# Double Threaded Stainless Steel Immersion Transmitters
# BA/T# -Ix-SS Temperature Transmitter
*Installation & Operating Instructions*

20919_ins_ImrsnDblThread_Active
rev. 06/30/15

## Overview

The BA/#-Ix-SS Double Threaded Stainless Steel (SS) Immersion Transmitter is made for thermowell mounting and temperature measurement in water pipes, water tanks or cooling tower sump applications. Direct probe insertion into a Threadolet is possible without a thermowell. However, this is not recommended as it cannot be removed after the pipe is pressurized. The rigid probe and threads are made of Stainless Steel and made in different lengths for a custom thermowell fit. The 4 to 20mA transmitter can be ordered with 100Ω (385), 1KΩ (385) RTDs or 10KΩ type 2 thermistor sensors. A 0 to 5VDC or 0 to 10VDC transmitter is also available with the 10KΩ type 2 thermistor sensor. Special high accuracy RTD matched transmitters (M) are available which match the sensor to the transmitter for improved accuracy. Enclosure mounting styles come in plastic or metal for both NEMA 3R and NEMA 4 applications and are all plenum rated.

## Identification

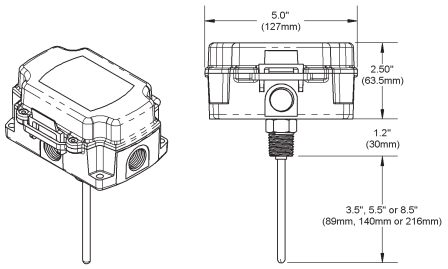


**Fig 1:** Double Threaded Immersion Sensor in a BAPI-Box (BB) Enclosure

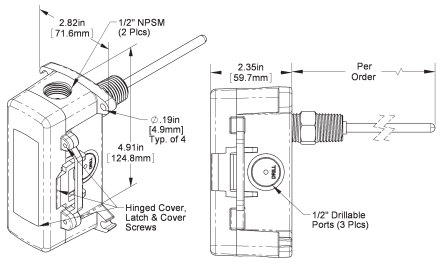


**Fig 2:** Double Threaded Immersion Sensor in a BAPI-Box 2 (BB2) Enclosure

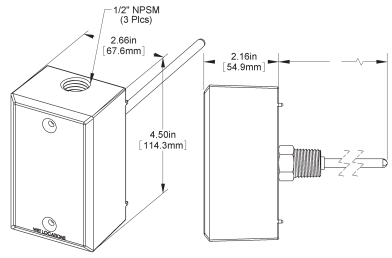


**Fig 3:** Double Threaded Immersion Sensor in a Weatherproof (WP) Enclosure

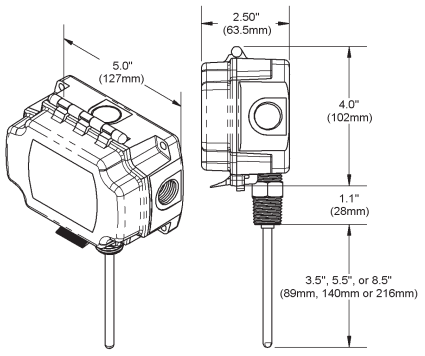


**Fig 4:** Double Threaded Immersion Sensor in a BAPI-Box (BBO) Enclosure with "Outside Mount" Configuration.

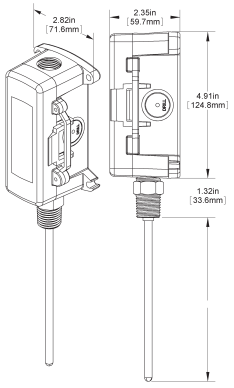


**Fig 5:** Double Threaded Immersion Sensor in a BAPI-Box 2 (BB2O) Enclosure with "Outside Mount" Configuration.

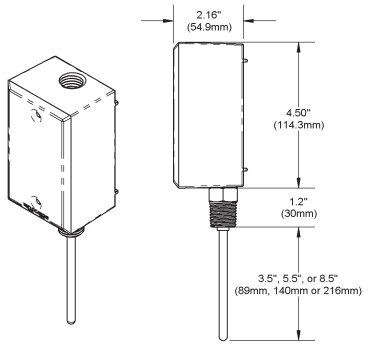


**Fig 6:** Double Threaded Immersion Sensor in a Weatherproof (WPO) Enclosure with "Outside Mount" Configuration.

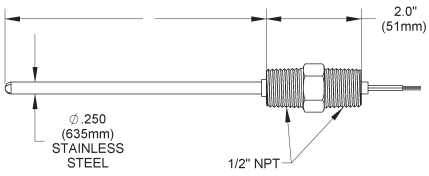


**Fig 7:** Double Threaded Stainless Steel Immersion Probe Only

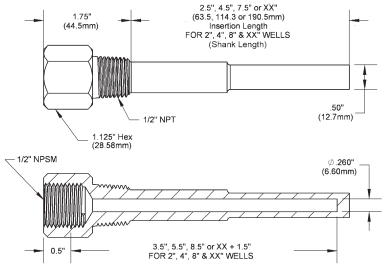


**Fig 8:** Machined Bar Stock Thermowell

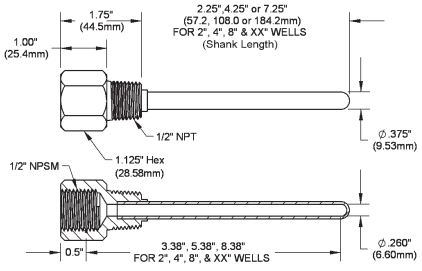


**Fig 9:** Two Part Welded Thermowell

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## *Mounting*

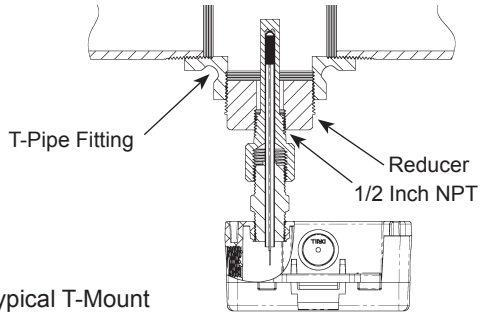


**Fig 10:** Typical T-Mount

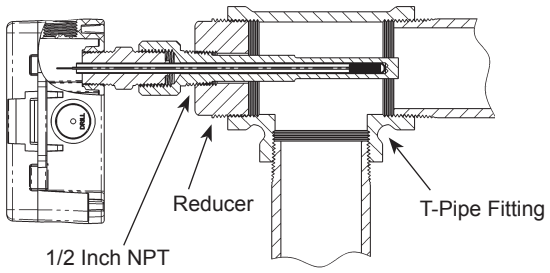


**Fig 11:** Typical Corner Mount

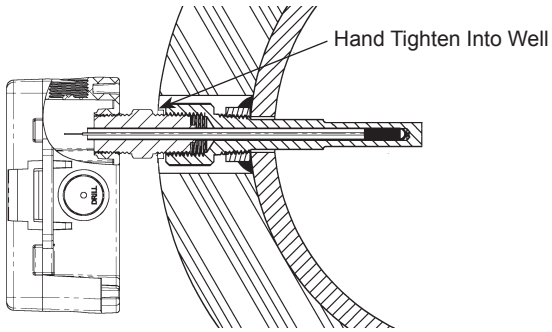


**Fig 12:** Typical Sensor Inserted

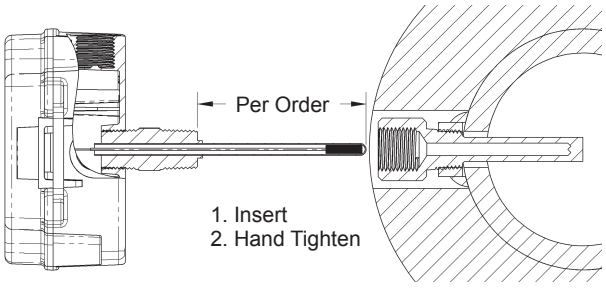


**Fig 13:** BAPI-Box (BB) Model Before Insertion

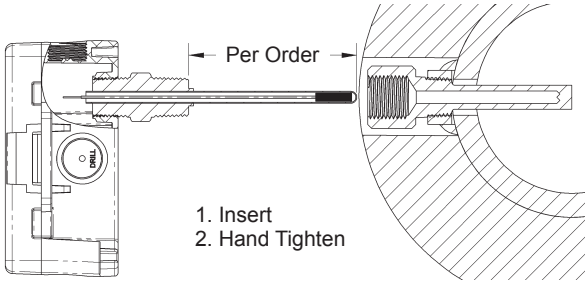


**Fig 14:** BAPI-Box 2 (BB2) Model Before Insertion

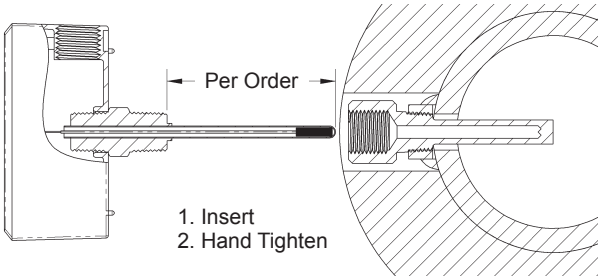


**Fig 15:** Weatherproof (WP) Sensor Before Insertion

**Application:** Figure 12 shows a typical thermowell and immersion probe installed into a pipe. In a properly insulated pipe with liquid or steam, the temperature is essentially the same across the entire cross section of the pipe. Usually thermowells are sized to extend to the center of the pipe; however, shorter thermowells will give proper temperature readings if properly insulated. The shorter thermowells are used in pipes with high flow velocities. See Application notes “Thermowells Explained” on our web site BAPIHVAC.com.

**Thermowell Installer:** Typically a Pipe Fitter drills a ¾-inch hole into the pipe where the thermowell is needed. A customer provided fitting, called a Threadolet or Weldolet, is welded to the pipe over the hole. The Threadolet has a ½” NPT thread in the center. Thread sealant such as Teflon tape or pipe dope is applied to the ½” NPT threads of the thermowell. The thermowell is then inserted into the Threadolet and tightened. Estimates on insertion depths can be seen in our Application note “Thermowells Explained” on our web site BAPIHVAC.com

**Sensor Installation:** Insert the immersion sensor into the well. Hand tighten the immersion sensor snugly without too much torque. The probe is tight fitting to the bottom and wall of the thermowell offering an accurate temperature reading.

Direct probe insertion into the pipe without a thermowell is possible. However, this is not recommended as it cannot be removed after the pipe is pressurized. Apply a minimum of five turns of Teflon tap to the SS probe side threads. Insert the SS probe and ½” NPT threads into the Threadolet and tighten with a wrench to achieve a water tight seal. The probe should not touch the far inside of the water pipe or probe failure may occur.



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## *Wiring & Termination*

BAPI recommends using twisted pair of at least 22AWG and sealant filled connectors for all wire connections. Larger gauge wire may be required for long runs. All wiring must comply with the National Electric Code (NEC) and local codes. Do NOT run this device's wiring in the same conduit as high or low voltage AC power wiring. BAPI's tests show that inaccurate signal levels are possible when AC power wiring is present in the same conduit as the sensor wires.

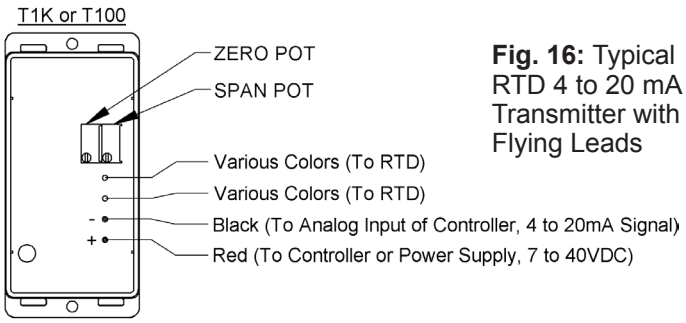


**Fig. 16:** Typical RTD 4 to 20 mA Transmitter with Flying Leads

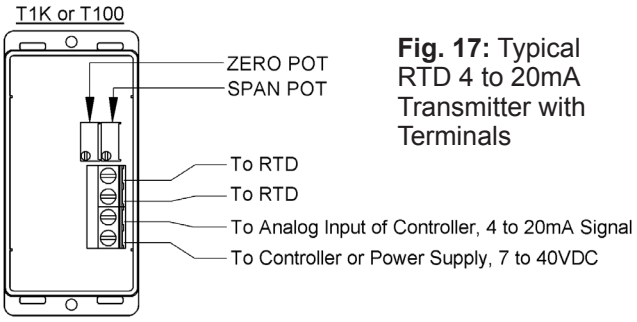


**Fig. 17:** Typical RTD 4 to 20mA Transmitter with Terminals

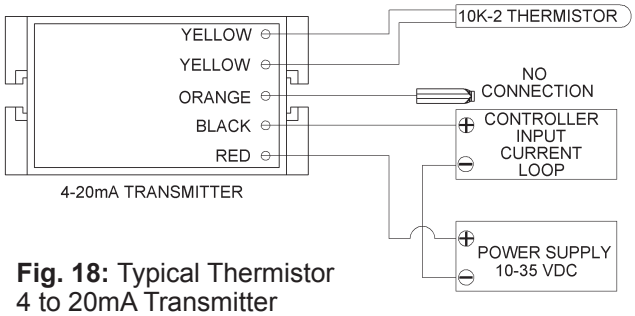


**Fig. 18:** Typical Thermistor 4 to 20mA Transmitter

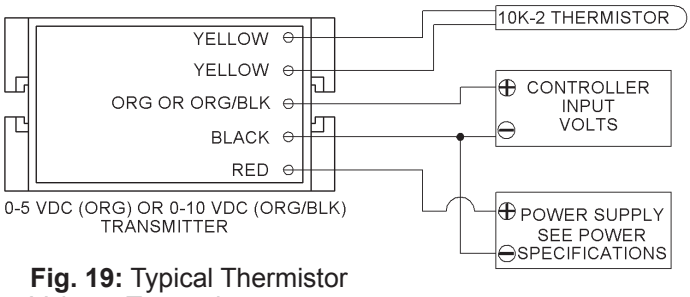


**Fig. 19:** Typical Thermistor Voltage Transmitter

## *Diagnostics*

**Possible Problems:**

• Unit will not operate.

**Possible Solutions:**

- Measure the power supply voltage by placing a voltmeter across the transmitter's (+) and (-) terminal. Make sure that it matches the drawings above and power requirements in the specifications.
- Check if the RTD wires are physically open or shorted together and are terminated to the transmitter.
- Measure the physical temperature at the temperature sensor's location using an accurate temperature standard. Disconnect the temperature sensor wires and measure the temperature sensor's resistance with an ohmmeter. Compare the temperature sensor's resistance to the appropriate temperature sensor table on the BAPI web site.

• The reading is incorrect in the controller.

- Determine if the input is set up correctly in the controllers and BAS software.
- For a 4-20mA current transmitter measure the transmitter current by placing an ammeter in series with the controller input. The current should read according to the "4-20mA Temperature Equation" shown below.
- For a voltage transmitter, measure the signal with a volt meter (Orange or Orange/Black to Black). The signal should read according to the "Voltage Temperature Equation" shown below.

**Voltage Temperature Equation**

$$T = T_{Low} + \frac{(V \times T_{Span})}{V_{Span}}$$

| | |
|---|---|
| T | = Temperature at sensor |
| $T_{Low}$ | = Low temperature of span |
| $T_{High}$ | = High temperature of span |
| $T_{Span}$ | = $T_{High}$ - $T_{Low}$ |
| $V_{Low}$ | = Low transmitter voltage usually=(0, 1 or 2v) |
| $V_{High}$ | = High transmitter voltage usually=(5 or 10v) |
| $V_{Span}$ | = $V_{High}$ - $V_{Low}$ |
| V | = Signal reading in volts |

**4-20mA Temperature Equation**

$$T = T_{Low} + \frac{(A - 4) \times (T_{Span})}{16}$$

| | |
|---|---|
| T | = Temperature at sensor |
| $T_{Low}$ | = Low temperature of span |
| $T_{High}$ | = High temperature of span |
| $T_{Span}$ | = $T_{High}$ - $T_{Low}$ |
| A | = Signal reading in mA |

Specifications subject to change without notice.

## *Specifications*

**RTD Transmitter**

| | |
|---|---|
| Power Required: | 7 to 40VDC |
| Transmitter Output: | 4 to 20mA, 850Ω@24VDC |
| Output Wiring: | 2 wire loop |
| Output Limits: | <1mA (short), <22.35mA (open) |
| Span: | Min. 30ºF (17ºC), Max 1000ºF, (555ºC) |
| Zero: | Min. -148°F (-100°C), Max 900ºF (482ºC) |
| Zero & Span Adjust: | 10% of span |
| Accuracy: | ±0.065% of span |
| Linearity: | ±0.125% of span |
| Power Output Shift: | ±0.009% of span |
| RTD Sensor: | 2 wire Platinum (Pt), 385 curve |
| Transmitter Ambient | -4 to 158ºF(-20 to 70ºC)<br>0 to 95% RH, Non-condensing |

**Thermistor Transmitter**

Supply Voltage:
- 10 to 35 VDC (0 to 5 VDC or 4 to 20 mA Outputs)
- 15 to 35 VDC (0 to 10 VDC Output)
- 12 to 24 VAC (0 to 5 VDC Outputs)
- 15 to 24 VAC (0 to 10 VDC Output)

| | |
|---|---|
| Transmitter Output: | 4 to 20mA, 700Ω@24VDC<br>0 to 5 & 0 to 10VDC, 10KΩ min |
| Output Wiring: | 2 & 3 wire (See wiring detail on pg. 3) |
| Transmitter Limits: | -40 to 185ºF, (-40 to 85ºC) |
| Accuracy: | ±1.015ºC, from (0 to 65ºC) |
| Linearity: | ±0.065ºC, from (0 to 65ºC) |
| Resolution: | Span/1024 |
| Thermistor Sensor: | 10K-2 Thermistor, 10KΩ @77ºF |
| Transmitter Ambient: | 32 to 158ºF, (0º to 70ºC)<br>0 to 95% RH, Noncondensing |

| | |
|---|---|
| **Thermistor:** | 10K-2**,** Thermal Resistor (Bare Sensor) |
| Accuracy (Std): | ±0.36ºF, (±0.2ºC) |
| Accuracy (High): | ±0.18ºF, (±0.1ºC), **[XP]** option |
| Stability: | < 0.036ºF/Year, (<0.02ºC/Year) |
| Heat Dissipation: | 2.7 mW/ºC |
| Probe Range: | -40º to 221ºF (-40º to 105ºC) |
| Wire Colors: | |
| Standard: | Yellow/Yellow (no polarity) |
| High Acc. [XP]: | Yellow/Yellow (no polarity) |
| **RTD:** | Resistance Temp Device (Bare Sensor) |
| Platinum (Pt): | 100Ω and 1KΩ @0ºC, 385 curve, |
| Pt Accuracy (Std): | 0.12% @Ref, or ±0.55ºF, (±0.3ºC) |
| Pt Accuracy (High): | 0.06% @Ref, or ±0.277ºF, (±0.15ºC), **[A]**option |
| Pt Stability: | ±0.25ºF, (±0.14ºC) |
| Pt Self Heating: | 0.4 ºC/mW @0ºC |
| Pt Probe Range: | -40º to 221ºF, (-40 to 105ºC) |
| Wire Colors: | General color code (other colors possible) |
| 1KΩ, Class B | Orange/Orange (no polarity) |
| 1KΩ, Class A | Orange/White (no polarity) |
| 100Ω, Class B | Red/Red (no polarity) |
| 100Ω, Class A | Red/Red-w/black stripe (no polarity) |

**Sensitivity:** Approximate @ 32ºF (0ºC)

| | |
|---|---|
| Thermistor: | Non-linear - (See www.bapihvac.com, click “Sensor Specs”) |
| RTD (Pt): | 3.85Ω/ºC for 1KΩ RTD<br>0.385Ω/ºC for 100Ω RTD |
| **Lead Wire:** | 22awg stranded |
| **Insulation:** | Etched Teflon, Plenum rated |
| **Probe Rigid:** | 316 Stainless Steel, 0.25” OD |
| **Probe Length:** | 2’, 4’, 8’ or custom per order |
| **Mounting:** | 1/2” NPT, 316 Stainless Steel Double Threaded Fitting |

**Enclosure Types:** (Part number designator in bold)

| | |
|---|---|
| Weatherproof: | **-WP,** w/ two ½” FNPT entries, (Bell box) |
| BAPI-Box: | **-BB,** w/ four ½” NPSM & one ½” drill-out |
| BAPI-Box 2: | **-BB2,** w/ three ½” NPSM & three ½” drill-outs |

**Enclosure Ratings:** (Part number designator in bold)

| | |
|---|---|
| No Box: | **-NB,** No Rating, (Probe Only) |
| Weatherproof: | **-WP,** NEMA 3R, IP14 |
| BAPI-Box: | **-BB,** NEMA 4, IP66, UV Rated |
| BAPI-Box 2: | **-BB2,** NEMA 4, IP66, UV Rated |

**Enclosure Material:** (Part number designator in bold)

| | |
|---|---|
| Weatherproof: | **-WP,** Cast Aluminum, UV rated |
| BAPI-Box: | **-BB,** Polycarbonate, UL94V-0, UV rated |
| BAPI-Box 2: | **-BB2,** Polycarbonate, UL94V-0, UV rated |

**Ambient (Enclosure):** 0 to 100% RH, Non-condensing

| | |
|---|---|
| Weatherproof | **-WP,** -40ºF to 212ºF, (-40º to 100ºC) |
| BAPI-Box | **-BB,** -40ºF to 185ºF, (-40º to 85ºC) |
| BAPI-Box 2 | **-BB2,** -40ºF to 185ºF, (-40º to 85ºC) |

| | |
|---|---|
| **Agency:** | RoHS<br>PT= DIN43760, IEC Pub 751-1983, JIS C1604-1989 |

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