFPA 70) AND THE CANADIAN ELECTRICAL CODE (C22.1) AS APPLICABLE.
2. NO REVISION TO DRAWING WITHOUT PRIOR FM APPROVAL.
3. UNUSED OPENINGS MUST BE PROPERLY SEALED TO MAINTAIN ENCLOSURE ENVIRONMENTAL AND/OR HAZARDOUS LOCATION RATINGS.
4. OPTIONAL FILTERS 401-0016-030 ANS 401-0016-031 MAY BE INSTALLED IN SENSOR ENCLOSURE.
5. CONDUIT SEAL REQUIRED SUITABLE FOR THE APPLICATION WHEN OPTIONAL PROBE FILTER IS NOT INSTALLED.
6. FOR USE IN AMBIENT TEMPERATURES ABOVE 50°C, INSTALLATION WIRING SHOULD BE RATED TO 90°C OR GREATER.
7. A SEAL IS REQUIRED WITHIN 50MM OF THE ENCLOSURE.

CERTIFIED MODELS

Vab102cde1fg

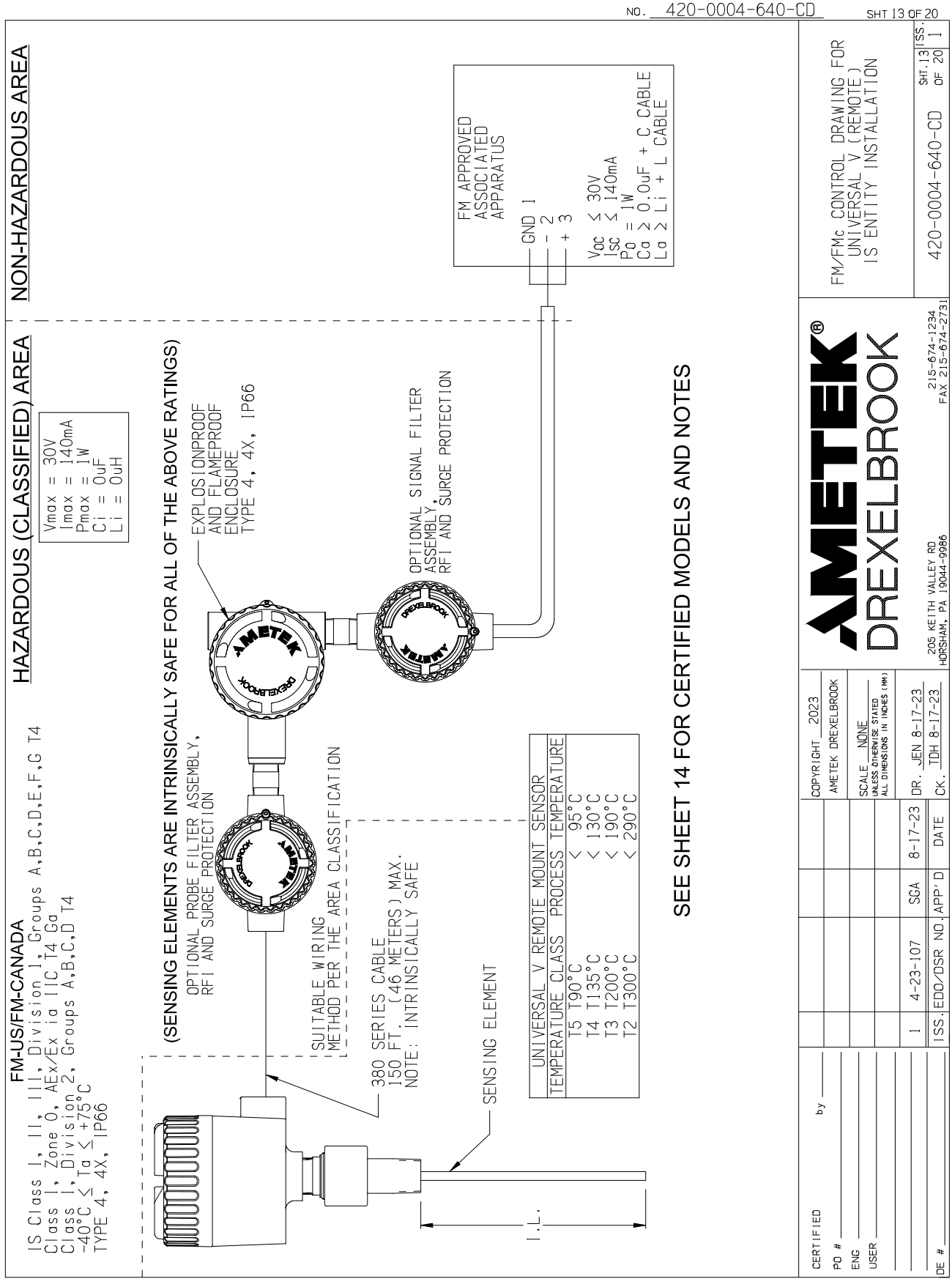
a = TYPE P, L, OR C.
b = FREQUENCY AND PHASING 0, 1, 2, 3
c = ENTRIES 0, 2
d = SURGE/NOISE SUPRESSION 0, 2, 3, 4, 5, 6, 7, D
e = CABLE OPTIONS: 1,2,3,4,5,6,7,8,9,A,C,B,D,E,F,G,H,J,K,L,M,N,P,R,S,Z
f = SENSING ELEMENT: 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 601, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, S02, S03, S04, S06, S08
g = 24 CHARACTER NUMBERING SYSTEM THAT DOES NOT AFFECT SAFETY

CERTIFIED by					COPYRIGHT 2023 AMETEK DREXELBROOK	AMETEK® DREXELBROOK
PO #					SCALE NONE UNLESS OTHERWISE STATED ALL DIMENSIONS IN INCHES (MM)	FM/FMc CONTROL DRAWING FOR UNIVERSAL V (REMOTE) XP INSTALLATION DUAL SEAL OPTION
ENG						
USER						
	1	4-23-107	SGA	8-17-23	DR. JEN 8-17-23	
DE #	ISS.	EDO/DSR NO.	APP'D	DATE	CK. TDH 8-17-23	420-0004-640-CD SHT. 12 OF 20 ISS. 1

205 KEITH VALLEY RD
HORSHAM, PA 19044-9986
215-674-1234
FAX 215-674-2731

NO. 420-0004-640-CD SHT 12 OF 20

8.1 FM US / FMC (Continued)



NOTES FOR PAGE 13:
1. THE INSTALLATION SHALL COMPLY WITH THE RELEVANT REQUIREMENTS OF THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE® (ANSI/NFPA 70) AND THE CANADIAN ELECTRICAL CODE (C22.1) AS APPLICABLE.
2. NO REVISION TO DRAWING WITHOUT PRIOR FM APPROVAL.
3. CONTROL EQUIPMENT CONNECTED TO ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.
4. ASSOCIATED APPARATUS MANUFACTURER'S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.
5. DUST-TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN CLASS II AND CLASS III ENVIRONMENTS.
6. WARNING - SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.
7. UNUSED OPENINGS MUST BE PROPERLY SEALED TO MAINTAIN ENCLOSURE ENVIRONMENTAL AND/OR HAZARDOUS LOCATION RATINGS.
8. OPTIONAL FILTERS 401-0016-030 AND 401-0016-031 MAY BE INSTALLED IN SENSOR ENCLOSURE.
9. FOR USE IN AMBIENT TEMPERATURES ABOVE 50°C, INSTALLATION WIRING SHOULD BE RATED TO 90°C OR GREATER.

CERTIFIED MODELS

Vab101cde0fg

a = TYPE P, L, OR C.
b = FREQUENCY AND PHASING 0, 1, 2, 3
c = ENTRIES 0, 2
d = SURGE/NOISE SUPRESSION 0, 1, 2, 3, 4, 5, 6, 7, D
e = CABLE OPTIONS 1,2,3,4,5,6,7,8,9,A,B,C,D,E,F,G,H,J,K,L,M,N,P,R,S,Z
f = SENSING ELEMENT: R09, 000, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 513, 601, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, S02, S03, S04, S06, S08, ZZZ*
g = 24 CHARACTER NUMBERING SYSTEM THAT DOES NOT AFFECT SAFETY

ZZZ* = SPECIAL SENSING ELEMENT
700- ANY 7 DIGIT NUMERIC COMBINATION

NOTES:
1. MAXIMUM PROCESS TEMPERATURE 290°C
2. MAXIMUM SENSOR CAPACITANCE < 1uF
3. MAXIMUM INSERTION LENGTH ***RIGID SENSOR*** 30 FEET (9.144 METERS)
4. MAXIMUM INSERTION LENGTH ***FLEXIBLE SENSOR*** 2000 FEET (609.6 METERS)
5. SENSING ELEMENT ENCLOSURE IP66 (IP RATING DOES NOT APPLY TO SPECIAL SENSORS SUPPLIED WITHOUT A 285- SERIES SENSING ELEMENT ENCLOSURE).

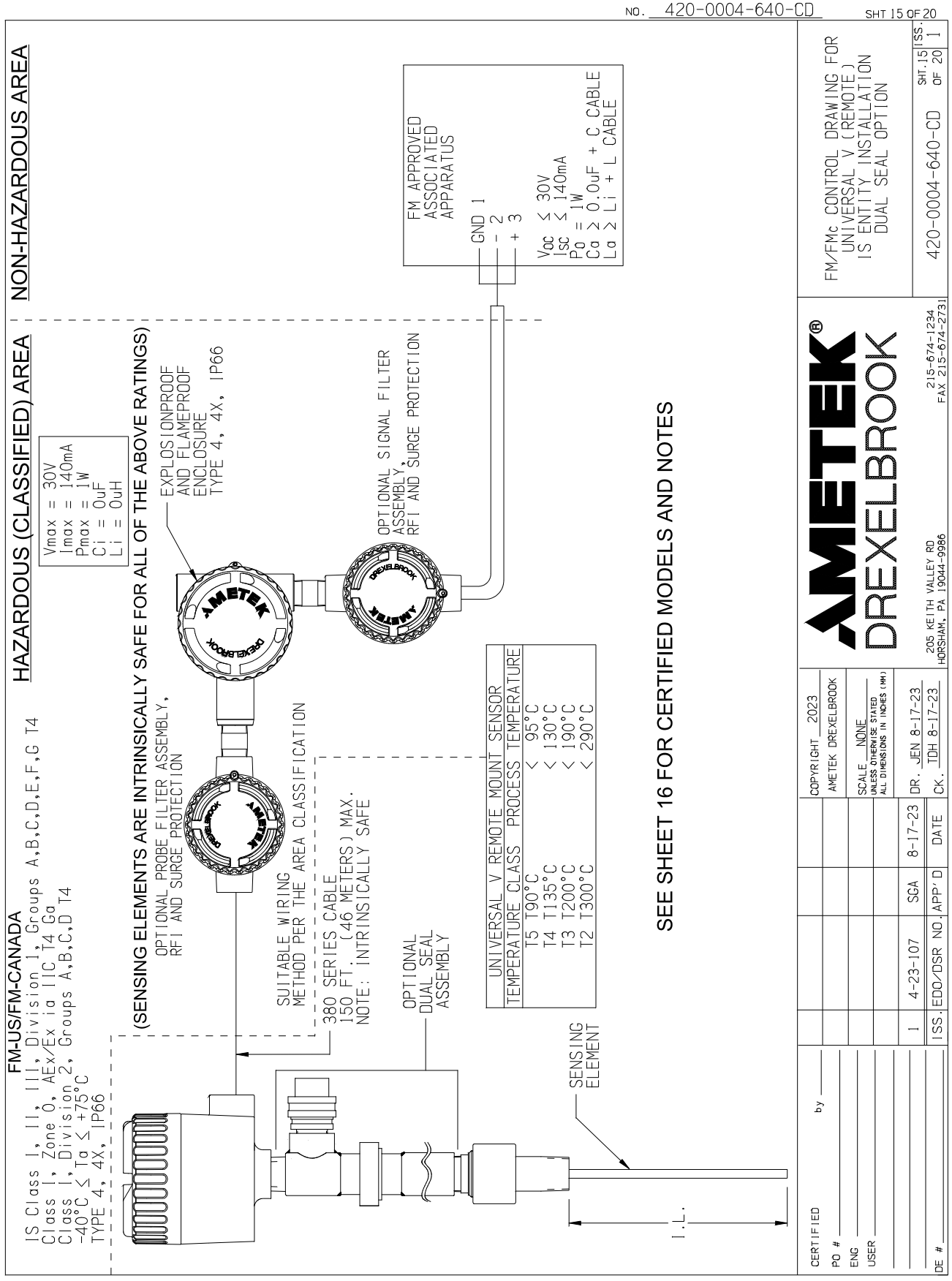
CERTIFIED by					COPYRIGHT 2023 AMETEK DREXELBROOK	AMETEK® DREXELBROOK
PO #						
ENG					SCALE NONE UNLESS OTHERWISE STATED ALL DIMENSIONS IN INCHES (MM)	
USER						
	1	4-23-107	SGA	8-17-23	DR. JEN 8-17-23	
DE #	ISS.	EDO/DSR NO.	APP'D	DATE	CK. TDH 8-17-23	205 KEITH VALLEY RD HORSHAM, PA 19044-9986 215-674-1234 FAX 215-674-2731

FM/FMc CONTROL DRAWING FOR UNIVERSAL V (REMOTE) IS ENTITY INSTALLATION

420-0004-640-CD SHT. 14 OF 20 ISS. 1

NO. 420-0004-640-CD SHT 14 OF 20

8.1 FM US / FMC (Continued)



NOTES FOR PAGE 15:

1. THE INSTALLATION SHALL COMPLY WITH THE RELEVANT REQUIREMENTS OF THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE® (ANSI/NFPA 70) AND THE CANADIAN ELECTRICAL CODE (C22.1) AS APPLICABLE.
2. NO REVISION TO DRAWING WITHOUT PRIOR FM APPROVAL.
3. CONTROL EQUIPMENT CONNECTED TO ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.
4. ASSOCIATED APPARATUS MANUFACTURER'S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.
5. DUST-TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN CLASS II AND CLASS III ENVIRONMENTS.
6. WARNING - SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.
7. UNUSED OPENINGS MUST BE PROPERLY SEALED TO MAINTAIN ENCLOSURE ENVIRONMENTAL AND/OR HAZARDOUS LOCATION RATINGS.
8. OPTIONAL FILTERS 401-0016-030 AND 401-0016-031 MAY BE INSTALLED IN SENSOR ENCLOSURE.
9. FOR USE IN AMBIENT TEMPERATURES ABOVE 50°C, INSTALLATION WIRING SHOULD BE RATED TO 90°C OR GREATER.

CERTIFIED MODELS

Vab101cde1fg

a = TYPE P, L, OR C.
b = FREQUENCY AND PHASING 0, 1, 2, 3
c = ENTRIES 0, 2
d = SURGE/NOISE SUPRESSION 0, 1, 2, 3, 4, 5, 6, 7, D
e = CABLE OPTIONS: 1,2,3,4,5,6,7,8,9,A,C,B,D,E,F,G,H,J,K,L,M,N,P,R,S,Z
f = SENSING ELEMENT: 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 601, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, S02, S03, S04, S06, S08
g = 24 CHARACTER NUMBERING SYSTEM THAT DOES NOT AFFECT SAFETY

CERTIFIED by					COPYRIGHT 2023 AMETEK DREXELBROOK	AMETEK® DREXELBROOK
PO #						
ENG					SCALE NONE UNLESS OTHERWISE STATED ALL DIMENSIONS IN INCHES (MM)	
USER						
	1	4-23-107	SGA	8-17-23	DR. JEN 8-17-23	
DE #	ISS.	EDO/DSR NO.	APP'D	DATE	CK. TDH 8-17-23	

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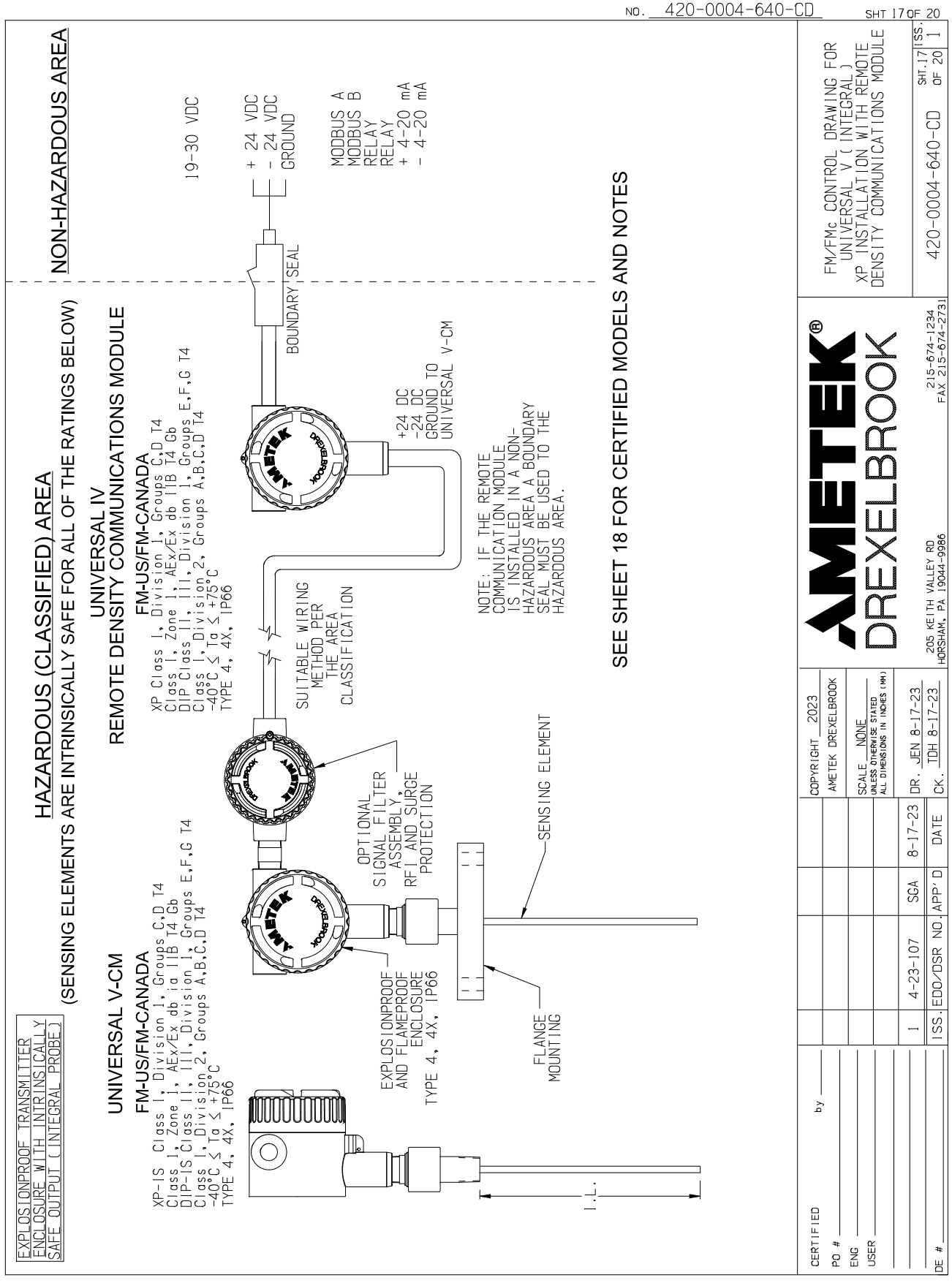
215-674-1234
FAX 215-674-2731

FM/FMc CONTROL DRAWING FOR UNIVERSAL V (REMOTE) IS ENTITY INSTALLATION DUAL SEAL OPTION

420-0004-640-CD SHT.16 OF 20 ISS. 1

NO. 420-0004-640-CD SHT 16 OF 20

8.1 FM US / FMC (Continued)



NOTES FOR PAGE 17:
1. THE INSTALLATION SHALL COMPLY WITH THE RELEVANT REQUIREMENTS OF THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE® (ANSI/NFPA 70) AND THE CANADIAN ELECTRICAL CODE (C22.1) AS APPLICABLE.
2. NO REVISION TO DRAWING WITHOUT PRIOR FM APPROVAL.
3. UNUSED OPENINGS MUST BE PROPERLY SEALED TO MAINTAIN ENCLOSURE ENVIRONMENTAL AND/OR HAZARDOUS LOCATION RATINGS.
4. FOR USE IN AMBIENT TEMPERATURES ABOVE 50°C, INSTALLATION WIRING SHOULD BE RATED TO 90°C OR GREATER.
5. A SEAL IS REQUIRED WITHIN 50MM OF THE ENCLOSURE.

CERTIFIED MODELS

VDa109bc00de

a = FREQUENCY AND PHASING 0, or R*
b = ENTRIES 0, 2
c = SURGE/NOISE SUPRESSION 0, 1
d = SENSING ELEMENT: R11, R12, R13, R14, R15, 201, 202, 203, 204, 205, 206, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 502, 503, 504, 505, 506, 507, 508, 510, 511, 512, S12, S13, S14, S16, S18, S42, S43, S44, S46, S48
e = 24 CHARACTER NUMBERING SYSTEM THAT DOES NOT AFFECT SAFETY

R* = Retrofit

CERTIFIED by					COPYRIGHT 2023 AMETEK DREXELBROOK
PO #					
ENG					SCALE NONE UNLESS OTHERWISE STATED ALL DIMENSIONS IN INCHES (MM)
USER					
	1	4-23-107	SGA	8-17-23	DR. JEN 8-17-23
DE #	ISS.	EDO/DSR NO.	APP'D	DATE	CK. TDH 8-17-23

AMETEK® DREXELBROOK
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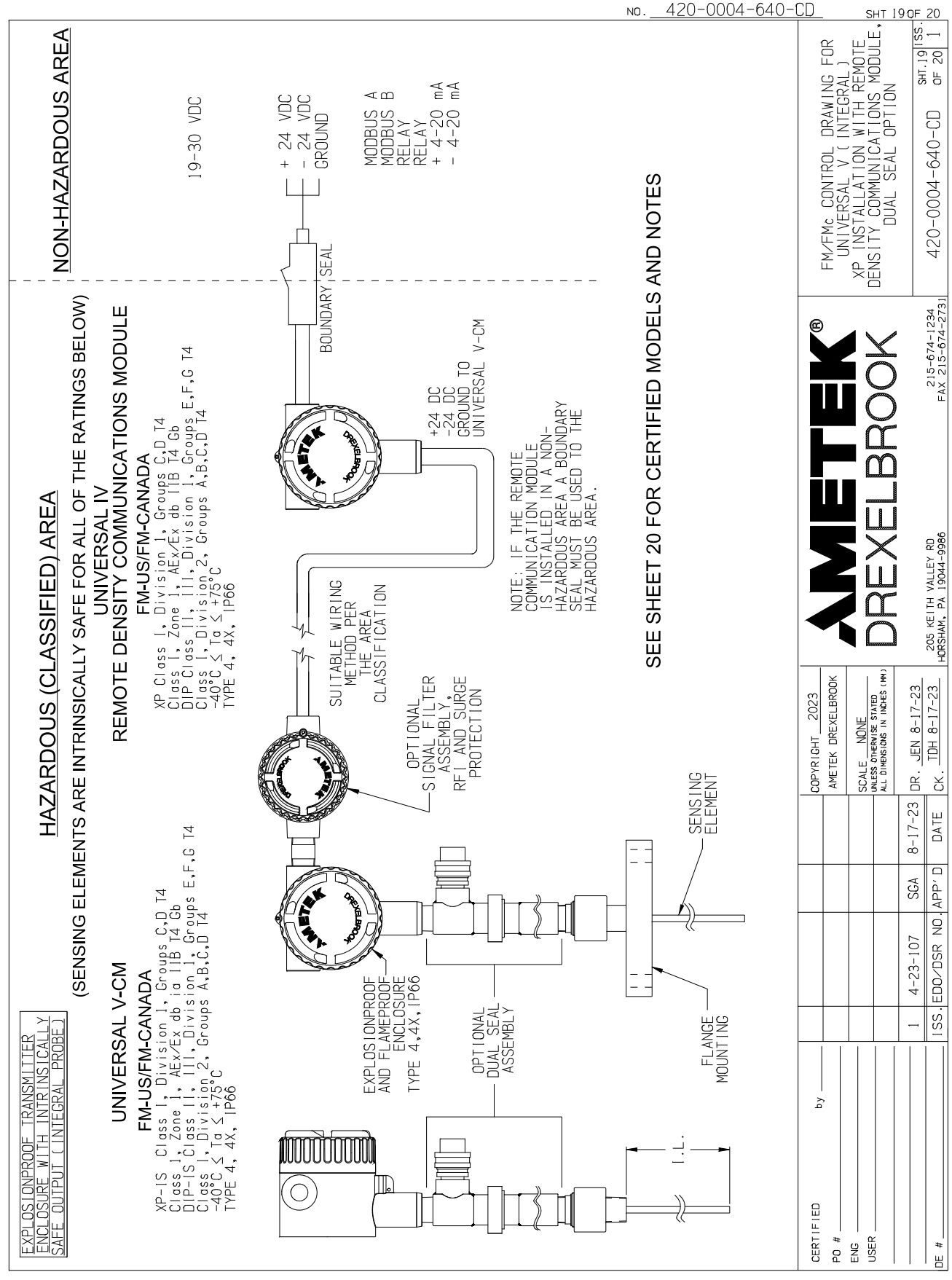
FAX 215-674-2731

FM/FMc CONTROL DRAWING FOR UNIVERSAL V (INTEGRAL) XP INSTALLATION WITH REMOTE DENSITY COMMUNICATIONS MODULE

420-0004-640-CD SHT.18 OF 20 ISS. 1

NO. 420-0004-640-CD SHT 18 OF 20

8.1 FM US / FMC (Continued)



NOTES FOR PAGE 19:
1. THE INSTALLATION SHALL COMPLY WITH THE RELEVANT REQUIREMENTS OF THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE® (ANSI/NFPA 70) AND THE CANADIAN ELECTRICAL CODE (C22.1) AS APPLICABLE.
2. NO REVISION TO DRAWING WITHOUT PRIOR FM APPROVAL.
3. UNUSED OPENINGS MUST BE PROPERLY SEALED TO MAINTAIN ENCLOSURE ENVIRONMENTAL AND/OR HAZARDOUS LOCATION RATINGS.
4. FOR USE IN AMBIENT TEMPERATURES ABOVE 50°C, INSTALLATION WIRING SHOULD BE RATED TO 90°C OR GREATER.
5. A SEAL IS REQUIRED WITHIN 50MM OF THE ENCLOSURE.

CERTIFIED MODELS

VDa109bc01de

a = FREQUENCY AND PHASING 0, or R*
b = ENTRIES 0, 2
c = SURGE/NOISE SUPRESSION 0, 1
d = SENSING ELEMENT: 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 201, 202, 203, 204, 205, 206, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, S02, S03, S04, S06, S08

e = 24 CHARACTER NUMBERING SYSTEM THAT DOES NOT AFFECT SAFETY

R* = Retrofit

CERTIFIED by					COPYRIGHT 2023 AMETEK DREXELBROOK
PO #					
ENG					SCALE NONE UNLESS OTHERWISE STATED ALL DIMENSIONS IN INCHES (MM)
USER					
	1	4-23-107	SGA	8-17-23	DR. JEN 8-17-23
DE #	ISS.	EDO/DSR NO.	APP'D	DATE	CK. TDH 8-17-23

AMETEK® DREXELBROOK
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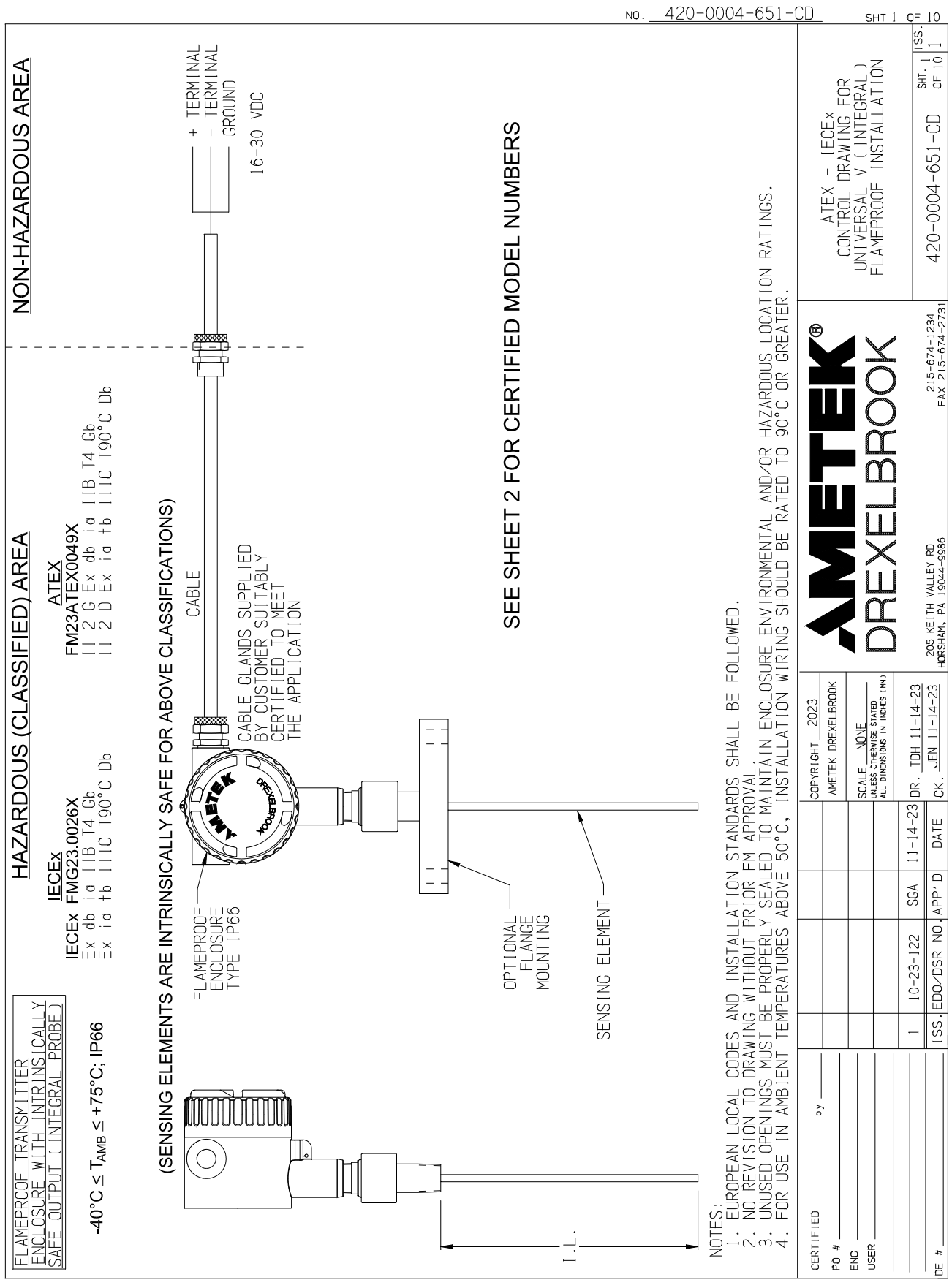
HORSHAM, PA 19044-9986
215-674-1234
FAX 215-674-2731

FM/FMc CONTROL DRAWING FOR UNIVERSAL V (INTEGRAL) XP INSTALLATION WITH REMOTE DENSITY COMMUNICATIONS MODULE, DUAL SEAL OPTION

420-0004-640-CD SHT.20 OF 20 ISS. 1

NO. 420-0004-640-CD SHT 20 OF 20

8.2 ATEX / IECEx



8.2 ATEX / IECEx (Continued)

NO. 420-0004-651-CD SHT 2 OF 10

CERTIFIED MODELS

Vab10cd000-e-f. Universal V - Flameproof - Model Code

a = TYPE P, L, C, T, OR M
b = FREQUENCY AND PHASING 0, 1, 2, OR 3
c = APPROVAL 4 (ATEX), 6 (IECEx)
d = ENTRIES 1 OR 2
e = SENSING ELEMENT 201, 202, 203, 204, 205, 206, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, S12, S13, S14, S16, S18, S42, S43, S44, S46, S48
f = 24 CHARACTER NUMBERING SYSTEM THAT DOES NOT AFFECT SAFETY

CERTIFIED
PO #
ENG
USER
DE #
by

ISS.	EDD/DSR NO.	APP'D	DATE
1	10-23-122	SGA	11-14-23

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SCALE NONE
UNLESS OTHERWISE STATED ALL DIMENSIONS IN INCHES (MM)

DR. TDH 11-14-23
CK. JEN 11-14-23

AMETEK® DREXELBROOK

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HORSHAM, PA 19044-9986

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FAX 215-674-2731

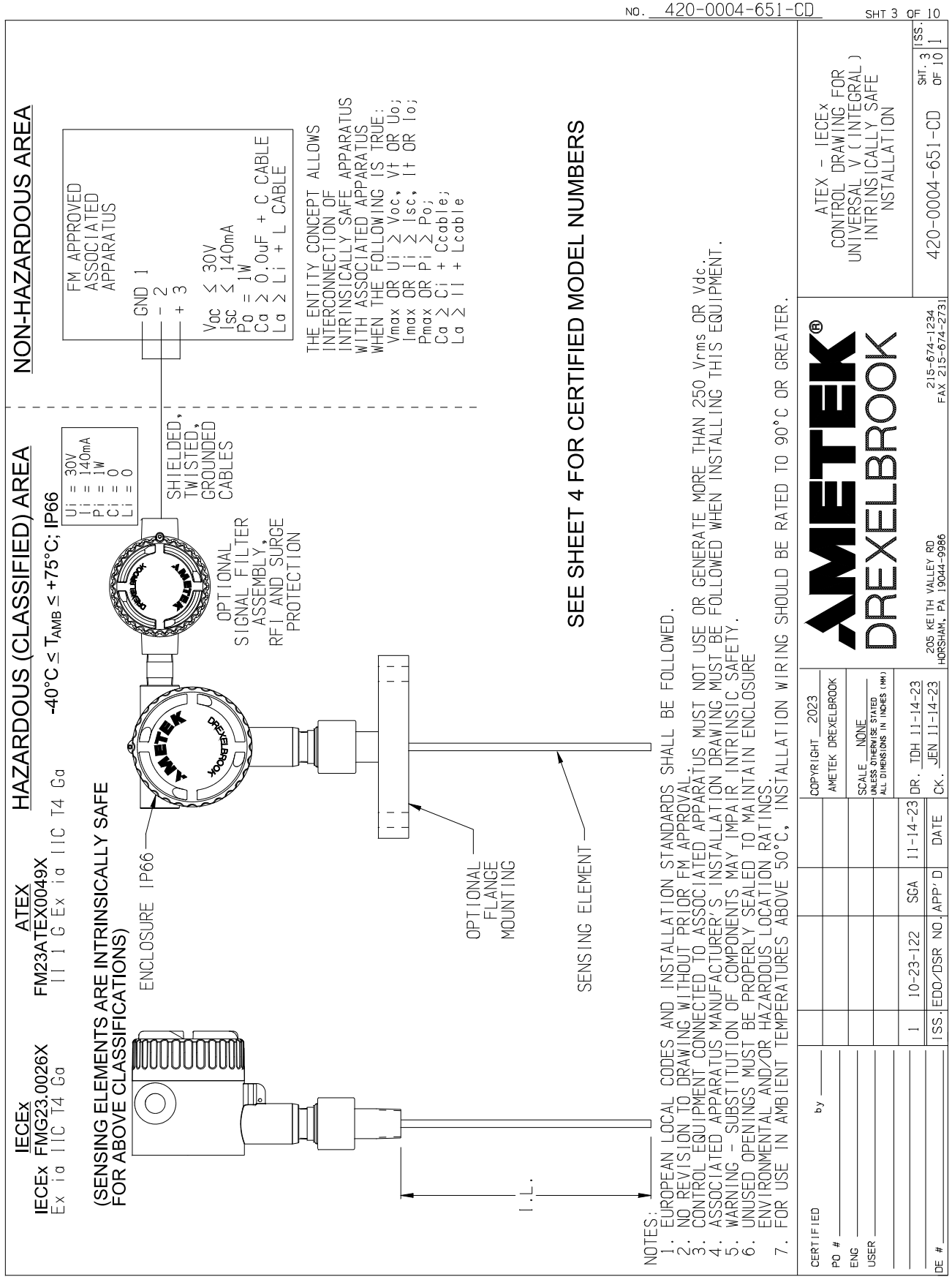
ATEX - IECEx
CONTROL DRAWING FOR
UNIVERSAL V (INTEGRAL)
FLAMEPROOF INSTALLATION

420-0004-651-CD

SHT. 2 OF 10

ISS. 1

8.2 ATEX / IECEx (Continued)



8.2 ATEX / IECEx (Continued)

NO. 420-0004-651-CD SHT 4 OF 10

CERTIFIED MODELS

Vab10cde00-f-g. Universal V - Integral Intrinsically Safe - Model Code

a = TYPE P, L, C, T, OR M
b = FREQUENCY AND PHASING 0, 1, 2, OR 3
c = APPROVAL 3 (ATEX), 5 (IECEx)
d = ENTRIES 1 OR 2
e = SURGE SUPPRESSION 0 OR 1
f = SENSING ELEMENT R00, R01, R02, R03, R04, R05, 201, 202, 203, 204, 205,
206, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262,
301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313,
314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326,
327, 328, 329, 330, 331, 332, 333, 334, 335, 501, 502, 503, 504,
505, 506, 507, 508, 509, 510, 511, 512, 513, 601, 603, 604, 605,
606, 607, 608, 609, 610, 611, 613, 703, 705, 706, 708, 709, 713,
714, 715, 722, S12, S13, S14, S16, S18, S42, S43, S44, S46, S48
ZZZ*
g = 24 CHARACTER NUMBERING SYSTEM THAT DOES NOT AFFECT SAFETY

ZZZ* = SPECIAL SENSING ELEMENT
700- ANY 7 DIGIT NUMERIC COMBINATION

NOTES:
1. MAXIMUM PROCESS TEMPERATURE 290°C
2. MAXIMUM SENSOR CAPACITANCE < 1uF
3. MAXIMUM INSERTION LENGTH ***RIGID SENSOR*** 30 FEET (9.144 METERS)
4. MAXIMUM INSERTION LENGTH ***FLEXIBLE SENSOR*** 2000 FEET (609.6 METERS)
5. SENSING ELEMENT ENCLOSURE IP66 (IP RATING DOES NOT APPLY TO
SPECIAL SENSORS SUPPLIED WITHOUT A 285- SERIES SENSING ELEMENT ENCLOSURE).

CERTIFIED
PO # _____
ENG _____
USER _____
DE # _____

ISS.	EDO/DSR NO.	APP'D	DATE
1	10-23-122	SGA	11-14-23

DR. TDH 11-14-23
CK. JEN 11-14-23

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SCALE NONE
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ALL DIMENSIONS IN INCHES (MM)

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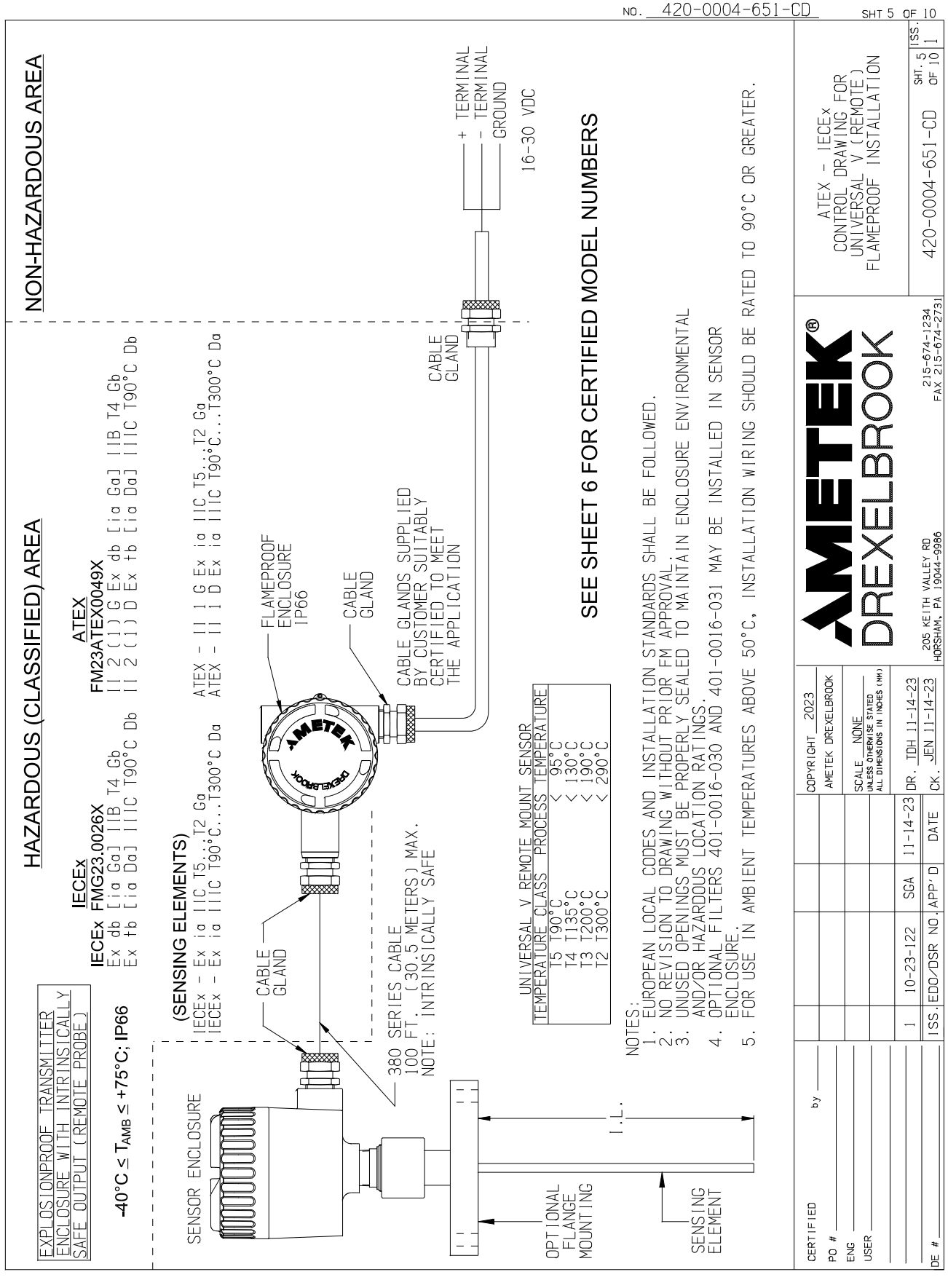
ATEX - IECEx
CONTROL DRAWING FOR
UNIVERSAL V (INTEGRAL)
INTRINSICALLY SAFE
INSTALLATION

420-0004-651-CD SHT. 4 OF 10 ISS. 1

8.2 ATEX / IECEx (Continued)



8.2 ATEX / IECEx (Continued)

NO. 420-0004-651-CD SHT 6 OF 10

CERTIFIED MODELS

Vab10cdef0-g-h. Universal V - Remote Flameproof - Model Code

a = TYPE P, L, OR C
b = FREQUENCY AND PHASING 0, 1, 2, OR 3
c = APPROVAL 4 (ATEX), 6 (IECEx)
d = ENTRIES 1 OR 2
e = SURGE SUPPRESSION 0, 4, OR D
f = REMOTE CONFIGURATION 1,2,3,4,5,6,7,8,9,A,B,C,D,E,F,G,H,J,K,L,M,N,P,R,S, OR Z
g = SENSING ELEMENT R09, 000, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110,
111, 112, 113, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311,
312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325,
326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 501, 502, 503, 504,
505, 506, 507, 508, 509, 510, 513, 601, 603, 604, 605, 606, 607, 608,
609, 610, 611, 612, 613, 701, 702, 703, 704, 705, 706, 707, 708, 709,
710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723,
724, 725, 726, 727, 728, 729, 730, 731, 732, 735, 736, 737, 738, 739,
740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, S02,
S03, S04, S06, S08, ZZZ*
h = 24 CHARACTER NUMBERING SYSTEM THAT DOES NOT AFFECT SAFETY.

ZZZ* = SPECIAL SENSING ELEMENT
700- ANY 7 DIGIT NUMERIC COMBINATION

NOTES:
1. MAXIMUM PROCESS TEMPERATURE 290°C
2. MAXIMUM SENSOR CAPACITANCE < 1uF
3. MAXIMUM INSERTION LENGTH ***RIGID SENSOR*** 30 FEET (9.144 METERS)
4. MAXIMUM INSERTION LENGTH ***FLEXIBLE SENSOR*** 2000 FEET (609.6 METERS)
5. SENSING ELEMENT ENCLOSURE IP66 (TP RATING DOES NOT APPLY TO SPECIAL SENSORS SUPPLIED WITHOUT A 285- SERIES SENSING ELEMENT ENCLOSURE).

CERTIFIED
PO #
ENG
USER
DE #

ISS.	EDO/DSR NO.	APP'D	DATE
1	10-23-122	SGA	11-14-23

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SCALE NONE
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DR. TDH 11-14-23
CK. JEN 11-14-23

AMETEK®
DREXELBROOK
205 KEITH VALLEY RD
HORSHAM, PA 19044-9986
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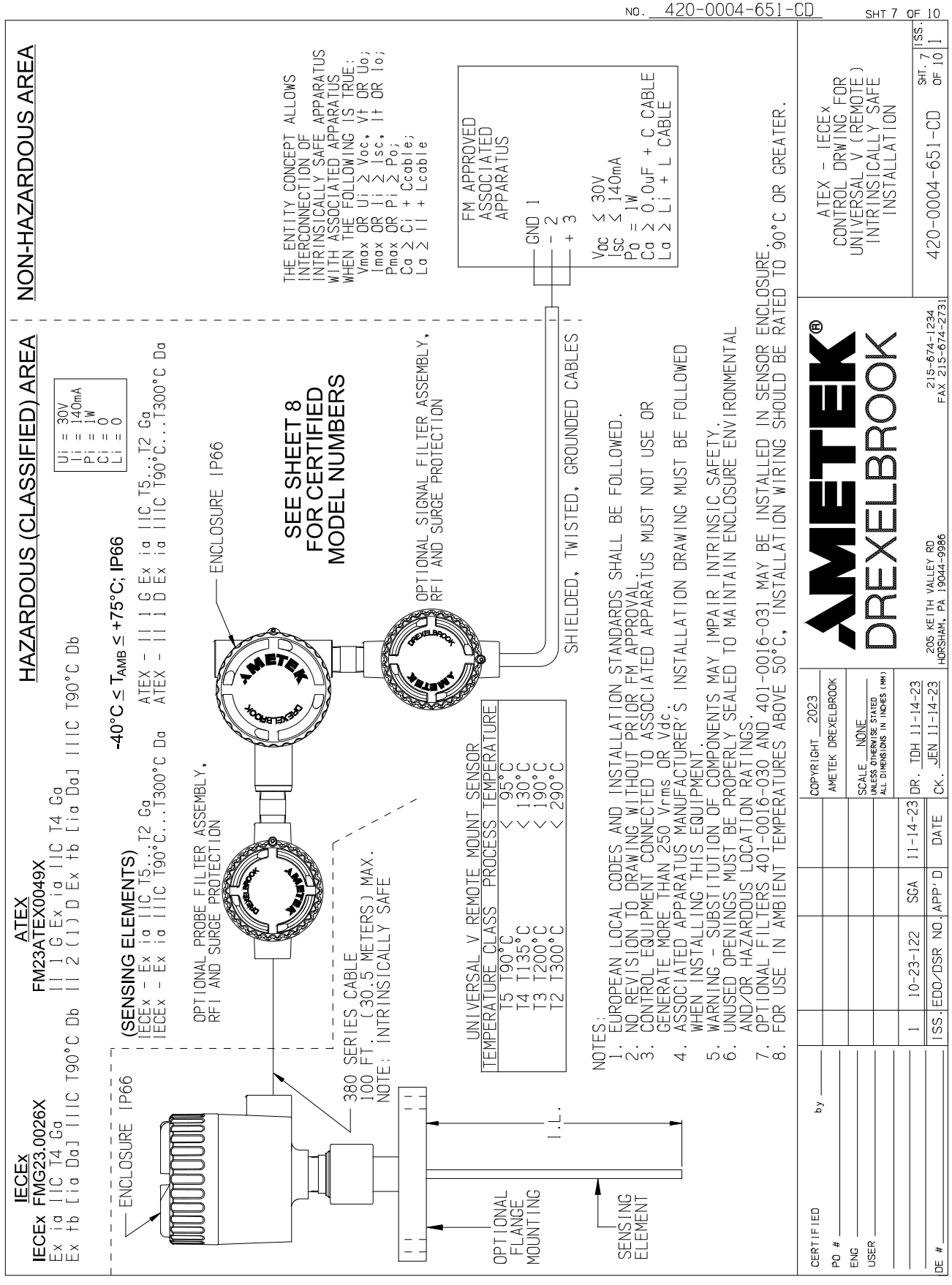
ATEX - IECEx
CONTROL DRAWING FOR
UNIVERSAL V (REMOTE)
FLAMEPROOF INSTALLATION

420-0004-651-CD
SHT. 6 OF 10
ISS. 1

8.2 ATEX / IECEx (Continued)



8.2 ATEX / IECEx (Continued)

NO. 420-0004-651-CD SHT 8 OF 10

CERTIFIED MODELS

Vab10cdef0-g-h. Universal V - Remote Intrinsically Safe - Model Code

a = TYPE P, L, OR C
b = FREQUENCY AND PHASING 0, 1, 2, OR 3
c = APPROVAL 3 (ATEX), 5 (IECEx)
d = ENTRIES 1 OR 2
e = SURGE SUPPRESSION 0, 1, 2, 3, 4, 5, 6, 7, OR D
f = REMOTE CONFIGURATION 1,2,3,4,5,6,7,8,9,A,B,C,D,E,F,G,H,J,K,L,M,N,P,R,S, OR Z
g = SENSING ELEMENT R09, 000, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110,
111, 112, 113, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311,
312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325,
326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 501, 502, 503, 504,
505, 506, 507, 508, 509, 510, 513, 601, 603, 604, 605, 606, 607, 608,
609, 610, 611, 612, 613, 701, 702, 703, 704, 705, 706, 707, 708, 709,
710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723,
724, 725, 726, 727, 728, 729, 730, 731, 732, 735, 736, 737, 738, 739,
740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, S02,
S03, S04, S06, S08, ZZZ*
h = 24 CHARACTER NUMBERING SYSTEM THAT DOES NOT AFFECT SAFETY

ZZZ* = SPECIAL SENSING ELEMENT
700- ANY 7 DIGIT NUMERIC COMBINATION

NOTES:
1. MAXIMUM PROCESS TEMPERATURE 290°C
2. MAXIMUM SENSOR CAPACITANCE < 1uF
3. MAXIMUM INSERTION LENGTH *RIGID SENSOR* 30 FEET (9.144 METERS)
4. MAXIMUM INSERTION LENGTH *FLEXIBLE SENSOR* 2000 FEET (609.6 METERS)
5. SENSING ELEMENT ENCLOSURE IP66 (IP RATING DOES NOT
APPLY TO SPECIAL SENSORS SUPPLIED WITHOUT A
285- SERIES SENSING ELEMENT ENCLOSURE).

CERTIFIED
PO # _____
ENG _____
USER _____
DE # _____

ISS.	EDO/DSR NO.	APP'D	DATE
1	10-23-122	SGA	11-14-23

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SCALE NONE
UNLESS OTHERWISE STATED
ALL DIMENSIONS IN INCHES (MM)

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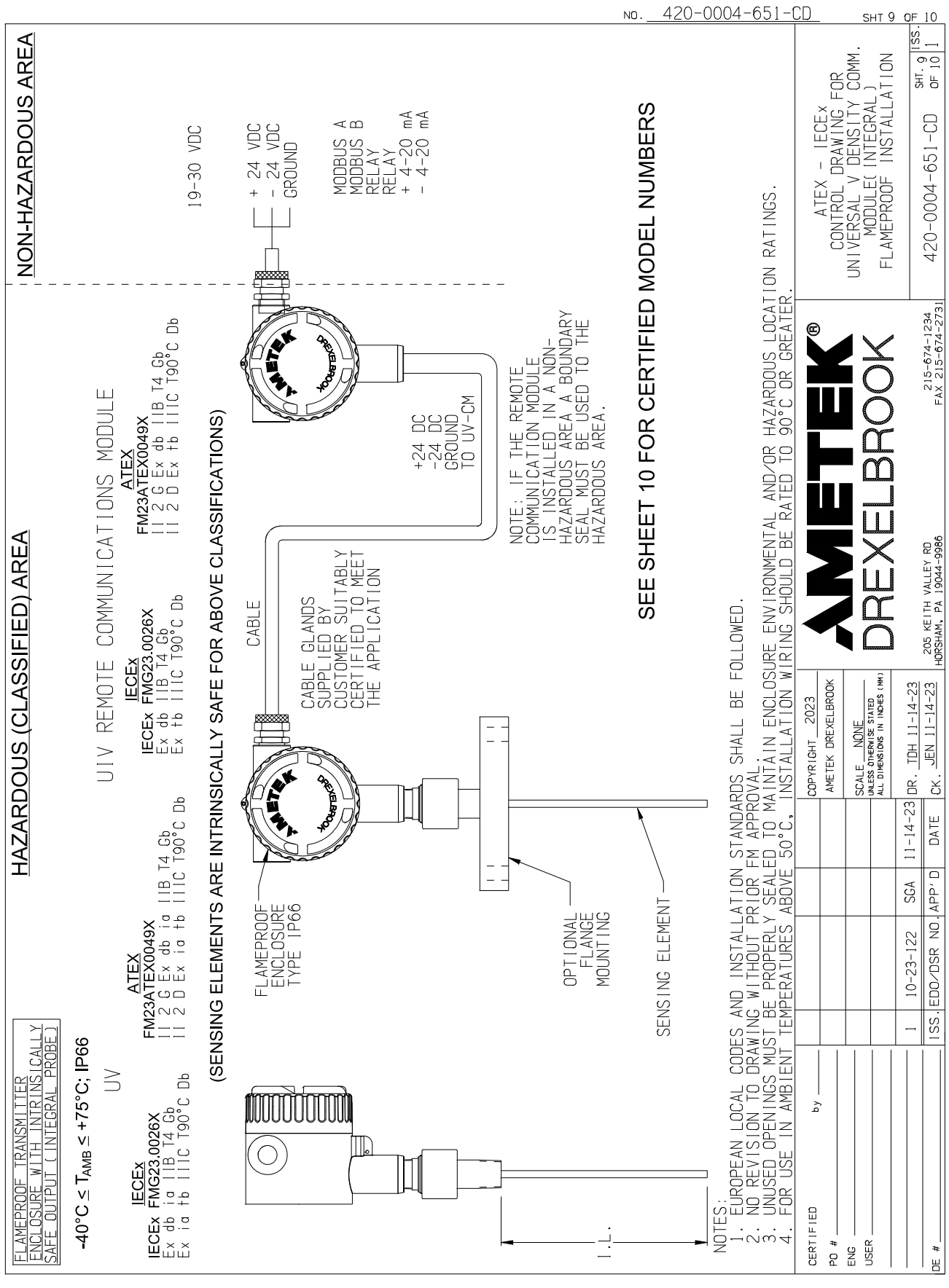
AMETEK®
DREXELBROOK
205 KEITH VALLEY RD
HORSHAM, PA 19044-9986
215-674-1234
FAX 215-674-2731

ATEX - IECEx
CONTROL DRAWING FOR
UNIVERSAL V (REMOTE)
INTRINSICALLY SAFE
INSTALLATION

420-0004-651-CD SHT. 8 OF 10 ISS. 1

8.2 ATEX / IECEx (Continued)



8.2 ATEX / IECEx (Continued)

NO. 420-0004-651-CD SHT 10 OF 10

CERTIFIED MODELS

VDa10bc000-d-e. Universal V - Flameproof - Model Code

a = FREQUENCY AND PHASING 0, or *R
b = APPROVAL A (ATEX), B (IECEx)
c = ENTRIES 1 OR 2
d = SENSING ELEMENT 201, 202, 203, 204, 205, 206, 251, 252, 253, 254, 255,
256, 257, 258, 259, 260, 261, 262, S12, S13, S14, S16,
S18, S42, S43, S44, S46, S48
e = 24 CHARACTER NUMBERING SYSTEM THAT DOES NOT AFFECT SAFETY

*R = Retrofit

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ATEX - IECEx
CONTROL DRAWING FOR
UNIVERSAL V DENSITY COMM.
MODULE (INTEGRAL)
FLAMEPROOF INSTALLATION

420-0004-651-CD

SHT. 10 OF 10 | ISS. 1

Notes

DREXELBROOK®

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AMETEK®

LEVEL MEASUREMENT SOLUTIONS

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ametek-measurement.com

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