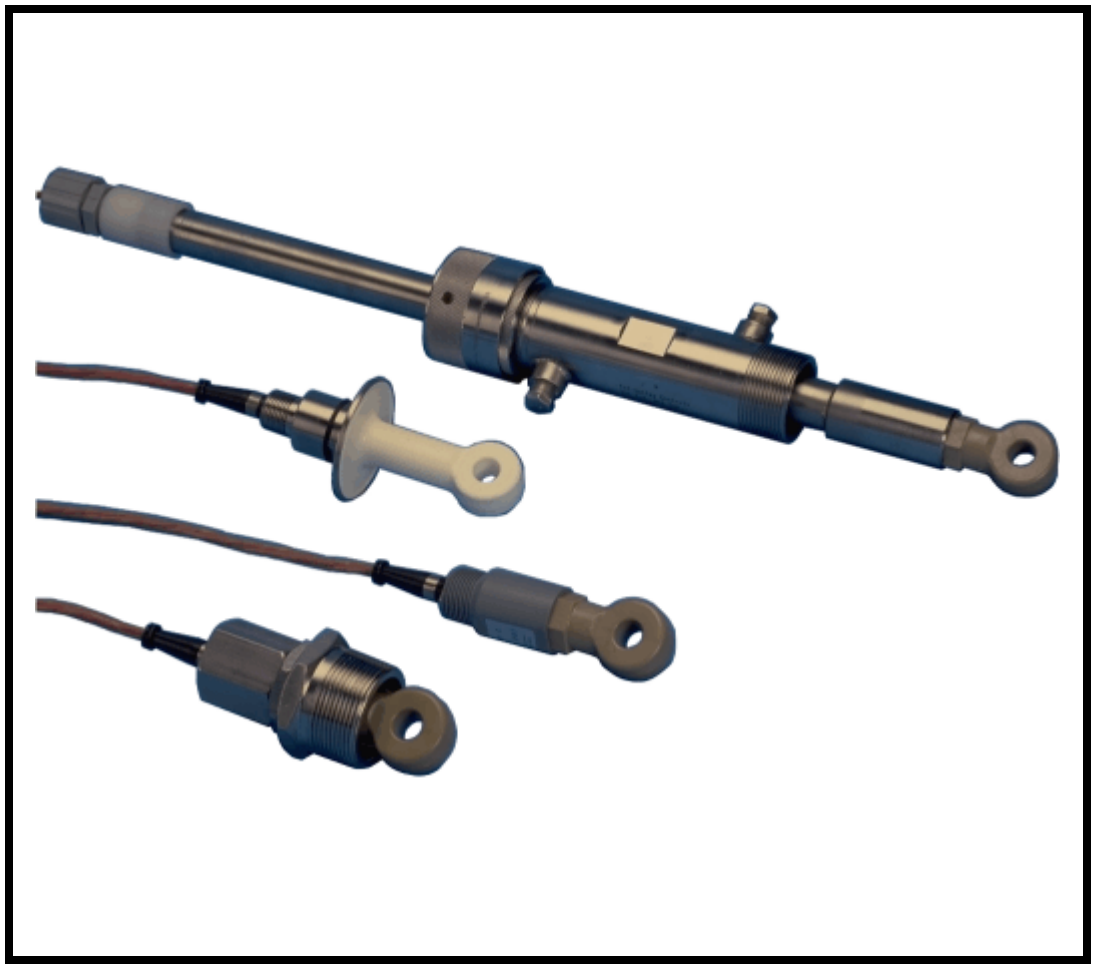
# Type TB404

## Toroidal Conductivity Sensor Series



PN25120

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# Preface

This publication is for the use of technical personnel responsible for installation of the ABB Type TB404 Toroidal Conductivity Sensor.

This instruction contains hardware installation instructions only. Wiring procedures, calibration procedures, etc., are covered in product instructions of instruments compatible with the Type TB404 sensor.

Some sections of this instruction have been prepared in procedure format. By treating each task as a separate entity, the procedures provide an easy method for finding the information needed to perform each task. The procedures can be removed and placed in separate folders or notebooks, or carried to the job site.

The procedures have check boxes in the margin by each step. When performing a procedure, check each box as each step is completed.

It is important for safety and operation that this instruction be read and understood before attempting anything related to installation, operation, maintenance or repair.

# List of Effective Pages

Total number of pages in this instruction is 35, consisting of the following:

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| Preface | Original |
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| iii through vi | August 23, 2006 |
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| PR4-1 through PR4-2 | August 23, 2006 |
| PR5-1 through PR5-3 | August 23, 2006 |
| PR6-1 through PR6-2 | August 23, 2006 |
| Index-1 | Original |

When an update is received, insert the latest changed pages and dispose of the superseded pages.

# Table of Contents



# List of Figures

# List of Figures (continued)



# List of Tables

# Safety Summary

**SPECIFIC WARNINGS**

Always use the sensor guide when using the high pressure hot tap assembly. The sensor guide is a tightly toleranced 1½ in.NPT nipple that prevents adverse play between the insertion rod and the sensor guide. Adverse play could damage the insertion rod and injure personnel. (p. PR3-2)

Never stand directly behind the insertion rod upon pressurization. If the insertion rod is not fully retracted upon pressurization, it could rapidly reach the blow out protection of the sensor assembly and severely injure personnel standing too close behind the insertion rod. (p. PR3-2)

Never exceed the sensor or sanitary clamp temperature and pressure limits. Exceeding these limits can damage the equipment in such a way as to pose the risk of injury to personnel. (p. PR4-1)

Firmly hold the insertion rod when loosening the compression fitting. When the compression rod is loosened, the pressure against the sensor assembly will cause the insertion rod to retract from the ball valve assembly with great velocity. This could injure personnel standing in the path of the retracting insertion rod. Allow only properly trained personnel to handle these types of sensor assemblies. (p. PR5-1)

Open one of the flushing ports after the sensor is retracted and the ball valve is closed. If a continuous stream of liquid exists, damage to the ball valve or components can occur or may have already occurred. This condition can cause a hazard to personnel upon removal of the insertion rod. (p. PR5-1)

Consider the material compatibility between cleaning fluids and process liquids. Incompatible fluids can react with each other causing injury to personnel and equipment damage. (p. PR6-1)

Acids and bases can cause severe burns. Use hand and eye protection when handling. (p. PR6-1)

Use solvents only in well ventilated areas. Avoid prolonged or repeated breathing of vapors or contact with skin. Solvents can cause nausea, dizziness and skin irritation. In some cases, overexposure to solvents has caused nerve and brain damage. Solvents are flammable - do not use near extreme heat or open flame. (p. PR6-1)

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# SECTION 1 - INTRODUCTION

## OVERVIEW

The Type TB404 Toroidal Conductivity Sensor Series monitors a wide variety of process liquids. The robust, encapsulated design of the sensor protects the internal electronics from corrosive process solutions.

This instruction contains information on sensor installation only. For information on maintenance, testing, troubleshooting, calibration and repair, refer to the product instruction of the analyzer or transmitter used with the sensor.

## INTENDED USER

This instruction is intended for use by technical personnel responsible for the installation of the Type TB404 sensor.

## SENSOR DESCRIPTION

The Type TB404 sensor employs an encapsulated design that makes it ideal for aggressive and harsh process streams. The analyzers and transmitters for which the sensor was designed measure moderate to high conductivity streams.

The sensor is available with a submersible adapter that accommodates submersible installations such as tanks and open vessels or waterways. The in-line flow assembly provides installation capability for pipelines and tanks. There are also two types of hot tap assemblies available: Low pressure units with either hand or wrench-tight compression fittings and high pressure units. The high pressure units can be ordered with ball valves. Ball valves for low pressure units must be ordered separately. Finally, there is a two-inch sanitary sensor that provides installation capability for sanitary pipelines and tanks with two-inch tri-clamp fittings.

## SENSOR APPLICATION

The Type TB404 sensor is intended to provide measurements for process monitoring and/or control applications.

Some typical applications include the measurement for display and control of the conductivity of process fluid streams, boilers, pulping and sugar liquor, concentrated chemical streams, clean-in-place systems, food and pharmaceutical systems, brine, and solutions with heavy solids or high ionic strength liquids.

## INSTRUCTION CONTENT

This instruction consists of four sections and a set of procedures. After becoming completely familiar with it and the sensor, it can be used as a reference.

**Introduction** Provides a product overview, a description of the sensor and its applications and a description of this instruction and how to use it. This section also has a list of reference documents on related equipment and subjects, the product identification (nomenclature) and a comprehensive list of specifications and accessories.

**Installation** Contains unpacking and inspection instructions, and location considerations. Included under location considerations are installation guidelines to follow for proper installation of the sensor. Following this information is a table that guides installation personnel to the appropriate installation procedures.

**Repair and Replacement** Contains procedures for removing the sensor from the hot tap hardware assemblies and cleaning the sensor.

**Support Services** Contains spare and replacement parts information as well as information on customer support.

## *HOW TO USE THIS INSTRUCTION*

Read this entire instruction in sequence before attempting to install, maintain or repair the sensor. After gaining a complete understanding of this instruction and the sensor, it can be used as a reference.

The installation section of this instruction has been prepared in procedure format. Table 2-1 directs installation personnel to the appropriate procedure. By treating each task as a separate entity, the procedures provide an easy method for finding the information needed to perform each task. The procedures can be removed and placed into separate folders or notebooks and carried to the job site.

## *REFERENCE DOCUMENTS*

Table 1-1 lists the ABB documents to be used in conjunction with this instruction.

*Table 1-1. Reference Documents*

| Number | Document |
|---|---|
| C-E67-23-1 | Conductivity/Resistivity Sensors for Process Monitoring |
| D-NCC-TB404 | Type TB404 Toroidal Conductivity Sensor Specification |
| I-E67-82-4A | TB82TC Toroidal Conductivity Transmitter |
| I-E67-84-4 | TB84TC Toroidal Conductivity Analyzer |
| D-NCA-TB82 | TB82 Data Sheet |
| D-NCA-TB84TC | TB84TC Data Sheet |
| D-NCC-TB4043 | Type TB4043 Toroidal Conductivity Sensor Specification |

## NOMENCLATURE

Table 1-2 lists the nomenclature for the Type TB404 sensor.

*Table 1-2. Nomenclature*

| Position | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | **T** | **B** | **4** | **0** | **4** | □ | □ | □ | □ | □ | □ | □ | □ | **Toroidal Conductivity Sensor** |
| | | | | | | | | | | | Next Page | | | **Sensor Style** |
| | | | | | | 2 | | | | | | | | Standard with $^{15}/_{16}$ -20 threads, PEEK encapsulated |
| | | | | | | 3 | | | | | | | | Sanitary, 2-in. tri-clamp, PEEK encapsulated with stainless steel backing |
| | | | | | | | | | | | | | | **Integral Temperature compensator** |
| | | | | | | | 2 | | | | | | | Pt 1000Ω RTD[1] |
| | | | | | | | | | | | | | | **O-ring Material** |
| | | | | | | | | 0 | | | | | | None (TB4043 only — no O-ring required) |
| | | | | | | | | 1 | | | | | | EPDM (TB4042 only) |
| | | | | | | | | 2 | | | | | | Viton® (TB4042 only) |
| | | | | | | | | 3 | | | | | | Kalrez (for flow, submersible or replacement TB4042 only) |
| | | | | | | | | 4 | | | | | | Kalrez (for hot tap TB4042 only) |
| | | | | | | | | | | | | | | **Hardware[2,3,5]** |
| | | | | | | | | | 0 | 0 | | | | None (TB4043)[3,7] |
| | | | | | | | | | S | 1 | | | | Submersible adapter, ¾ in. NPT, CPVC |
| | | | | | | | | | S | 2 | | | | Submersible adapter, ¾ in. NPT, 316 stainless steel |
| | | | | | | | | | S | 3 | | | | Submersible adapter, ¾ in. NPT, Kynar |
| | | | | | | | | | F | 1 | | | | In-line flow, 1-½ in. NPT, CPVC |
| | | | | | | | | | F | 2 | | | | In-line flow, 1-½ in. NPT, 316 stainless steel |
| | | | | | | | | | F | 3 | | | | In-line flow, 1-½ in. NPT, Titanium |
| | | | | | | | | | L | 1 | | | | Low pressure hot top without ball valve, wrench tight compression fitting, 316 stainless steel[2] |
| | | | | | | | | | L | 2 | | | | Low pressure hot top without ball valve, hand tight compression fitting, 316 stainless steel[2] |
| | | | | | | | | | L | 3 | | | | Low pressure hot top without ball valve, wrench tight compression fitting, Titanium[2] |
| | | | | | | | | | L | 4 | | | | Low pressure hot top without ball valve, hand tight compression fitting, Titanium[2] |
| | | | | | | | | | H | 1 | | | | High pressure hot tap with ball valve, 316 stainless steel[2] |
| | | | | | | | | | H | 2 | | | | High pressure hot top without ball valve, 316 stainless steel[2] |
| | | | | | | | | | H | 3 | | | | High pressure hot tap without ball valve, Titanium[2] |

*Table 1-2. Nomenclature (continued)*

| Position | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | T | B | 4 | 0 | 4 | □ | □ | □ | □ | □ | □ | □ | □ | Toroidal Conductivity Sensor |
| | | | | | | Previous Page | | | | | | | | |
| | | | | | | | | | | | | | | **Low Pressure Hot Tap Insertion Rod[4]** |
| | | | | | | | | | | | 0 | | | None or sanitary (required for TB4043) |
| | | | | | | | | | | | 1 | | | 50.8 cm (20.0 in.), 316 stainless steel |
| | | | | | | | | | | | 2 | | | 61.0 cm (24.0 in.), 316 stainless steel |
| | | | | | | | | | | | 3 | | | 76.2 cm (30.0 in.), 316 stainless steel |
| | | | | | | | | | | | 4 | | | 91.4 cm (36.0 in.), 316 stainless steel |
| | | | | | | | | | | | 5 | | | 50.8 cm (20.0 in.), Titanium |
| | | | | | | | | | | | 6 | | | 61.0 cm (24.0 in.), Titanium |
| | | | | | | | | | | | 7 | | | 76.2 cm (30.0 in.), Titanium |
| | | | | | | | | | | | 8 | | | 91.4 cm (36.0 in.), Titanium |
| | | | | | | | | | | | | | | **Cable Length[6]** |
| | | | | | | | | | | | | 1 | | 1.5 m (5.0 ft) |
| | | | | | | | | | | | | 2 | | 3.0 m (10.0 ft) |
| | | | | | | | | | | | | 3 | | 4.6 m (15.0 ft) |
| | | | | | | | | | | | | 4 | | 6.1 m (20.0 ft) |
| | | | | | | | | | | | | 5 | | 9.1 m (30.0 ft) |
| | | | | | | | | | | | | 6 | | 12.2 m (40.0 ft) |
| | | | | | | | | | | | | 7 | | 15.2 m (50.0 ft) |
| | | | | | | | | | | | | | | **Identification Tag** |
| | | | | | | | | | | | | | 0 | None |
| | | | | | | | | | | | | | 1 | Mylar® |
| | | | | | | | | | | | | | 2 | Stainless steel |

**NOTES:**

1. Temperature compensator is required when using the sensor with ABB instrumentation.
2. If hot tap hardware and compression fittings are ordered, and Kalrez O-rings are desired, position 8 must be a 4.
3. Positions 9 and 10 require 00 when ordering replacement sensors or Type TB4043 sanitary sensors.
4. An insertion length must be specified in position 11 for all sensors having L1, L2, L3 or L4 in positions 9 and 10. The type of material selected in position 11 must match the material selected in positions 9 and 10.
5. Stainless steel 1-½-in. full port ball valves are available from ABB. Refer to Table 1-4.
6. An interconnecting cable going from the sensor to the conductivity instrument is available for a per foot charge. Refer to Table 1-4.
7. The tri-clamp gasket is not provided and must be supplied by the customer.

## *SPECIFICATIONS*

Table 1-3 lists the specifications for the Type TB404 sensors.

*Table 1-3. Specifications*

| Property | Characteristic/Value |
|---|---|
| TB4042??F | |
| Range[1] | Minimum 0 to 400 microsiemens (µS), maximum 0 to 2,000 millisiemens (mS) |
| Pressure[2] | 2,068 kPa (300 psig) with 316 stainless steel adapter |
| | 2,068 kPa (300 psig) with Titanium adapter |
| | 689 kPa (100 psig) with CPVC adapter |
| Temperature[2] | 200°C (392°F) with 316 stainless steel adapter |
| | 200°C (392°F) with Titanium adapter |
| | 65°C (149°F) with CPVC adapter |
| TB4042??H | |
| Range[1] | Minimum 0 to 400 µS, maximum 0 to 2,000 mS |
| Pressure[2] | 2,068 kPa (300 psig) |
| Temperature[2] | 150°C (302°F) |
| Seals | Teflon® ferrule in compression fitting, O-rings per sensor nomenclature |
| Materials | 316 stainless steel and Titanium |
| Process connection | 1½ in. NPT with ABB supplied ball valve (Titanium ball valve supplied by customer) |
| TB4042??L | |
| Range[1] | Minimum 0 to 400 µS, maximum 0 to 2,000 mS |
| Pressure[2] | 689 kPa (100 psig) |
| Temperature[2] | 150°C (302°F) |
| Seals | Teflon ferrule in compression fitting, O-rings per sensor nomenclature |
| Materials | 316 stainless steel and Titanium |
| Process connection | Minimum 1½ in. NPT depending on type of ball valve chosen |
| TB4042??S | |
| Range[1] | Minimum 0 to 400 µS, maximum 0 to 2,000 mS |
| Pressure[2] | 689 kPa (100 psig) with 316 stainless steel adapter |
| | 689 kPa (100 psig) with CPVC adapter |
| | 689 kPa at 80°C (100 psig at 176°F) |
| | 276 kPa at 140°C (80 psig at 284°F) with Kynar adapter |
| Temperature[2] | 200°C (392°F) with 316 stainless steel adapter |
| | 80°C (176°F) with CPVC adapter |
| | 140°C at 276 kPa (284°F at 40 psig) |
| | 80°C at 689 kPa (176°F at 100 psig) with Kynar adapter |
| TB4043 | |
| Range[1] | Minimum 0 to 400 µS, maximum 0 to 2,000 mS |
| Pressure[2] | 2068 kPa (300 psig) |
| Temperature[2] | 200°C (392°F) |

**NOTES:**

1. Range depends on conductivity instrument used.
2. Maximum pressure and temperature ratings may vary according to required hardware.

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

## ACCESSORIES

Table 1-4 lists the accessories available for use with the Type TB404 sensors.

*Table 1-4. Accessories*[1]

| Accessory | Description |
|---|---|
| 4TB3004-0008 | Interconnecting cable, Teflon jacketed, 6-conductor, sensor to conductivity instrument |
| 4TB4711-0021 | Retaining nut for in-line flow assembly |
| 4TB4906-0014 | Viton gasket for in-line flow assembly |
| 4TB4951-0092 | Submersible coupling adapter ($^{15}/_{16}$-20 x ¾ in. NPT), CPVC |
| 4TB4951-0093 | Submersible coupling adapter ($^{15}/_{16}$-20 x ¾ in. NPT), Kynar |
| 4TB4951-0094 | Submersible coupling adapter ($^{15}/_{16}$-20 x ¾ in. NPT), 316 stainless steel |
| 4TB5110-0067 | Conduit/cable gland adapter for in-line flow assembly, ¾ in. |
| 4TB5205-0285 | Full port ball valve, 1-½ in., 316 stainless steel |
| 4TB8006-0025 | High temperature silicone grease |
| 4TB8006-0045 | Anti-seize compound |
| 4TB9515-0065 | Hardware kit for high pressure hot tap assembly with Titanium hardware and EPDM hardware O-rings (Nos. 014 and 132) |
| 4TB9515-0066 | Hardware kit for high pressure hot tap assembly with Titanium hardware and Viton hardware O-rings (Nos. 014 and 132) |
| 4TB9515-0067 | Hardware kit for high pressure hot tap assembly with Titanium hardware and Kalrez hardware O-rings (Nos. 014 and 132) |
| 4TB9515-0069 | Hardware kit for high pressure hot tap assembly with 316 stainless steel hardware and EPDM hardware O-rings (Nos. 014 and 132) |
| 4TB9515-0070 | Hardware kit for high pressure hot tap assembly with 316 stainless steel hardware, EPDM hardware O-rings (Nos. 014 and 132) and ball valve |
| 4TB9515-0071 | Hardware kit for high pressure hot tap assembly with 316 stainless steel hardware and Viton hardware O-rings (Nos. 014 and 132) |
| 4TB9515-0072 | Hardware kit for high pressure hot tap assembly with 316 stainless steel hardware, Viton hardware O-rings (Nos. 014 and 132) and ball valve |
| 4TB9515-0073 | Hardware kit for high pressure hot tap assembly with 316 stainless steel hardware and Kalrez hardware O-rings (Nos. 014 and 132) |
| 4TB9515-0074 | Hardware kit for high pressure hot tap assembly with 316 stainless steel hardware, Kalrez hardware O-rings (Nos. 014 and 132) and ball valve |
| 4TB9515-0104 | In-line fitting for in-line flow assembly, 1-½ in., 316 stainless steel |
| 4TB9515-0105 | In-line fitting for in-line flow assembly, 1-½ in., Titanium |
| 4TB9515-0106 | In-line fitting for in-line flow assembly, 1-½ in., CPVC |
| 4TB9515-0107 | Sensor O-ring kit (No. 117), EPDM |
| 4TB9515-0108 | Sensor O-ring kit (No. 117), Viton |
| 4TB9515-0109 | Sensor O-ring kit (No. 117), Kalrez |

**NOTE:**

1. Most accessories are available as nomenclature options or come installed with sensor assemblies. Refer to Table 1-2.

# SECTION 2 - INSTALLATION

## INTRODUCTION

This section contains unpacking and inspection instructions, and special location and safety considerations.

Following these topics is a table that guides personnel, seeking to perform a specific installation task, to the proper procedure or procedures needed to perform that task.

> **NOTE:** Sensor wiring procedures are located in the product instruction of the analyzer or transmitter used with the sensor.

## UNPACKING AND INSPECTION

Examine the equipment upon receipt for possible damage in transit. If there is evidence of damage, file a damage claim with the responsible transportation company and notify the nearest ABB sales office.

Carefully inspect the packing material before discarding it to make certain that all mounting equipment and any special instructions or paperwork have been removed. Careful handling and installation insures satisfactory performance of the sensor.

Use the original packing material and container for storage. The storage environment should be protected and free from extremes in temperature and humidity and fall within the environmental specifications listed in Table 1-3.

## LOCATION CONSIDERATIONS

The Type TB404 sensor employs an encapsulated design that makes it ideal for aggressive and harsh process streams. Sensor variations accommodate submersible installations such as tanks and open vessels or waterways, pipelines, and sanitary pipelines and tanks with two-inch tri-clamp fittings. Figure 2-1 shows the anatomy of the Type TB4042 sensor.

When installing the sensor, choose a location that insures the following:

- The solution around the sensing area (Fig. 2-1) must be representative of the bulk solution.
- The fluid velocity must not damage the sensing area either by cavitation or abrasion.
- The solution must actively circulate through and around the sensing area and must not contain entrained air or vapors.
- The sensing area must be perpendicular to the fluid flow path. Figure 2-2 shows the sensor orientation requirements.

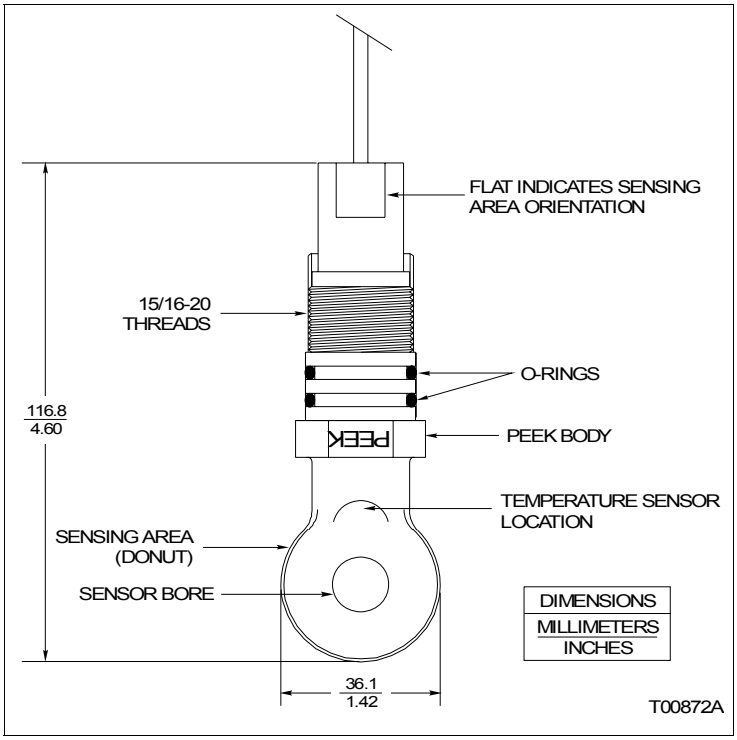


*Figure 2-1. Type TB4042 Sensor*

- The sensing area must be completely immersed into the fluid (Fig. 2-2). Partial and varying immersion will cause measurement errors.

- The sensor position within the process pipe or any container during calibration must not cause air entrapment around the sensing area.

- The sensor cable should be housed in a flexible type of metal or shielded conduit to minimize the effects of radio frequency interference (RFI) and electromagnetic interference (EMI). Submersion sensors require nonflexible piping or conduit.

- The sensor position must not allow accumulation of excess sediment or other foreign material around the sensing area.

- The sensor position must insure that the internal temperature sensor is facing into the fluid flow path.

  **NOTE:** The temperature sensor is located at the sensing area on the same side as the embossed PEEK insignia (Fig. 2-1).

- Lubricate all O-rings with a silicone grease or equivalent before assembling the sensor into the installation hardware.

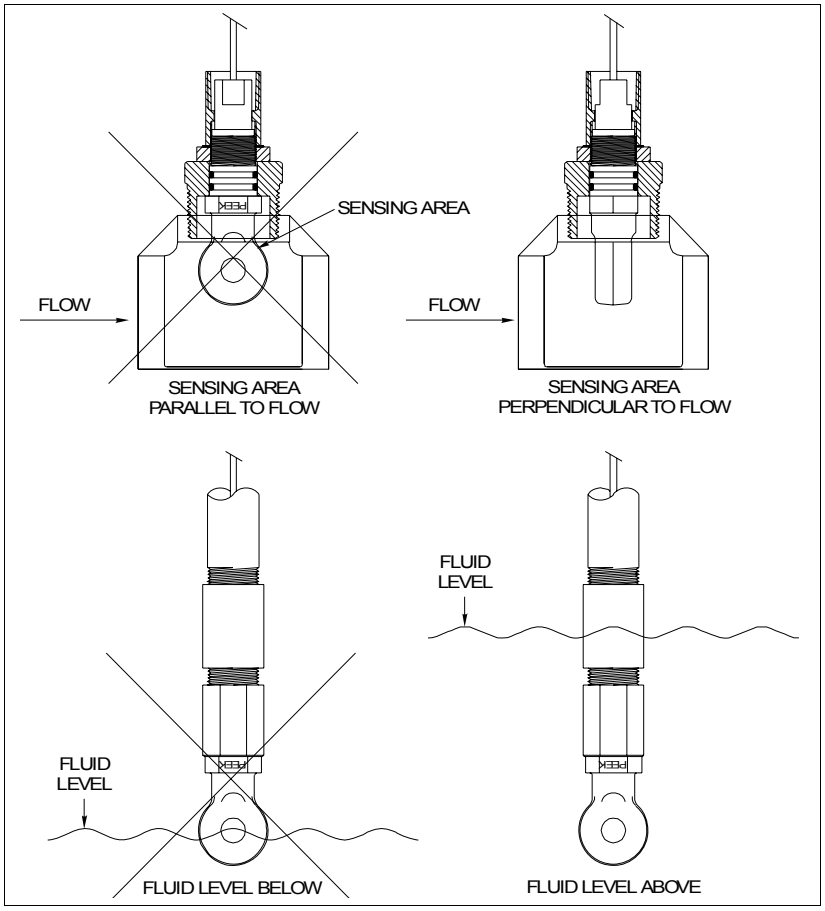


*Figure 2-2. Sensor Orientation Requirements*

## INSTALLATION PROCEDURES

Table 2-1 lists the installation procedures for the various sensor hardware types.

*Table 2-1. Installation Procedures*

| Description | Procedure |
|---|---|
| Submersible assembly | PR1 |
| In-line flow assembly | PR2 |
| Hot top assemblies | PR3 |
| Two-inch sanitary in-line flow assembly | PR4 |

# SECTION 3 - REPAIR AND REPLACEMENT

## *INTRODUCTION*

This section does not contain repair instructions for the Type TB404 Toroidal Conductivity Sensor. Due to the nature of its design, complete sensor replacement is required when it has been damaged or does not properly function. Contact ABB for replacement toroidal conductivity sensors.

If using a high or low pressure hot tap assembly, the sensor must be removed from the hot tap hardware for replacement or service. Refer to PR5 for the procedure. PR6 contains the sensor cleaning procedures.

# SECTION 4 - SUPPORT SERVICES

## INTRODUCTION

When ordering replacement parts, specify nomenclature type, part name and part number.

ABB is ready to assist in the use and repair of its products at any time. Requests for sales and/or application service should be made to the nearest sales or service office.

Factory support in the use of the Type TB404 Toroidal Conductivity Sensor can be obtained by contacting:

ABB Inc.
9716 S. Virginia St., Ste E
Reno, NV 89511 USA
Phone: +1 (775) 850 4800
Fax: +1 (775) 850 4808
www.abb.com/instrumentation

## REPLACEMENT PARTS

When making repairs at your facility, order spare parts from a ABB sales office. Provide this information.

1. Spare part description, part number and quantity.

2. Model and serial number (if applicable).

3. ABB instruction manual number, page number and reference figure that identifies the part.

Contact ABB for replacement toroidal conductivity sensors. Table 1-4 lists the accessories available for the sensor. This table also applies to spare and replacement parts. When ordering standard parts from ABB, use the part numbers and descriptions from Table 1-4. Order parts without commercial descriptions from the nearest ABB sales office.

# PROCEDURE PR1 - SUBMERSIBLE ASSEMBLY

## *PURPOSE/SCOPE*

20 min.

This procedure explains how to install the submersible assembly.

**Parts**

| Number | Qty | Description |
|---|---|---|
| 4TB4951-0092 | 1 | Submersible coupling adapter, ($^{15}/_{16}$-20 x ¾ in. NPT), CPVC |
| 4TB4951-0093 | | Submersible coupling adapter, ($^{15}/_{16}$-20 x ¾ in. NPT), Kynar |
| 4TB4951-0094 | | Submersible coupling adapter, ($^{15}/_{16}$-20 x ¾ in. NPT), 316 stainless steel |
| 4TB8006-0025 | A/R | Silicone grease, high temperature |
| Customer-supplied | 1 | Conduit pipe |
| Customer-supplied | 1 | Pipe coupling, ¾ in. NPT |
| Customer-supplied | A/R | Pipe sealant, Teflon tape, or equivalent |
| Customer-supplied | A/R | Coupling and cable gland, or caulk |
| Customer-supplied | A/R | Conduit clamp or similar device |

A/R = as required

**Tools** None.

## *PROCEDURE*

The submersible adapter allows installation of the Type TB4042 sensor into submersible installations such as tanks and open vessels or waterways.

❑ 1. Lightly lubricate the sensor O-rings with high temperature silicone grease or equivalent.

❑ 2. Attach the sensor to the submersible coupling adapter as shown in Figure PR1-1.

❑ 3. Place pipe sealant, Teflon tape or equivalent onto the ¾ in. NPT male threads of the submersible coupling adapter.

**NOTE:** ABB recommends the application of pipe sealant, Teflon tape or equivalent onto all pipe threads to prevent process liquids from seeping into the conduit piping.

❑ 4. Attach the ¾ in. NPT pipe coupling to the submersible coupling adapter.

❑ 5. Attach a section of conduit pipe to the pipe coupling. This section should be long enough to position the sensor in the desired location within the tank, vessel or trough to meet the installation guidelines described in Section 2.

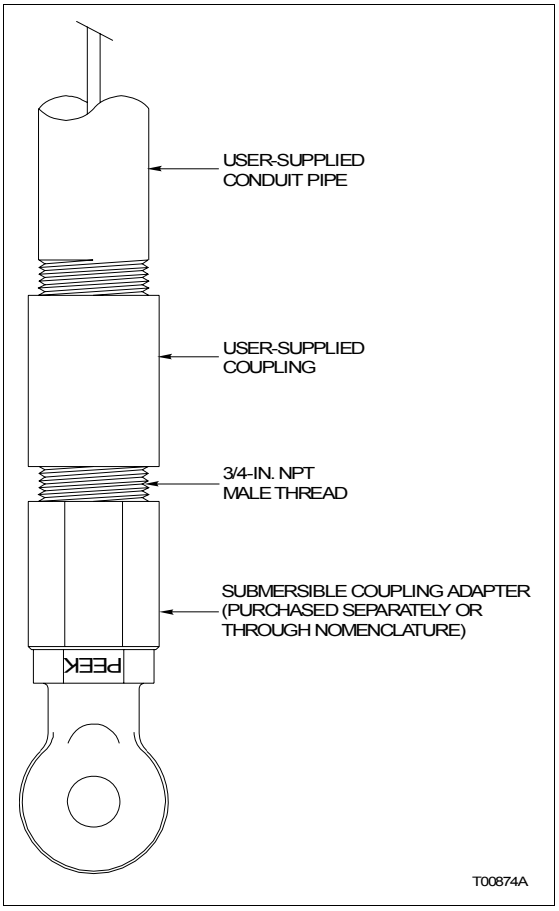


*Figure PR1-1. Submersible Assembly*

❑ 6. Use a coupling and cable gland, or caulk to seal the area around the sensor cable and top of the conduit pipe to prevent moisture from entering the pipe.

❑ 7. Position the pipe in the desired location and retain it in a fixed position using a conduit clamp or similar device.

❑ 8. Orient the sensor in the flow according to the installation guidelines described in Section 2.

# PROCEDURE PR2 - IN-LINE FLOW ASSEMBLY

## *PURPOSE/SCOPE*

20 min.

This procedure explains how to install the in-line flow assembly.

**Parts**

| Number | Qty | Description |
|---|---|---|
| 4TB4711-0021 | 1 | Nut, retaining |
| 4TB4906-0014 | 1 | In-line gasket, Viton |
| 4TB4951-0085 | 1 | In-line fitting, 1½-in., 316 stainless steel |
| 4TB4951-0087 | | In-line fitting, 1½-in., CPVC |
| 4TB4951-0088 | | In-line fitting, 1½-in., Titanium |
| 4TB5110-0067 | 1 | Conduit/cable gland adapter, ¾ in. |
| 4TB8006-0025 | A/R | Silicone grease, high temperature |
| 4TB9515-0107 | 2 | O-ring, No. 117, EPDM |
| 4TB9515-0108 | | O-ring, No. 117, Viton |
| 4TB9515-0109 | | O-ring, No. 117, Kalrez |
| Customer-supplied | A/R | High temperature pipe sealant |
| Customer-supplied | A/R | Flexible conduit or cable gland |

A/R = as required

**Tools**

- Two-inch open-end wrench.
- $\frac{9}{16}$-inch open-end wrench.
- 1½-inch open-end wrench.

## *PROCEDURE*

The in-line flow assembly provides installation capability for pipelines and tanks.

❑ 1. Lightly lubricate the No. 117 O-rings (Fig. PR2-1) with high temperature silicone grease or equivalent.

❑ 2. Install the sensor into the 1½-inch in-line fitting.

❑ 3. Thread the retaining nut onto the sensor. Hand-tighten it only to allow for adjustment when the assembly is installed into the pipeline or tank.

❑ 4. Apply high temperature pipe sealant onto the outer threads of the in-line fitting.

❑ 5. Install the in-line fitting into the pipe or tank fitting using a two-inch open-end wrench to tighten the fitting (Fig. PR2-2).

**NOTE:** The pipe or tank fitting must have a female 1½-NPT thread

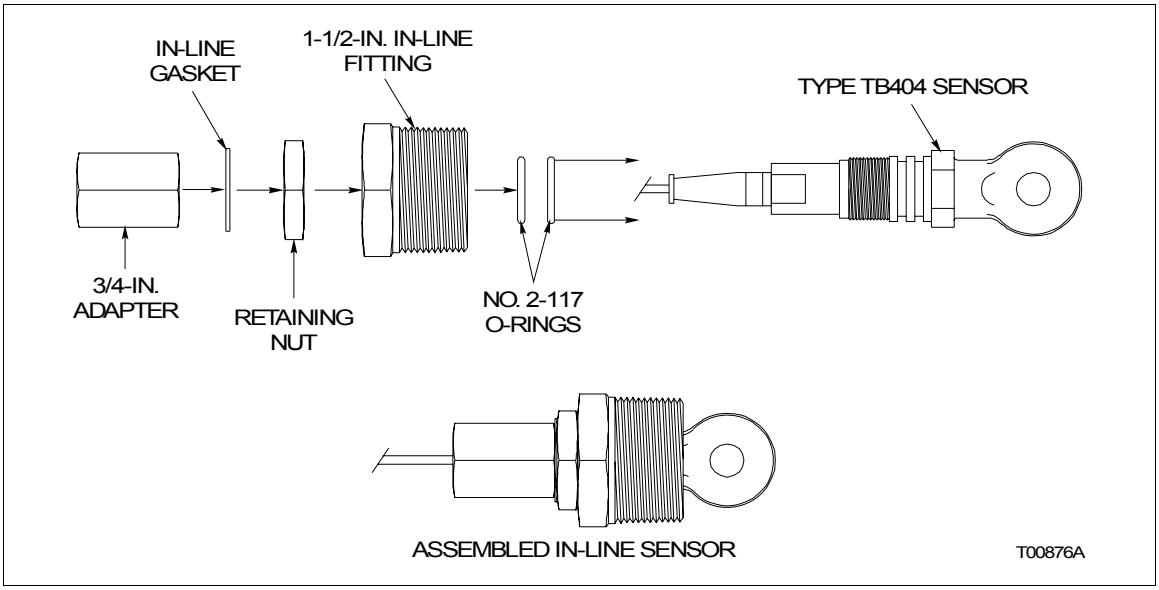


*Figure PR2-1. In-Line Assembly, Exploded View*

❑ 6. Using the $^{9}/_{16}$-inch open-end wrench on the wrench flats on the sensor, rotate the sensor so that the sensing area is perpendicular to the flow path to meet the installation guidelines described in Section 2.

❑ 7. While maintaining the sensor orientation with the $^{9}/_{16}$-inch open-end wrench, use a 1½-inch open-end wrench to tighten the retaining nut.

❑ 8. Slide the Viton gasket over the back of the sensor and onto the retaining nut.

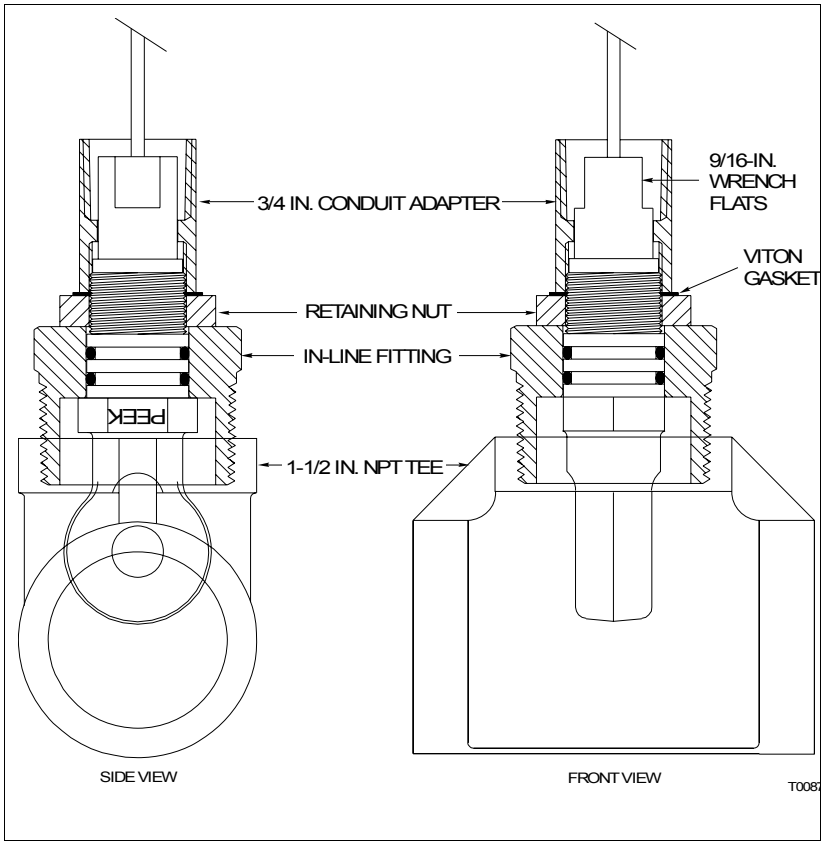


*Figure PR2-2. In-Line Assembly in Pipe or Tank Fitting*

❑ 9. Install the threaded end of the conduit/cable gland adapter onto the remaining threads on the sensor.

❑ 10. Attach ¾-inch flexible conduit or a cable gland to the conduit/cable gland adapter.

# PROCEDURE PR3 - HOT TAP ASSEMBLIES

## *PURPOSE/SCOPE*

20 min.

This procedure explains how to install the hot tap assemblies.

**Parts**

| Number | Qty | Description |
|---|---|---|
| customer-supplied | A/R | Pipe sealant, high temperature |
| customer-supplied | 1 | Receptacle, 1½ in. NPT |
| 4TB9515-0065 | 1 | Hardware kit for high pressure hot tap assembly with Titanium hardware and EPDM hardware O-rings (Nos. 014 and 132) |
| 4TB9515-0066 | | Hardware kit for high pressure hot tap assembly with Titanium hardware and Viton hardware O-rings (Nos. 014 and 132) |
| 4TB9515-0067 | | Hardware kit for high pressure hot tap assembly with Titanium hardware and Kalrez hardware O-rings (Nos. 014 and 132) |
| 4TB9515-0069 | | Hardware kit for high pressure hot tap assembly with 316 stainless steel hardware and EPDM hardware O-rings (Nos. 014 and 132) |
| 4TB9515-0070 | | Hardware kit for high pressure hot tap assembly with 316 stainless steel hardware, EPDM hardware O-rings (Nos. 014 and 132) and ball valve |
| 4TB9515-0071 | | Hardware kit for high pressure hot tap assembly with 316 stainless steel hardware and Viton hardware O-rings (Nos. 014 and 132) |
| 4TB9515-0072 | | Hardware kit for high pressure hot tap assembly with 316 stainless steel hardware, Viton hardware O-rings (Nos. 014 and 132) and ball valve |
| 4TB9515-0073 | | Hardware kit for high pressure hot tap assembly with 316 stainless steel hardware and Kalrez hardware O-rings (Nos. 014 and 132) |
| 4TB9515-0074 | | Hardware kit for high pressure hot tap assembly with 316 stainless steel hardware, Kalrez hardware O-rings (Nos. 014 and 132) and ball valve |
| 4TB9515-0107 | 1 | Sensor O-ring kit (No. 117), EPDM |
| 4TB9515-0108 | | Sensor O-ring kit (No. 117), Viton |
| 4TB9515-0109 | | Sensor O-ring kit (No. 117), Kalrez |

A/R = as required

**Tools**

- Pipe wrench.

## SAFETY CONSIDERATIONS

**WARNING**

**1. Always use the sensor guide when using the high pressure hot tap assembly. The sensor guide is a tightly toleranced 1½ in. NPT nipple that prevents adverse play between the insertion rod and the sensor guide. Adverse play could damage the insertion rod and injure personnel.**

**2. Never stand directly behind the insertion rod upon pressurization. If the insertion rod is not fully retracted upon pressurization, it could rapidly reach the blow out protection of the sensor assembly and severely injure personnel standing too close behind the insertion rod.**

## PROCEDURE

Two types of hot tap assemblies are available: Low pressure units with either hand or wrench-tight compression fittings and high pressure units. The high pressure hot tap assemblies can be ordered with ball valves. A ball valve must be ordered separately for low pressure hot tap assemblies.

For a low pressure hot tap assembly without a ball valve, valve sizes are limited to a minimum throat diameter of 1½ inches (e.g., 1½-inch full port, two-inch regular port, etc.). Since mating hardware requires 1½ in. NPT threads, ball valves greater than 1½ inches require a reducing bushing.


When using high pressure hot tap assemblies, a 1½-inch full port ball valve is required. This is to maintain the proper insertion length for the sensor and the correct positioning of the insertion rod guides with the 1½ in. NPT sensor guide.

Sensors purchased through nomenclature with the hot tap hardware included are shipped fully assembled and only require installation into a 1½ in. NPT female receptacle followed by connection to the toroidal analyzer or transmitter. Separately purchased replacement hardware kits come unassembled. Assembly instructions in drawing format are provided with the kit. To assemble these kits, follow the procedures outlined in these drawings before installing the sensor into the process piping or tank.

Low pressure hot tap assemblies can be purchased with many different insertion rod lengths. Different lengths allow for flexibility in positioning the sensor to the desired depth of the final installed location.

One difficulty often encountered is the lack of repeatability in positioning of the sensor relative to the flow and insertion depth per the installation guidelines described in Section 2. A way to overcome this is to place a scribe or permanent mark on the insertion rod that indicates the required insertion depth and sensor position. These marks allow the sensor to be returned to the desired location and orientation in a repeatable manner. Many methods can be employed to determine where these marks should be located. The following example describes one of them.

Example:

1. Temporarily insert the sensor assembly into the process receptacle.

2. Set the insertion rod to the proper depth and orientation according to the installation guidelines described in Section 2 or measure the distance from the end of the process receptacle to the desired sensor location.

3. Set the insertion length of the assembly to the measured length assuming at least five threads of engagement on the male threads of the sensor assembly.

4. Permanently mark the insertion rod with either a permanent marker, paint or scribe at the intersection of the rod and the compression nut.

5. Make a second mark perpendicular to the first mark that corresponds to the position of the sensing area of the sensor according to the installation guidelines described in Section 2.

To install the sensor hardware:

❑ 1. Loosen the compression fitting (Fig. PR3-1).

❑ 2. Position the sensor against the compression fitting body or extraction housing (Fig. PR3-2) by pulling the insertion rod until the assembly stops moving

❑ 3. Hand tighten the compression fitting to prevent the insertion rod and sensor from moving during the remaining steps.

❑ 4. Apply high temperature pipe sealant to the unused pipe threads of the 1½ in. NPT nipple attached to the ball valve.

❑ 5. Install the nipple into the piping or tank receptacle using a pipe wrench.

**NOTE:** This fitting must have a female 1½ in. NPT thread..

❑ 6. Tighten the fitting and position the ball valve to the required orientation.

❑ 

7. Close the ball valve and pressurize the process pipe or tank.

❑ 8. Check for leaks.

❑ 9. Ensure that the sensor is against the compression fitting and that the fitting is tightened.

❑ 

10. Open the ball valve.

❑ 11. While holding the insertion rod tightly to prevent kickback, loosen the compression fitting.

❑ 12. Push the insertion rod into the process until the desired insertion is reached.

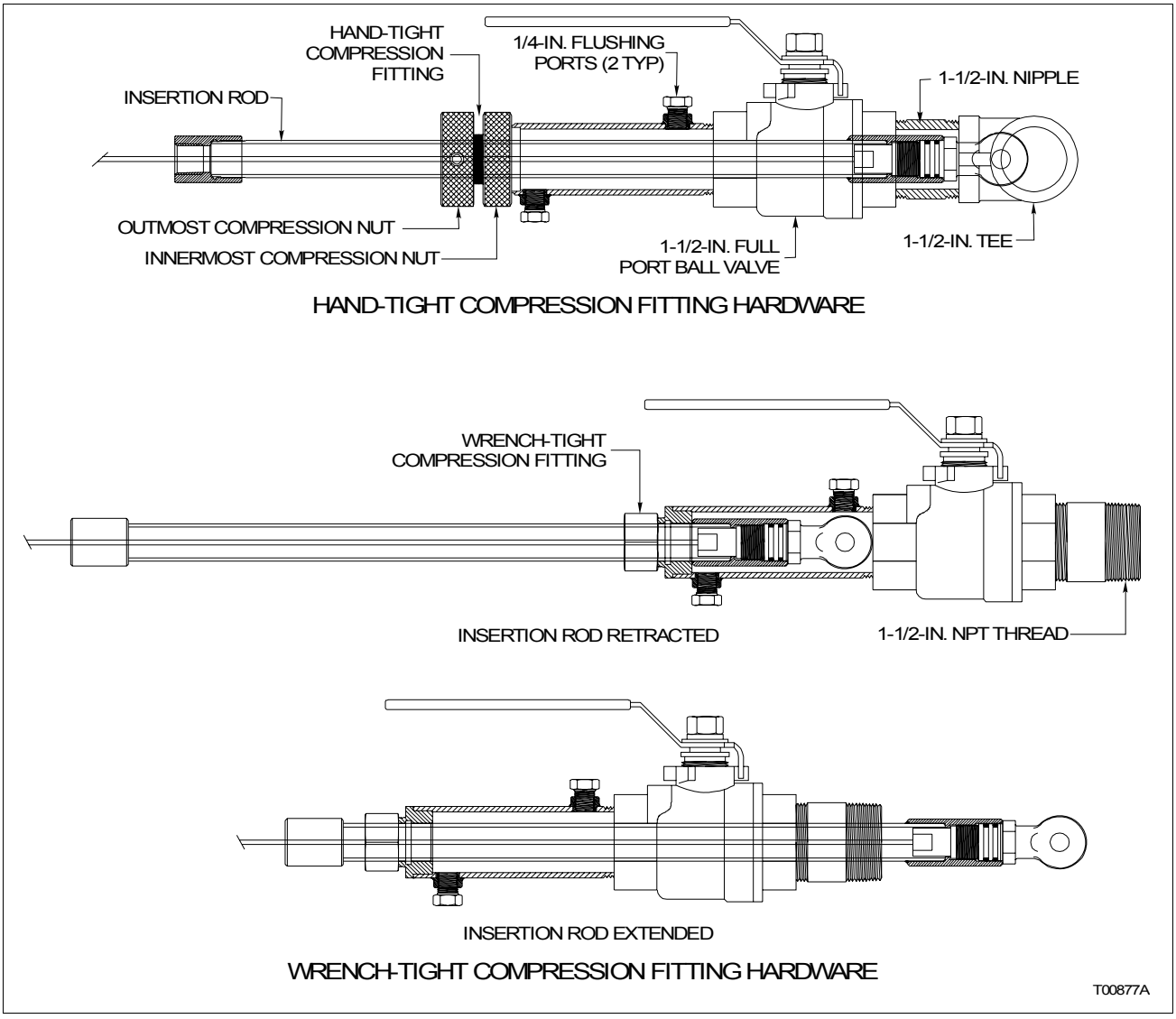


*Figure PR3-1. Low Pressure Hot Tap Assemblies*

❑ 13. Check for the proper sensor orientation.

❑ 14. Tighten the compression fitting, making sure the sensor orientation to the flow is not altered.

❑ 15. Slowly reduce the hand pressure against the insertion rod, thus verifying the compression fitting is secure.

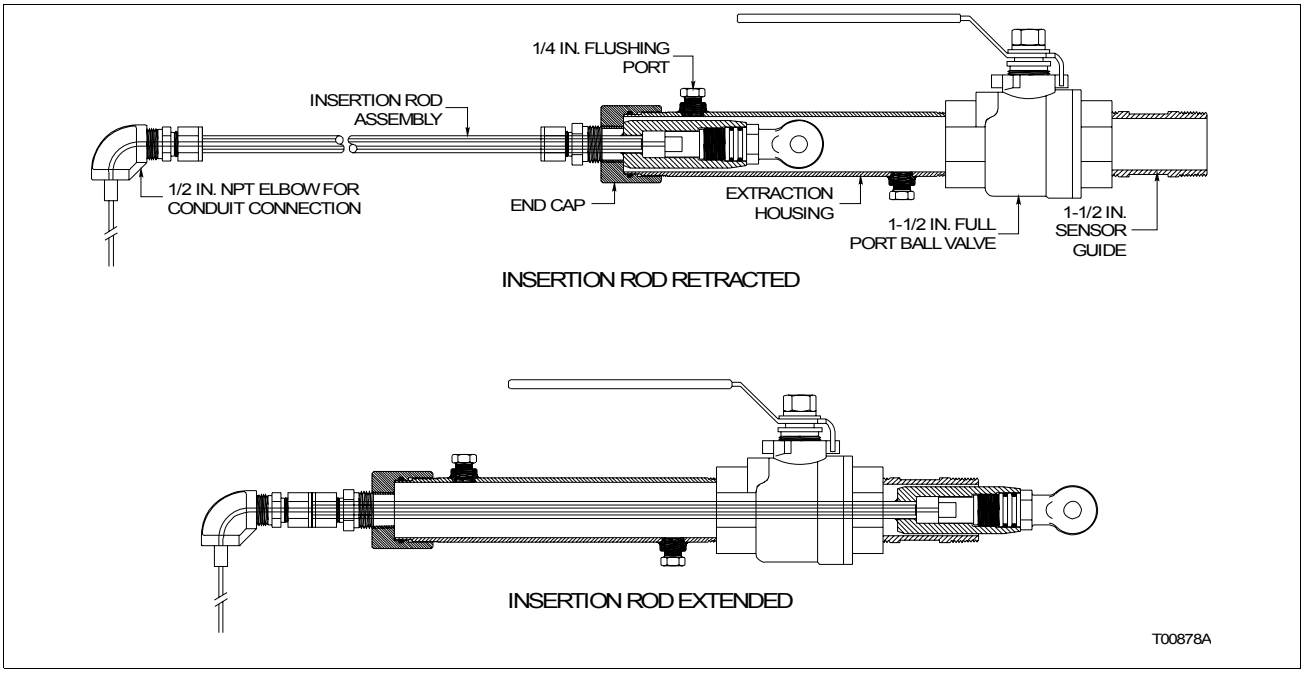


*Figure PR3-2. High Pressure Hot Tap Assembly*

# PROCEDURE PR4 - TWO-INCH SANITARY TRI-CLAMP ASSEMBLY

## *PURPOSE/SCOPE*

20 min.

This procedure explains how to install the two-inch sanitary tri-clamp assembly

**Parts**

| Number | Qty | Description |
|---|---|---|
| customer-supplied | 1 | Gasket, sanitary |
| customer-supplied | 1 | Tri-clamp tee, sanitary, 2 in. |
| customer-supplied | 1 | Tri-clamp, sanitary |
| customer-supplied | 1 | Conduit/cable gland adapter, ½ in. |
| customer-supplied | A/R | Conduit, flexible, ½ in., or cable gland |

A/R = as required

**Tools** None.

## *SAFETY CONSIDERATIONS*

| | |
|---|---|
| **WARNING** | **1. Never exceed the sensor or sanitary clamp temperature and pressure limits. Exceeding these limits can damage the equipment in such a way as to pose the risk of injury to personnel.** |

## *PROCEDURE*

The Type TB4043 Toroidal Conductivity Sensor provides installation capability for sanitary pipelines and tanks with two-inch tri-clamp fittings.

❑ 


1. Install the sanitary gasket onto the two-inch sanitary tri-clamp tee (Fig. PR4-1).

❑ 2. Slide the sensor into the two-inch sanitary tri-clamp tee.

❑ 3. Position the sensor so that the sensing area is perpendicular to the flow path to meet the installation guidelines described in Section 2.

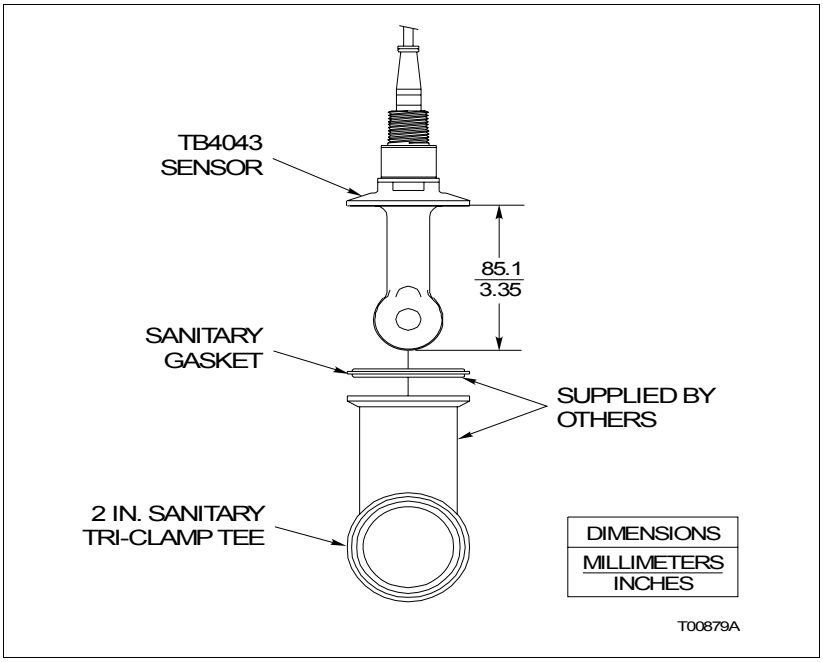


*Figure PR4-1. Sanitary In-Line Flow Assembly*

❑ 4. Clamp the sensor to the two-inch sanitary tri-clamp tee using the sanitary tri-clamp, being sure to maintain the sensor orientation (Fig. PR4-2).

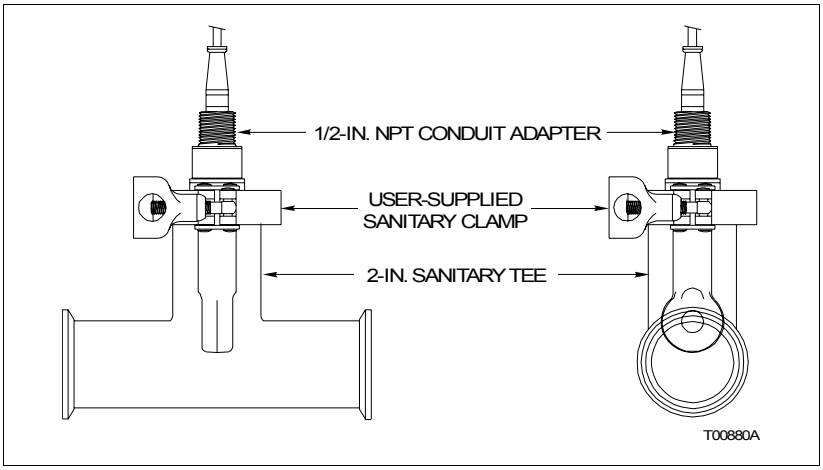


*Figure PR4-2. Sanitary In-Line Flow Assembly with Tri-Clamp*

❑ 5. Install a ½ in. NPT conduit/cable gland adapter onto the sensor threads.

❑ 6. If desired, attach ½-inch flexible conduit or a cable gland to the ½ in. NPT conduit/cable gland adapter.

# PROCEDURE PR5 - REMOVING SENSOR FROM HOT TAP ASSEMBLIES

## *PURPOSE/SCOPE*

5 min.

This procedure explains how to remove the sensor from hot tap assemblies.

**Parts**

| Number | Qty | Description |
|---|---|---|
| 4TB8006-0025 | A/R | Silicone grease |
| 4TB8006-0045 | A/R | Anti-seize compound |
| Customer-supplied | A/R | Pipe sealant |

A/R = as required

**Tools** None

## *SAFETY CONSIDERATIONS*

**WARNING**

**1. Firmly hold the insertion rod when loosening the compression fitting. When the compression rod is loosened, the pressure against the sensor assembly will cause the insertion rod to retract from the ball valve assembly with great velocity. This could injure personnel standing in the path of the retracting insertion rod. Allow only properly trained personnel to handle these types of sensor assemblies.**

**2. Open one of the flushing ports after the sensor is retracted and the ball valve is closed. If a continuous stream of liquid exists, damage to the ball valve or components can occur or may have already occurred. This condition can cause a hazard to personnel upon removal of the insertion rod.**

## *PROCEDURE*

❑ 


1. Firmly grasp the insertion rod assembly and loosen the compression fitting (Fig. PR5-1).

❑ 2. Slowly retract the sensor until it is fully extended.

❑ 3. Close the ball valve.

❑ 


4. Relieve the internal pressure in the compression fitting body or extraction housing (Fig. PR5-1) by opening one of the two ¼-inch flushing ports.

❑ 5. Flush the internal chamber if required, and drain the extraction housing.

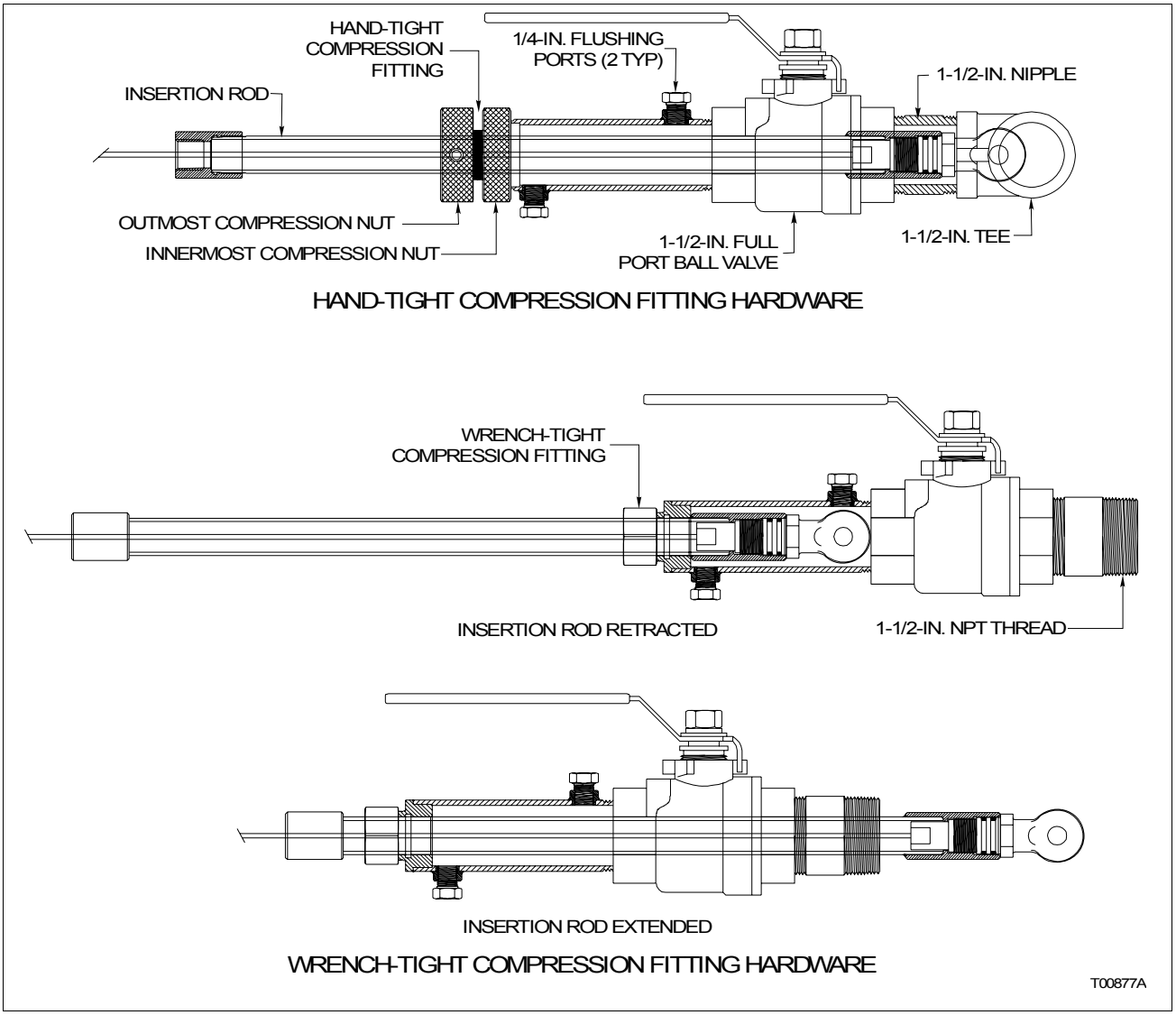


*Figure PR5-1. Low Pressure Hot Tap Assemblies*

❑ 6. Access the sensor by one of the following three methods.

a. Hand-tight low pressure hardware — Undo the outermost compression nut followed by the innermost compression nut and withdraw the insertion rod assembly from the compression fitting body.

b. Wrench-tight low pressure hardware — Undo the 1½ in. NPT thread connecting the compression fitting body to the ball valve.

c. High pressure hardware — Undo the end cap and withdraw the insertion rod assembly from the extraction housing.

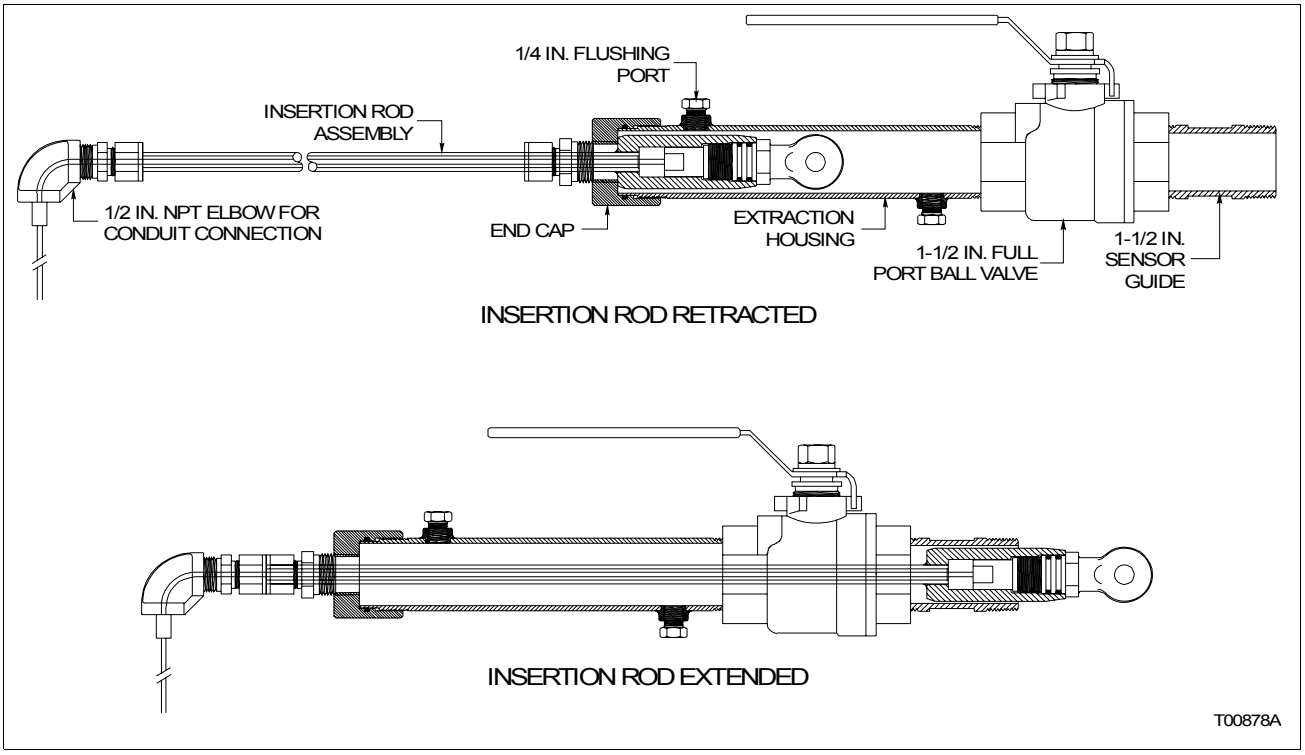


*Figure PR5-2. High Pressure Hot Tap Assembly*

❑ 7. Service the sensor as required. Sensor maintenance procedures appear in PR6.

**NOTE:** Before assembling the sensor into the housing, lubricate all exposed O-rings with silicone grease, all straight threads with anti-seize compound and all pipe threads with pipe sealant.

# PROCEDURE PR6 - SENSOR CLEANING

## PURPOSE/SCOPE

20 min.

This procedure describes how to clean the sensor.

**Parts** None.

**Tools**

- Gloves.
- Eye protection.
- Safety shield.
- Other protective items as applicable.
- 1% to 5% Hydrochloric Acid (HCl) solution (for acid dip).
- Isopropyl alcohol or other appropriate solvent (for solvent dip).
- Clean cloth.
- Rag, acid brush or tooth brush (for physical cleaning).
- Water.

## SAFETY CONSIDERATIONS

**WARNING**

**1. Consider the material compatibility between cleaning fluids and process liquids. Incompatible fluids can react with each other causing injury to personnel and equipment damage.**

**2. Acids and bases can cause severe burns. Use hand and eye protection when handling.**

**3. Use solvents only in well ventilated areas. Avoid prolonged or repeated breathing of vapors or contact with skin. Solvents can cause nausea, dizziness and skin irritation. In some cases, overexposure to solvents has caused nerve and brain damage. Solvents are flammable - do not use near extreme heat or open flame.**

## PROCEDURE

ABB toroidal conductivity sensors are cleaned using one or a combination of methods. These are recommendations and may not be suitable for all applications. When cleaning, observe all safety precautions required for handling chemicals. When handling chemicals, always use gloves, eye protection, safety shields and similar protective items and consult material data safety sheets.

### *Acid Dip*

This method removes scales caused by hard water.

❑ 


1. Verify that any process fluid on the sensor is not incompatible with HCl.

❑ 


2. Put on gloves, eye protection, safety shields and other protective items as needed for protection.

❑ 3. Dip the donut portion of the sensor into a one percent to five percent solution of HCl until this region is free of the unwanted coating. Do not expose any of the metal on the sensor to this solution or corrosion may occur.

❑ 4. Rinse the sensor with water.

### *Solvent Dip*

This method removes organic coatings.

❑ 


1. Verify that any process fluid on the sensor is not incompatible with isopropyl alcohol or other appropriate solvent.

❑ 


2. Put on gloves, eye protection, safety shields and other protective items as needed for protection.

❑ 3. Dip the sensor into the solvent. Do not use a solvent that is known to be incompatible with the plastic of the sensor.

❑ 4. Remove the solvent using a clean cloth.

❑ 5. Rinse the sensor with soap and water.

### *Physical Cleaning*

This method removes especially thick scales and accumulations.

❑ 1. Use a rag, acid brush or tooth brush to clean the sensor.

# Index

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