AMETEK®
DREXELBROOK

Leader in
Level Measurement

Installation and Operating Instructions

Total Tank Level System
(Single or Dual 4-20mA Output)

Magnetostrictive
Total Level, Interface Level, & Temperature Measurement System

Worldwide Technical Assistance + 1-215-674-1234
Website: www.drexelbrook.com
Email: drexelbrook.service@ametek.com

Total Tank Level System

Magnetostrictive
Total Level, Interface Level, & Temperature
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ULTRAFLEX **RIGID**

AMETEK®
DREXELBROOK

An ISO 9001 Certified Company

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Section 1

Section 1: Introduction

1.1 Product Description

The AMETEK Drexelbrook Total Tank Level System is an integral assembly that measures Liquid Level, Interface Level, and Temperature using magnetostrictive technology.

A single or dual 4-20mA HART output is provided for level, interface and temperature data.

A variety of floats and mounting accessories are available to fit nearly all applications.

1.2 Terminology

Magnetostriction: A magnetic field produces small change in the physical dimension of ferromagnetic materials on the order of several parts per million in carbon steel and conversely, a physical deformation or strain (torsion) produces a change of magnetization in the material.

1.3 Magnetostrictive Technology

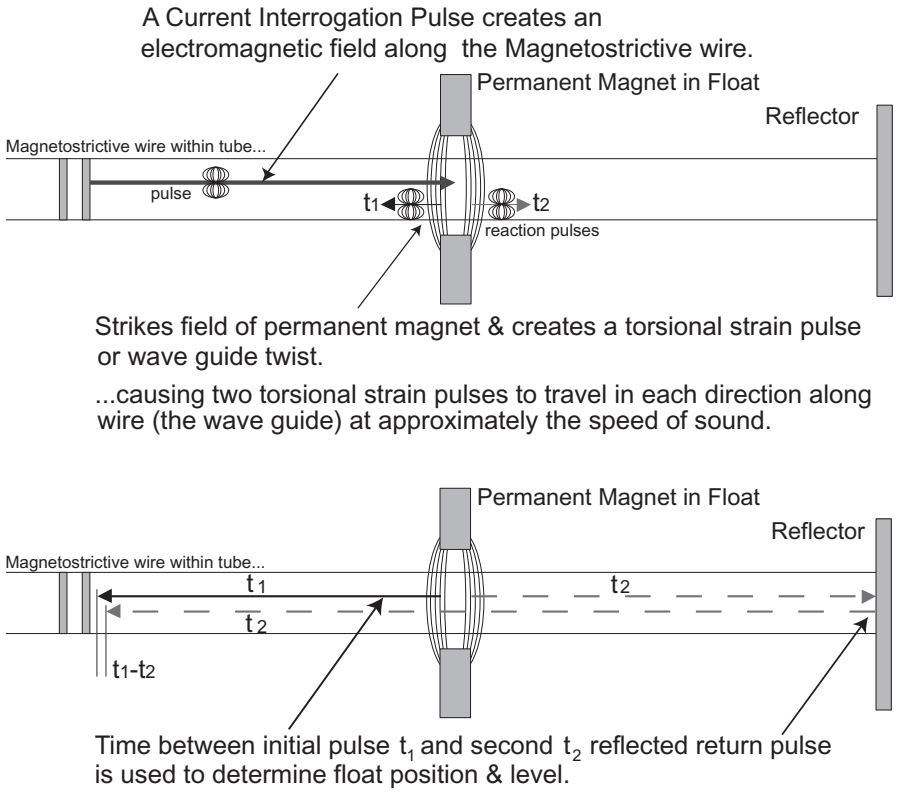


Figure 1-1
Magnetostrictive Theory

1.3 Magnetostrictive Technology (Continued)

In a magnetostrictive level sensor a current pulse is sent down a wave guide made of a special nickel alloy wire designed to enhance magnetostrictive properties. A permanent magnet within a float is used to indicate the position or level being measured. The interaction of the current pulse with the magnetic field created by a float (with magnet) produces a torsional strain pulse that travels at approximately the speed of sound along the wire. A small induction pickup coil senses the strain pulse. The position of the float is determined with high precision by measuring the time between the launching of the current pulse and the arrival of the torsional strain pulse.

The magnetostrictive wire is linearized during manufacture and the speed of the torsional pulse is determined for the specific sensor. Inherently, magnetostrictive sensors have very high resolution and repeatability.

Magnetostrictive technology is excellent for applications where the dielectric constant is very low or is changing. The technology has been used quite successfully for the detection of leaks in underground storage tanks, for example. The measurement of a 0.1 gallon leak out of a 10,000 gallon tank over a period of one hour is the standard for EPA mandated leak detection.

1.3.1 Magnetostrictive System Description

The Total Level Tank Level System (TLS) measures up to 2 fluid levels and up to 5 temperature points within a tank.

Each AMETEK Total Level Tank Level System (TLS) system consists of a
1. Magnetostrictive Level Probe (SS Rigid or PVDF Flexible)
2. Float package (if ordered)
3. Retaining clip and or weight kit (Flexible)

1.4 Model Number

Model - Total Tank Level System

M Total Tank Level System

Output

2 Single 4-20mA w/HART

3 Dual 4-20mA w/HART (Single HART output)

Housing

3 Dual compartment powder coated aluminum, 3/4" NPT (No Display)

4 Dual compartment powder coated aluminum, M20 (No Display)

5 Dual compartment powder coated aluminum, 3/4" NPT (Display w/Viewport Lid)

6 Dual compartment powder coated aluminum, M20 (Display w/Viewport Lid)

Dual Seal

X None

1 Yes

Material

B 316 SS Stainless Steel (Rigid) 20" to 378" Long

V PVDF (UltraFlex) 65" to 600" Long

S Sanitary, 3A (Tri-clamp mounting, polished tubing 240 grit 316 SS Rigid only) 21" to 140"

F Food Grade (Tri-clamp mounting, 180 grit 316 SS Rigid only) 21" to 200"

Mounting

1 Adjustable, 16" Long Extension Tube UltraFlex Option only

2 3/4 NPT 316 SS Rigid Option only

3 Adjustable 316 SS Rigid Option only

A 2" Tri-clamp Sanitary or Food Grade Option only

B 2 1/2" Tri-clamp Sanitary or Food Grade Option only

C 3" Tri-clamp Sanitary or Food Grade Option only

D 4" Tri-clamp Sanitary or Food Grade Option only

Level Measurement Span (LMS)

XXX 3 figure number (specified in inches)

Temperature Points

R1 1 Sensor (@18" for Rigid, Flex Probe Position Varies)

R5 5 Sensors

T1 1 Sensor (close to bottom)

Number of Floats

F1 1 Float

F2 2 Floats

Over All Length (OAL)

XXX 3 figure number (specified in inches)

Float Kit 1 - Total Product Float Kit

XXX = None

001 = 316SS, 2.06" Diameter, 0.54 SG. UltraFlex PVDF Option

002 = 316SS, 2.06" Diameter, 0.64 SG. UltraFlex PVDF Option

003 = 316SS,2.06" Diameter, 0.54 SG. E-Clip/Spacer 1.25" Long Rigid

004 = 316SS, 2.06" Diameter, 0.64 SG. E-Clip/Spacer 1.25" Long Rigid

005 = 316SS, 1.83" Diameter, 0.65 SG. R-Clip (3A Sanitary) Rigid "S" Option

006 = 316SS, 1.83" Diameter, 0.65 SG. E-Clip (Food Grade) Rigid "F" Option

Float Kit 2 - Interface Float Kit

XXX = None

101 316SS, 2.06" Diameter, 0.85 SG. UltraFlex PVDF Option

102 316SS, 2.06" Diameter, 0.96 SG. UltraFlex PVDF Option

103 316SS, 2.05" Diameter, 0.85 SG. E-Clip/Spacer .875" Long Rigid

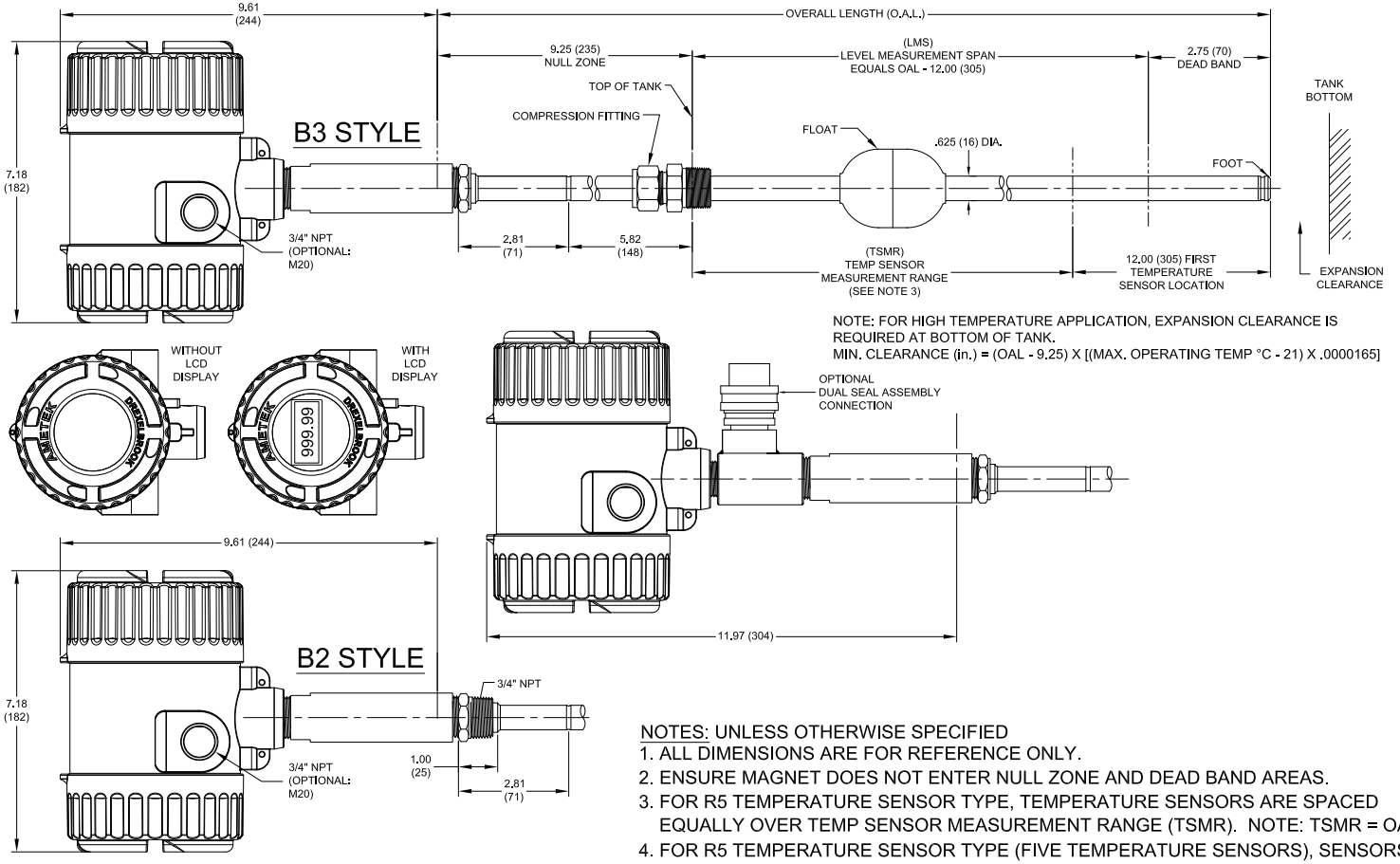
104 316SS, 2.05" Diameter, 0.96 SG. E-Clip/Spacer .875" Long Rigid

105 316SS, 2.05" Diameter, 1.10 SG. E-Clip/Spacer .875" Long Rigid

M	X	X	X	X	X	XXX	XX	XX	XXX	XXX	XXX

1.5 316 SS Rigid Probe (B Style) Dimensions - Inches (mm)

	DESIGNATION	LENGTH
OVERALL LENGTH OF PROBE	OAL	CUSTOMER SPECIFIED
LEVEL MEASUREMENT SPAN	LMS	OAL - 12.00 (305)
TEMPERATURE SENSOR MEASUREMENT RANGE	TSMR	OAL - 21.25 (540)



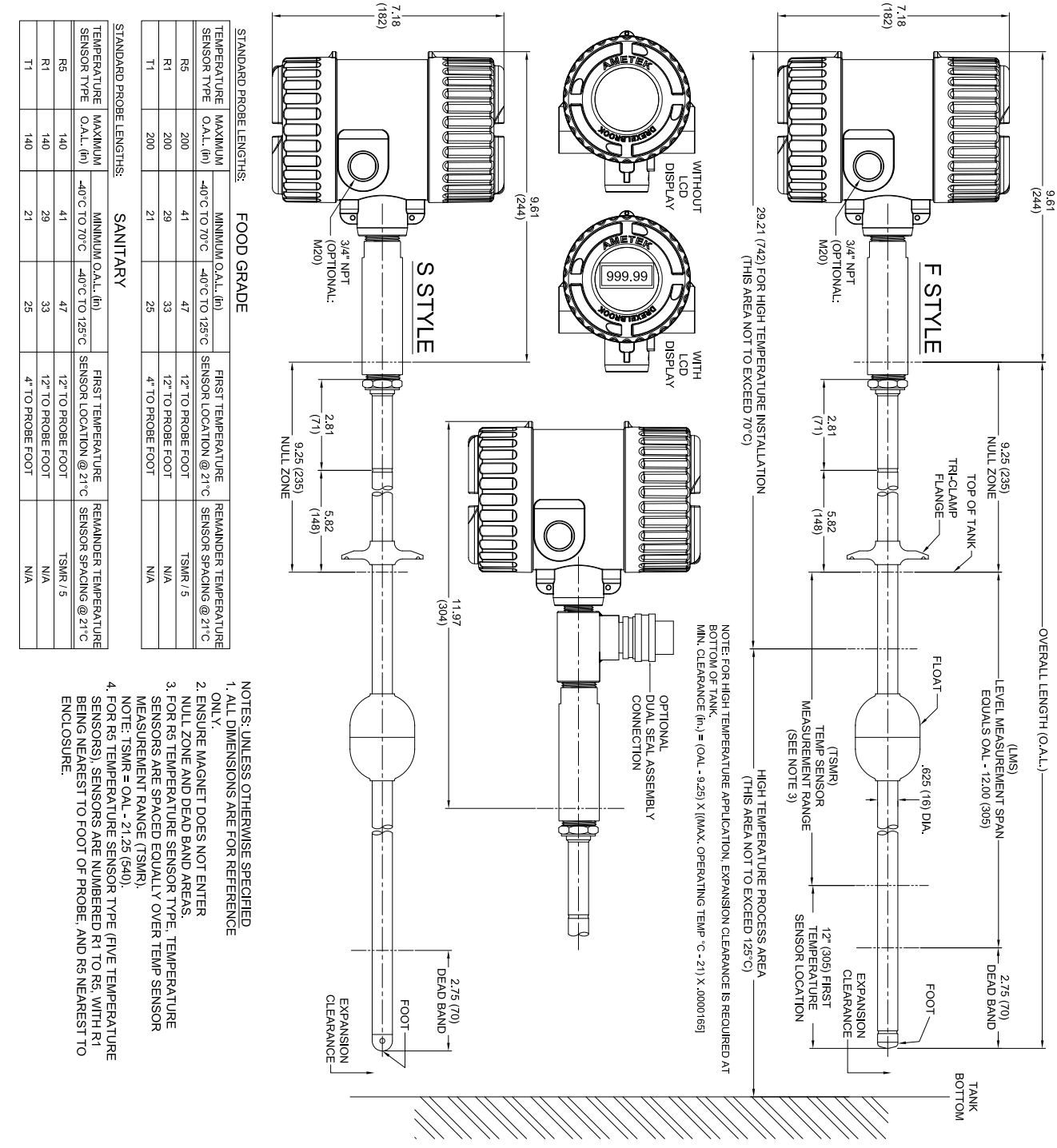
NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL DIMENSIONS ARE FOR REFERENCE ONLY.
2. ENSURE MAGNET DOES NOT ENTER NULL ZONE AND DEAD BAND AREAS.
3. FOR R5 TEMPERATURE SENSOR TYPE, TEMPERATURE SENSORS ARE SPACED EQUALLY OVER TEMP SENSOR MEASUREMENT RANGE (TSMR). NOTE: TSMR = OAL - 21.25 (540).
4. FOR R5 TEMPERATURE SENSOR TYPE (FIVE TEMPERATURE SENSORS), SENSORS ARE NUMBERED R1 TO R5, WITH R1 BEING NEAREST TO FOOT OF PROBE, AND R5 NEAREST TO ENCLOSURE.

STANDARD PROBE LENGTHS:

TEMPERATURE SENSOR TYPE	MAXIMUM O.A.L. (in)	MINIMUM O.A.L. (in)		FIRST TEMPERATURE SENSOR LOCATION @ 21°C	REMAINDER TEMPERATURE SENSOR SPACING @ 21°C
		-40°C TO 70°C	-40°C TO 125°C		
R5	378	41	47	12" TO PROBE FOOT	TSMR / 5
R1	378	29	33	12" TO PROBE FOOT	N/A
T1	378	21	25	4" TO PROBE FOOT	N/A

1.6 316 SS Rigid Probe (F & S Style) Dimensions - Inches (mm)



STANDARD PROBE LENGTHS: FOOD GRADE

TEMPERATURE SENSOR TYPE	MAXIMUM O.A.L. (in)	MINIMUM O.A.L. (in)		FIRST TEMPERATURE SENSOR LOCATION @ 21°C	REMAINDER TEMPERATURE SENSOR SPACING @ 21°C
		-40°C TO 70°C	-40°C TO 125°C		
R5	200	41	47	12" TO PROBE FOOT	TSMR / 5
R1	200	29	33	12" TO PROBE FOOT	N/A
T1	200	21	25	4" TO PROBE FOOT	N/A

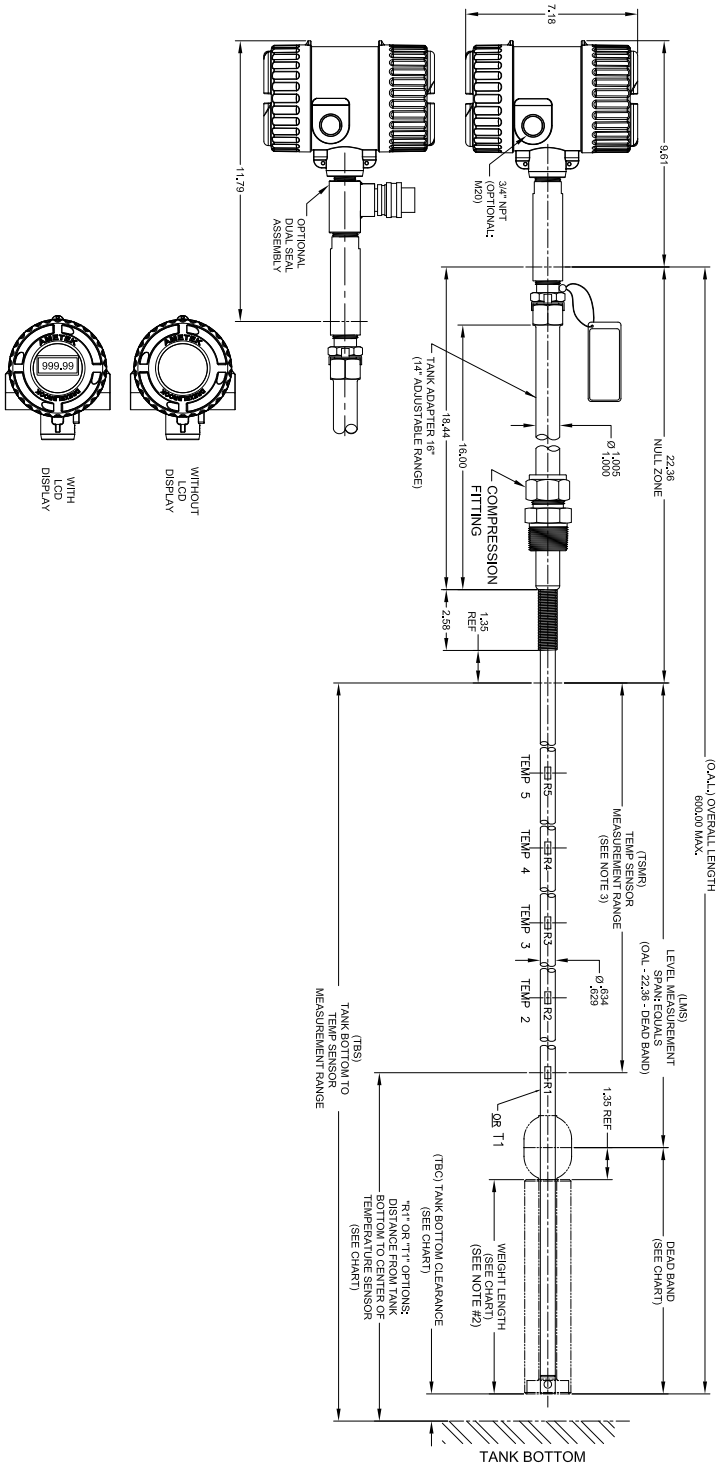
STANDARD PROBE LENGTHS: SANITARY

TEMPERATURE SENSOR TYPE	MAXIMUM O.A.L. (in)	MINIMUM O.A.L. (in)		FIRST TEMPERATURE SENSOR LOCATION @ 21°C	REMAINDER TEMPERATURE SENSOR SPACING @ 21°C
		-40°C TO 70°C	-40°C TO 125°C		
R5	140	41	47	12" TO PROBE FOOT	TSMR / 5
R1	140	29	33	12" TO PROBE FOOT	N/A
T1	140	21	25	4" TO PROBE FOOT	N/A

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL DIMENSIONS ARE FOR REFERENCE ONLY.
2. ENSURE MAGNET DOES NOT ENTER NULL ZONE AND DEAD BAND AREAS.
3. FOR R5 TEMPERATURE SENSOR TYPE, TEMPERATURE SENSORS ARE SPACED EQUALLY OVER TEMP SENSOR MEASUREMENT RANGE (TSMR).
   NOTE: TSMR = OAL - 21.25 (540).
4. FOR R5 TEMPERATURE SENSOR TYPE (FIVE TEMPERATURE SENSORS), SENSORS ARE NUMBERED R1 TO R5, WITH R1 BEING NEAREST TO FOOT OF PROBE, AND R5 NEAREST TO ENCLOSURE.

1.7 UltraFlex Probe Dimensions - Inches (mm)



OVERALL LENGTH OF PROBE (O.A.L.)	DEAD BAND	WEIGHT LENGTH (SEE NOTE 2)	TANK BOTTOM CLEARANCE (TBC) @ 70° F (21° C)	DISTANCE FROM TANK BOTTOM TO TEMPERATURE SENSOR: "R1" OPTION	DISTANCE FROM TANK BOTTOM TO FIRST TEMPERATURE SENSOR: "R5" OR "T1" OPTION	REMAINDER OF TEMPERATURE SENSOR SPACING: R5 OPTION
65 ~ 144	4.85	3.50	2.00	27.00	12.13	(OAL - 32.5) / 5
145 ~ 216	7.35	6.00	3.00	30.00	13.13	(OAL - 32.5) / 5
217 ~ 288	7.35	6.00	3.00	30.00	14.13	(OAL - 33.5) / 5
289 ~ 336	8.35	7.00	4.00	35.00	15.13	(OAL - 33.5) / 5
337 ~ 432	8.35	7.00	4.00	35.00	16.13	(OAL - 34.5) / 5
433 ~ 468	12.35	11.00	5.00	39.00	17.13	(OAL - 34.5) / 5
469 ~ 588	12.35	11.00	5.00	39.00	18.13	(OAL - 35.5) / 5
589 ~ 600	12.35	11.00	5.00	39.00	19.13	(OAL - 36.5) / 5

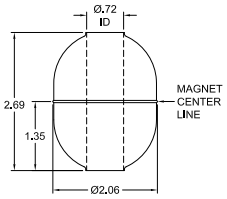
NOTES: UNLESS OTHERWISE SPECIFIED

1. OPERATING TEMPERATURE -40°C TO +70°C (-40°F TO +158°F)
2. ALL DIMENSIONS ARE REFERENCE IN INCHES.
   A) DEAD BAND IS BASED ON THE CENTER LINE OF MAGNET.
   B) WEIGHT LENGTH IS BASED ON DEAD BAND AND 1.35 FLOAT REFERENCE DIMENSION SHOWN.
3. TEMP SENSORS ARE SPACED EQUALLY OVER TEMP SENSOR MEASUREMENT RANGE (TSMR).

1.8 Float options (Dimensions) inches

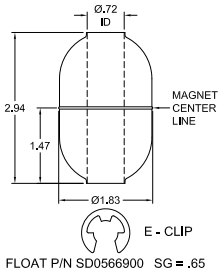
PRODUCT FLOATS

PRODUCT FLOATS
UltraFlex PVDF Probes



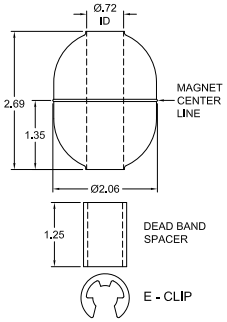
FLOAT P/N 14020002 SG = .54
FLOAT P/N SD0566600 SG = .64

PRODUCT FLOAT
Rigid 316 SS Food Grade Probe



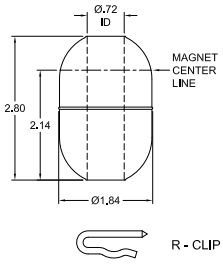
FLOAT P/N SD0566900 SG = .65

PRODUCT FLOATS
Rigid 316 SS Probes



FLOAT P/N SD0557200 SG = .54
FLOAT P/N SD0557201 SG = .64

PRODUCT FLOAT
Rigid 316 SS 3A Sanitary Probe

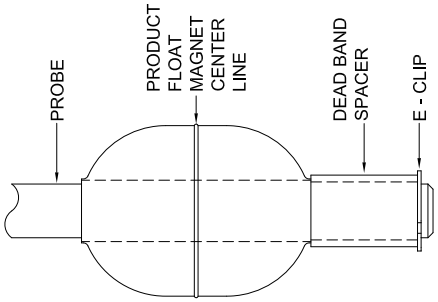


FLOAT P/N SD0566000 SG = .65

Note: Product level floats must be installed prior to an interface level float. If using with an interface float do not install the float dead band spacer below the product float.

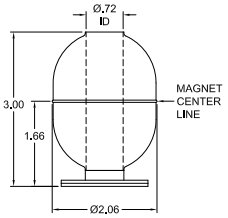
Installation Procedure:

1) First, slide float onto probe. Orientation of the top & bottom of these floats is not required (Except for the 3A Sanitary Float SD0566000) since the magnet is located in the middle of the float. *For the 3A Sanitary Float, the magnet needs to be at the top of the float*.
2) Next, slide the float spacer onto the probe.
3) Finally, capture the components on the probe with the float retaining E-clip or R-clip. The E-clip presses into the groove at the bottom of the probe. The R-clip insterts into the hole at the bottom of the 3A Sanitary probe.



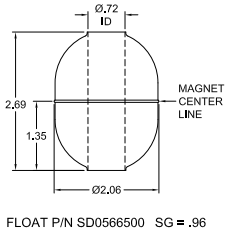
INTERFACE FLOATS

INTERFACE FLOATS
UltraFlex PVDF Probes



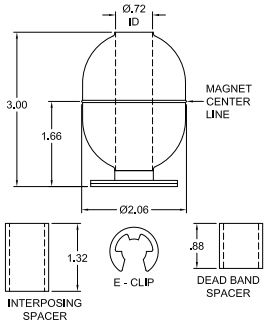
FLOAT P/N SD0437900 SG = .85

INTERFACE FLOATS
UltraFlex PVDF Probes



FLOAT P/N SD0566500 SG = .96

INTERFACE FLOATS
Rigid 316 SS Probes

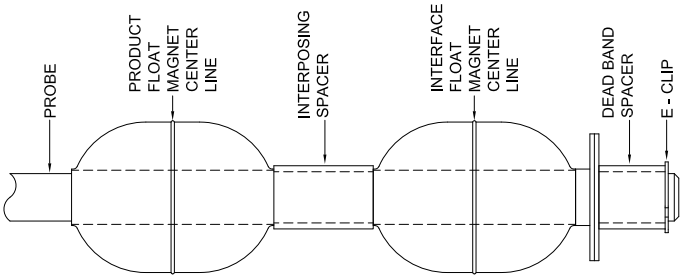


FLOAT P/N SD0548301 SG = .85
FLOAT P/N SD0556800 SG = .96
FLOAT P/N SD0564900 SG = 1.10

Note: Interface floats are for use below the Product floats.

Installation Procedure:

1) First, slide interposing float spacer onto probe.
2) Next, slide the interface float onto the probe with the ballast plates at the bottom when provided.
3) Now, slide the dead band float spacer onto the probe.
4) Finally, capture the components on the probe with the float retaining E-clip. The E-clip presses into the groove at the bottom of the probe.



Section 2

Section 2: Installation

2.1 Mounting Considerations

Mounting considerations may vary (Flanges, Compression Fitting, etc.) depending on the application. For underground tanks, the probe is generally mounted in the riser, resting on the bottom of the tank. Spacers are used to hold the sensor in the riser and a cable is suspended from the tank cap.

While most underground tanks are horizontal and fairly standard in design, above ground tanks vary considerably. The requirements for mounting these probes are fairly simple.

Since the sensor requires a float to provide level position, there is a minimum process connection size required for insertion of the float into the tank. It is recommended that a minimum of 2” NPT (2" Tri-Clamp for "S" and "F" Style Probes) be used for the most reliable system.

The size and material of the float being used will have a slight impact on the overall accuracy of the measuring system. In general, the larger the float the easier it is to provide a high accuracy measurement.

2.1.1 Probe Termonology

Insertion Length:
Is the distance from the top of the tank mounting flange to the inside bottom of the tank.

Overall Length (OAL):
Is the probe length required, determined by subtracting the tank bottom clearance from the Insertion Length plus the distance selected from the top tank mounting flange.

The amount of Active Range in a tank will vary, depending on the mounting style and probe lengths.

Stainless Steel Rigid probes are available in lengths:
Rigid 316 SS style probes up to 31.5 feet (9.6 M), see drawing on page 4.
Sanitary "S" style probe up to 11.6 feet (3.5 M), see drawing on page 5.
Food Grade "F" style probe up to 16.6 feet (5.0 M), see drawing on page 5.

Operational Measurement Span (OMS):
The operational measurement span is the section of probe that is functional. Generally this will represent the overall length (OAL) minus the dead band section at the bottom of the probe and minus the null zone section at the top of the probe. The OMS section also represent the section of probe that contains the temperature measurement sensors if ordering the R5 (5 temperature sensors) option.

2.2 General Probe Information

Stainless Steel Probes are to be mounted with probe end about 1/2” (12.7mm) from the tank bottom. Minimum process connection depends on the diameter of float, but it is suggested to use 2” NPT or larger.

Stainless Steel probes utilizing a compression fitting, the fitting should be positioned no closer than 1" below the “crimp” in the 5/8" diameter tube.

PVDF probes are available in lengths up to 50 feet (15.2 M). Reference drawing on page 6 for dimensional details.

PVDF probes use a (customer supplied) compression fitting at the top of the tank allowing adjustability over a range of 14" (355.6 mm).

IMPORTANT

Be sure to read & understand all of the Installation and handling Instructions procedure provided with product before beginning!
Installation and Handling Instructions can also be found on the website.
http://www.drexelbrook.com/Continuous-Level-Measurement/Index.aspx

2.2.1 Unpacking

Carefully remove the contents of the shipping carton and check each item against the packing list before destroying any packing materials. If there is any shortage or damage, report to the factory at 1-215-674-1234.

2.2.2 Storage

Total Tank Level System systems should be stored in their original shipping containers until ready for installation.
Damage that occurs in storage is not covered under manufacturers system warranty.

2.3 Mounting Conditions

CAUTION ⚠

- **When installing probes, do not bend the probes, permanent damage may result.**
- **Longer probes need to be supported at both ends or during uncoiling while handling.**
- **Probes are sealed at the factory and have electronic circuits inside. Do not attempt to open probe or weld the tube.**
- Total Tank Level System is designed for industrial applications, but should be mounted in a location as free as possible from vibration, corrosive atmospheres, or any possibility of mechanical damage.
- Place the level gauge in a reasonably accessible location. Ambient temperature should be between -40°F and 158°F (-40°C to 70°C).
- Mount the probe in a vertical position. See Figure 2-1.
- Float should have free movement along probe. Float dimensions are shown in Section 1.8.

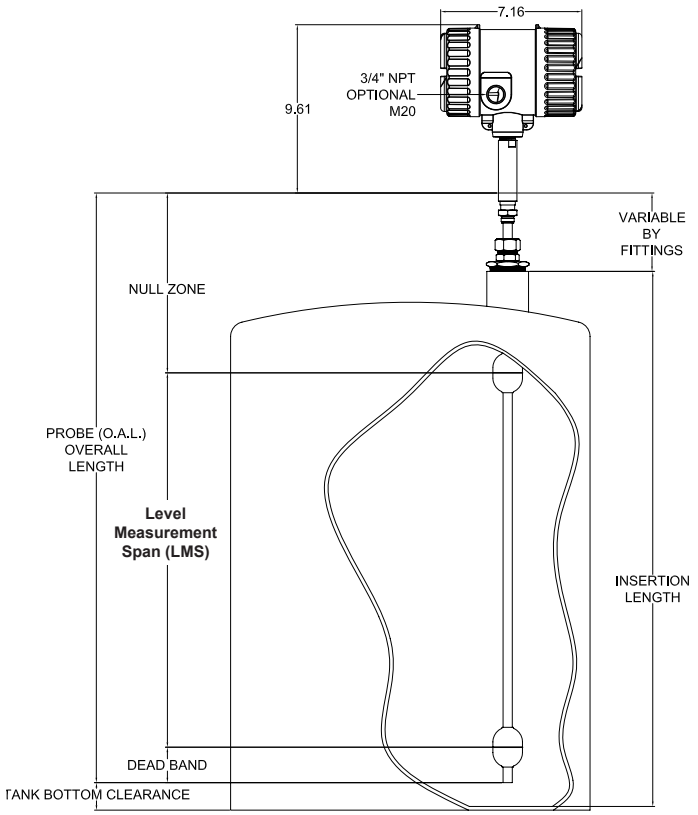
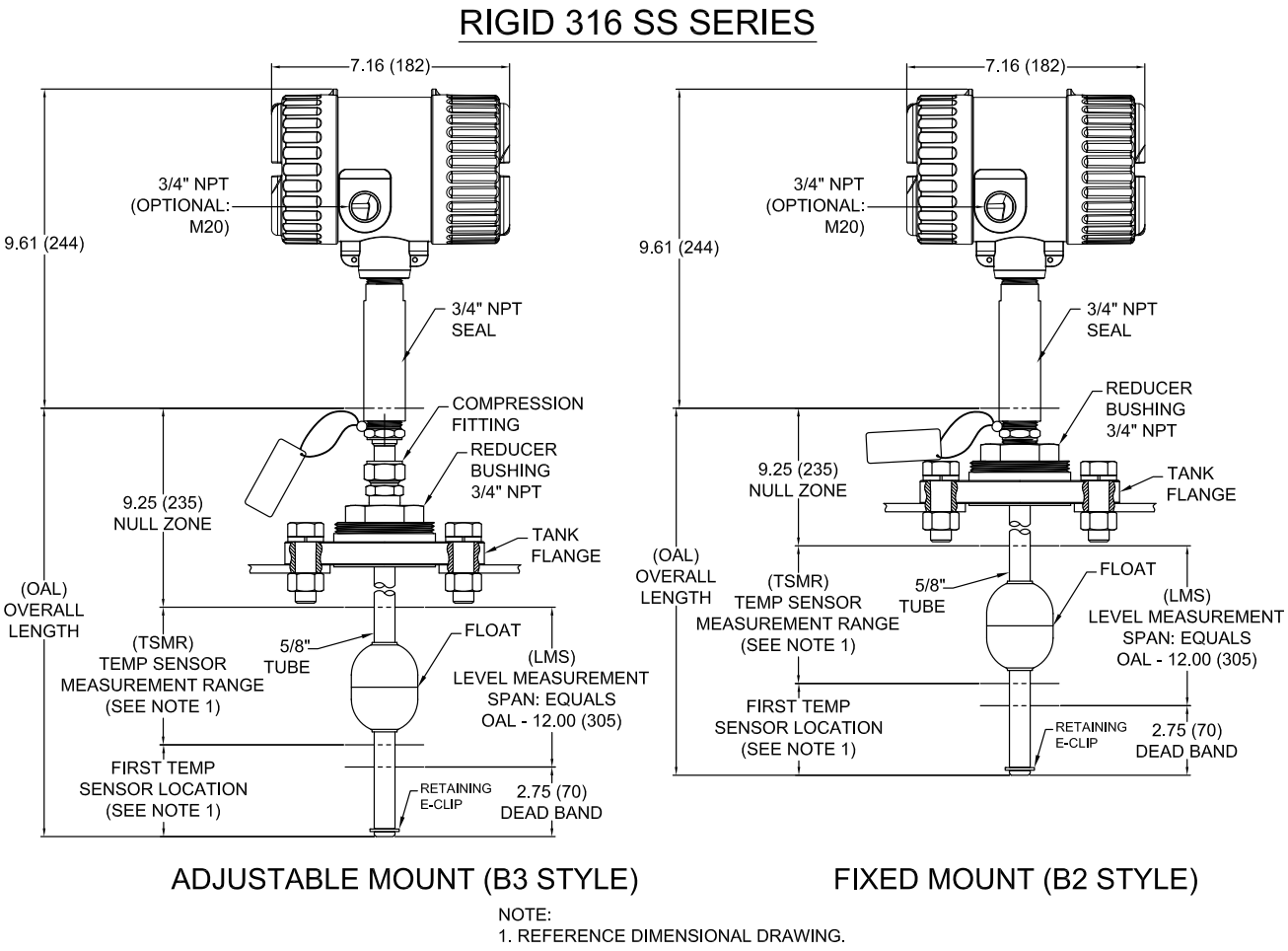


Figure 2-1

2.4 Rigid 316 SS Probe Mounting



NOTE:
1. REFERENCE DIMENSIONAL DRAWING.

Figure 2-2
Rigid Probe Installation Drawing

2.5 UltraFlex Probe Mounting

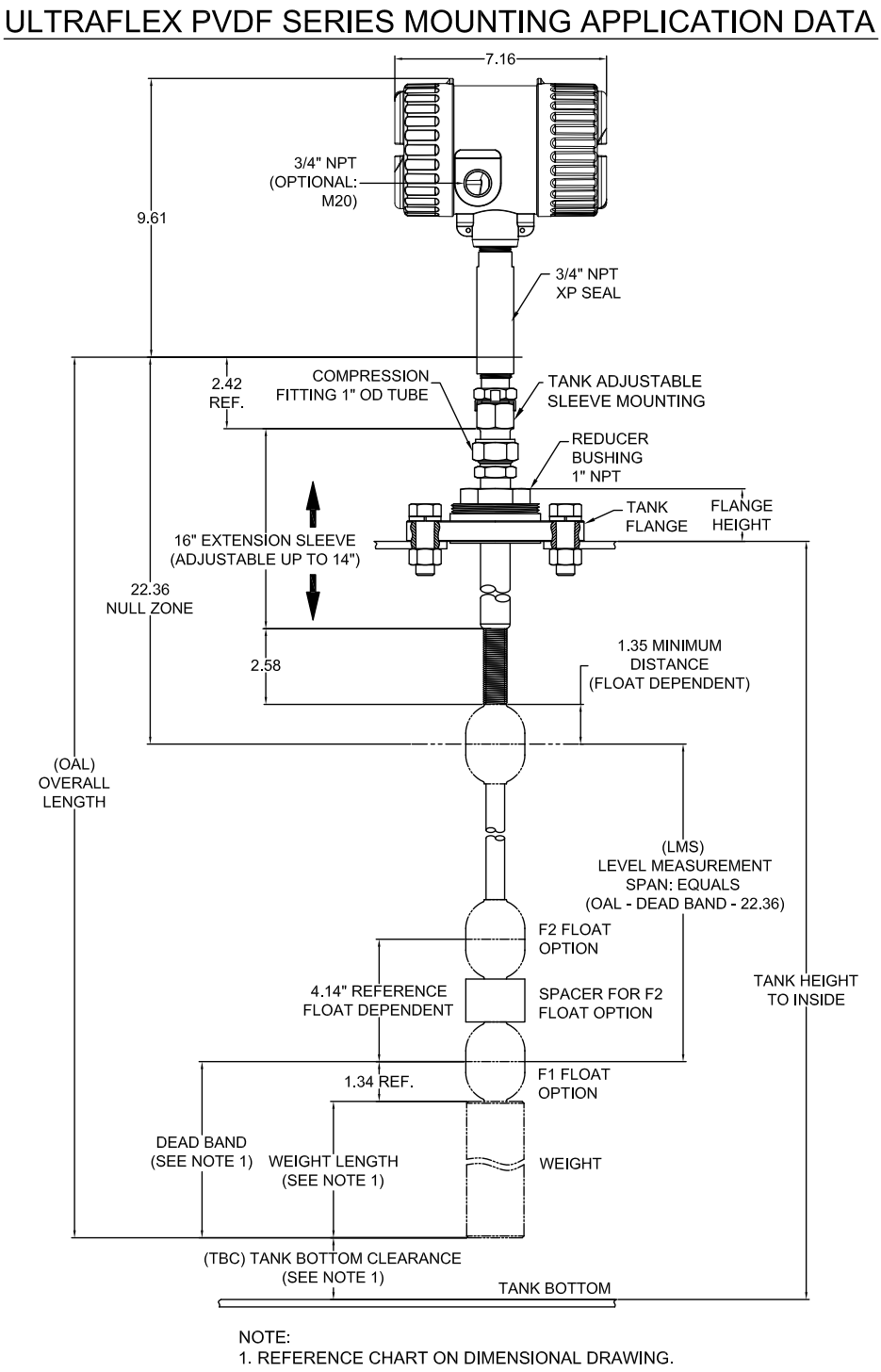


Figure 2-3
UltraFlex Probe Installation Drawing

2.6 Rigid 316 SS F and S Probe Mounting

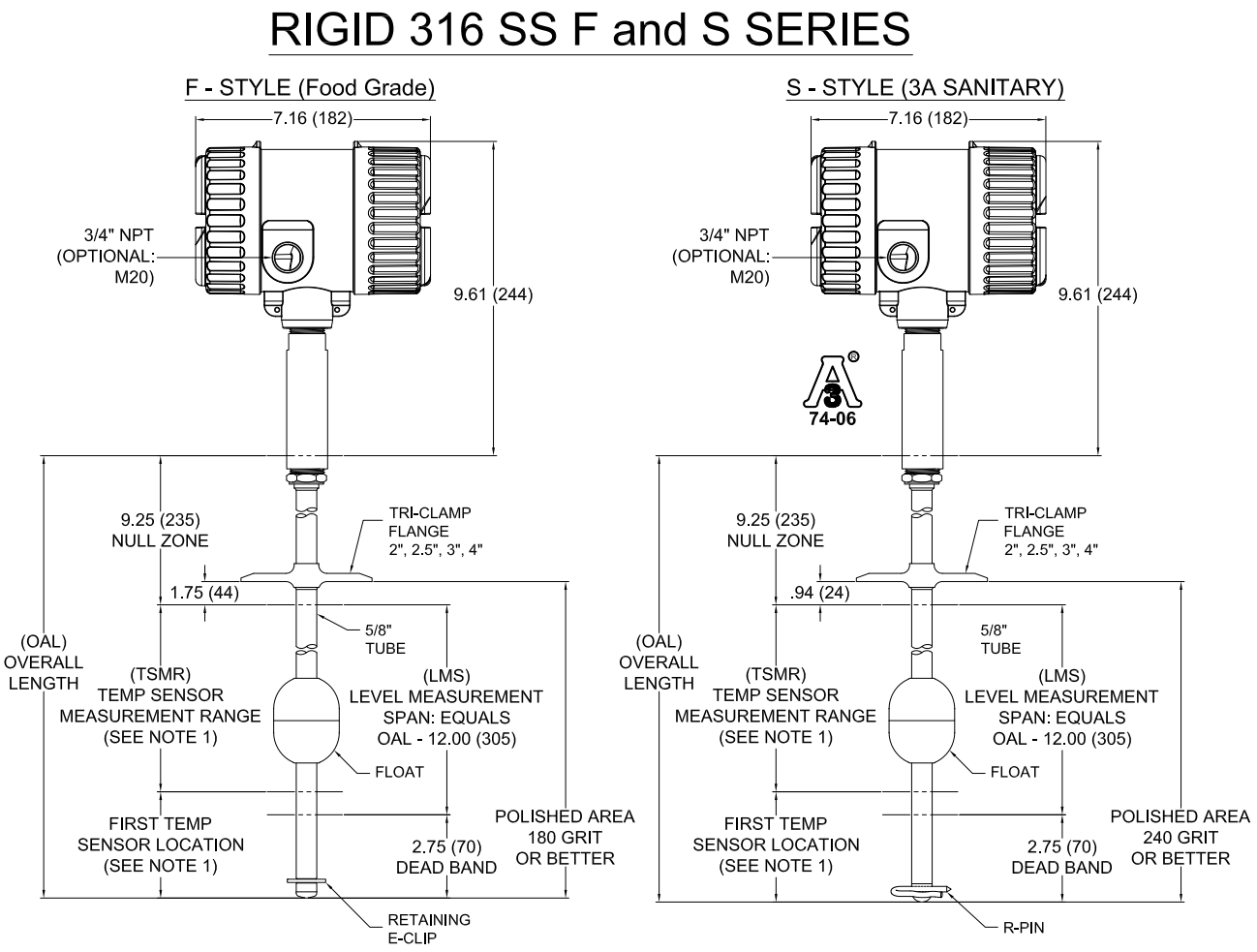
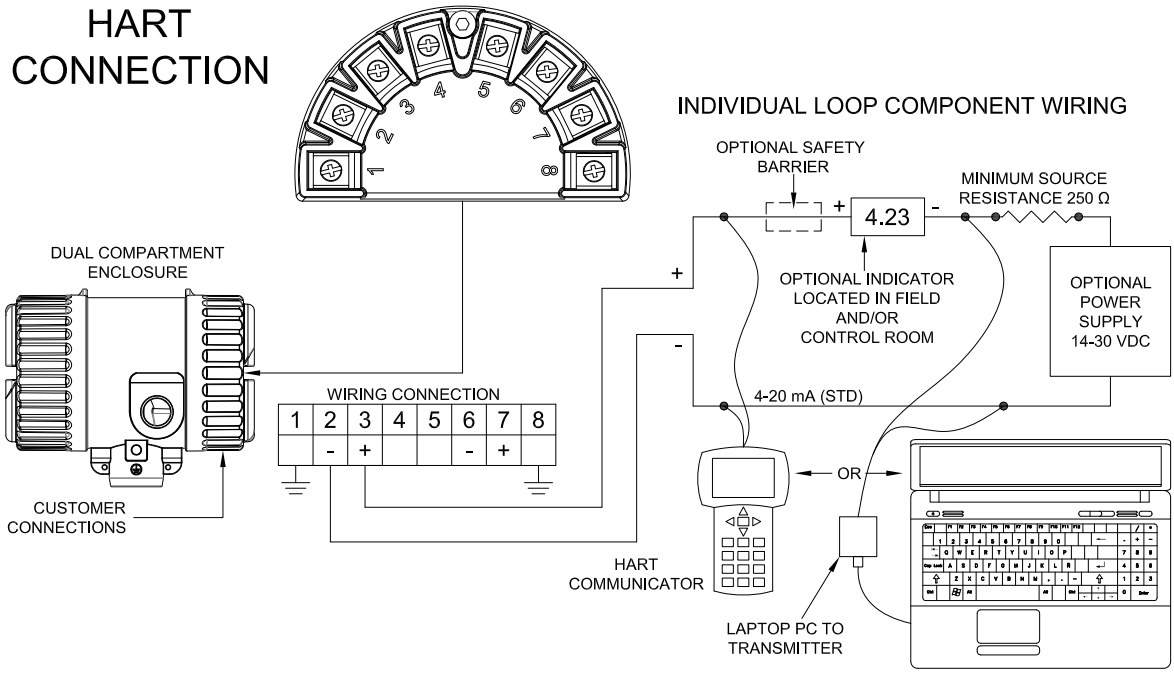
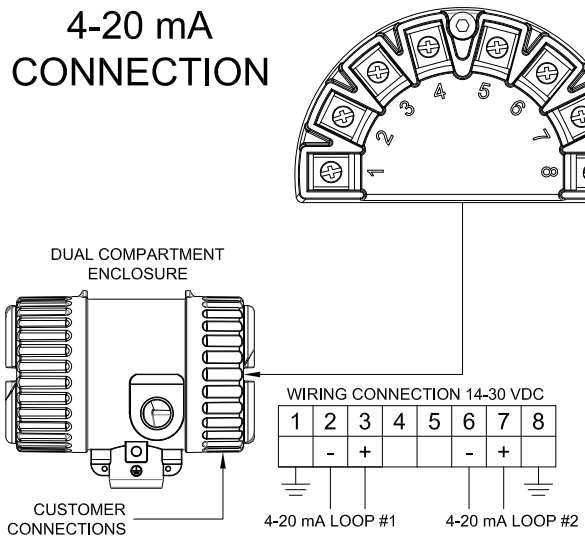


Figure 2-4
Rigid 316 SS F and S Installation Drawing

2.7 Wiring

WARNING! If the Total Tank Level System is located in a hazardous environment, do not open the enclosure cover or make / break any electrical connections without first disconnecting electrical power at the source. Ensure that wiring, electrical fittings and conduit connections conform to electrical codes and Approval Agency Control Drawings for specific location and environment.





Section 3

Section 3: Display Operation

3.1 Display / Keypad Operation

To enter the Display Menu:

- Press and Hold the "Enter" Button for approximately 5 seconds.
- Use the "Up", "Down" and "Back" Buttons to scroll through the available menu selections.
- Press "Enter" to access sub-menu items.
- Press "Enter" again to allow setting to be edited.
- Use the "Up", "Down" and "Back" Buttons to adjust settings.
  Settings that can be adjusted will be "flashing".
- Press "Enter" to accept the adjustment...Or...
- Press and Hold the "Back" Button for approximately 5 seconds to exit to the main display.

3.2 Configuration Menu

Display These are items that can be viewed on the display when not in the menu. The Display menu allows each item to be enabled or disabled according to the user's wishes. Pressing the UP or DOWN button will move the display to the next enabled item. Hitting ENTER will scroll the character abbreviation with the appropriate units. For example "TTL LVL" (level in inches) will scroll TTL LVL -- INCH.

Name	Description	Abbreviated Display Name
Total Level	Total height of liquid from tank bottom or other specified reference point	(TTL LVL)
Interface Level	Height of liguid from probe bottom or other specific reference point to media interface point	(INT LVL)
Product Level	Height of product level from the top of the interface level or other specific reference point to the top product level	(PRD LVL)
Total Volume	Liquid volume calculated for specified tank type	(TTL VOL)
Interface Volume	Liquid volume from the top of the interface level to the bottom of the tank, calculated for a specific tank type	(INT VOL)
Product Volume	Liquid volume from the top of the interface level to the top of the product level, calcualted for a specific tank type	(PRD VOL)
Average Temperature	Average temperature of all temperature sensors in liquid	(AVG TMP)
Interface Temperature	Average temperature of all temperature sensors in the interface level	(INT TMP)
Product Temperature	Average temperature of all temperature sensors in the product level (between the top of the interface level and the top of the product level)	(PRD TMP)
Primary Loop Current	Loop Current on the Primary Output Channel	(4-20 L1)
Secondary Loop Current	Loop Current on the Secondary Output Channel	(4-20 L2)

Name	Abbreviated Display Name
English Units	
Inches	(INCH)
Gallons	(GAL)
Degress F	(DEGF)
Metric Units	
Centimeters	(CM)
Liters	(LTR)
Degrees C	(DEGC)

3.3 Configuration Menu Table

Function	Item (Display)	Description & Comment	Menu Selection Choices
Fct. 1	**Setup (SETUP)**	**General Setup**	
Fct 1.1	Units of Measure (UNITS)	Basic units of measurement of all entities	ENGLISH
			METRIC
Fct. 2	**Display (DISPLAY)**		
Fct. 2.1	Enable/Disable auto toggle in meter mode (TOGGLE)	Used to determine if paramters list will be auto toggled in meter mode	YES
			NO
Fct. 2.2	Enable/Disable Level (LEVEL)	Used to enable/diable level parameters in meter mode	
Fct. 2.2.1	Total Level (TTL LVL)	System configuration for total level	ENABLE
			DISABLE
Fct. 2.2.2	Interface Level (INT LVL)	System configuration for interface level	ENABLE
			DISABLE
Fct. 2.2.3	Product Level (PRD LVL)	System configuration for product level only	ENABLE
			DISABLE
Fct. 2.3	Enable/Disable Volume (VOLUME)	Used to enable/diable volume parameters in meter mode	
Fct. 2.3.1	Total Volume (TTL VOL)	System configuration for total volume	ENABLE
			DISABLE
Fct. 2.3.2	Interface Volume (INT VOL)	System configuration for interface volume	ENABLE
			DISABLE
Fct. 2.3.3	Product Volume (PRD VOL)	System configuration for product volume	ENABLE
			DISABLE
Fct. 2.4	Enable/Disable Temperature (TEMPERATURE)	Used to enable/diable temperature parameters in meter mode	
Fct. 2.4.1	Average Temperature (AVG TMP)	System configuration for average temperature	ENABLE
			DISABLE
Fct. 2.4.2	Interface Temperature (INT TMP)	System configuration for interface temperature	ENABLE
			DISABLE
Fct. 2.4.3	Product Temperature (PRD TMP)	System configuration for product temperature	ENABLE
			DISABLE
Fct. 2.5	Enable/Disable 4-20 Loop (4-20)	Used to enable/diable 4-20 loop parameters in meter mode	
Fct. 2.5.1	Primary Loop Current (4-20 L1)	System configuration for primary loop channel	ENABLE
			DISABLE
Fct. 2.5.2	Secondary Loop Current (4-20 L2)	System configuration for secondary loop channel	ENABLE
			DISABLE
Fct. 3	**Service (SERVICE)**		
Fct. 3.1	LCD Contrast Adjustment (CONTRAST)	Used to adjust the contract ratio of the LCD display	0-9
Fct. 3.2	Software Versions (SW VER)	Software Version	
Fct. 3.2.1	TLS		Read only date code
Fct. 3.3	Menu Scroll Enable/Disable (MSSCROLL)	Enables/Disables the scrolling of menu descriptions	ENABLE
			DISABLE

Section 4

4.0 STExplorer

4.1 STExplorer Description

STExplorer™ is a PC software utility designed to provide connectivity and configuration functionality for the Drexelbrook Total Level Tank Level System (TLS). STExplorer™ is a successor to HRTWin.

Configuration and calibration of the Total Level Tank Level System (TLS) is accomplished via the onboard keypad/LCD display or remotely by a PC running STExplorer™ software with a HART modem.

4.2 Minimum PC Hardware Requirements

Operating System: Windows 7 or greater

CPU: Pentium Processor at 1 GHZ

RAM: 1 GB

Hard Drive: 25MB available disk space

4.3 STExplorer Installation Process

4.3.1 Download the STExplorerTM files from the Ametek website (www.drexelbrook.com). Follow the software download link on the support page.

4.3.2 Run the Set up file for STExplorer.exe and follow the on-screen instructions.

4.3.3 Insure that the instrument connections are correctly installed per the wiring instructions in section 2.7.

4.3.4 HART Modem: STExplorer requires the use of a HART modem to establish communication directly with the TLS System. The HART modem can be connected anywhere on the TLS side of the 4-20mA loop. Note: Minimum loop resistance for HART® communications is 250 Ω.

4.4 Installing the USB Modem

Refer to Figure 2.7 for a connection diagram and use the following procedure to install the hardware that is necessary to run the PC software.

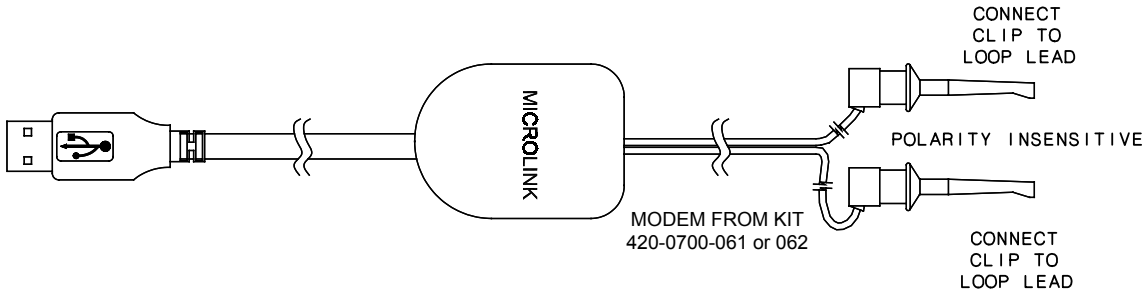
1. Turn on the computer
2. Install Modem Software per the manufacturer's instructions.

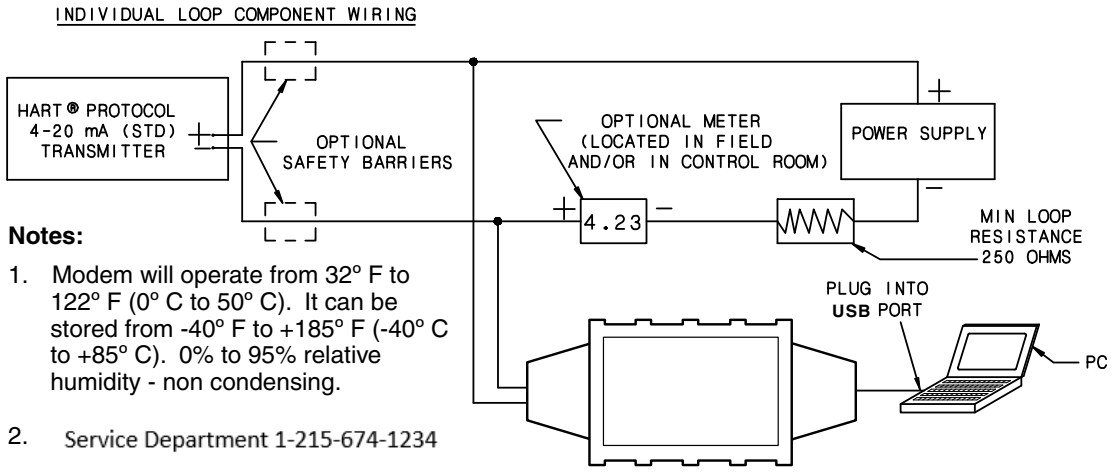
   It is highly recommended the USB drivers be installed BEFORE you plug in the modem.

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

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

   Follow any "On-Screen" Instructions.
3. Connect the Drexelbrook Modem 401-700-062 to a **USB** port on the computer. With the USB drivers already installed, the computer will detect the modem and assign a COM PORT number.
4. Connect the Modem's 4-20 loop connectors to the transmitter loop.



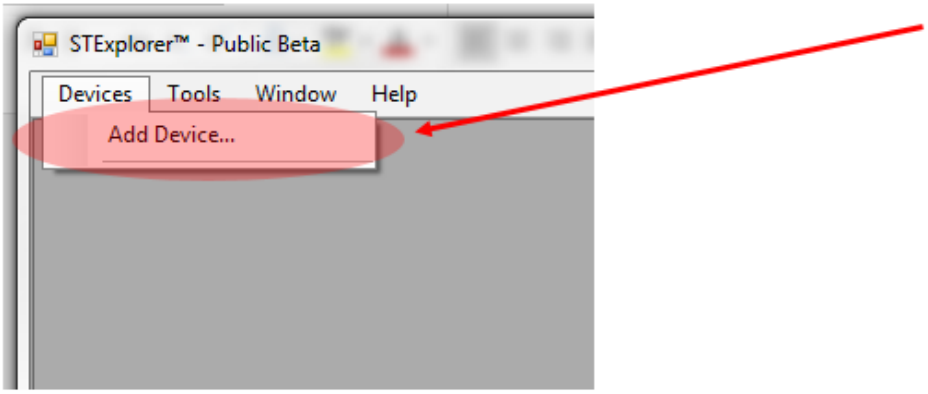


Notes:

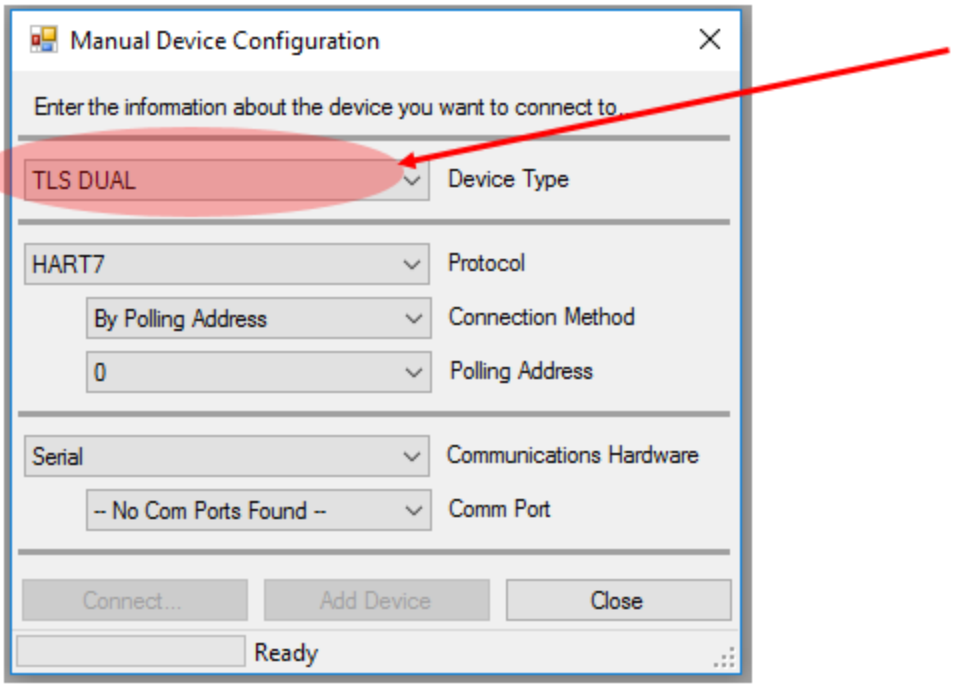
1. Modem will operate from 32° F to 122° F (0° C to 50° C). It can be stored from -40° F to +185° F (-40° C to +85° C). 0% to 95% relative humidity - non condensing.
2. Service Department 1-215-674-1234

4.5 Establishing Communications with the TLS

4.5.1 Insure that the instrument connections are corerectly installed per sec 2.7
4.5.2 STExplorer requires the use of a HART modem to establish communication with the the TLS System. The HART modem can be connected anywhare on the tLS side of the 4-20mA loop.
4.5.3 Run STExplorer.exe.
4.5.4 Select Devices from the menu
4.5.5 Select Add Device

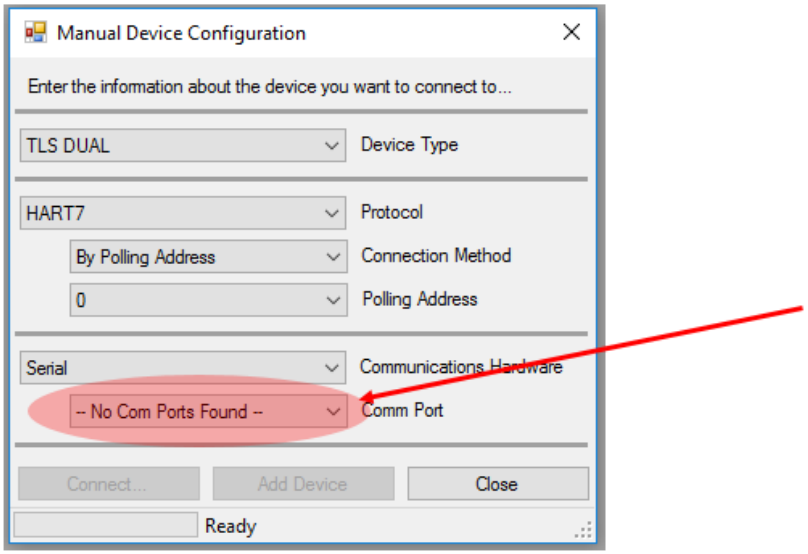


4.5.6 Select "TLS DUAL" from the device drop down list

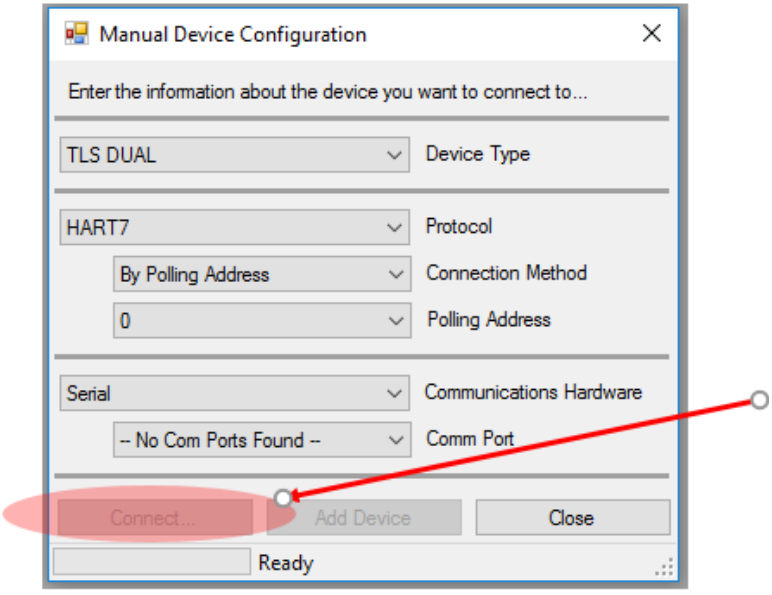


4.5 Establishing Communications with the TLS (Continued)

4.5.7 Select the proper COM Port from the Comm Port drop down list

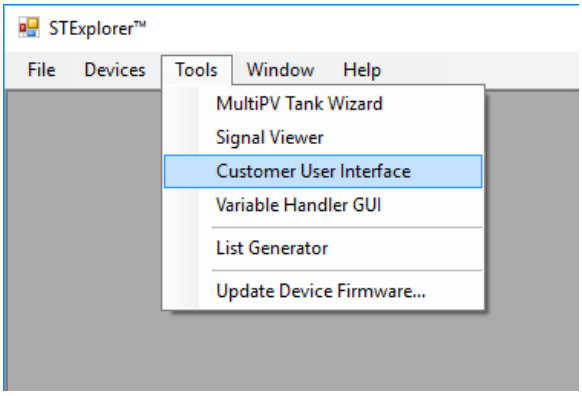


4.5.8 Select :Connect", Add Device" will change from grayed out to normal
4.5.9 Select "Add Device"
4.5.9.1 Select "Close" to close screen

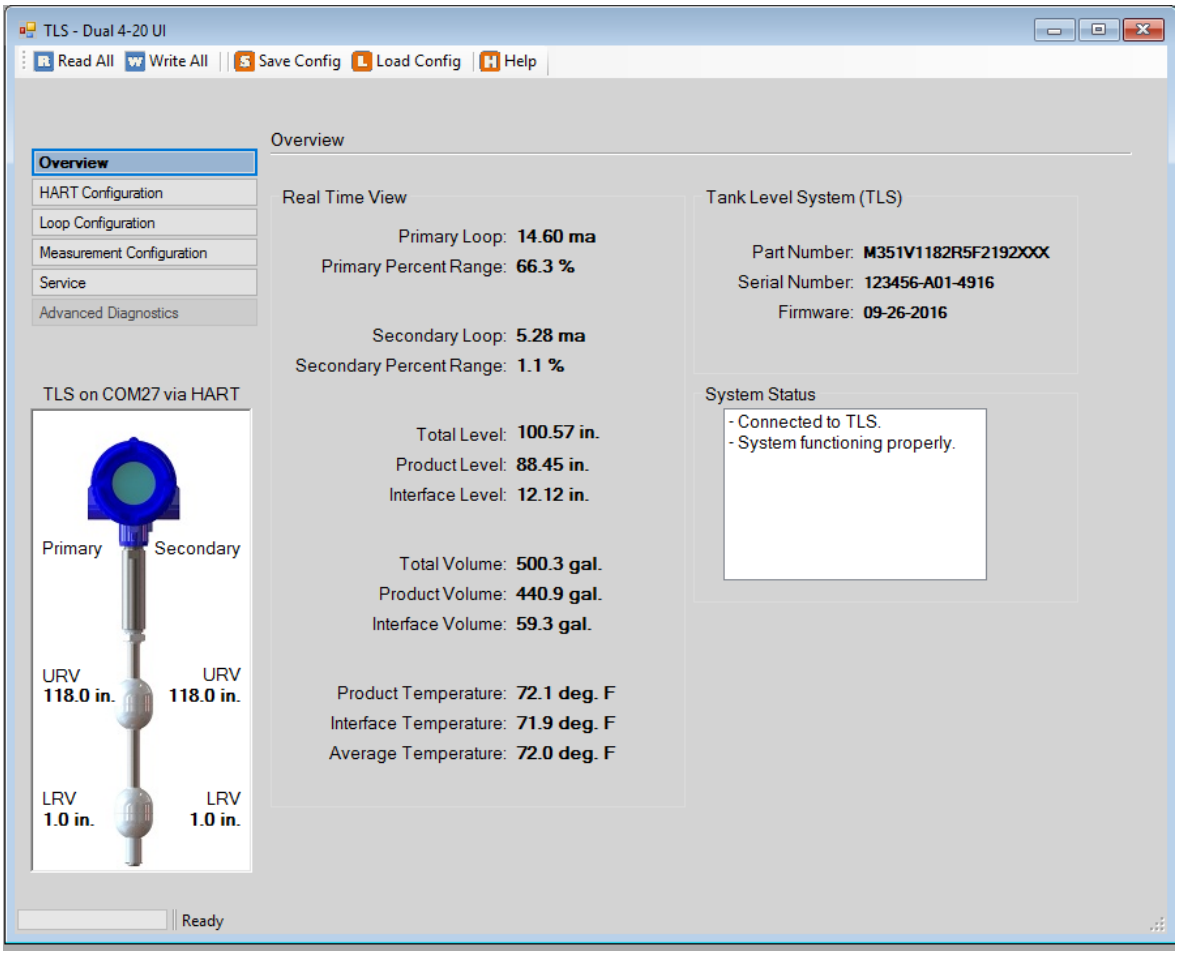


4.6 Accessing the Customer User Interface

4.6.1 Select "Tools", then select "Customer User Interface"



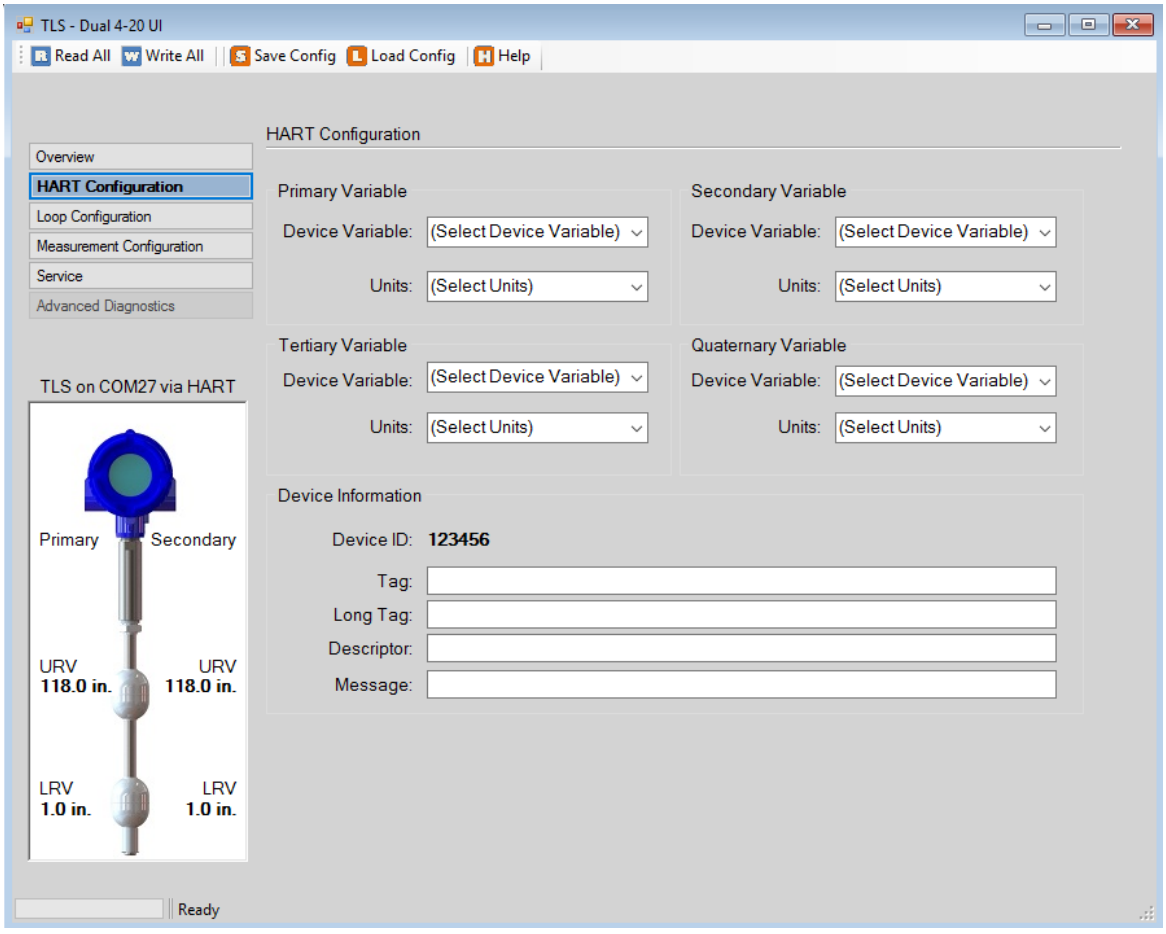
4.6.2 Instrument Overview: Select the Overview button on the top left side of page. This button provides a real time view of the active signal outputs from the device that is connected.



4.6 Accessing the Customer User Interface (Continued)

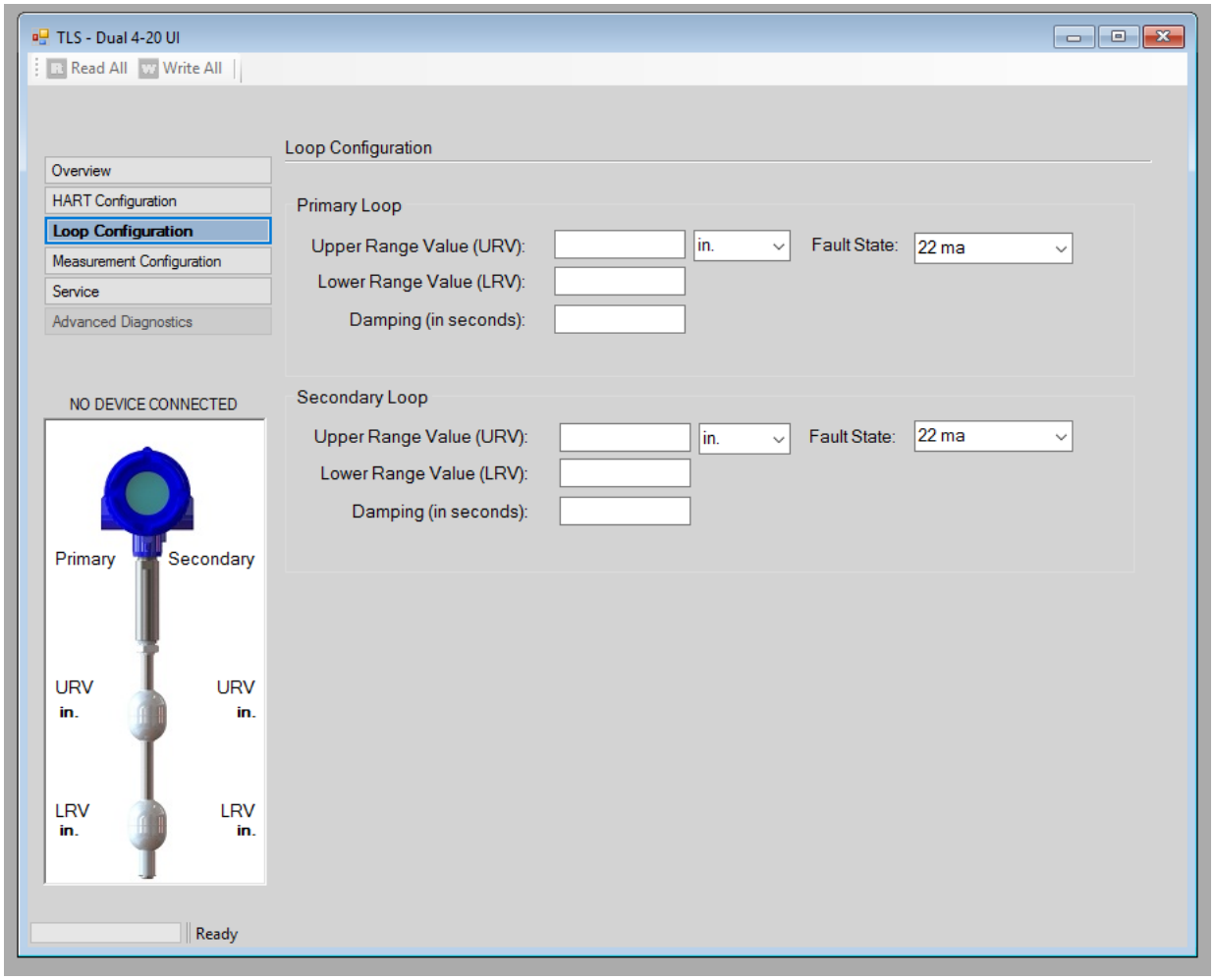
4.6.3 HART Configuration: Select the HART Configuration button on the top left side of the page. This button provides the user with a method to select and adjust the HART output variables. The selection of the HART output variables will also set the 4-20mA Output Loop 1 and Loop 2 variables. The primary and secondary variables are also Loop 1 and Loop 2 selections. The following 9 variables can be selected:

- Total Level (The uppermost level measurement)
- Product Level (The level position of the upper fluid)
- Interface Level (The top level position of the lower fluid in a 2 fluid system)
- Total Volume (The volume of fluid in the entire tank)
- Product Volume (The volume of only the upper fluid in a 2 fluid system)
- Interface Volume (The volume of only the lower fluid in a 2 fluid system)
- Average Temperature (The avg temp of the 5 temp sensors if option R1 or R5 is selected)
- Product Temperature (The avg temp of the sensors in the upper fluid, R5 Option)
- Interface Temperature (The avg temp of the sensors in the lowerr fluid, R5 Option)



4.6 Accessing the Customer User Interface (Continued)

4.6.4 Loop Configuration: Select the Loop Configuration button in the top left side of the page. This button provides the user with a method to select and adjust the Upper Range, Lower Range and Damping varaibles for the primary and secondary measurements that were set in the HART Configuration screen. Units of measure will automatically select to the proper measurement type based on the measured variable. These can be changed based on user preference.



4.6 Accessing the Customer User Interface (Continued)

4.6.5 Measurement Configuration: Select the Measurement Configuration button on the top left side of the page. This button provides the user with a method to select and configure a vessel type along with creating a custom strapping table to determine volume on non-standard tanks.

The Strapping Table is a 2-21 Point, table used to create a Custom non-linear output relationship to Level.

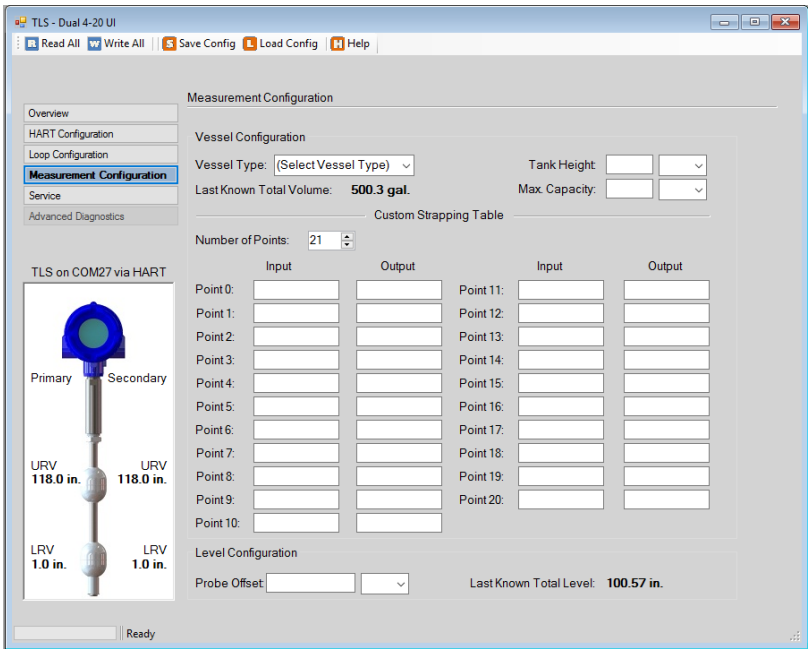
Volume Applications
Several pre-defined vessel types are available. If none of the pre-defined vessel types are appropriate for the application, a Custom Strapping Table will be necessary.

Load Standard Table (Volume Only)
If the application does not match one of the pre-defined vessel types, but the application is similar, a pre-defined vessel type may be loaded into the Strapping Table for custom editing.

To load a pre-defined Vessel Type into the Strapping Table:
From The Main Screen, under the Volume Configuration Section , select the vessel type that is similar to the actual vessel.

Pre-defined Vessel Types:

- Linear (Vertical Tank)
- Horizontal Tank with Flat Ends
- Horizontal Tank with Dished Ends
- Horizontal Tank with Hemispherical Ends
- Spherical Tank



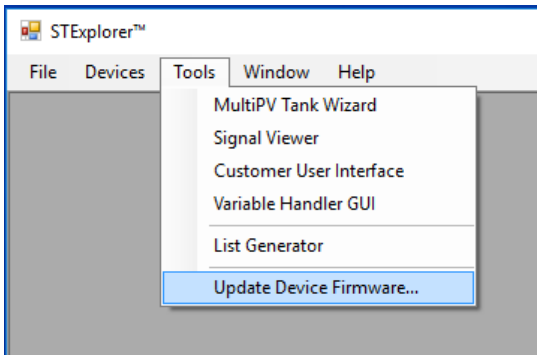
4.7 Using the Flash Update Utility in STExplorer

4.7.1 Flash Update Utility Overview

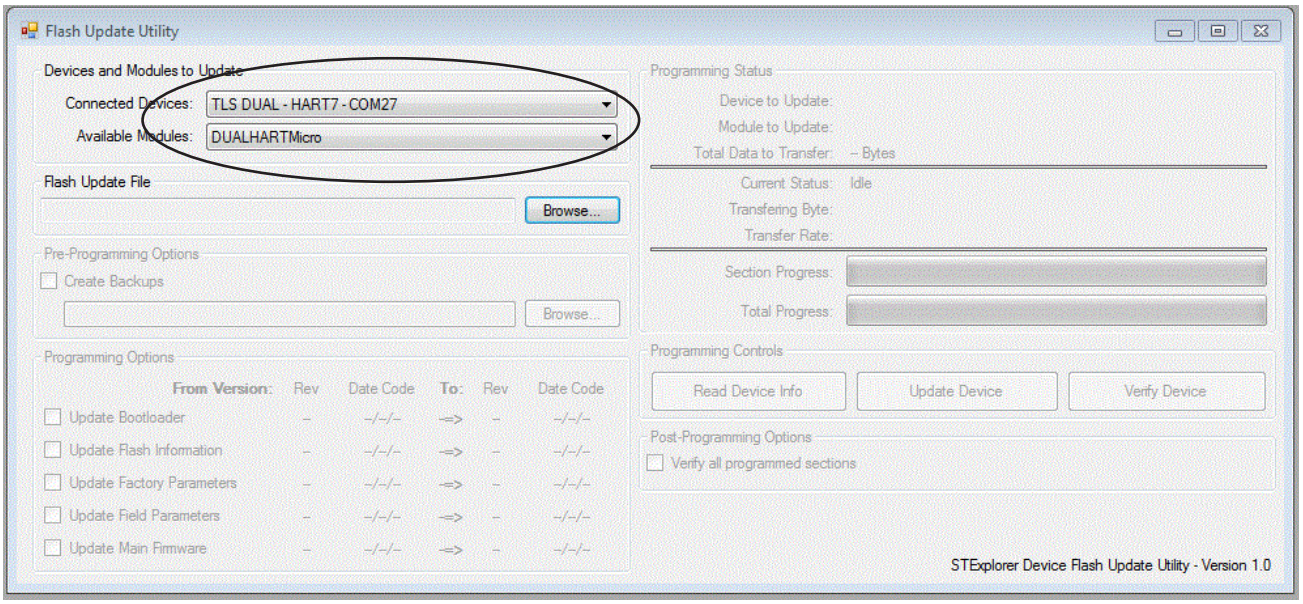
The flash update utility is used to update the device when new revisions of the device firmware become available.The software allows updating the TLS software via HART.

4.7.2 Instructions

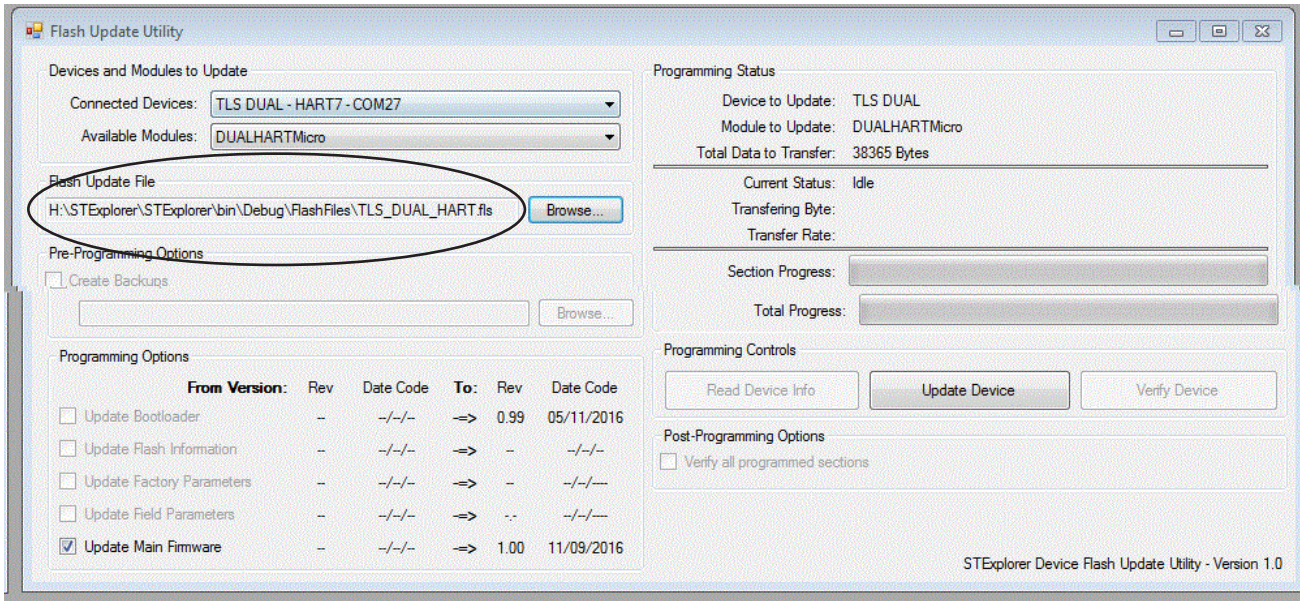
4.7.2.1 Select "Tools" from the menu
4.7.2.2 Select "Update Device Firmware" from the drop down list



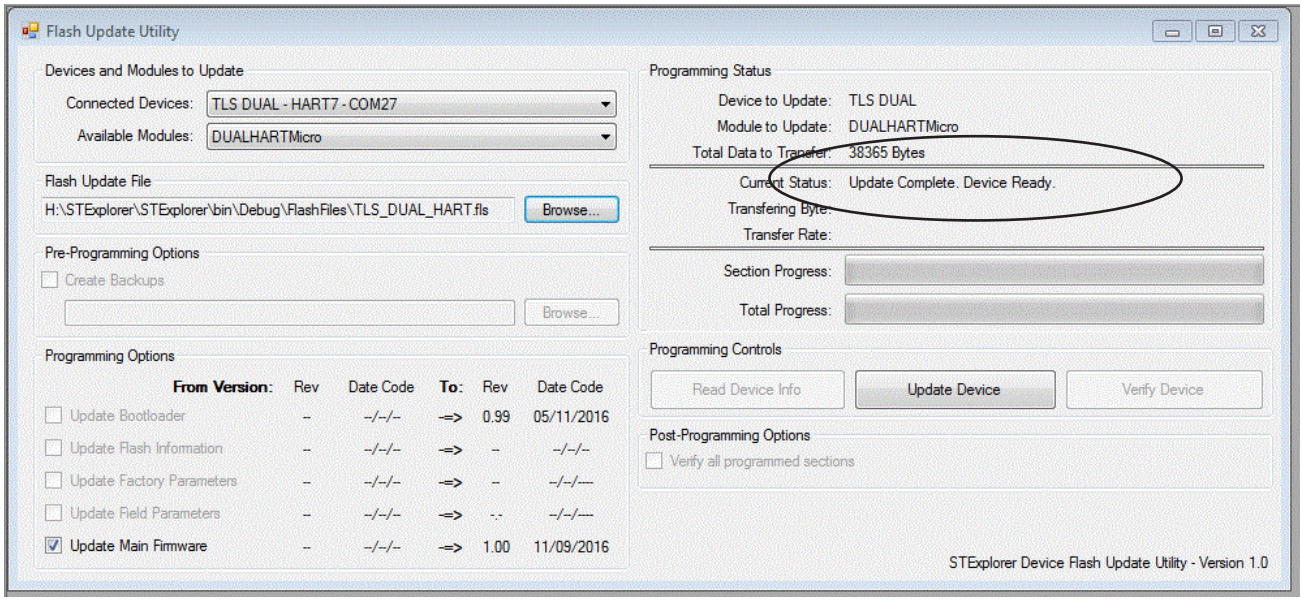
4.7.2.3 Select the connected device to update
4.7.2.4 Select the Available Module to update



4.7.2.5 Select the bootload file (*.fls) for the available module. This will show up in the Flash Update File location. If STExplorerTM detects the selected .fls file and it does not match the user selection of device and module, an error will be generated.



4.7.2.6 Select the update device button. The current status will be displayed until complete. The current status will read “Update Complete. Device Ready” when successful.



Section 5

Section 5: Live Maintenance

Warning!
Repair and maintenance should only be carried out by skilled personnel training in explosion proof methods.

Test equipment used to perform "Live Maintenance" must be certified for use in the associated hazardous area.

The Intrisically Safe cover (view port side) may be opened for the purposes of accessing the display/keypad for system configuration and adjustment.

5.1 Intrinsically Safe Installations

When the TLS is installed as an intrinsically safe device per the agency control drawings, either the view port housing cover or the customer connection terminal side housing cover may be safely opened. For system configuration, remove the view port housing cover to access the display/keypad for local system configuration.

5.2 Explosion Proof Installations

When the TLS is installed as an explosion proof device per the agency control drawings, only the view port housing cover may be removed for the purpose of accessing the display/keypad for local system configuration and adjustment. For system configuration, observe that the view port housing cover permits you to see the display. Remove the view port housing cover to access the display/keypad for local configuration.

Section 6

Section 6: Troubleshooting

6.1 Factory Assistance

AMETEK Drexelbrook can answer any questions about The Total Tank Level System instrument. Call Customer Service at 1-215-674-1234 (US, Canada and all International).

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

Contact your local Drexelbrook representative,

Telephone the Service department:

- 1-215 674-1234 (US and Worlwide)

FAX: Service Department + 215-443-5117
E-mail: drexelbrook.service@ametek.com

Please provide the following information:

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

6.2 Field Service

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

6.3 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 write to: AMETEK Drexelbrook, Communications and Training Group or call 215-674-1234.

6.4 Status Messages

Table below shows all possible status messages that can be shown on the main display menu.

Key	
Failure	The unit can not make a measurement at all.
Error	The unit can make a measurement, however, 'Outputs' (Digital & Analog) are **NOT** representative of the **ACTUAL** process conditions
Warning	The unit can make a measurement, 'Outputs' (Digital & Analog) **ARE** representative of the **ACTUAL** process conditions, however, the unit has detected a condition that may result in increased measurement error in no user intervention is performed.
Info	Unit is performing as designed and is accurate; for information purposes only

Display Message	Description	
-MASTER INIT FAILURE-	Master micro status handler initialization failure	**Failure**
-PROBE INTERMITTENT COMM LOSS WARNING-	Probe intermittent loss of communication warning	**Warning**
-PROBE CRITICAL COMM LOSS FAILURE-	Probe loss of communication failure	**Failure**
-PROBE FLOAT FAILURE-	Probe reporting loss of float/signal	**Failure**
-PROBE THERMISTOR 1 ERROR-	Probe reporting error in reading thermistor 1	**Error**
-PROBE THERMISTOR 2 ERROR-	Probe reporting error in reading thermistor 2	**Error**
-PROBE THERMISTOR 3 ERROR-	Probe reporting error in reading thermistor 3	**Error**
-PROBE THERMISTOR 4 ERROR-	Probe reporting error in reading thermistor 4	**Error**
-PROBE THERMISTOR 5 ERROR-	Probe reporting error in reading thermistor 5	**Error**
-HART STACK OVERFLOW FAILURE-	HART micro stack overflow	**Failure**
-HART EE CHECKSUM ERROR-	HART micro failed EE checksum	**Error**
-HART EE WRITE ERROR-	HART micro failed to write to EEProm	**Error**
-FIELD FLASH CKSM ERROR-	Field flash checksum error	**Error**
-FLASH CKSM FAILURE-	Factory flash checksum failure	**Failure**
-FLASH REGISTRATION FAILURE-	Parameter module couldn't register with Flash Manager	**Failure**
-TOO MANY SH FAILURE-	Number of device errors exceeds defined limit	**Failure**
-MEASUREMENT OVER RANGE ERROR-	The primary variable is > (URV+ 5%)	**Error**
-MEASUREMENT UNDER RANGE ERROR-	The primary variable is < (LRV - 5%)	**Error**
-MEASUREMENT SPAN WARNING-	The URV and LRV are equal	**Warning**
-PRIMARY IN FIXED CURRENT MODE-	The primary loop is in a fixed current mode	**Error**
-SECONDARY IN FIXED CURRENT MODE-	The secondary loop is in a fixed current mode	**Error**
-IM CRITICAL COMM LOSS ERROR-	The HART micro has stopped communicating with the display	**Error**

6.5 Equipment Return

In order to provide the best service, any equipment being returned for repair or credit must be pre-approved by the factory.

In many applications, sensing elements are exposed to hazardous materials.

- **OSHA mandates** that our employees be informed and protected from hazardous chemicals.
- **Material Safety Data Sheets (MSDS)** listing the hazardous materials to which the sensing element has been exposed MUST accompany any repair.
- It is your responsibility to fully disclose all chemicals and **decontaminate** the sensing element.

To obtain a return authorization (RA#), contact the Service department at 1-215-674-1234 (US and Worldwide).

- Please provide the following information:
- Model Number of Return Equipment
- Serial Number
- Original Purchase Order Number
- Process Materials to which the equipment has been exposed.
- MSDS sheets for any hazardous materials
- Billing Address
- Shipping Address
- Purchase Order Number for Repairs
- Please include a purchase order even if the repair is under warranty. If repair is covered under warranty, you will not be charged.

Ship equipment freight prepaid to:

AMETEK-DREXELBROOK.
6380 BROCKWAY RD.
PECK, MI 48466
COD shipments will not be accepted

Section 7

Section 7: Specifications

Technology:
- Magnetostrictive

Operating Voltage:
- 14 - 30 VDC

Output Signal:
- Single or Dual 4-20mA
- HART provided on one output

Response Time:
- 1.0 Second (Approximately)

Temperature Range:

Rigid 316 SS Probe
Options (F and S) Probes only
- Process: -40°F to 212°F (-40°C to 100°C)
- Housing: -40° F to 158° F (-40°C to 70°C)

Option (B) Probe
- -40°F to 212°F (-40°C to 100°C)

UltraFlex PVDF Probe
- -40°F to 158°F (-40°C to 70°C)

Process Pressure Rating:
- Rigid 316 SS Probe: 1000 psig. (69 bar)
- UltraFlex PVDF Probe: 150 psig. (10 bar)
- Float: Dependent, 316SS floats Typical to 350 psig, (24 bar) Consult Factory

Resolution:
- +/- 0.01”

Repeatability:
- +/- 0.01”

Accuracy:
- Level: 0.01% or +/- 0.039” (1 mm) Whichever is greater
- Temp. Sensor: +/- 1°F (+/- 0.5°C)

Hysteresis:
- 0.002% or .005" Whichever is greater

Null Zone (Top of Probe):

Rigid 316 SS Probe
- 9.25" (235 mm)

UltraFlex PVDF Probe
- Variable by selection

Dead band (Bottom of Probe):

Rigid 316 SS Probe
- 2.00" (51 mm)

UltraFlex PVDF Probe
- Variable by selection

Enclosure Rating:
- IP66, IP67, TYPE 4-4X

Wetted Parts:
- Rigid - 316 SS
- Flexible - PVDF (Kynar)

Probe Length:
- *316SS*
  Option (B) 20” to 378” (508 - 9601 mm)
  Option (F) 20" to 200" (508 - 5080 mm)
  Option (S) 20" to 140" (508 - 3556 mm)
- *Flexible PVDF (Kynar)*
  65” to 600” (915 - 15240 mm)
  Probes available in 1” (25 mm) increments

Minimum Liquid / Liquid Interface Measurement:
- ≥ 4.2" (100 mm)

Hazardous Area Approvals

XP-IS CL I, DIV 1, GRP C,D T4
IS CL I, DIV 1, GRP C,D T4
NI CL I, DIV 2, GRP A,B,C,D T4
DIP-IS CL II, III, DIV 1, GRP E,F,G T4
CL I ZN 0 AEx/Ex ia IIB T4 Ga
CL I ZN 0/1 AEx/Ex ia/db IIB T4 Ga/Gb
FM16US0417X
FM16CA0192X
-40ºC ≤ Ta ≤ + 70ºC
TYPE 4, 4X IP67

ATEX

FM 16 ATEX0114X
II 1/2 G Ex ia/db IIB T4 Ga/Gb
II 2 D Ex ia tb IIIC T90ºC Db
II 1 G Ex ia IIB T4 Ga
-30ºC ≤ Ta ≤ + 70ºC
IP66, IP67

IECEx

IECEx FMG 17.005X
Ex ia/db IIB T4 Ga/Gb
Ex ia tb IIIC T90ºC T4 Db
Ex ia IIB T4 Ga
-30ºC ≤ Ta ≤ + 70ºC
IP66, IP67

2460

NOTE:
Consult the Manufacturer if Dimensional Information on the Flameproof Joints is Necessary.

Installation of PVDF Probe

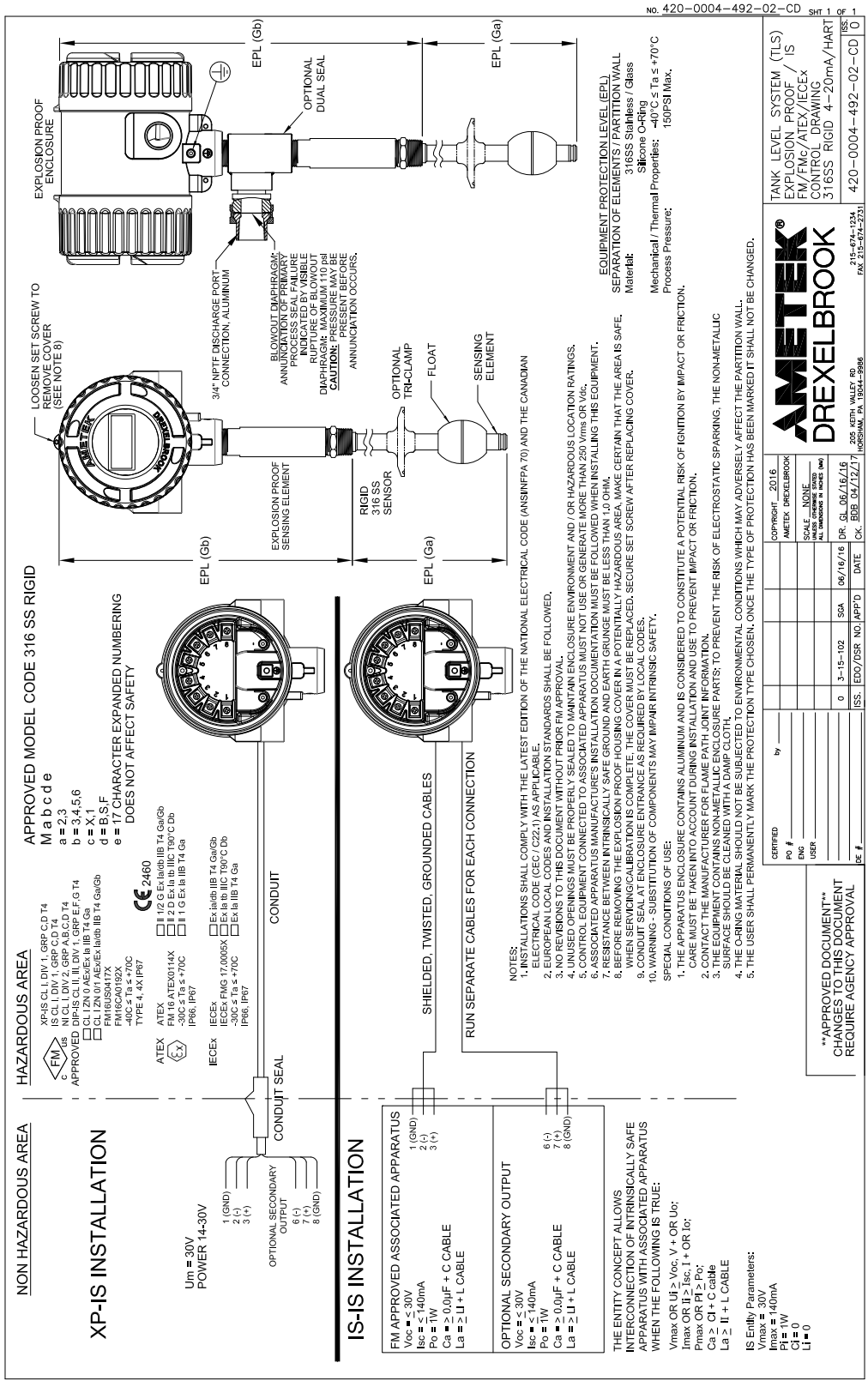
CAUTION!
Part of the equipment enclosure is constructed of non-metallic material; to prevent the risk of electrostatic sparking, the non-metallic enclosure material should be cleaned only with a damp cloth.

3A Sanitary Option (S) Probe Only
Note: 3A Sanitary Option (S) Pobes only

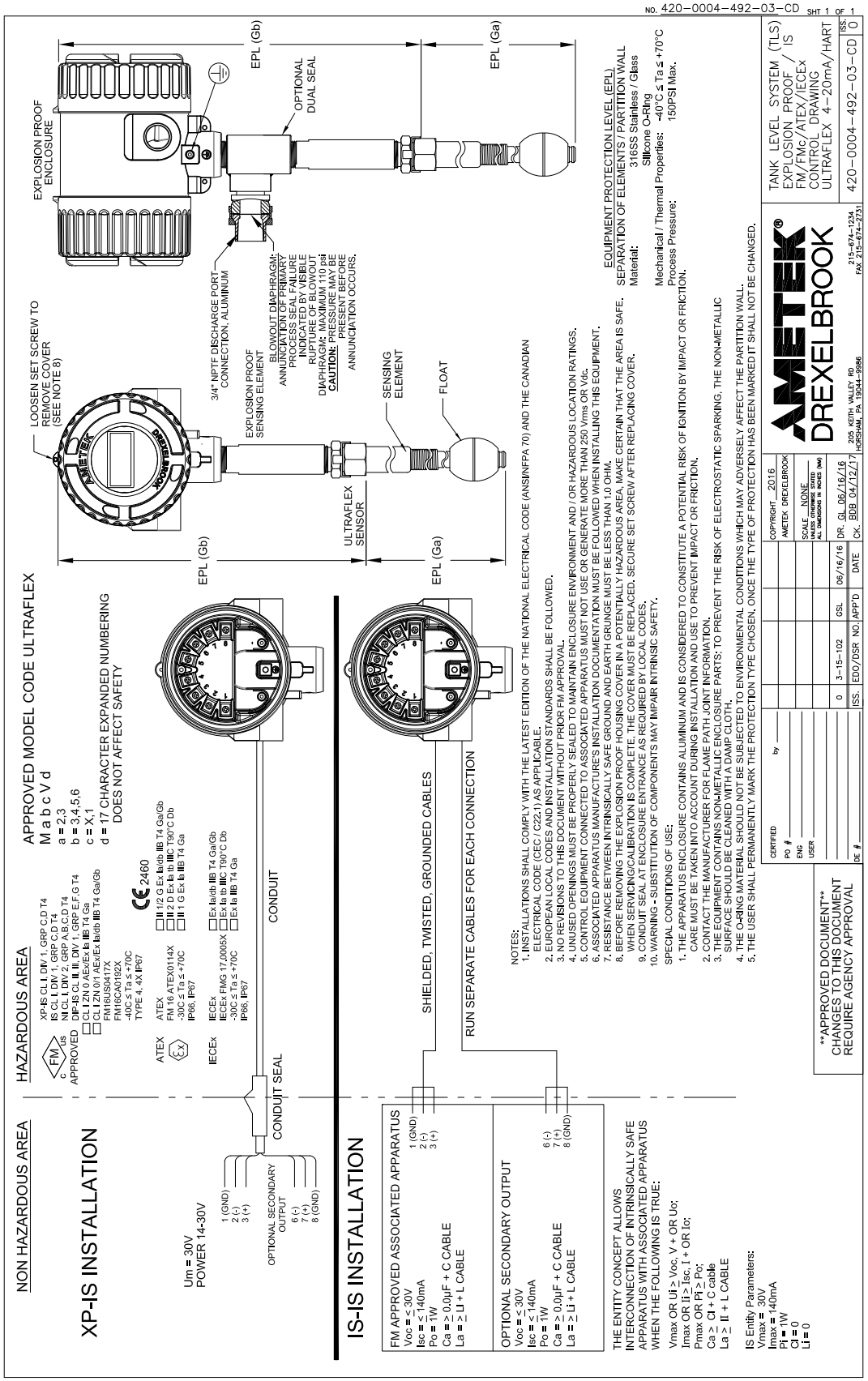
Section 8

Section 8: Drawings

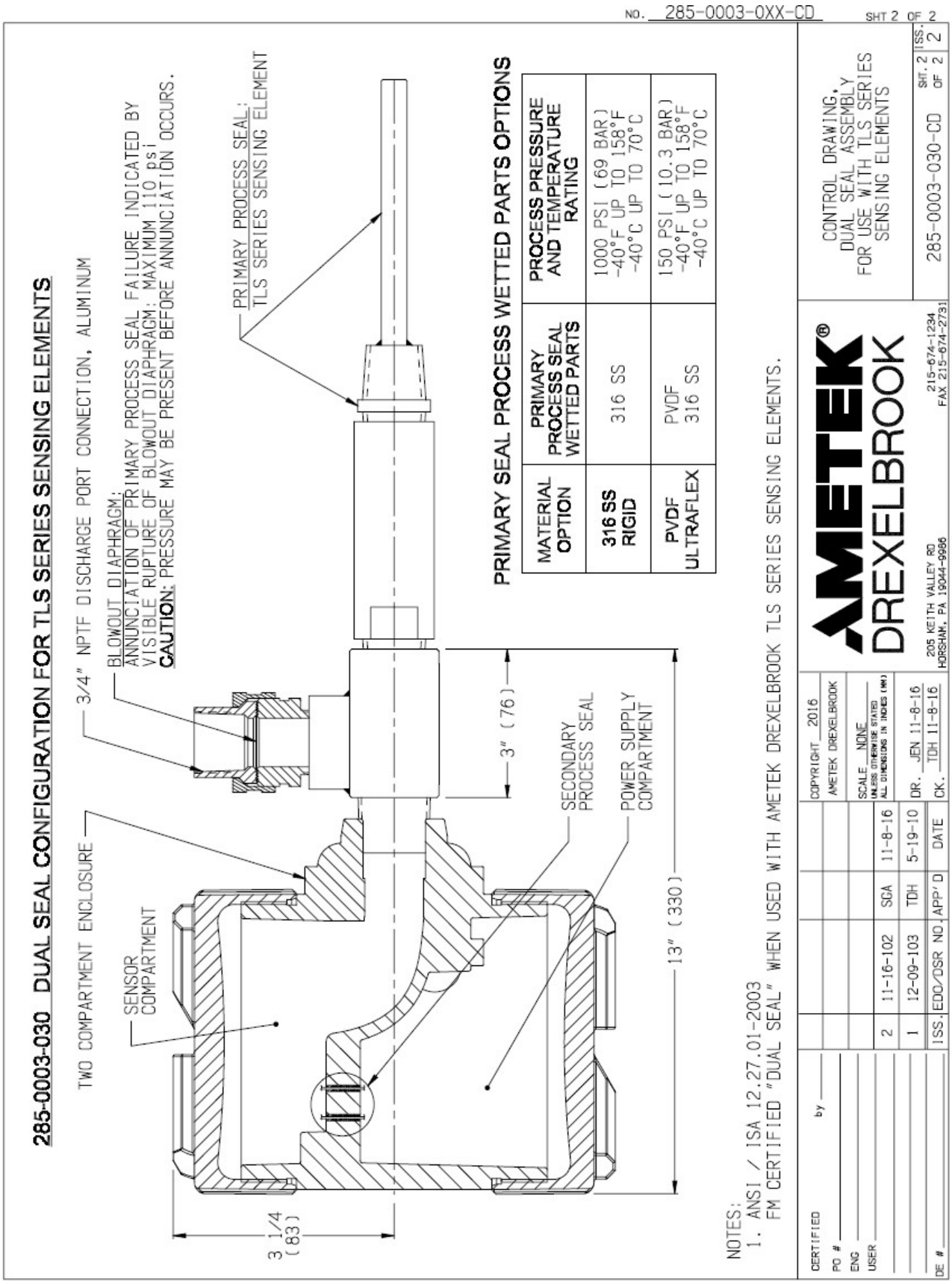
8.1 Installation Drawings 316 SS Probes



8.2 Installation Drawings UltraFlex Probes



8.3 Dual Seal Configuration Drawings TLS Sensing Elements



8.4 Terms & Conditions

AMETEK, Inc.
TERMS AND CONDITIONS OF SALE

THE FOLLOWING TERMS/CONDITIONS, TOGETHER WITH ANY OTHER TERMS/CONDITIONS SPECIFICALLY AGREED TO IN WRITING BY SELLER, SHALL APPLY TO ALL ORDERS ("Order(s)") FROM, AND SALES OF PRODUCTS ("Products") OR SERVICES ("Services") TO BUYER. ANY ACCEPTANCE OF ANY ORDER OF BUYER IS CONDITIONED UPON THESE TERMS/CONDITIONS. ANY ADDITIONAL OR DIFFERENT TERMS/CONDITIONS PROPOSED BY BUYER IN ANY DOCUMENT ARE OBJECTED TO AND SHALL NOT BE BINDING UPON SELLER. No salesperson is authorized to bind Seller to any promise or understanding not expressed herein.

I. PRICES All prices are subject to change without notice in the event of any changes in cost of materials or labor, specifications, quantities, delivery schedules, customs duties, other factors beyond Seller's control, or in the event of delays caused by instructions of the Buyer, or failure of the Buyer to give Seller adequate information. Further, prices payable by the Buyer shall be subject to immediate increase, should the Seller as a result of governmental action or regulation including, without limitation, those contemplated by an investigation under Section 232 of the Trade Expansion Act of 1962 (19 U.S.C. §1862), incur additional duties, tariffs or restrictions on products sold hereunder, or on the raw materials that are used in making such products. In no event shall prices include any amounts imposed on the Buyer in connection with Buyer's purchases from Seller, such as taxes, including but not limited to Value Added Tax (VAT) or excise taxes, duties, tariffs, or any other costs assessed against the Buyer by a governmental authority.

II. DELIVERY Delivery dates are approximate and are dependent on prompt receipt by Seller of all necessary information. Seller may deliver all or any part of Products/ Services as early as 30 days in advance of agreed schedule. The point of delivery shall be "Ex-works" Seller's premises, unless otherwise specified by Seller. Upon delivery, title to Products and all risk of loss or damage thereto shall pass to Buyer. Where Buyer notifies Seller that it cannot take timely delivery of the Products, Seller may place such Products in storage, at the risk of Buyer, and Buyer shall reimburse Seller for all expenses incurred in connection with such storage. Buyer shall dispose of the packing materials for Products at its own expense, and shall defend, indemnify and hold harmless Seller from any legal obligations in connection with such packing waste.

III. PAYMENT A. The term of payment shall be net 30 days from date of Seller's invoice, unless otherwise specified. Payments shall be made by Buyer without any deduction or set-off. Unless otherwise agreed, payment shall be made in U.S. dollars. Seller may charge late payment fees at the rate of 1.5% per month, or the highest rate permitted by law, whichever is less, accruing daily.
B. If the financial condition of Buyer is unsatisfactory to Seller, Seller may require full or partial payment in advance, or satisfactory security, in the form of a letter of credit or otherwise. In the event of bankruptcy or insolvency of Buyer, Seller may immediately cancel any Order then outstanding.
C. Buyer grants Seller a purchase money security interest in Products located in the United States, or Services, as well as any proceeds, for the purpose of securing the obligations of Buyer hereunder. Buyer authorizes Seller to execute on Buyer's behalf and file such financing statements as Seller deems appropriate to perfect and notify Buyer's creditors of Seller's security interest.

IV. VARIATIONS IN QUANTITY; CHANGES. Buyer shall accept delivery of quantities greater or smaller than the quantity specified in Order(s), provided that any such variation shall not exceed 5% of the quantity originally specified, or 2 units, whichever is greater. Seller shall not be required to give notice of any such variations other than in the applicable shipping notice and invoice. Seller reserves the option to make changes to Products or Services which do not affect form, fit, or function, and shall deliver Products to the latest configuration part number at the time of delivery.

V. EXPORT CONTROLS; FCPA; ANTI-BOYCOTT
A. Buyer shall not make any disposition of the Products, by way of transshipment, re-export, diversion or otherwise, except as applicable U.S. export laws and regulations may expressly permit, and other than in and to the ultimate country of destination specified on Order(s) or declared as the country of ultimate destination on Seller's invoices or in the End Use Statement that Buyer supplies Seller. Seller shall not be named as shipper or exporter of record or U.S. principal party-in-interest (USPPI) unless specifically agreed to in writing by Seller in which case, Buyer shall provide Seller with a copy of the documents filed by Buyer for Export clearance purposes. At Seller's request, Buyer shall supply end-use and end-user information to determine export license applicability. Failure of Buyer to comply with this section shall constitute a material default allowing Seller to cancel related Order(s) without liability.
B. Buyer warrants that it shall not violate or cause the Seller to violate the U.S. Foreign Corrupt Practices Act of 1977 (FCPA), as amended, the United Kingdom Bribery Act (UKBA) of 2010, as amended, or their respective implementing regulations in connection with Buyer's sale or distribution of the Products and/or Services, and that Buyer does not know or have reason to believe that any consultant, agent, representative or other person retained by Buyer in connection with the sale and/or distribution of Products/Services has violated, nor caused Seller to violate the FPCA and/or the UKBA. Where Buyer learns of or has reason to know of any violation of FCPA and/or or UKBA in connection with the sale or distribution of Products/Services, Buyer shall immediately advise Seller.
C. Buyer further warrants that Buyer shall not violate or cause Seller to violate the U.S. Antiboycott Provisions of the U.S. Export Administration Regulations issued pursuant to the U.S. Export Administration Act of 1979, as amended, in connection with Buyer's purchase of Products/Services and that Buyer shall not request or require Seller to make statements or certifications against countries that are not subject to boycott by the U.S.

VI. WARRANTIES A. Seller warrants that Products manufactured by Seller, when delivered, shall be free from defects in material/workmanship. Seller warrants that Services shall be performed in accordance with generally accepted industry practice. Seller's obligations under this warranty shall be limited exclusively to repairing or replacing, at Seller's option, any part of Products which, if properly installed, used and maintained, proved to have been defective in material or workmanship within 1 year from the date of shipment, or re-performing the Services. Seller warrants for a period of 1 year from the date of shipment that software or firmware, when used with Products, shall perform in accordance with Seller's published specifications. Seller makes no warranty, express or implied, that the operations of the software or firmware shall be uninterrupted or error-free, or that functions contained therein shall meet or satisfy the Buyer's intended use/requirements. Buyer shall notify Seller of any defect in the quality or condition of Products (including software/firmware) or Services within 7 days of the date of delivery or performance, unless the defect was not apparent on reasonable inspection, in which case, within 7 days after discovery of the defect. If Buyer does not provide such timely notification, it shall not be entitled to reject Products (including software/firmware) or Services, and Seller shall have no liability for such defect.
B. Seller's warranty obligations shall not apply to Products which (1) have been altered or repaired by someone other than Seller, or (2) have been subjected to misuse, neglect, or improper use or application, or (3) are normally consumed in operation, or (4) have a normal life inherently shorter than the warranty period stated therein.
C. No Products may be returned unless authorized in advance by Seller, and then only upon such conditions to which Seller may agree. Buyer must obtain a Return Material Authorization (RMA) number from Seller prior to any return shipment, and such RMA number must appear on the shipping label and packing slip. Buyer shall be responsible for returned Products until such time as Seller receives the same at its facility, and for all charges for packing, inspection, shipping, transportation or insurance associated with returned Products.
D. This section VI sets forth the exclusive remedies and obligations for claims based upon defects in or nonconformity of Products/Services, whether the claim is in contract, warranty, tort (including negligence of any degree or strict liability) or otherwise. **THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES,**

WHETHER ORAL, WRITTEN, EXPRESS, IMPLIED OR STATUTORY. NO IMPLIED OR STATUTORY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE SHALL APPLY.

VII. PATENTS/INDEMNITY If Buyer receives a claim that Products, or part thereof manufactured by Seller infringes a patent, Buyer shall notify Seller promptly in writing and give Seller information, assistance and exclusive authority to evaluate, defend and settle such claim. Where Buyer has furnished specifications/designs for the manufacture of the allegedly- infringing Products, Buyer shall defend, indemnify and hold harmless Seller against third-party claims for infringement arising out of Seller's use of such specifications/designs.

VIII. LIMITATION OF LIABILITY
The total liability of Seller on any claim, whether in contract, tort (including negligence of any degree and strict liability) or otherwise arising out of, connected with, or resulting from the manufacture, sale, delivery, resale, repair, replacement or use of any Products/Services, shall not exceed the price allocable to the Products/Services or part thereof which gives rise to the claim. **IN NO EVENT, WHETHER AS A RESULT OF BREACH OF CONTRACT, WARRANTY, TORT, (INCLUDING NEGLIGENCE OF ANY DEGREE, STRICT LIABILITY OR PATENT INFRINGEMENT) OR OTHERWISE, SHALL SELLER, ITS AFFILIATES, SUBCONTRACTORS, OR SUPPLIERS BE LIABLE FOR ANY LOSS OF PROFIT OR REVENUES, LOSS OF USE OF THE PRODUCTS OR SERVICES, OR ANY ASSOCIATED EQUIPMENT, COST OF CAPITAL, COST OF SUBSTITUTE GOODS, FACILITIES, SERVICES OR REPLACEMENT POWER, DOWNTIME COSTS OR CLAIMS OF BUYER'S CUSTOMERS FOR DAMAGES OR FOR ANY SPECIAL, PROXIMATE, CONSEQUENTIAL, INCIDENTAL, INDIRECT OR EXEMPLARY DAMAGES.** If Buyer transfers title to, or leases Products sold hereunder to, or otherwise permits or suffers use by, any third party, Buyer shall obtain from such third party a provision affording Seller and its subcontractors/suppliers the protection of the preceding sentence. Any action against Seller must be brought within 18 months after cause of action accrues.

IX. EXCUSABLE DELAYS A. Seller shall not be liable for delays in delivery or failure to perform due directly or indirectly to causes beyond Seller's reasonable control including but not limited to: acts of God; war; terrorism; civil commotion; riots; embargoes; government regulations, orders, instructions or priorities; port congestion; acts of or failure to act on the part of Buyer or its agents/employees; fires; floods; sabotage; nuclear incidents; earthquakes; storms; epidemics; strikes; lockouts or other labor difficulties; shortages of or inability to timely obtain proper labor, materials, components, shipping space or transportation, fuel, supplies or power at current prices; or due to limitations imposed by the extent of availability of Seller's normal manufacturing facilities.
B. If a delay excused per the above extends for more than 90 days and the parties have not agreed upon a revised basis for continuing providing Products/Services at the end of the delay, including adjustment of the price, then either party (except where delay is caused by Buyer, in which event only Seller) upon thirty (30) days' notice may terminate the Order with respect to the unexecuted portion of the Products/Services, whereupon Buyer shall promptly pay Seller its reasonable termination charges upon submission of Seller's invoices thereof.

X. SOFTWARE/TECHNICAL/PROPRIETARY INFORMATION
A. Buyer shall not acquire any rights to any software which may be delivered with Products, except as granted in Seller's standard software license. Any software license granted in connection with Products shall be an interim license, which may be withdrawn, pending payment for Products in full.
B. The purchase of Products shall not include any right to supply of technical information such as drawings or specifications.
C. Proprietary information, including drawings, documents, technical data, reports, software, designs, inventions and other technical information supplied by Seller in connection herewith (hereinafter called "Data"), shall remain Seller's sole property and shall be held in confidence by Buyer. Data shall not be reproduced, used or disclosed to others by Buyer without Seller's prior written consent. Upon completion of Order, Buyer shall promptly return all Data to Seller together with all copies or reprints thereof then in Buyer's possession or control, and Buyer shall thereafter make no future use, either directly or indirectly, of any Data or any information derived therefrom without Seller's prior written consent. The foregoing shall in no way obligate Seller to provide or supply Data.

XI. DIES, TOOLS, PATTERNS Seller's charges for dies, molds, patterns and the like represent the Buyer's proportionate cost thereof, it being expressly understood that they remain the property of Seller. Modifications made to dies, molds, patterns and the like in order to manufacture Products shall be at the discretion of Seller.

XII. GENERAL A. The rights and obligations of the Buyer and Seller hereunder shall be governed in all respects by the law of the Commonwealth of Pennsylvania, U.S.A. The exclusive forum for adjudication of any disputes shall be the federal or state courts of the Commonwealth of Pennsylvania, and Buyer/Seller hereby consent to personal jurisdiction and venue in such courts in any proceeding. The United Nations Convention on the International Sale of Goods shall not apply.
B. These Terms and Conditions of Sale together with any other terms specifically agreed to in writing by Seller constitute the entire agreement between Buyer and Seller and supersede any prior or contemporaneous representations, agreements, proposals, warranties, or understandings, oral or written, express or implied. No waiver, modification, amendment, rescission or other change to these Terms and Conditions of Sale shall be binding unless specifically agreed to in writing by an authorized representative of Seller.
C. The invalidity, of any part hereof shall not affect the validity of the remainder. The failure of Seller to assert any right at any time hereunder shall not prevent Seller's subsequent assertion of the same or different rights.
D. Buyer may not assign this contract without the prior written approval of the Seller.

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

Where Seller approves the application of the Products in a nuclear facility, the Buyer shall, before such use or provision, arrange for insurance or governmental indemnity protecting the Seller against liability and hereby releases and agrees to indemnify the Seller and its suppliers for any nuclear damage, including loss of use, in any manner arising out of a nuclear incident, whether alleged to be due, in whole or in part to the negligence or otherwise of the Seller or its suppliers.

XIV. STATUTORY REQUIREMENTS
Seller reserves the right to make any changes in the general specifications of the Products which are required for the Products to conform to any statutory requirement.

XV. GOVERNMENT CONTRACTS
Only Federal Acquisition Regulation ("FAR") supplement clauses expressly accepted in writing by Seller shall be included or incorporated by reference herein. Seller shall not be bound by and makes no representation of compliance with any FAR or FAR supplement clauses that Seller shall not have expressly accepted in writing.

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