



IMMERSION SERIES TEMPERATURE TRANSMITTER

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Installation & Operation Instructions

GENERAL INFORMATION

The ACI Immersion Series sensors and transmitters are single point sensors that output 4-20 mA with an optional voltage signal output of 1-5VDC or 2-10VDC signal to BAS or controller. All ACI/TT and TTM temperature transmitters can be powered from either an unregulated or regulated 8.5 to 32 VDC power supply.

MOUNTING INSTRUCTIONS

For optimal temperature readings, follow these tips:

- Apply thermal grease to the end of the probe before installation into thermowell (ACI Item #102595).
- The tip of the thermowell should be located in the middle of the pipe.
- The sensor thermowell should be installed against the flow of the water, where water temperature is well mixed (no stratification).
- Make sure the entire thermowell is immersed. If the thermowell is longer than the pipe diameter, the thermowell should be installed in an elbow or Tee.

THERMOWELL INSTALLATION

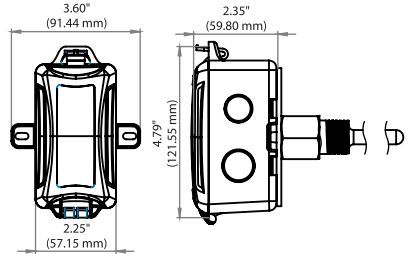
ACI's standard Immersion sensors are made to install into a 1/2" NPT female thread. Typically a Thredolet or Tee is installed into the pipe, but a hole can also be drilled and tapped. The pipe/system will need to be drained, unless a Hot Tap is being used. The recommend drill size is 23/32 in. (18 mm). Drill the hole, and tap the hole with 1/2"-14NPT.

Always use proper thread sealants on tapered pipe threads of the thermowell. Screw the thermowell into the Thredolet, Tee, or tapped hole, using a wrench to tighten it firmly. Refill the system and check for leaks.

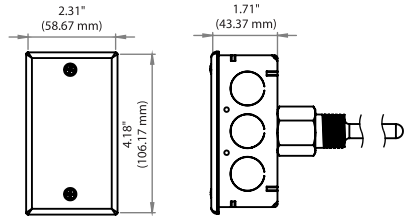
Best practice is to apply thermal grease to the end of the probe, but not required. Insert and push the sensor probe into the thermowell. Turn the sensor probe assembly clockwise to tighten down completely.

FIGURE 1: ENCLOSURE DIMENSIONS

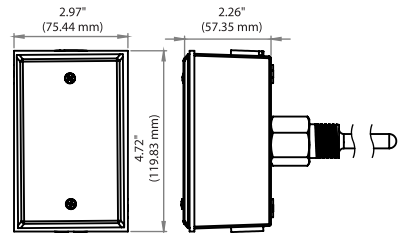
PLASTIC BOX (-PB)



GALVANIZED ENCLOSURE (-GD)



BELL BOX (-BB)



NEMA -4X (-4X)

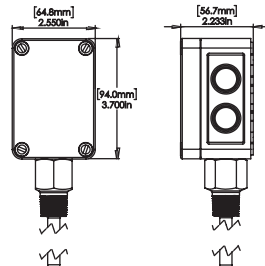


FIGURE 2: THREDOLET ASSEMBLY

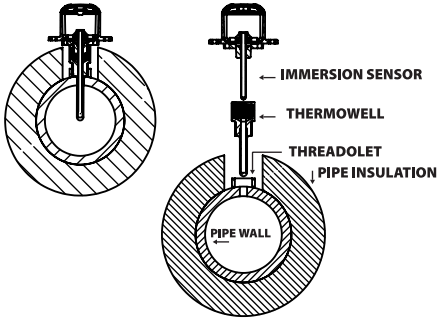


FIGURE 3: ELBOW ASSEMBLY

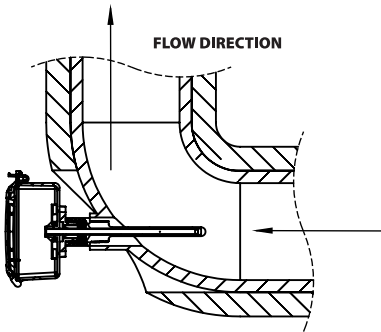
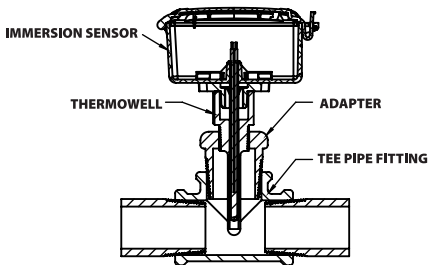


FIGURE 4: TEE MOUNT ASSEMBLY



PROBE INSERTION

The immersion sensors “-I” include a welded thermowell but can be ordered without the thermowell “-INW” version. The “-INW” includes a standard 1/2” NPS process thread to be used with a machined thermowell or previously installed thermowell. Verify the existing thermowell insertion length of the pipe is suitable for your selected Immersion.

If the length of the probe is too large, the probe may be pressed into its enclosure - up to an inch of clearance.

Note: *Fabricated (welded) thermowells (-I) are not intended for moving water or high pressure service. Fluid velocity and wake frequency are primary factors in well failure. Machined thermowells (-IM) should be used in these types of applications. Fabricated thermowells are intended for tank, or low to no flow, applications.

FIGURE 5: PROBE and IMMERSION

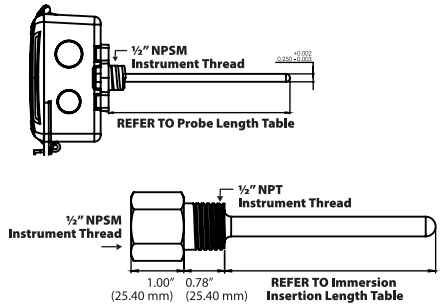


TABLE 1: PROBE LENGTH and INSERTION LENGTH

ACI PART #	IMMERSION LENGTH	PROBE LENGTH
A/TTxx-INW-2.5"-yy-zz	2.5" (63.50 mm)	4.31" (109.47 mm) +/- 0.13" (3.30 mm)
A/TTxx-INW-4"-yy-zz	4.0" (101.60 mm)	5.81" (147.57 mm) +/- 0.13" (3.30 mm)
A/TTxx-INW-6"-yy-zz	6.25" (158.75 mm)	7.81" (198.37 mm) +/- 0.13" (3.30 mm)



MAXIMUM VELOCITY VS THERMOWELL INSERTION LENGTH MACHINED THERMOWELL									
Straight Shank Insertion Length "U"					Stepped Shank Insertion Length "U"				
Material:	Media Type:	1.0" (25.4 mm)	2.5" (63.5 mm)	8.0" (203.2 mm)	4.0" (101.6 mm)	6.0" (152.4 mm)	12.0" (304.8 mm)	18.0" (457.2 mm)	24" (609.6 mm)
304/316 SS	Air/Gas/Steam ¹	349 ft/s (106.3 m/s)	349 ft/s (106.3 m/s)	71.9 ft/s (21.9 m/s)	109 ft/s (33.2 m/s)	73.6 ft/s (22.4 m/s)	19.4 ft/s (5.9m/s)	8.8 ft/s (2.7m/s)	5.2 ft/s (1.6m/s)
304/316 SS	Water	360 ft/s (109.7 m/s)	360 ft/s (109.7 m/s)	71.9 ft/s (21.9 m/s)	82.2 ft/s (25.1 m/s)	26.9 ft/s (8.2 m/s)	11.3 ft/s (3.4m/s)	4.7 ft/s (1.43m/s)	2.5 ft/s (0.8m/s)

Note¹: Values are for Air/Gas/Steam and similar density media based upon Max pressure of 2900 PSI @ 1000°F (537.8°C) | **Note²:** Values are for Water (No Glycol or other Chemicals factored in) @ 68 °F (20°C) and max pressure of 5700 PSI. (Calculated to ASME PTC 19.3 TW-2016 Code B31.1) | **Note³:** 6-24" Machined Thermowells meet ASME PTC 19.3 TW-2016 Code B31.1.

MAXIMUM PRESSURE VS TEMPERATURE RATINGS TWO PART FABRICATED WELDED THERMOWELL							
Material:	70°F (21.1°C)	200°F (93.3°C)	400°F (204.4°C)	600°F (315.6°C)	800°F (426.7°C)	1000°F (537.8°C)	1200°F (648.9°C)
304/316 SS	982 PSI (67.7 Bar)	820 PSI (56.6 Bar)	675 PSI (46.5 Bar)	604 PSI (41.6 Bar)	550 PSI (37.9 Bar)	510 PSI (35.1 Bar)	290 PSI (20.0 Bar)

MAXIMUM FLUID VELOCITY RATINGS TWO PART FABRICATED WELDED THERMOWELL				
Straight Shank Insertion Length "U"				
Material:	Media Type:	2.5" (63.5 mm)	4.0" (101.6 mm)	6.0" (152.4 mm)
304/316 SS	Air/Gas/Steam ²	169 ft/s (51.5 m/s)	61 ft/s (18.6 m/s)	20 ft/s (6.1 m/s)
304/316 SS	Water	88 ft/s (26.8 m/s)	20 ft/s (6.1 m/s)	10 ft/s (3.05 m/s)

Note²: Values are for Air/Gas/Steam and similar density media

WIRING INSTRUCTIONS



PRECAUTIONS

- Transmitter is powered by 24 VDC only.
- Remove power before wiring. NEVER connect or disconnect wiring with power applied.
- When removing the shield from the sensor end, make sure to properly trim the shield to prevent any chance of shorting.
- When using a shielded cable, ground the shield ONLY at the controller end. Grounding both ends can cause a ground loop.
- If the 24 VDC power is shared with devices that have coils such as relays, solenoids, or other inductors, each coil must have an MOV, DC Transorb, Transient Voltage Suppressor (ACI Part: 142583), or diode placed across the coil or inductor. The cathode, or banded side of the DC Transorb or diode, connects to the positive side of the power supply. Without these snubbers, coils produce very large voltage spikes when de-energizing that can cause malfunction or destruction of electronic circuits.



WIRING INSTRUCTIONS

Open the cover of the enclosure. ACI recommends 16 to 26 AWG twisted pair wires or shielded cable for all transmitters. Twisted pair may be used for 2-wire current output transmitters or 3-wire for voltage output. Refer to **FIGURE 6** (right) for wiring diagrams. All wiring must comply with local and National Electric Codes. All ACI TT and TTM temperature transmitters can be powered from either an unregulated or regulated 8.5 to 32VDC power supply. The TT and TTM DO NOT support an AC input. All TT and TTM temperature transmitters are reverse polarity protected. After wiring, attach the cover to the enclosure.

The minimum voltage at the transmitter power terminal is 8.5V after load resistor voltage drop.

- 249 Ω load resistor (1-5 VDC output) = 13.5 V min supply voltage
- 499 Ω load resistor (2-10 VDC output) = 18.5 V min supply voltage

Note: Adding extra wire length between the sensor and transmitter board may affect accuracy.

Note: All RTD's are supplied with (2) or (3) flying lead wires. ACI's transmitters are supplied with a 2 pole terminal block for RTD sensor connections. When wiring a 3 wire RTD, connect the (2) common wires (same color) together into the same terminal block - see **FIGURE 7** (bottom right).

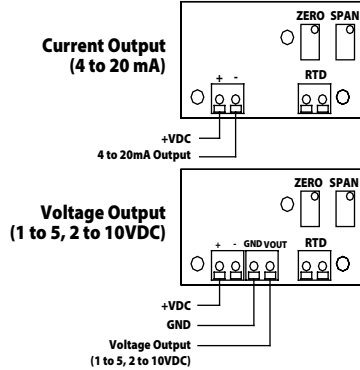
Formula for Number of Transmitters

Several transmitters may be powered from the same supply as shown in **FIGURE 8** (p. 4). Each transmitter draws 25mA; refer to the following equation to obtain the number of permissible transmitters:

$$[\# \text{ Transmitters}] = [\text{Current}] / (25 \text{ mA}).$$

FIGURE 6: WIRING DIAGRAMS

STANDARD UNITS



POTTED UNITS

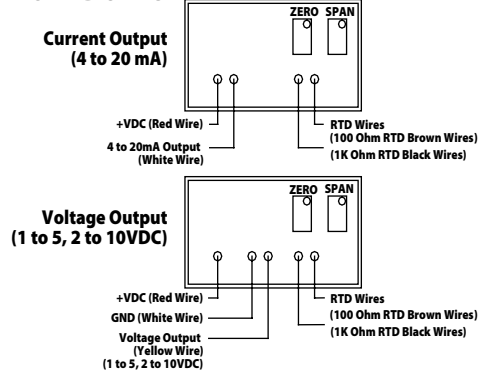


FIGURE 7: 3 WIRE RTD

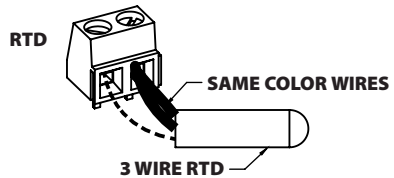
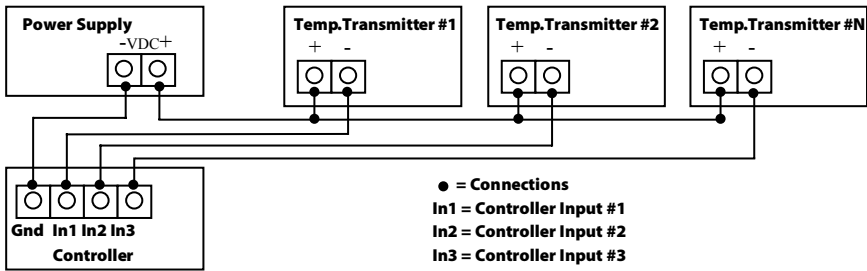


FIGURE 8: MULTIPLE TRANSMITTER CONNECTIONS



TROUBLESHOOTING

PROBLEM	SOLUTION(S)
No Reading	<ul style="list-style-type: none"> No power to board - check voltage at power terminal - should be between +8.5 and 32 VDC.
Reading Too Low	<ul style="list-style-type: none"> RTD wires shorted. Disconnect wires from terminal block and check with ohmmeter. Reading should be close to 100 Ω or 1 KΩ. RTD Improper range of transmitter (too low). Check current or voltage - should be between 4-20 mA, 1-5 V, or 2-10 V.
Reading Too High	<ul style="list-style-type: none"> RTD opened. Disconnect sensor wires from terminal block and check with ohmmeter. Reading should be close to 100 Ω or 1 KΩ. Improper range of transmitter (too high). Check current or voltage - should be between 4-20 mA, 1-5 V, or 2-10 V.
Reading is Inaccurate	<ul style="list-style-type: none"> Sensor check: Disconnect sensor wires from terminal block and check with ohmmeter. Compare the resistance reading to the Temperature vs Resistance curves located on ACI's website. Transmitter check: Make sure sensor wires are connected to terminal block. Determine that the proper output is being transmitted based on predetermined span: <ol style="list-style-type: none"> Go to ACI Website, Span to Output Page: http://www.workaci.com/content/span-output Enter the low end of the span Enter the high end of the span Click on the output of the transmitter. This will generate a span to output chart. Measure output of transmitter. Compare measured output to calculated output

WARRANTY

The ACI Immersion Series temperature sensors is covered by ACI's Five (5) Year Limited Warranty, which is located in the front of ACI'S SENSORS & TRANSMITTERS CATALOG or can be found on ACI's website: www.workaci.com.

W.E.E.E. DIRECTIVE

At the end of their useful life the packaging and product should be disposed of via a suitable recycling centre. Do not dispose of with household waste. Do not burn.

PRODUCT SPECIFICATIONS

SENSOR NON-SPECIFIC

Storage Temperature Range:	-40 to 85 °C (-40 to 185 °F)
Operating Humidity Range:	10 to 90% RH, non-condensing
Lead Length Conductor Size:	14" (35.6 cm) 22 AWG (0.65mm)
Lead Wire Insulation Wire Rating:	Etched Teflon (PTFE) Colored Leads Mil Spec 16878/4 Type E)
Conductor Material:	Silver Plated Copper
Thermowell Instrument Thread Process Thread:	½" NPS (National Pipe Straight) ½" NPT (National Pipe Tapered)
Enclosure Specifications: (Temperature, Material, Flammability, NEMA/IP Ratings)	<p>“-GD” Enclosure: Galvanized Steel, -40 to 121 °C (-40 to 250 °F), NEMA 1 (IP10)</p> <p>“-PB” Enclosure: ABS Plastic, UL94-HB, -30 to 90 °C (-22 to 194 °F), Plenum Rated</p> <p>“-BB” Enclosure: Aluminum, -40 to 121°C (-40 to 250 °F), Plenum Rated, NEMA 3R (IP 14)</p> <p>“-4X” Enclosure: Polystyrene Plastic, UL94-V2, -40 to 70°C (-40 to 158°F), NEMA 4X (IP 66)</p>

SENSOR

Sensor Type Sensor Curve Sensing Points:	Platinum RTD PTC (Positive Temperature Coefficient) One
Sensor Output @ 0°C (32°F):	A/TT100/TTM100: 100 Ω nominal A/TT1K/TTM1K: 1 KΩ nominal
RTD Tolerance Class Accuracy:	+/- 0.06% Class A (Tolerance Formula: +/- °C = (0.15 °C + (0.002 * t)) where t is the absolute value of temperature above or below 0 °C in °C)
Din Standard Temperature Coefficient:	DIN EN 60751 (IEC 751) 3850 ppm / °C
Sensor Stability:	+/- 0.03% after 1000 Hours @ 300 °C (572 °F)
Response Time (63% Step Change):	8 Seconds nominal
Sensor Operating Temperature Range:	-40 to 200 °C (-40 to 392 °F)
Probe Diameter Probe Material:	0.250" (6.35mm) 304 Stainless Steel

TRANSMITTER

Transmitter Supply Voltage Supply Current:	+8.5 to 32 VDC (Reverse Polarity Protected) 25 mA minimum 250 Ω Load: +13.5 to 32 VDC 500 Ω Load: +18.5 to 32 VDC
Maximum Load Resistance:	(Terminal Voltage - 8.5 V) 0.020 A
Output Signals:	Current: 4-20 mA (2-Wire) Voltage: 1-5 VDC or 2-10 VDC (3-Wires)
Calibrated Accuracy Linearity¹:	T. Spans < 500 °F (260 °C): +/- 0.2%
Thermal Drift²:	T. Spans < 100 °F (38 °C): +/- 0.04%/°F T. Spans > 100 °F (38 °C): +/- 0.02%
Min./Max. Calibrated Temperature Spans:	Min. T. Span: 50 °F (28 °C) Max T. Span: 400 °F (204 °C)
TTM100/TTM1K Certification Points:	3 Pt. NIST: 20, 50, & 80% of span 5 Pt. NIST: 20, 35, 50, 65, & 80% of span
Warm Up Time Warm Up Drift:	10 Minutes +/- 0.1%
Transmitter Operating Temperature Range:	-40 to 185 °F (-40 to 85 °C)
Transmitter Operating Humidity Range:	0 to 90%, non-condensing
Connections Wire Size:	Screw Terminal Blocks 16 AWG (1.31 mm2) to 26 AWG (0.129 mm2)
Terminal Block Torque Rating:	0.37 ft-lb (0.5 Nm) nominal

Note¹: Transmitter's calibrated at 71°F (22°C) nominal | Note²: Thermal Drift is referenced to 71°F (22°C) nominal calibration temperature



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