

# Reliable Conductivity Measurement with Self-Checking Sensor



*Model Q45C4*  
4E Conductivity Monitor

# One Sensor for the Entire Conductivity Range

While the theory of monitoring conductivity is simple, in practice it can be very frustrating. While simple 2-electrode sensors are inexpensive and can provide accurate data, continuous monitoring of even relatively clean water can foul the electrodes and degrade the measurement. Maintaining accuracy is made more difficult when the amount of solids dissolved in the process varies over a wide concentration range. In this case, a simple 2-electrode sensor is limited by its cell constant, which means it cannot measure the process accurately.

ATI's Q45C4 4-Electrode Conductivity Monitor is the answer for monitoring almost any water-based process. Drinking water, plating bath solutions, cooling water, process wash water, or virtually any other aqueous system can be monitored accurately and reliably. The unique drive/control scheme used in the 4-electrode system allows a single sensor configuration to be used in conductivity ranges from 0-200  $\mu\text{S}$  to as high as 0-2,000 mS (0-2 S). The "auto-ranging" feature enables the monitor to display the actual conductivity value during "overshoot" conditions. For chemical mixing applications, a concentration display can be selected for a limited number of acids and bases. If your application



4E Conductivity Monitor

involves very low conductivity/resistivity measurement, ATI can provide the Q45C2 System that is used in process waters with conductivities below 20  $\mu\text{S}$  (see separate brochure for details).

## Monitor Features

**Loop-powered, AC, or Battery Versions:** This line of microprocessor based instrumentation allows for easy implementation of loop-powered, line-powered, or battery-powered capability within the same instrument. It can be rapidly converted between any of these versions with no requirement for software change

- Loop-powered (16-35 VDC) transmitter, 4-20 mA output
- Line-powered (115/230 VAC) analyzer, dual relays, dual 4-20 mA outputs
- Battery-powered (9 VDC) Monitor/Data Logger, dual 0-2.5 VDC outputs

**Portable Data Logger:** For even greater versatility, a portable unit powered by a standard 9V battery is also available. The dual 0-2.5 VDC outputs are assignable to conductivity and temperature. This instrument can be supplied with an internal data logger, making it ideal for

short-term monitoring at remote sites. The unit will run for 10 days on a single battery and the data logger will store up to 32,000 data points.

**Intuitive User Interface:** Four-button programming provides intuitive navigation through the menu driven user interface.

**Dual Alarm Relays/Analog Outputs:** AC operated systems provide two relays that are configurable for either "control mode" or "alarm mode" of operation.

**Diagnostic Messaging:** Diagnostic messages provide a clear description of system condition, which eliminates confusing error codes that are difficult to decipher.

**Flexible Calibration:** Two-point and sample calibration options include stability monitors to check temperature and main parameter stability before accepting data.



## Benefits of a 4-Electrode Sensor

Q45C4 Conductivity monitors are designed to use a rugged 4-electrode sensor that provides wide-range conductivity measurement without the need for multiple sensors. Virtually all conductivity applications ranging from 0-200  $\mu\text{S}$  up to 0-2,000,000  $\mu\text{S}$  (0-2 S) can be reliably measured using this unique and flexible system. What can be accomplished with a single 4-electrode would normally require at least three conventional 2-electrode sensors with increasing cell constants. This "one sensor fits all" approach to conductivity measurement eliminates the need to inventory multiple sensor types, as well as the confusion in matching cell constants to conductivity ranges.

The 4-electrode sensors not only provide wide range measurement capability, but also excellent resistance to electrode coatings that can degrade measurement accuracy. Changes in electrode condition are compensated for in the electronic



transmitter, so even partially fouled sensors continue to produce accurate measurements. And should the sensor become so fouled that it requires cleaning, the monitor will display a "fouled sensor" indication to ensure that operating personnel are alerted.

Sensors for the Q45C4 system are available in a variety of mounting configurations: convertible-style with 1" NPT threads for pipe or tank mounting, 1-1/2" or 2" sanitary-style fittings in 316 stainless steel, and insertion-style for 1-1/4" NPT hot-tap assemblies that allow the sensor to be removed from service without shutting down the process.

## How a 4-Electrode Sensor Works

In a traditional 2-electrode sensor, each electrode performs two functions. First, the electrodes are used to generate a "drive potential" through the aqueous solution. Second, the electrodes are used to measure the level of current flow as the conductivity of the solution varies. It is this dual role that limits a 2-electrode sensor to a narrow functional conductivity range.

A 4-electrode sensor splits the two functions between two sets of electrodes. One set of electrodes is used to generate the drive

potential through the aqueous solution. The other set of electrodes is used to measure the current that flows between the two drive electrodes. Because these two functions are separate, the 4-electrode sensor does not suffer the polarization effects that limit a 2-electrode sensor to a narrow functional range. This allows a single 4-electrode sensor to operate reliably over the entire 0-2 S/cm conductivity range.

## Sensor Features

**4-Electrode Style Sensor:** Allows the sensor to be used over 0 to 2,000,000  $\mu\text{S}$  range.

**PEEK® Sensor Construction:** Electrode holders made of PEEK®, a high performance thermoplastic that provides outstanding mechanical strength and chemical resistance. High structural integrity ensures accurate conductivity measurement.

**Multiple Mounting Styles:** Sensors available in 1" NPT convertible-style, insertion-style, and 1-1/2" or 2" sanitary styles.

**Titanium Electrodes:** The four electrodes used in the sensor are made of titanium for greater chemical resistance.

**Sensor Diagnostics:** Sensor diagnostics are used to alarm the user in the event of loss of sensor seal integrity or integral temperature sensor failure. Automatic foulant rejection circuitry is used to compensate for the effects of sensor fouling. As the two drive electrodes become coated by the process solution, a feedback mechanism involving the two sensing electrodes detects the decrease in drive potential and automatically re-establishes the proper drive potential. When the degree of coating reaches a limit where compensation is no longer possible, the diagnostics actuate an alarm to signal that the sensor requires cleaning.

**Multiple Sealing Materials:** Multiple sealing materials are used to preserve sensor integrity over a wide range of chemical processes and varying temperature.

## Monitor Specifications

Main Display Range:	0.0 to 200.0, 0 to 2,000 $\mu$ S; 0.00 to 20.00, 0.0 to 200.0, 0 to 2,000 mS
Repeatability:	0.3% of span, or 0.1 $\mu$ S, whichever is greater
Sensitivity:	0.05% of span or 0.1 $\mu$ S, whichever is greater
Non-linearity:	0.3% of span, or 0.1 $\mu$ S, whichever is greater
Response Time:	6 seconds to 90% of step input at lowest setting
Display:	Large 4 digit main display, 0.75" characters. 12 digit alpha-numeric second line display
Power:	16-35 VDC for loop-powered unit; 115/230 VAC, 50/60 Hz., 10 VA max.; 9 VDC for battery power
Control Relays:	Two SPDT relays, 6A @ 250 VAC, 5A @ 24 VDC, resistive
Relay Mode:	Programmable for control or alarm function
Analog Outputs:	Isolated 4-20 mA, 550 ohm max. load. Two assignable 4-20 mA outputs, 550 ohm max. (AC only)
Data Logger:	Battery version only, stores 32,000 data points
Operating Conditions:	-20-60°C, 0-95% R.H. non-condensing
Enclosure:	NEMA 4X (IP-66) polycarbonate wall, panel, or pipe mount
Weight:	2-wire or battery units: 1 lbs. (.45 Kg.) AC power units: 2 lbs. (.9 Kg.)

## Ordering Information: Model Q45C4-A-B-C Conductivity Monitor

Suffix A - Power	1 - 24 VDC, 2-wire (single output only)
	2 - 115 VAC with 2 relays
	3 - 230 VAC with 2 relays
	4 - Battery operated with two 0-2.5 VDC outputs
	5 - Battery operated with internal data-logger
Suffix B - Sensor Style	1 - Convertible-style, PEEK
	2 - Insertion-style, 316SS
	3 - 1-1/2" Sanitary-style, 316SS
	4 - 2" Sanitary-style, 316SS
Suffix C - Sensor Cable Length	1 - 15 feet
	2 - 30 feet
	9 - Special
OPTIONS:	
00-0048	Junction box
07-0100	NEMA 4X junction box
31-0057	Sensor interconnect cable
07-0202	Submersion mounting hardware
09-0046	Conductivity standard, 84 $\mu$ S, 500 mL
09-0047	Conductivity standard, 447 $\mu$ S, 500 mL
09-0048	Conductivity standard, 1,500 $\mu$ S, 500 mL
09-0049	Conductivity standard, 8,974 $\mu$ S, 500 mL
09-0050	Conductivity standard, 80,000 $\mu$ S, 500 mL
47-0005	2" U-bolt, 304SS
05-0068	Panel mount bracket kit

## Sensor Specifications

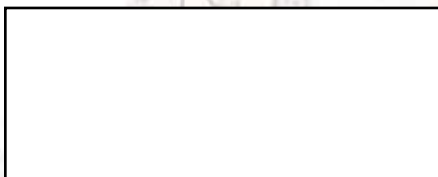
Measuring Range:	0 to 2,000,000 $\mu$ S
Wetted Materials:	PEEK®, titanium, Viton®, EDPM 316 Stainless Steel with sanitary or insertion body styles
Temperature Compensation:	Pt1000 RTD
Sensor Cable:	6 conductor plus 2 shields, HDPE jacket
Temperature Range:	-10 to 125°C (14 to 257°F).
Pressure Range:	0 to 100 psig
Max. Flow Rate:	10 feet (3 meters) per second
Max. Sensor to Analyzer Distance:	60 feet (18.3 meters)
Sensor Body Options:	1" NPT convertible 1-1/4" insertion 1-1/2" or 2" sanitary-style

## Notes

1. All sensor cable lengths greater than 30 feet require a junction box (07-0100) and sensor interconnect cable (31-0057).
2. PEEK sensor body is only available in convertible style.
3. Pipe mount requires two 2" U-bolts (47-0005).
4. Panel mount requires bracket (05-0068).



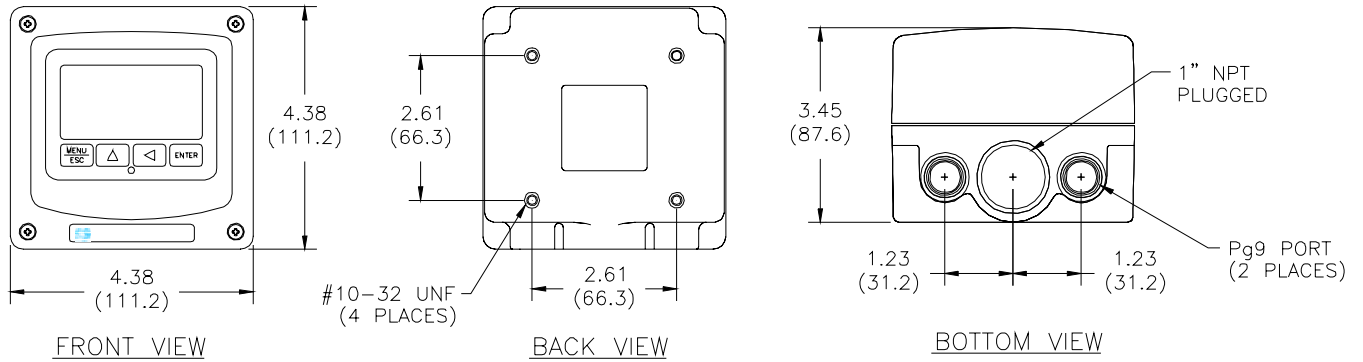
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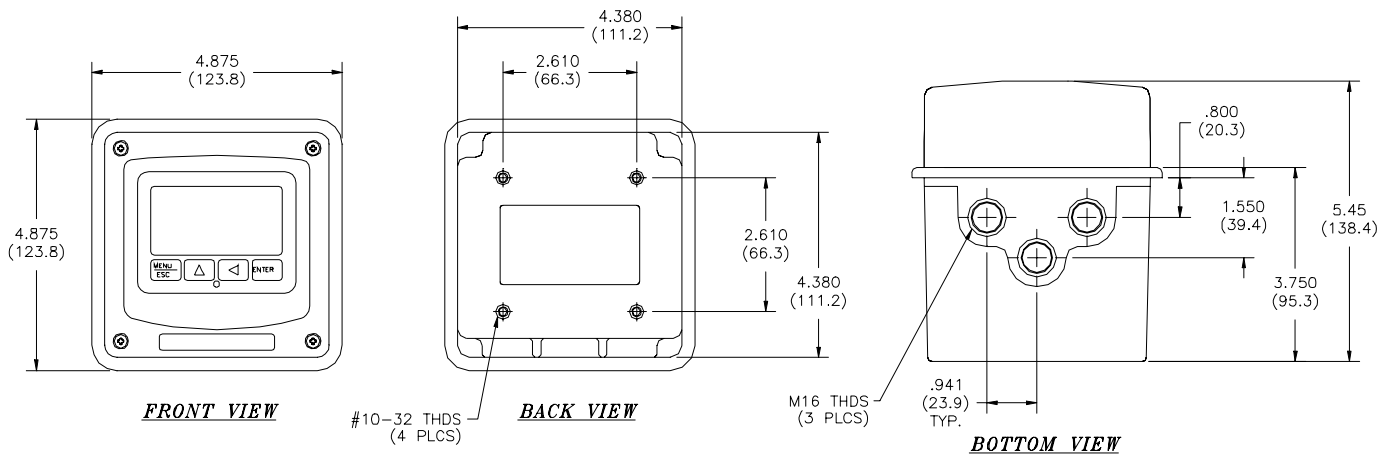
**2-WIRE VERSION (or BATTERY POWERED)**



**NOTE: JUNCTION BOXES HAVE SAME DIMENSIONS AS 2-WIRE TRANSMITTER**

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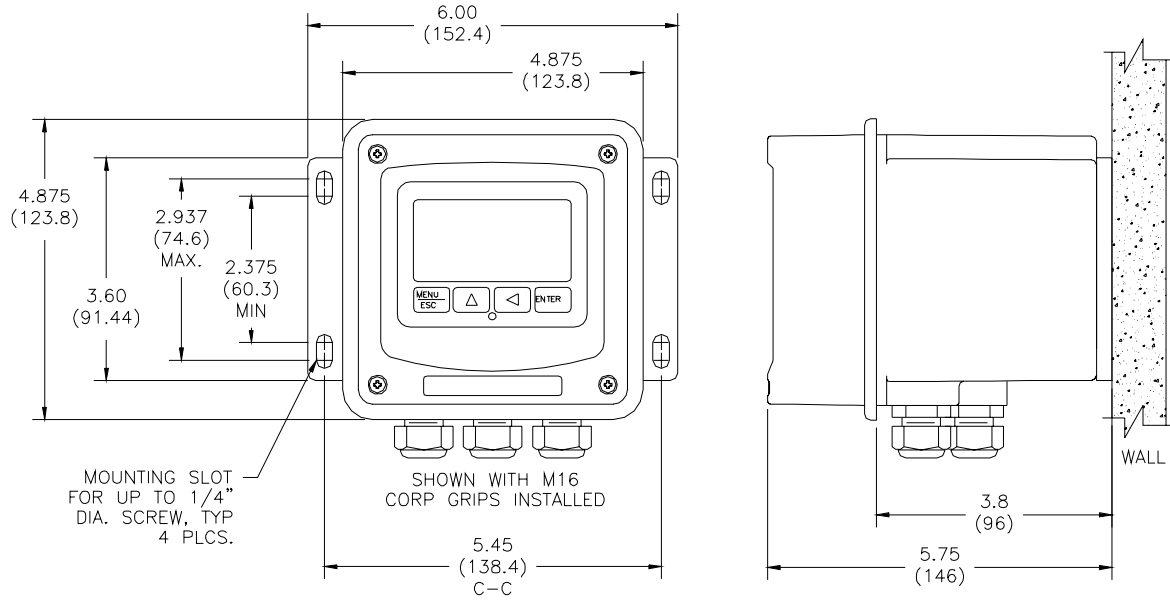
**AC POWERED VERSION**



Material: Polycarbonate  
 Ratings: Nema 4X (IP-66)  
 V-0 Fire Retardant

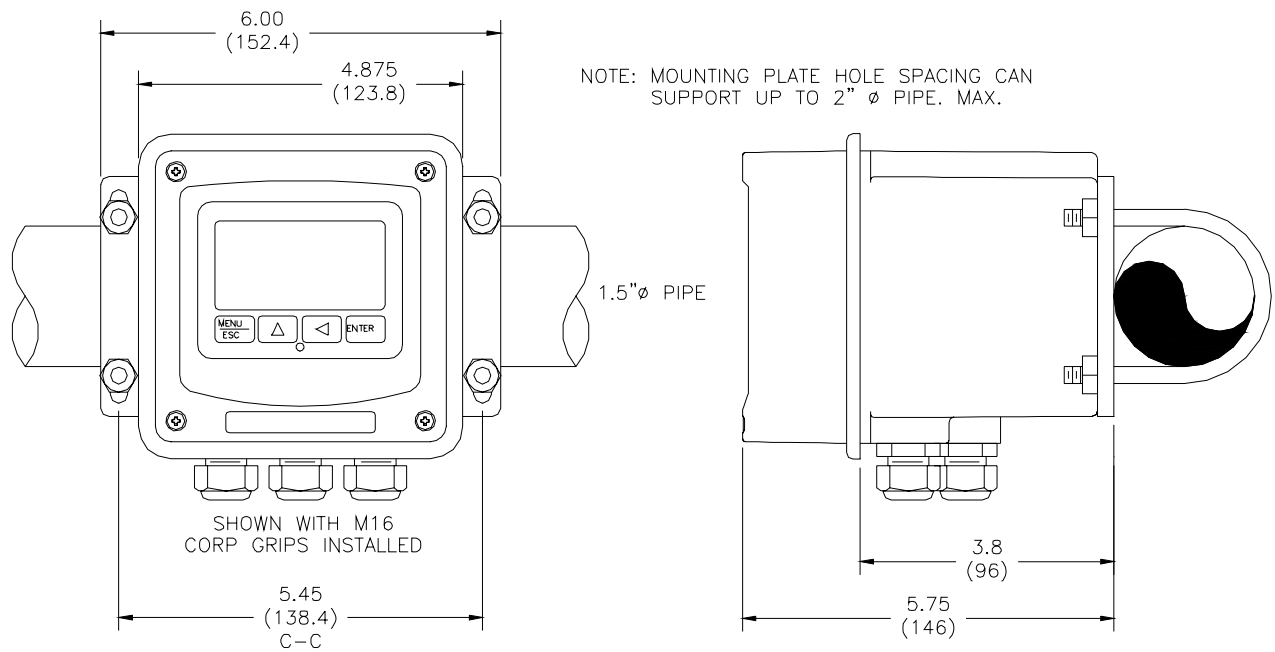
ATI-0706

**WALL MOUNTING**



ATI-0709

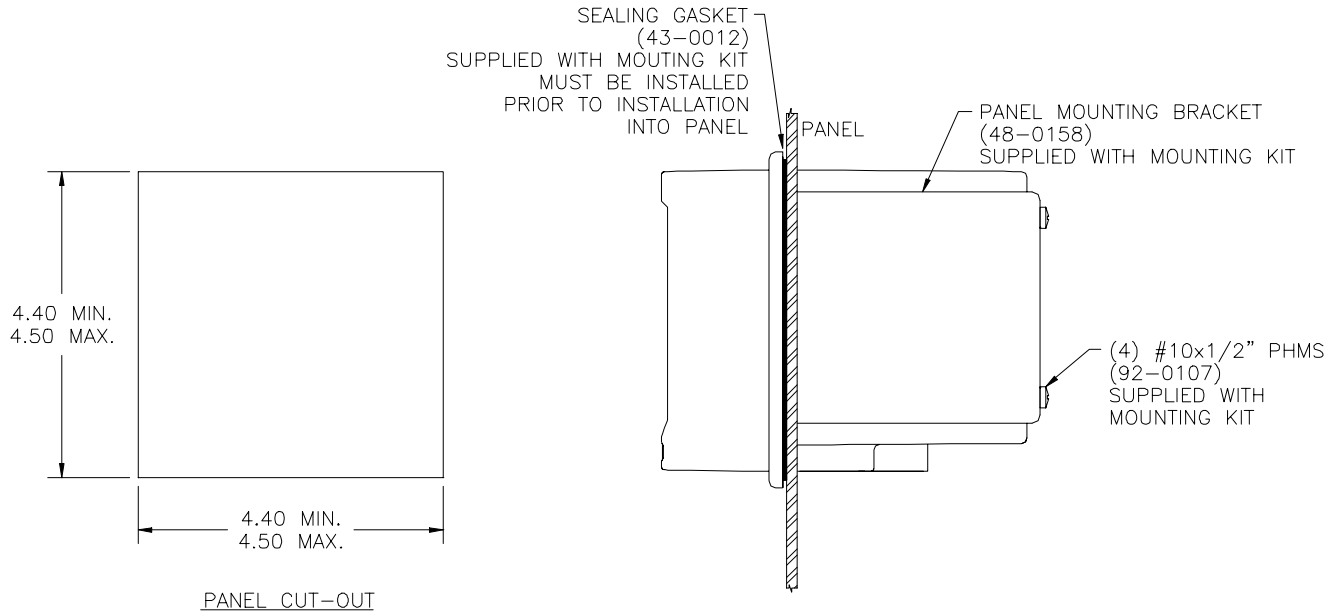
**PIPE MOUNTING**



NOTE: PLATE MAY BE TURNED 90° FOR VERTICAL PIPE MOUNTING

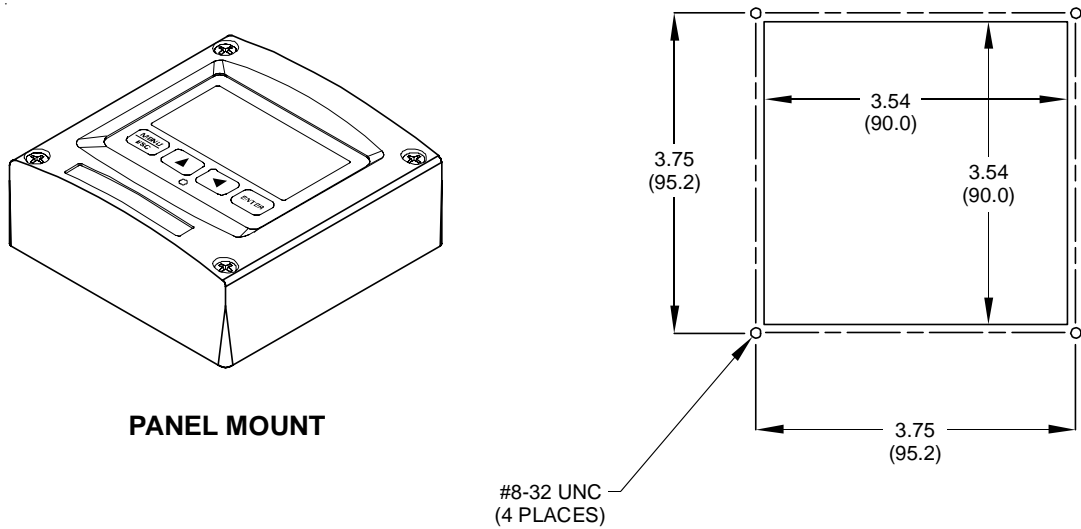
ATI-0710

**PANEL MOUNTING - AC UNITS**



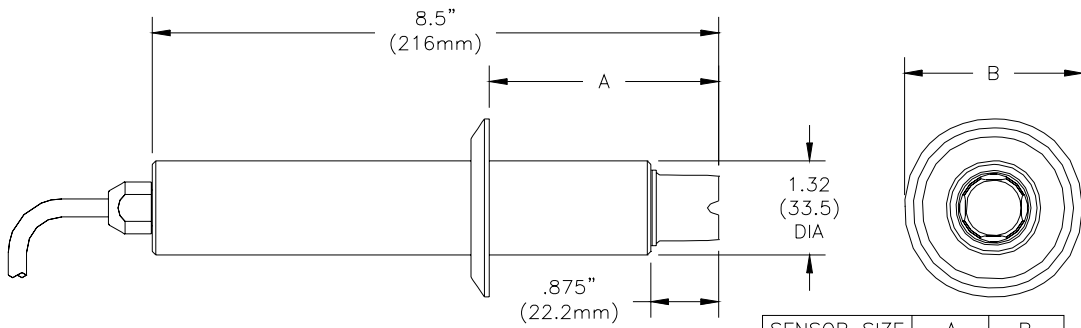
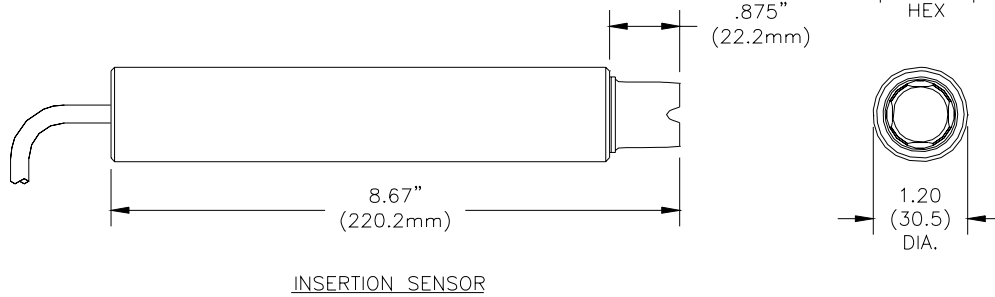
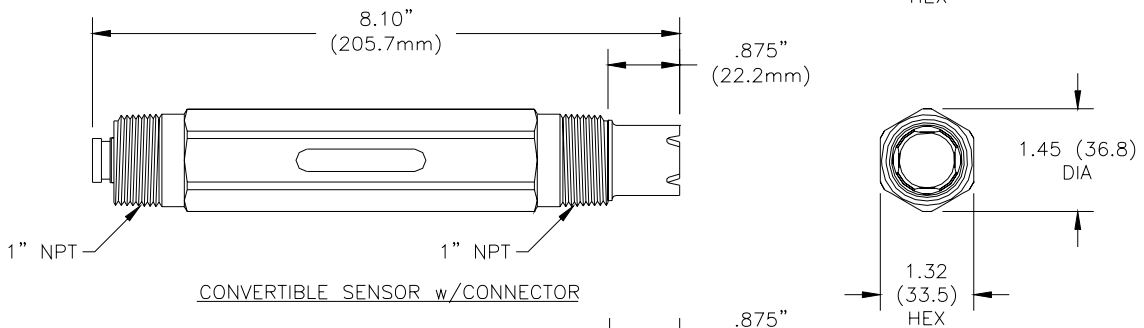
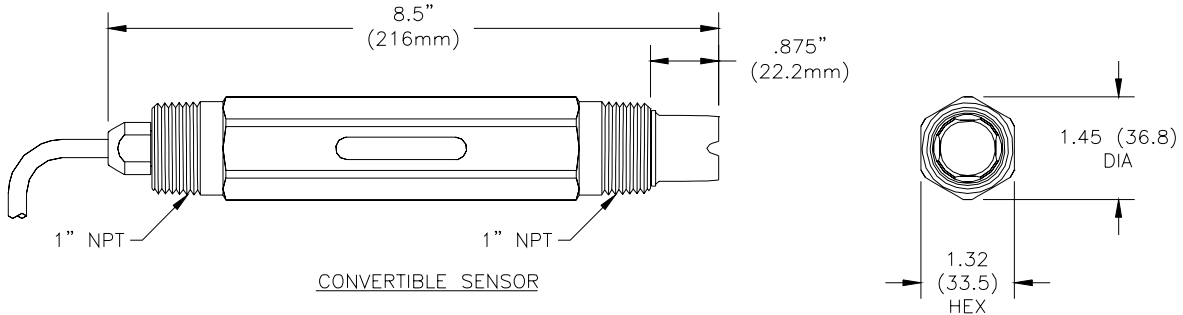
ATI-0711

**2-WIRE FLUSH MOUNT**



ATI-0611

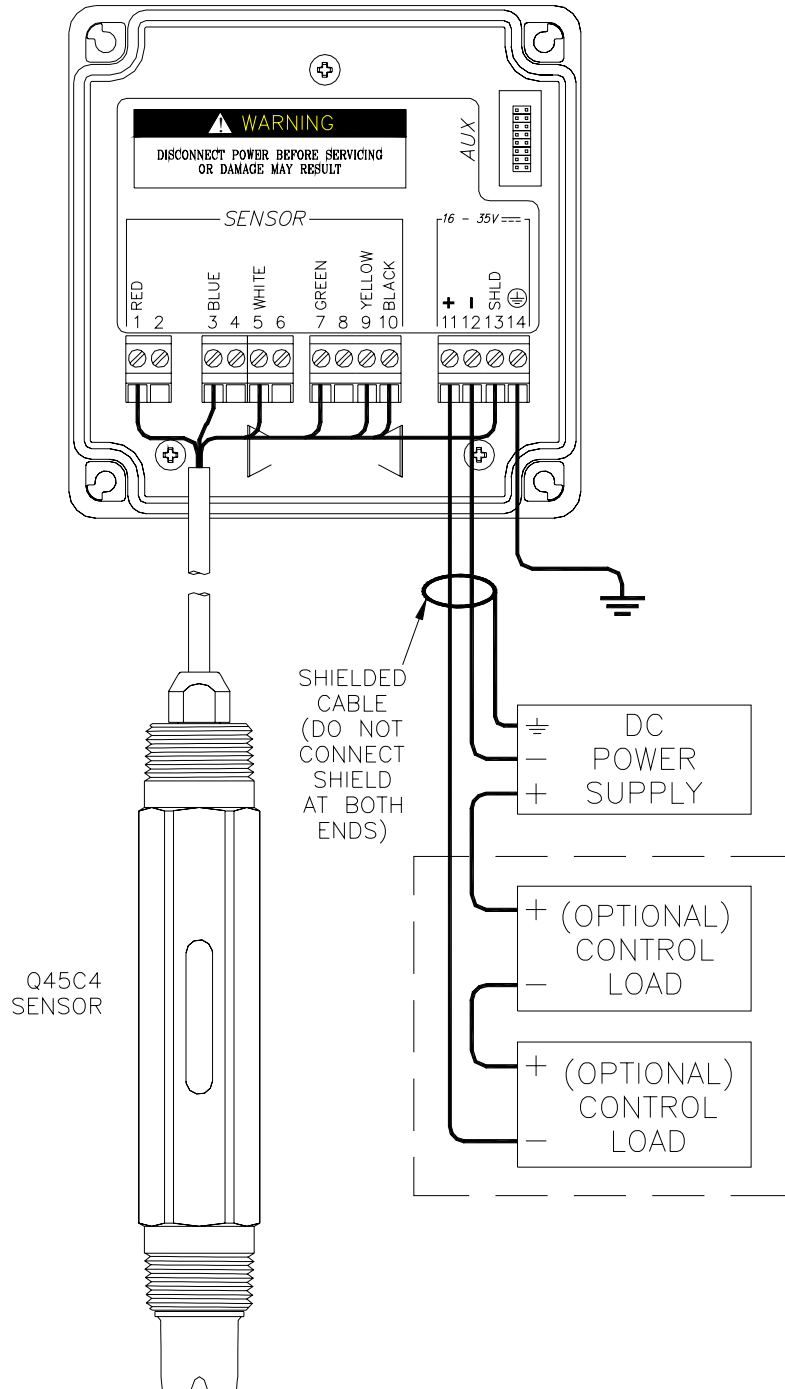
**Q25C4 4E CONDUCTIVITY SENSOR DIMENSIONS**



SENSOR SIZE	A	B
1-1/2"	2.38 (60.5)	1.98 (50.4)
2"	3.13 (80.0)	2.50 (63.5)

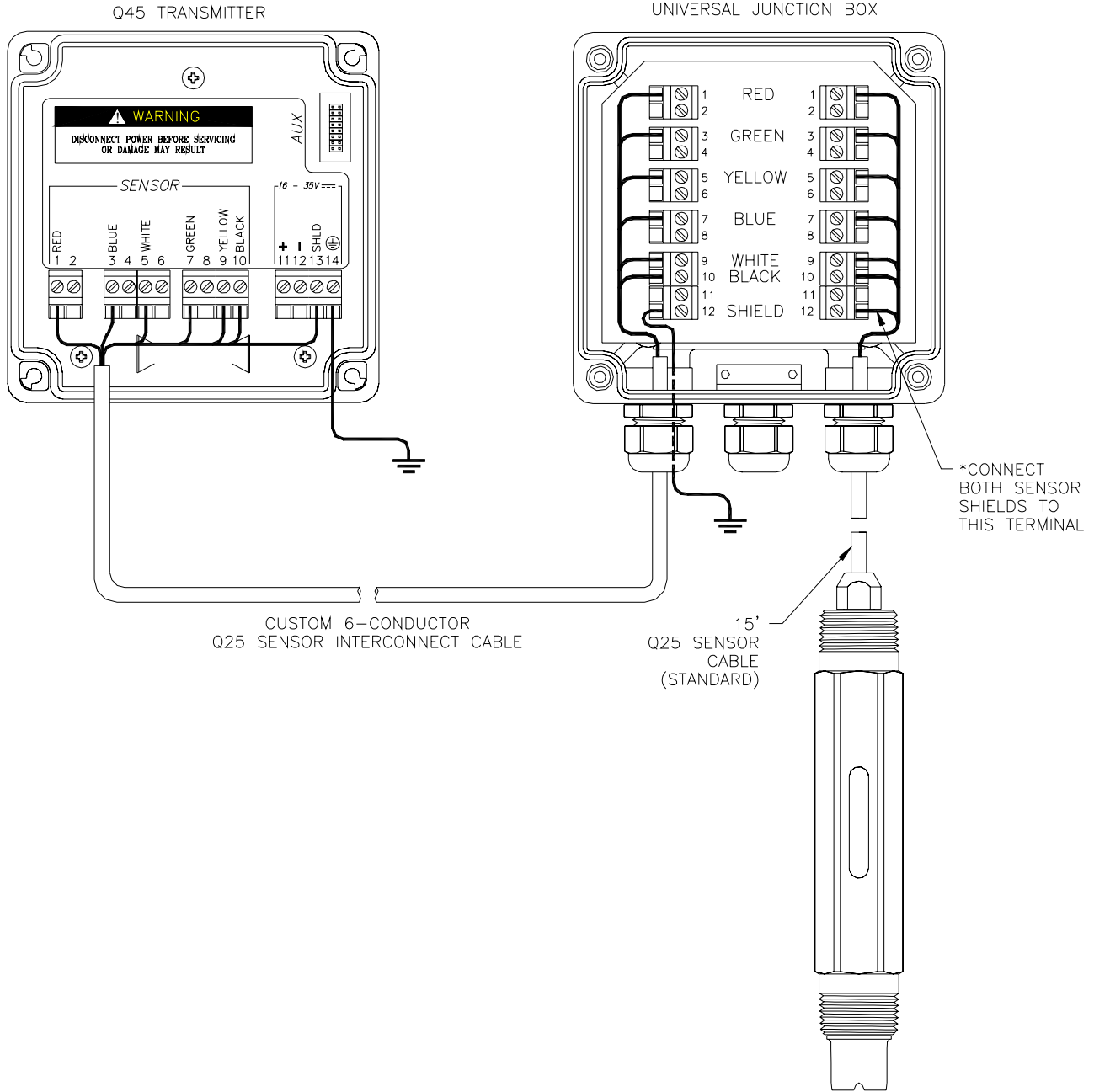


**ELECTRICAL CONNECTIONS - 2-WIRE TRANSMITTER**



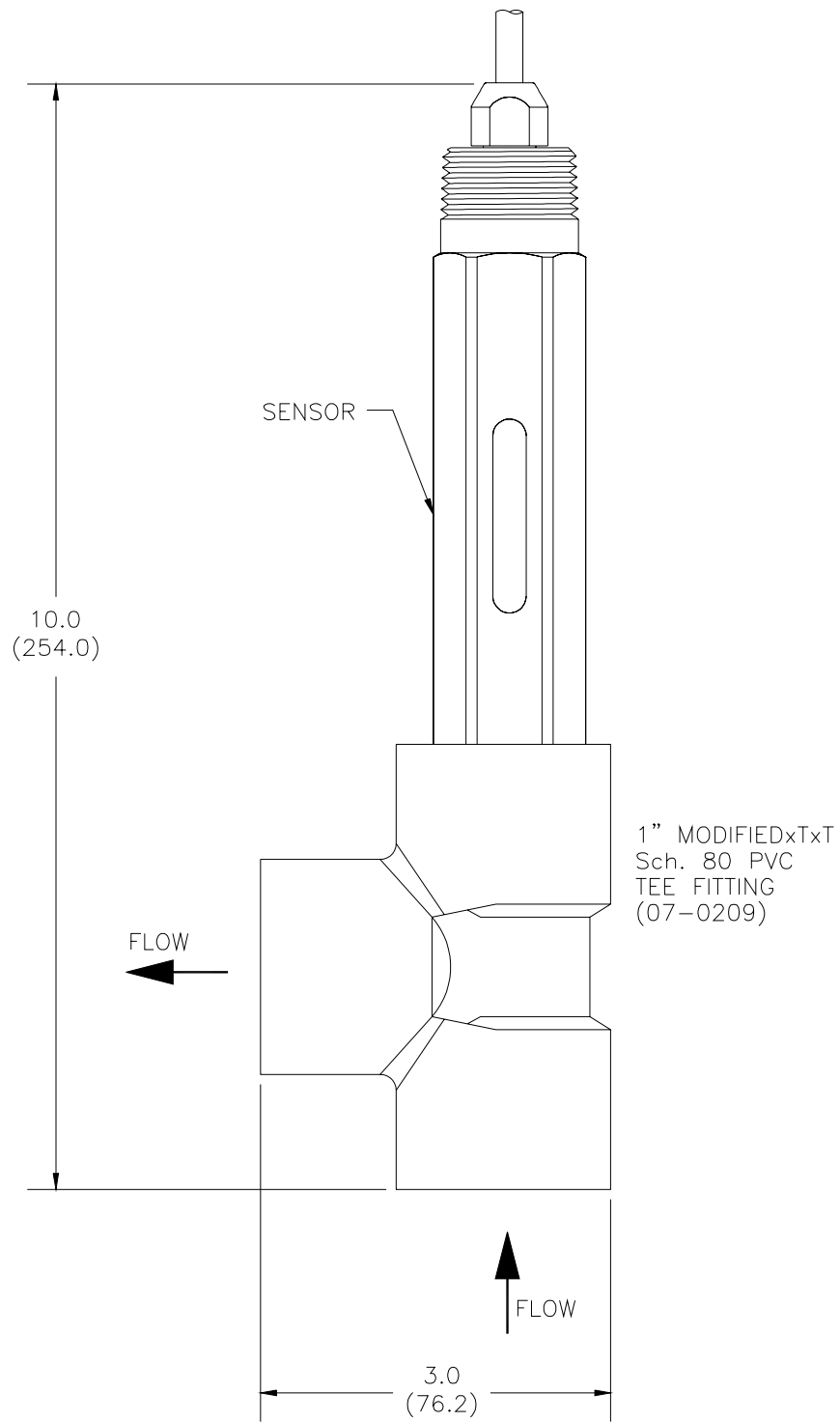
- NOTES:** 1. Voltage between Terminals 9 & 10 MUST be between 16 & 35 VDC.  
 2. Earth ground into Terminal 12 is HIGHLY recommended. This connection can greatly improve stability in electrically noisy environments.

**ELECTRICAL CONNECTIONS - 2-WIRE WITH JUNCTION BOX**



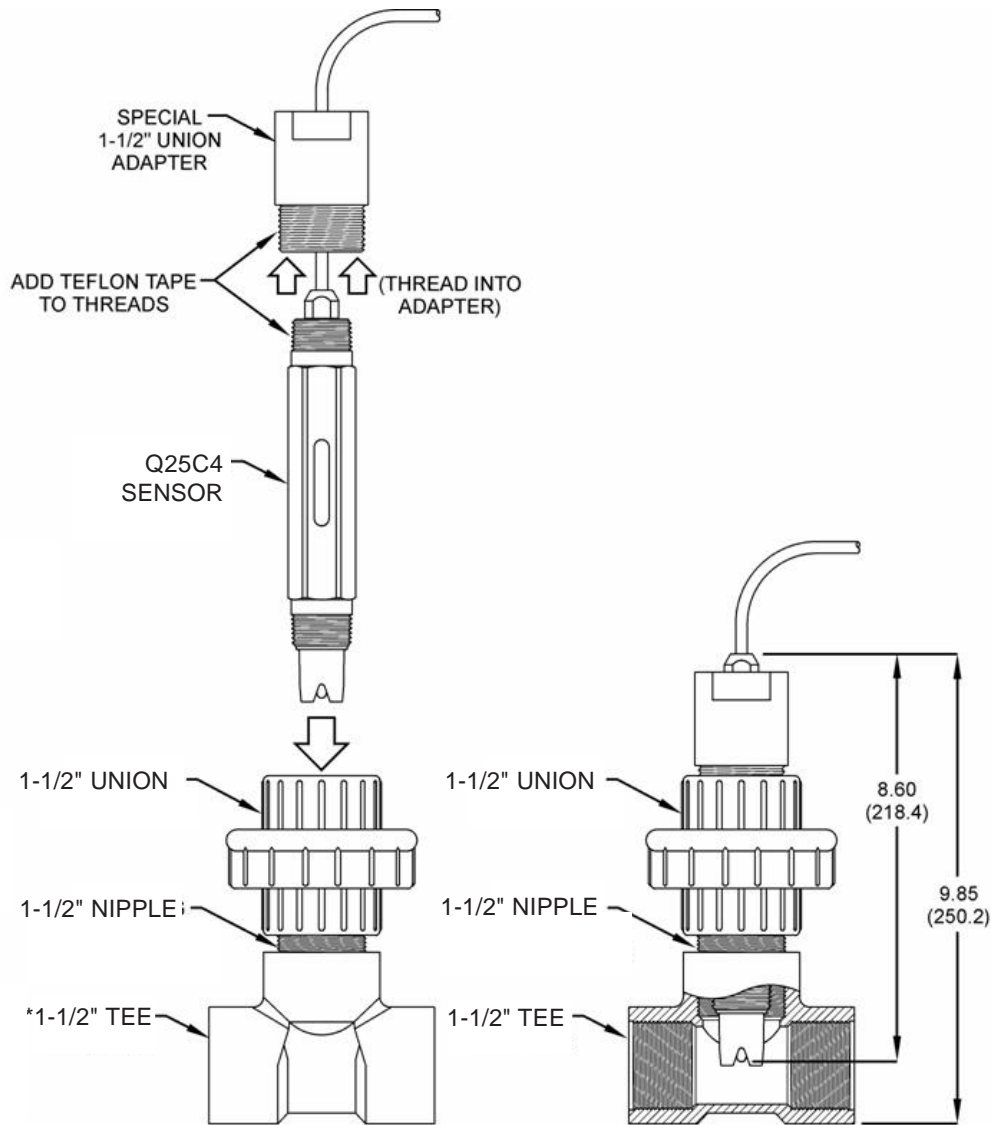
ATI-0738

**FLOW TEE DETAIL**



ATI-0727

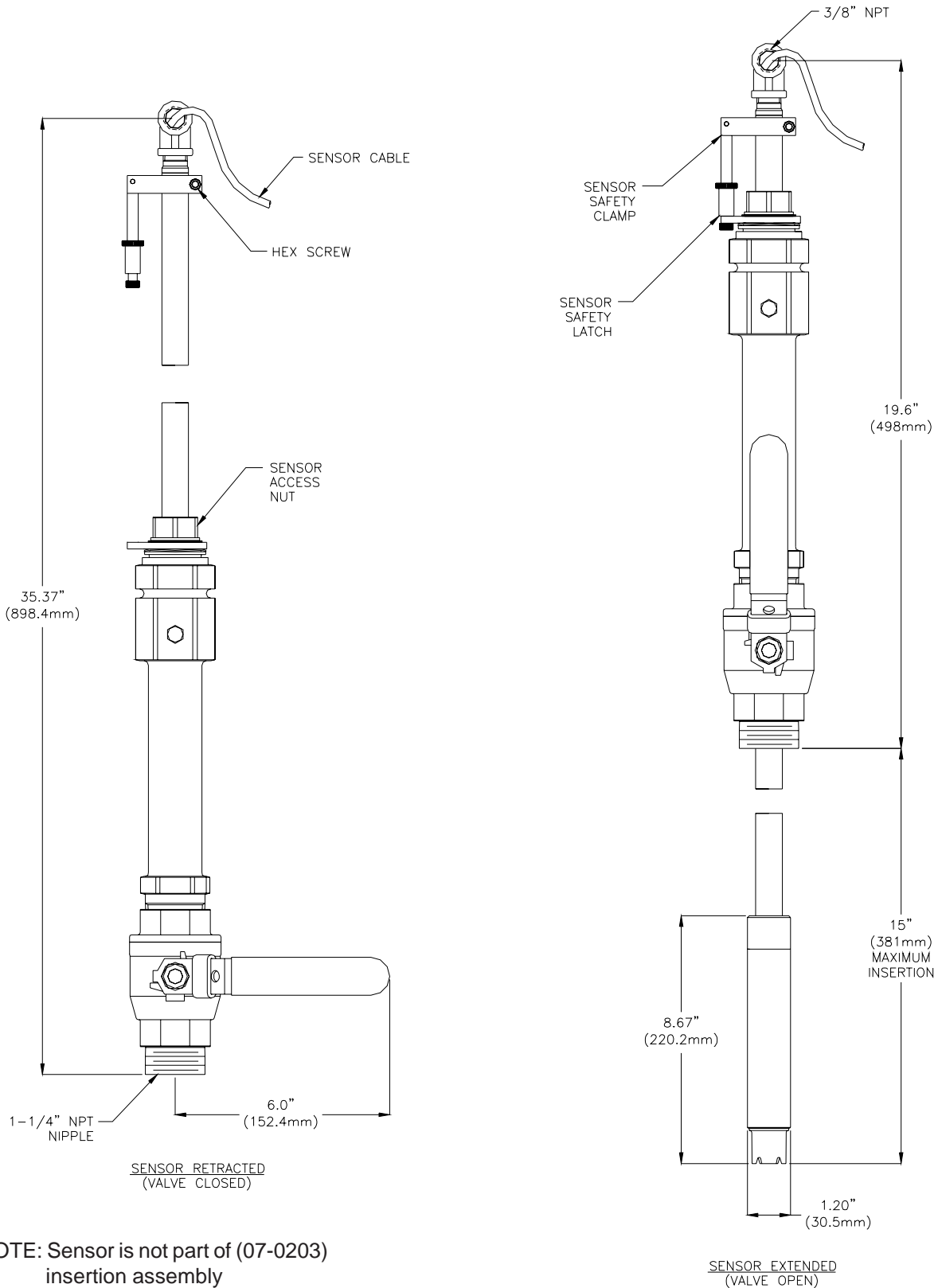
1-1/2" UNION DETAIL - (07-0221)



\* 1-1/2" TEE Fitting not supplied with P/N (07-0221). Tee Fitting must be ordered Separately



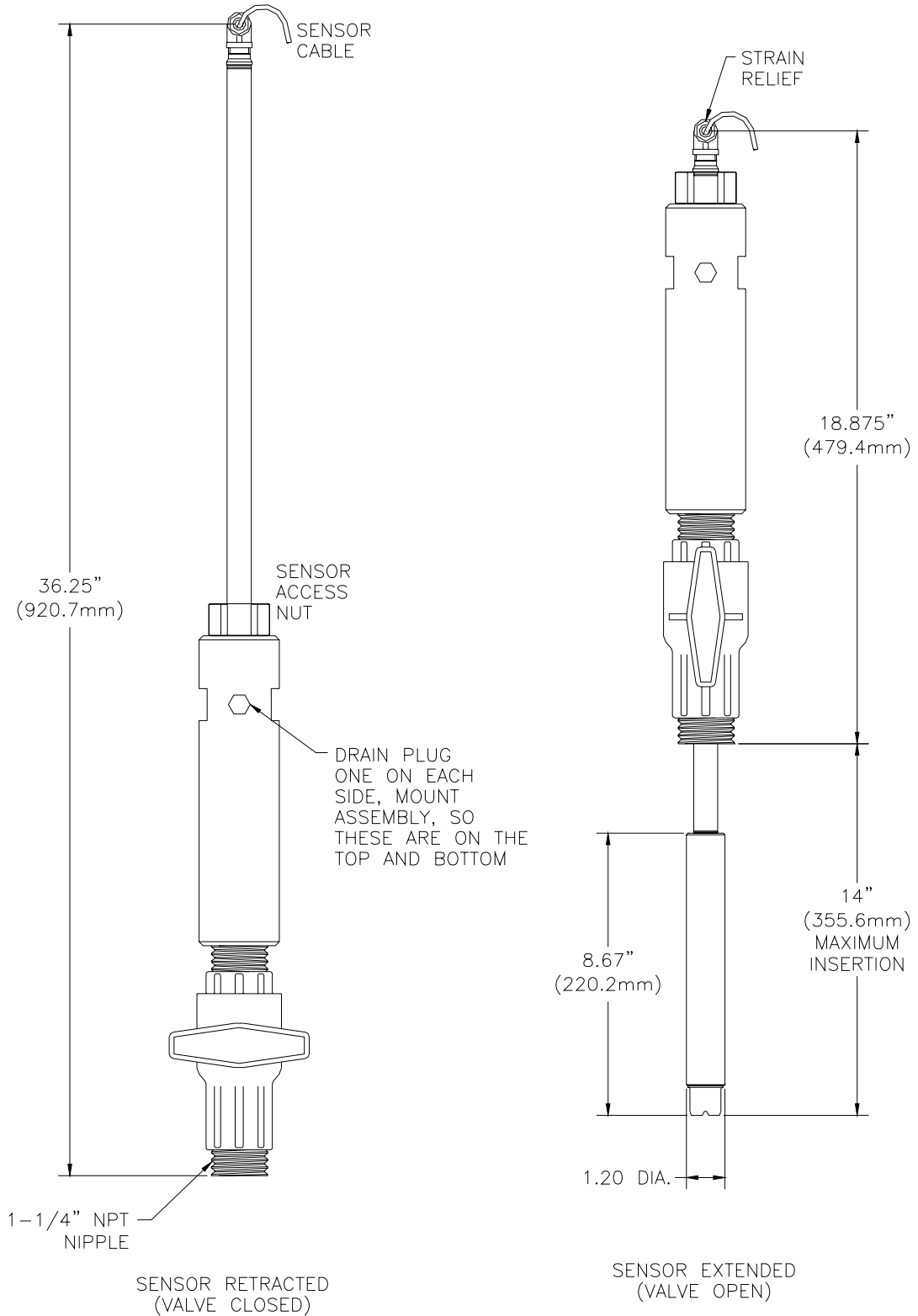
**INSERTION ASSEMBLY DETAIL (07-0203) - (SS VERSION)**



NOTE: Sensor is not part of (07-0203) insertion assembly

ATI-0739

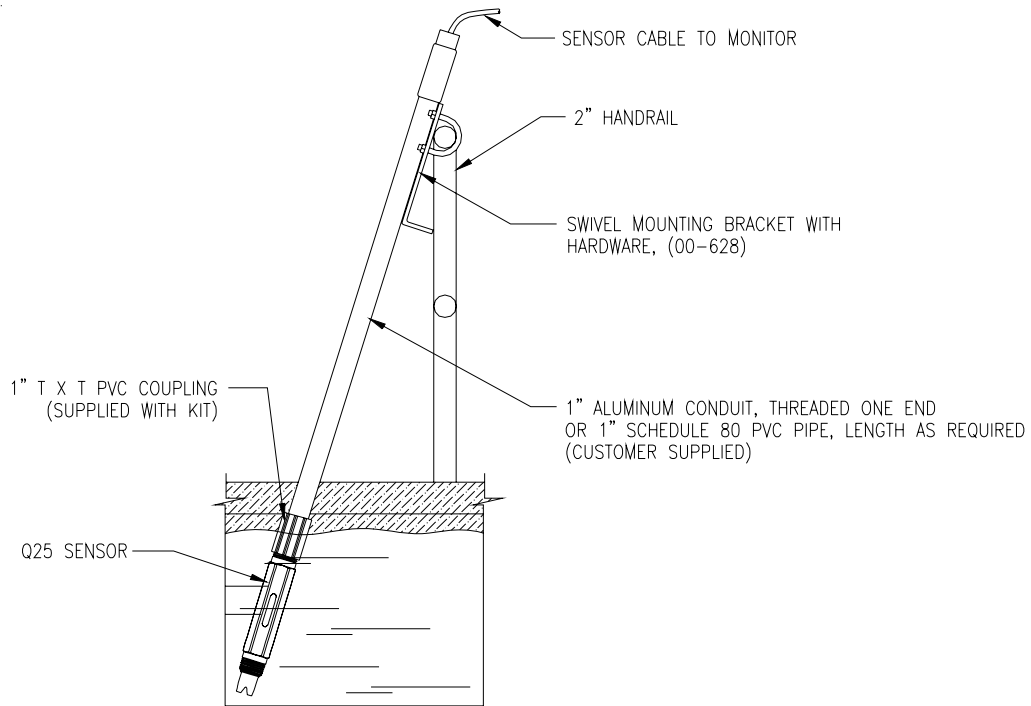
**INSERTION ASSEMBLY DETAIL (07-0223) - (CPVC VERSION)**



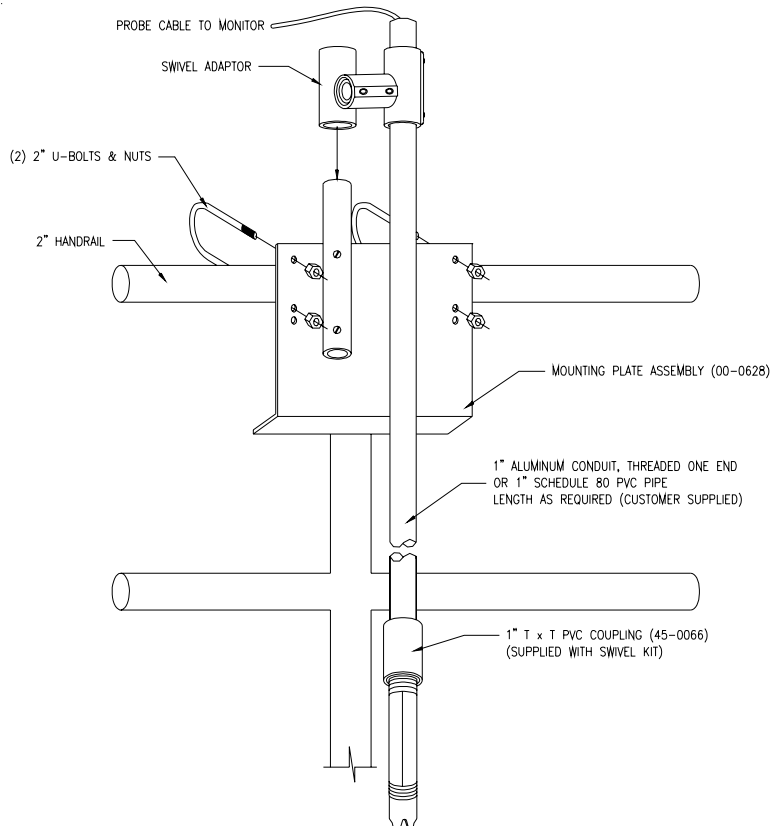
NOTE: Sensor is not part of (07-0223) insertion assembly

ATI-0682

**(00-0628) SUBMERSION MOUNTING ASSEMBLY**



ATI-0728



ATI-0729