Instruction

MI 611-205
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PH10 DolpHin® Series pH Sensors
and
ORP10 DolpHin Series ORP Sensors

Installation, Troubleshooting, Maintenance, and Parts List

invensys
Foxboro®

Contents

Figures

Tables

1. Introduction

The PH10 DolpHin® Series pH Sensors and ORP10 DolpHin Series ORP Sensors are suitable for a wide range of pH and ORP measurement applications. They are designed for use with Foxboro® brand 875PH, 873PH, and 873DPX Analyzers, and 876PH and 870ITPH Transmitters. Some can also be used with 873APH Analyzers. When used with 875PH Analyzers or 876PH and 870ITPH Transmitters, they provide the additional capability of on-line diagnostics to signal the user if any of several common sensor faults occur.

The sensors are available with a choice of temperature compensation and cable termination. They are available with an internal preamplifer for use up to 150 m (500 ft) from the analyzer or transmitter. The sensors can be mounted to the process in a number of ways. They have a 3/4-inch external NPT connection on both the electrode and cable end. The sensors can be inserted directly into the process line or tank or mounted through a variety of accessories including bushings, tees, flowchambers, and ball valves/insertion assemblies.

Dangers, Warnings, and Cautions

DANGER

When installing or removing sensors, wear appropriate protective clothing including safety goggles. Escaping chemicals under pressure can cause severe injury, including blindness.

WARNING

1. Use care when connecting and disconnecting high-pressure service connection. Use proper gloves and follow the recommended procedures to avoid severe injury to personnel or damage to equipment.

2. When processing hazardous liquids, follow the recommended procedures. Failure to do so could result in injury to personnel and damage to equipment.

3. Use only Invensys recommended replacement parts. Substitution parts could result in damage to equipment, damage to the process, and/or injury to personnel.

WARNING

In addition to the pressure and temperature limits of the sensor, the DolpHin mounting accessories also have pressure and temperature limits. The specifications for the mounting accessories may be greater or less than the sensor specifications. Always use the lesser of the two specification limits when designing the installation of DolpHin sensors with accessories.

CAUTION

To prevent damage, use care when handling sensitive sensor components such as glass electrodes.

Reference Documents

Document No.	Description
DP 611-174	Junction Box BS811MR and BS813XN
DP 611-160	Junction Box BS807BZ
DP 611-171	DolpHin Series pH/ORP Sensors
DP 611-172	Legacy Insertion Tube and Ball Valve Assemblies for DolpHin Series pH and ORP Sensors
DP 611-182	BVA Series Ball Valve Insertion Assemblies for DolpHin Series pH and ORP Sensors
DP 611-173	DolpHin Series pH/ORP Sensor Accessories
MI 611-165	873PH Series Electrochemical Analyzers for pH or ORP Measurement
MI 611-190	873DPX Dual pH, ORP, or ISE Electrochemical Analyzers
MI 611-191	873APH Ace Series Electrochemical Analyzers for pH Measurement
MI 611-204	Use of Universal Adapter with DolpHin Series pH and ORP Sensors
MI 611-211	870ITPH pH and ORP Transmitters
MI 611-225	875PH pH and ORP Analyzers
MI 611-262	876PH Intelligent Transmitter for pH, ORP, and ISE Measurement

Theory of Operation

pH Measurement

pH indicates the concentration of hydrogen ions (H^+) present in aqueous solution. Since the concentration of hydrogen ions determines the degree of acidity or alkalinity of the solution, pH is also said to be a measure of acidity or alkalinity. pH is defined as the negative logarithm of the hydrogen ion concentration:

$$pH = -\log [H^+]$$

The pH scale ranges from 0 to 14 with a pH of 7 being neutral, a pH less than 7 being acidic, and a pH greater than 7 being basic (alkaline).

Measurement of pH using a DolpHin series pH sensor is accomplished by immersing the sensing tip of the probe, which consists of integral pH and reference electrodes, in the process solution. The pH electrode, which is sensitive to hydrogen ions in solution, develops an electrical potential proportional to pH. The reference electrode, which consists of Silver/Silver Chloride connected to the process via a potassium chloride salt bridge through a ceramic junction, provides a stable reference potential against which the glass electrode potential is measured. These two electrodes constitute a galvanic cell having a millivolt output proportional to the pH of the solution.

ORP Measurement

ORP is a measure of the electrical potential of a reaction known as an oxidation-reduction (redox) reaction. A redox reaction is one in which one component loses one or more electrons (oxidation) while another component gains one or more electrons (reduction). The oxidation-reduction potential is related to the ratio of oxidation activity to reduction activity. By convention, a solution that contains an excess of oxidizing agent has a positive ORP, and a solution that contains an excess of reducing agent has a negative ORP.

Measurement of ORP is accomplished by immersing the DolpHin series ORP sensor, configured with either a gold or platinum electrode, in a solution along with its integral silver/silver chloride reference electrode. The sensor develops a millivolt output (similar to pH measurement) that is proportional to the ratio of oxidizing agent to reducing agent, or ORP.

Standard Specifications

Measurement Range

pH 0 and 14 pH (domed glass)
2 and 12 pH (flat glass)
1 and 11 pH (antimony)

ORP ±2000 mV

Automatic Temperature Compensation (ATC): as specified from the following selections:

2-Wire 100 Ω platinum RTD
3-Wire 1000 Ω platinum RTD
2-Wire 100 Ω platinum RTD, Enhanced Response Speed
3-Wire 1000 Ω platinum RTD, Enhanced Response Speed
2-Wire, 3 kΩ Balco RTD

NOTE

Refer to Table 13 for resistance temperature relationships.

Storage Temperature Limits: -5 and +65°C (-23 and +149°F)

Process Pressure Limits: 0 and 0.7 MPa (0 and 100 psi)

Process Temperature Limits: See Table 1.

NOTE

In Table 1, in-line installation means that only the sensing end, not the sensor body, is immersed in the solution. Submersion installation is when the entire sensor assembly (sensing end and body) is completely submersed.

WARNING

In addition to the pressure and temperature limits of the sensor, the DolpHin mounting accessories also have pressure and temperature limits. The specifications for the mounting accessories may be greater or less than the sensor specifications. Always use the lesser of the two specification limits when designing the installation of a DolpHin senors with accessories.

Table 1. Process Temperature Limits

Measuring Electrode Type	Without Internal Preamp.	With Internal Preamp	
		Ball Valve or Submersion Installation	In-Line Installation [a]
Domed Glass - pH	0 to 121°C (32 to 250°F)	0 to 85°C (32 to 185°F)	0 to 121°C (32 to 250°F)
Flat Glass - pH	0 to 85°C (32 to 185°F)	0 to 85°C (32 to 185°F)	0 to 85°C (32 to 185°F)
Antimony - pH	0 to 121°C (32 to 250°F)	0 to 85°C (32 to 185°F)	0 to 121°C (32 to 250°F)
Platinum - ORP	0 to 121°C (32 to 250°F)	0 to 85°C (32 to 185°F)	0 to 121°C (32 to 250°F)
Gold - ORP	0 to 121°C (32 to 250°F)	0 to 85°C (32 to 185°F)	0 to 121°C (32 to 250°F)

a. For in-line installations of a DolpHin sensor with internal preamp, the upper body must be in ambient temperatures of 54°C (130°F) or less.

Materials:

Sensor Body: Kynar®

Measuring Electrode:

pH: Domed Glass, Flat Glass, or Antimony as specified
ORP: Platinum or Gold as specified

Reference Electrode: Silver/Silver Chloride ceramic junction

O-Ring: Viton® standard; EPDM and Chemraz optional, as specified

Solution Ground: Conductive Kynar (nonmetallic)

Cable Length:

3 m (10 ft) standard; 6, 9, 12, and 15 m (20, 30, 40, and 50 ft) optional as specified

Cable Termination:

Integral sensor cable terminated with crimped-on straight pin lugs
Integral sensor cable terminated with Variopin quick connector
Variopin quick connector integral to sensor housing end

Variopin Connector Protection Class:

Meets the ingress protection rating of IP66/68 per IEC 60529; IP68 immersion rating is at a depth of 2 m (6.6 ft) for 48 hours

Sensor Mounting: Up to 90° from vertical with the electrode end downward

Electromagnetic Compatibility (EMC):

When properly installed per the applicable instructions with 875PH, 873PH, 873APH, or 873DPX (220 V ac, 240 V ac Metal Enclosures only) Analyzers, 876PH or 870ITPH Transmitters, or other compliant transmitters/analyzers, the DolpHin pH and ORP sensors comply with the Electromagnetic Compatibility Requirements of European EMC Directive 2004/108/EC by conforming to the following EN and IEC Standards: EN-61326-1 and IEC 61000-4-2 through 61000-4-6.

Electrical Safety Specifications: See Table 2.

Table 2. Electrical Safety Specifications

Testing Laboratory, Types of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
ATEX Intrinsically safe; II GD 1 EEx ia IIC; Zone 0.	Temperature Class T4 to T6.	CS-E/AAA
ATEX Type N (Limited Energy); II GD 3 EEx nL IIC; Zone 2.	Temperature Class T4 to T6.	CS-E/ANN
CSA intrinsically safe for using in Class I, II, III Division 1, Groups A, B, C, D, E, F, and G.	Connect to certified 870ITPH Transmitter, per MI 611-206. Temperature Class T4 Ta=85°C; T5 Ta=40°C.	CS-E/CAA
CSA Non Incendive for Class I, II, III Division 2, Groups A, B, C, D, E, F, and G.	Connect to certified 870ITPH Transmitter, per MI 611-206. Temperature Class T4 Ta=85°C; T5 Ta=40°C.	CS-E/CNN
FM intrinsically safe (Entity) for using in Class I, II, III Division 1, Groups A, B, C, D, E, F, and G.	When installed per MI 611-206; Temperature Class T4 Ta=85°C; NEMA Type 4X.	CS-E/FAA
FM Non Incendive (NIFW) for using in Class I, Division 2, Groups A, B, C, and D; Class II, III, Division 2, Groups F and G.	When installed per MI 611-206; Temperature Class T4 Ta=85°C; NEMA Type 4X.	CS-E/FNN
IECEx intrinsically safe; II GD 1 EEx ia IIC; Zone 0.	Temperature Class T4 Ta = -20°C to 85°C.	CS-E/DAA
IECEx Type N (Limited Energy); Ex nL IIC; Zone 2.	Temperature Class T4 Ta = -20°C to 85°C.	CS-E/DNN

— NOTE

These sensors have been designed to meet the electrical safety descriptions listed in the table above. For detailed information or status of testing laboratory approvals/certifications, contact Invensys.

Sensor Identification

The DolpHin Sensor data labels are located approximately 300 mm (12 in) from each end of the sensor cable. Sensors that do not have integral cables (PH10-***Q and ORP10-***Q) have a data label on the connector, immediately adjacent to the sensor body. The model code (for example, PH10-3A1A), the top number on the label, is the number to be used when ordering a replacement sensor. The bottom number (for example, 2B0230) is the manufacturing date code. For a complete explanation of the model code, refer to “MODEL CODE – PH SENSOR” on page 38 and “MODEL CODE – ORP SENSOR” on page 39.

2. Installation

Removing the Sensor Protection Cap

The key to proper storage of your sensor is keeping both the measuring electrode and the reference junction hydrated while it is stored at normal room temperature. Your sensor was shipped with a protection cap, containing an electrolyte solution. The cap should remain in place until you are ready to install your sensor in the process. The cap is removed by pulling it off with a slight twisting motion using care not to splash its liquid contents. Invensys recommends saving the cap for future use if the sensor may be removed from the process for more than a few hours. For information on how to store your sensor, see "Storing a Sensor" on page 35.

General Installation Guidelines

NOTE

1. All piping techniques should comply with standard and acceptable practices.
2. Do not over-tighten threaded connectors. Over-tightening can damage the threads.
3. When applying PTFE tape to threaded connectors, do not start the tape before the first thread of the connector and do not wrap the tape beyond the last thread. Remove any PTFE tape that is exposed after joining threaded connectors. Excess tape can break off and contaminate or block the process.

Proper mounting of the sensor is important for efficient and accurate operation.

For dimensional information, see Dimensional Prints listed in "Reference Documents" on page 2.

For all applications and sensor configurations, mounting arrangements must be located so that:

- Sample at the sensing area is representative of the solution.
- Solution circulates actively and continuously past the sensing area (electrodes should stay wetted at all times).
- Flow velocity at sensing area does not cause cavitation or electrode damage.
- Position and orientation of the sensor does not trap air bubbles within the sensing area.
- Orientation of the sensor is any position up to 90° from vertical with the electrode end downward.
- Accessibility for replacement is considered. A flow-type installation must have blocking valves (user supplied) to allow for sensor replacement.
- Deposits of sediment or other foreign material do not accumulate within the sensing area.
- Provision for removal of the sensor from the process is considered. If cable is installed in metal conduit (recommended), either use flexible conduit or make some other provision.

CAUTION

When installing a sensor, be careful **not** to bottom the sensor in the vessel, particularly in a small diameter pipe.

WARNING

Antimony is a toxic material. When an antimony electrode is installed, avoid contact with the surface of the antimony pellet. If skin contact is made with the antimony pellet, wash the contacted skin area with soap and water. Refer to MSDS051.

Insertion Installation Using Sensor Threads

NOTE

All piping techniques should comply with standard and acceptable practices.

1. Wrap PTFE tape on the 3/4 NPT threads of the sensor.
2. Insert the sensor into the process vessel. Tighten as required.

Figure 1. Side of Tank/Vessel Mounting

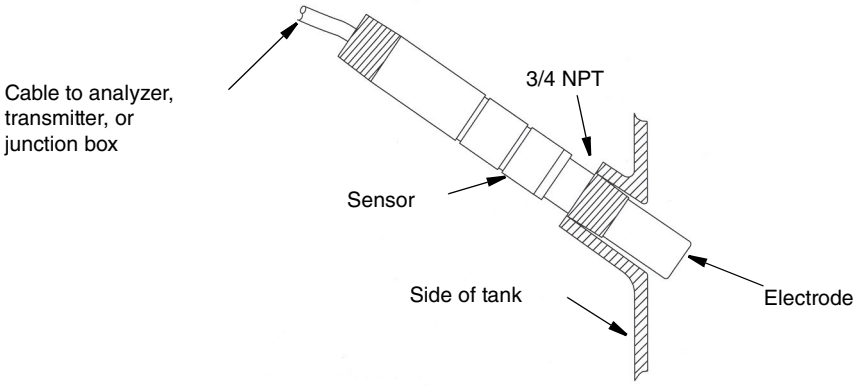
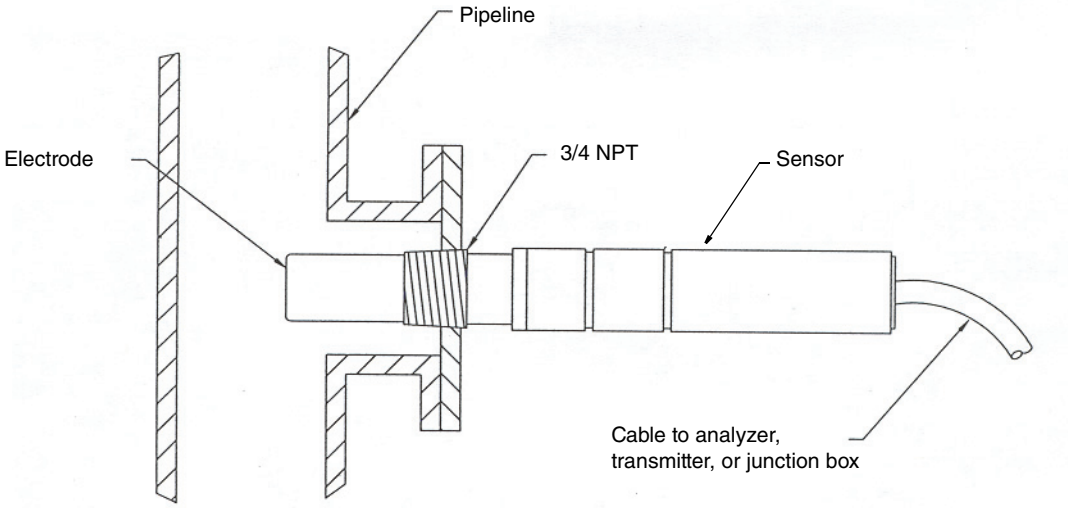


Figure 2. Pipe Mounting



Submersion/Immersion Installations

In a submersion/immersion installation, the cable end of the sensor must be enclosed in a user-supplied conduit to protect the sensor from moisture. Refer to Figures 3 and 4 for examples.

Figure 3. Submersion/Immersion Mounting for Sensor with Integral Cable

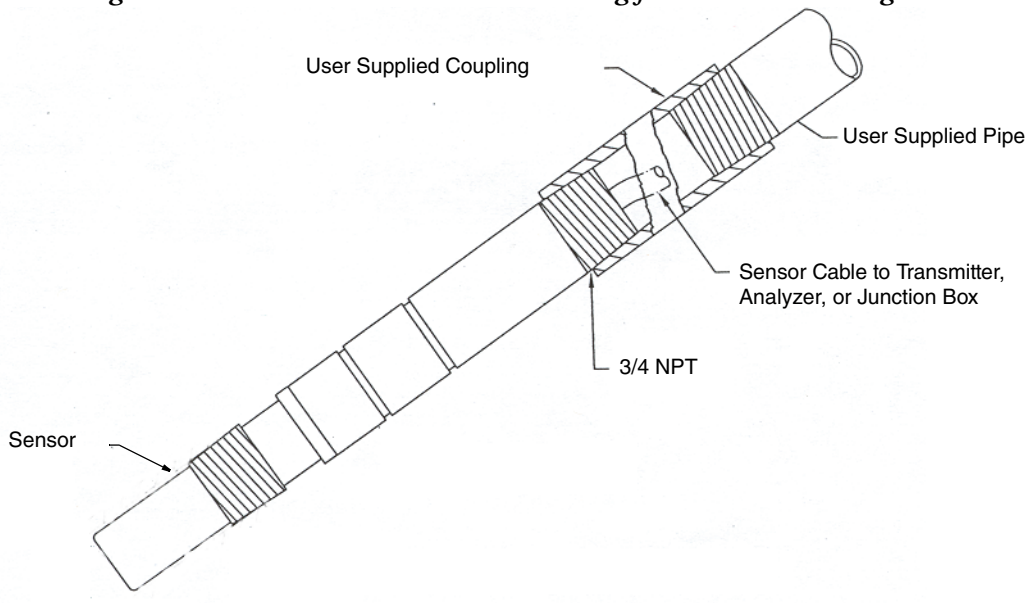
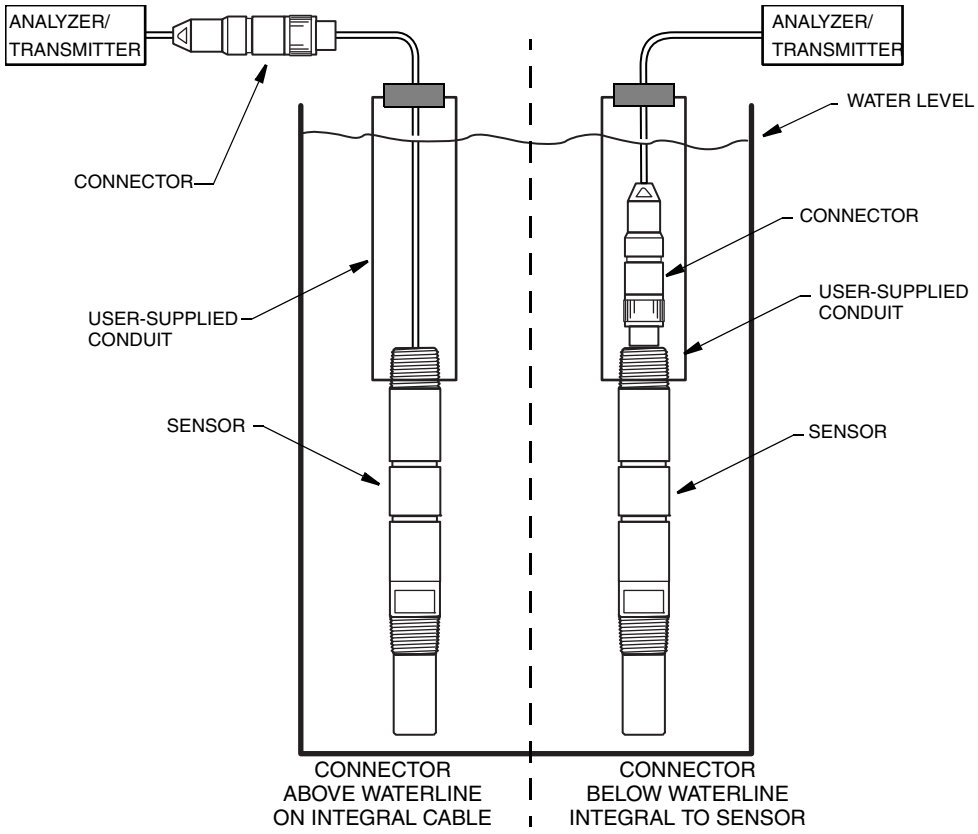
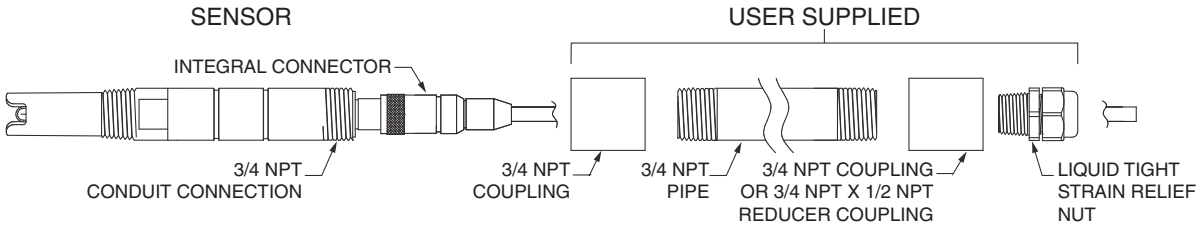


Figure 4. Submersion/Immersion Mounting with Variopin Quick Connector



In addition, all sensor cable connections must be completely protected from moisture. For a connector that is integral to the sensor, this includes any condensate that may form within the user-supplied conduit. Refer to Figure 5 for details.

Figure 5. Sealing an Integral Connector



WHEN USING THE SENSOR FOR SUBMERSION MOUNTING, FOLLOW THE THE DIAGRAM ABOVE. ALWAYS USE THREAD SEALANT ON ALL PIPE THREADS.

CAUTION: WHEN REMOVING THE SENSOR, LOOSEN THE LIQUID TIGHT STRAIN RELIEF NUT AND REMOVE THE STRAIN RELIEF FROM THE COUPLING TO PREVENT CABLE WRAP-UP.

NOTE

1. All piping techniques should comply with standard and acceptable practices.
2. Use appropriate pipe thread sealant.

1. Wrap PTFE tape on the 3/4 NPT threads of the sensor and user supplied pipe.
2. Attach a 3/4 NPT internally threaded coupling (user supplied) to the sensor. Tighten as required.
3. Slide a 3/4 NPT externally threaded length of pipe (user supplied) over sensor cable and thread pipe into coupling. Tighten as required.

Insertion Installation Using a Bushing

Bushings are used to mount sensors in a system that has process piping larger than the external 3/4 NPT threaded connection on the sensor. Bushings are offered with 1, 1¼-inch or 1½-inch external connections. Those made of 316 ss or PVDF have NPT external connections. Those made of CPVC have a solvent weld connection. Refer to Table 3 for specifications of bushings with a 3/4 NPT internal thread that are used directly with a sensor.

Figure 6. 3/4 NPT Bushings

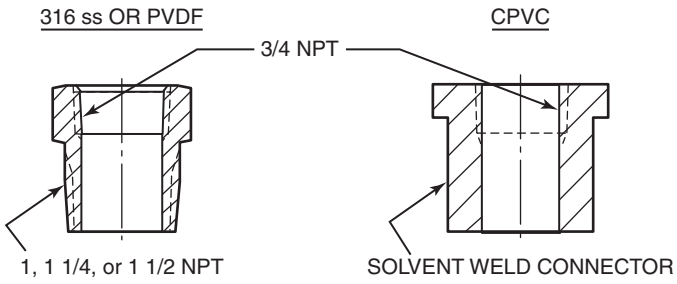


Table 3. Bushing Specifications

Bushing Material	Sensor Connection	Process Connection	Maximum Pressure/ Temperature Rating
316 ss	3/4 NPT	1 NPT	1.4 MPa (200 psi) at 121°C (250°F)
	3/4 NPT	1 1/4 NPT	
	3/4 NPT	1 1/2 NPT	
PVDF	3/4 NPT	1 NPT	0.7 MPa (100 psi) at 90°C at (194°F) 0.35 MPa (50 psi) at 121°C (250°F)
	3/4 NPT	1 1/2 NPT	
CPVC	3/4 NPT	1 in solvent weld	0.7 MPa (100 psi) at 70°C at (158°F) 0.4 MPa (60 psi) at 85°C (185°F)
	3/4 NPT	1 1/4 in solvent weld	
	3/4 NPT	1 1/2 in solvent weld	

For part numbers, see "ACCESSORY – 3/4 NPT BUSHINGS" on page 43.

WARNING

Do **not** exceed the pressure/temperature ratings of the materials used.

NOTE

All piping techniques should comply with standard and acceptable practices.

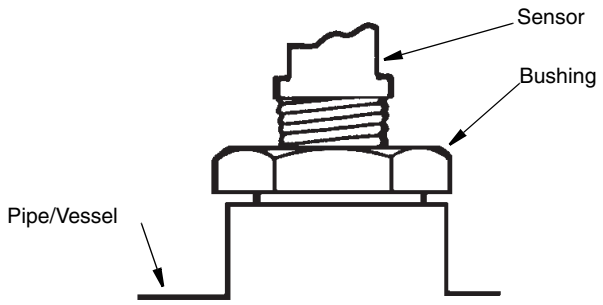
Install the bushing and sensor as follows:

1. On 316 ss or PVDF bushings, wrap PTFE tape on the external thread of the bushing and insert the bushing into the process vessel. Tighten as required.

   On CPVC bushings, brush PVC solvent onto the bushing and insert the bushing into the process vessel.

2. Wrap PTFE tape on the 3/4 NPT threads of sensor. Insert the sensor into the bushing. Tighten as required.

Figure 7. Bushing Installation



Insertion Installation Using the Universal Bushing Assembly

The Universal Bushing Assembly provides a 1 NPT, R 1 1/2, or R 2 process connection with two options of insertion depth and easy sensor removal/replacement that avoids cable "wind-up." The Universal Bushing Assembly consists of a universal assembly bushing, split ring, O-ring, O-ring lubricant, backup ring, and locking cap. The split ring can be positioned in one of two grooves on the sensor body. See Figure 8. The result is adjustment of the insertion depth of:

- PH10-1: 63 or 88 mm (2.5 or 3.5 in)
- PH10-2: 58 or 84 mm (2.3 or 3.3 in)
- PH10-3, ORP10-1, ORP10-2: 54 or 80 mm (2.1 or 3.1 in)
- PH10-4: 56 or 81 mm (2.2 or 3.2 in)

Table 4. Universal Bushing Assemblies

Material	Part Number	Pressure/Temperature Rating	
316 ss	BS810XC BS810XD BS810XE	1.4 MPa at 121°C	200 psi at 250°F
PVDF	BS810XB	0.7 MPa at 90°C 0.35 MPa at 121°C	100 psi at 194°F 50 psi at 250°F

NOTE

Installation procedures for the Universal Tri-Clamp Assembly and the Universal Flanged Assembly are similar to those for the Universal Bushing Assembly. Refer to "ACCESSORY – UNIVERSAL TRI-CLAMP CONNECTION ASSEMBLY" on page 48 and "ACCESSORY – UNIVERSAL FLANGED CONNECTION ASSEMBLY" on page 50 for diagrams and part numbers.

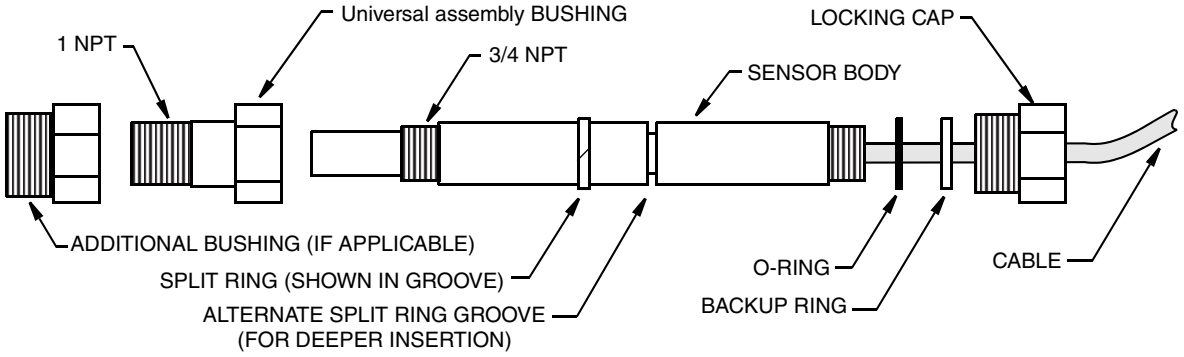
1. Mount the universal assembly bushing (and any additional required fittings, such as a bushing and/or tee) to the process.
2. Insert the sensor body through the locking cap. Push the locking cap to the far end of the sensor body. The threaded end of the locking cap should face the electrode end of the sensor body. Refer to Figure 8.
3. Add the backup ring and push it to the far end of the sensor body as well.
4. Lubricate the O-ring and position it just beyond the groove where you intend to position the split ring.
5. Position the split ring in the desired groove. Make sure the ring is fully seated in the groove.

! CAUTION

There are two grooves on the sensor. The **split ring** goes in the groove of your choice depending on the desired insertion depth. The O-ring **does not** go in either groove. Refer to Figure 8.

6. Bring the O-ring and backup ring down to meet the split ring.
7. Insert the sensor into the universal assembly bushing. It will stop at the split ring.
8. Screw the locking cap into the universal assembly bushing and tighten as required.

Figure 8. Sensor and Universal Bushing Assembly with Additional Bushing to Process Connection



If a Universal Bushing Assembly must mount in a system that has a process piping connection larger than the universal assembly bushing, or if less depth is needed, an additional bushing can be added. Such bushings are offered with 1 NPT internal connections and 1, 1¼, or 1½-inch external connections. Those made of 316 ss or PVDF have NPT external connections. Those made of CPVC have a solvent weld connection. Refer to Table 5 for bushing specifications.

For example, the 1 NPT x 1 NPT bushing allows the universal assembly bushing to be used with a 1-inch tee, which otherwise would be too shallow to accept the sensor.

Install the bushing as follows:

- On 316 ss or PVDF bushings, wrap PTFE tape on the external thread of the bushing and insert the bushing into the process vessel. Tighten as required.
- On CPVC bushings, brush PVC solvent onto the bushing and insert the bushing into the process vessel.

Figure 9. 1 NPT Bushings

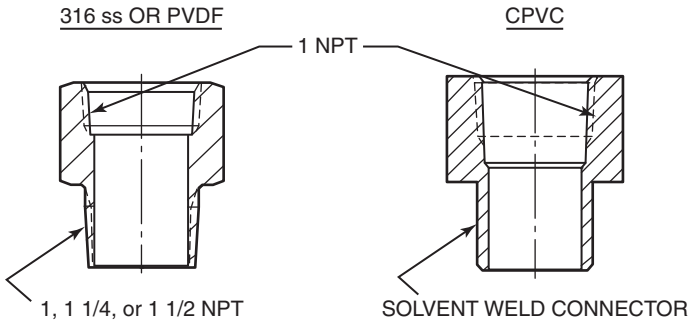


Table 5. Bushing Specifications

Bushing Material	Adapter Bushing Connection	Process Connection	Maximum Pressure/Temperature Rating
316 ss	1 NPT	1 NPT	1.4 MPa (200 psi) at 121°C (250°F)
	1 NPT	1 1/4 NPT	
	1 NPT	1 1/4 NPT	
PVDF	1 NPT	1 NPT	0.7 MPa (100 psi) at 90°C at (194°F) 0.35 MPa (50 psi) at 121°C (250°F)
	1 NPT	1 1/2	
CPVC	1 NPT	1 in solvent weld	0.7 MPa (100 psi) at 70°C at (158°F) 0.4 MPa (60 psi) at 85°C (185°F)
	1 NPT	1 1/4 in solvent weld	
	1 NPT	1 1/2 in solvent weld	

For part numbers, see "ACCESSORY – 1 NPT BUSHINGS" on page 44.

Flow-Through Installation Using a Tee

Tees (Figure 10) are used for flow-through installations in a pipe line. The sensor connection port and process inlet and outlet ports have internally threaded ends for the 316 ss and PVDF Tee materials, and solvent weld connections for the CPVC Tee material. A bushing is used to connect the tee to the 3/4 NPT sensor threads or 1 NPT universal assembly bushing. A tee and bushing can be purchased together as a tee kit; these parts are also available separately. Refer to Table 6 for tee kit specifications.

Table 6. Tee Kit Specifications

Tee Material	Process Connections	Sensor Connection	Maximum Pressure/Temperature Rating
316 ss	1 NPT	3/4 NPT	1.4 MPa (200 psi) at 121°C (250°F)
		1 NPT	
	1 1/4 NPT	3/4 NPT	
		1 NPT	
	1 1/2 NPT	3/4 NPT	
		1 NPT	
PVDF	1 NPT	3/4 NPT	0.7 MPa (100 psi) at 90°C at (194°F) 0.35 MPa (50 psi) at 121°C (250°F)
		1 NPT	
	1 1/2 NPT	3/4 NPT	
		1 NPT	
CPVC	25 mm (1 in) I.D.	3/4 NPT	0.7 MPa (100 psi) at 70°C at (158°F) 0.4 MPa (60 psi) at 85°C (185°F)
		1 NPT	
	33 mm (1.3 in) I.D.	3/4 NPT	
		1 NPT	
	38 mm (1.5) in I.D.	3/4 NPT	
		1 NPT	

For part numbers, see "ACCESSORY – TEE KITS" on page 46.

WARNING

Do **not** exceed the pressure/temperature ratings of the materials used.

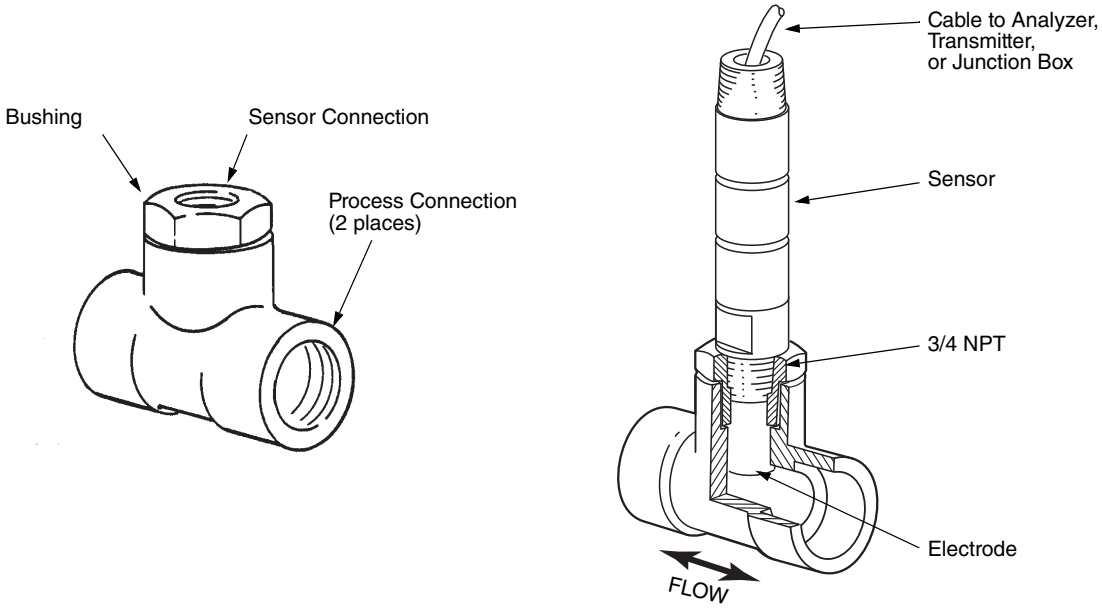
NOTE

All piping techniques should comply with standard and acceptable practices.

Install the sensor as follows:

1. Wrap PTFE tape on the external thread of the bushing. Insert the bushing into the tee. Tighten as required.
2. Wrap PTFE tape on the 3/4 NPT threads of sensor. Insert the sensor into the bushing. Tighten as required.

Figure 10. Tee and Tee Application



Installation in a Flow Chamber

Flow chambers (Figure 11) are a convenient way of mounting sensors in a system where a sample is provided by a small diameter sample line. The inlet and outlet ports of the flow chamber have 1/2 NPT internal threads and connect to the system with user supplied fittings. The flow chamber is offered in 316 ss, PVDF, or CPVC. Refer to Table 7 for flow chamber specifications.

Table 7. Flow Chamber Specifications

Flow Chamber Material	Inlet/Outlet Connection	Sensor Connection	Maximum Pressure/Temp Rating
316 ss	1/2 NPT	3/4 NPT	1.4 MPa (200 psi) at 121°C (250°F)
PVDF	1/2 NPT	3/4 NPT	0.7 MPa (100 psi) at 90°C at (194°F) 0.35 MPa (50 psi) at 121°C (250°F)
CPVC	1/2 NPT	3/4 NPT	0.7 MPa (100 psi) at 70°C at (158°F) 0.4 MPa (60 psi) at 85°C (185°F)
316 ss	1/2 NPT	Universal Assembly	1.4 MPa (200 psi) at 121°C (250°F)

For part numbers of Flow Chambers, see "ACCESSORY – FLOW CHAMBER" on page 51.

WARNING

Do **not** exceed the pressure/temperature ratings of the materials used.

CAUTION

The flow chamber can pass up to 125 mL/s (2 gpm) of process sample without introducing a damagingly high pressure drop. To avoid damage to the sensor, do not exceed 125 mL/s (2 gpm).

NOTE

All piping techniques should comply with standard and acceptable practices.

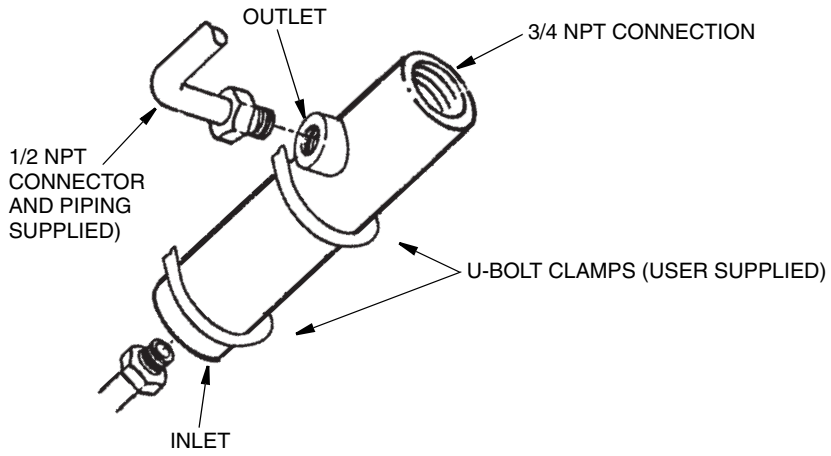


Figure 11. Flow Chamber with 3/4 NPT Sensor Connection

A flow chamber installation must meet mounting arrangements specified in "General Installation Guidelines" on page 7 as well as the following requirements:

- Mount the flow chamber so that the sensor is located between vertical and 45° with the electrodes facing down.
- Direct the outlet piping **upward** a minimum of 50 mm (2 in) so that bubbles do not settle in the measuring electrode.
- Provide space for removal of the sensor from the flow chamber.

Flow Chamber Installation with 3/4 NPT Sensor Connection

1. Mount the flow chamber to a rigid surface with U-bolts (user supplied).
2. Connect the two 1/2 NPT user-supplied inlet and outlet fittings.
3. Install the sensor into the flow chamber. Tighten as required.

Flow Chamber Installation with the Universal Mounting Assembly

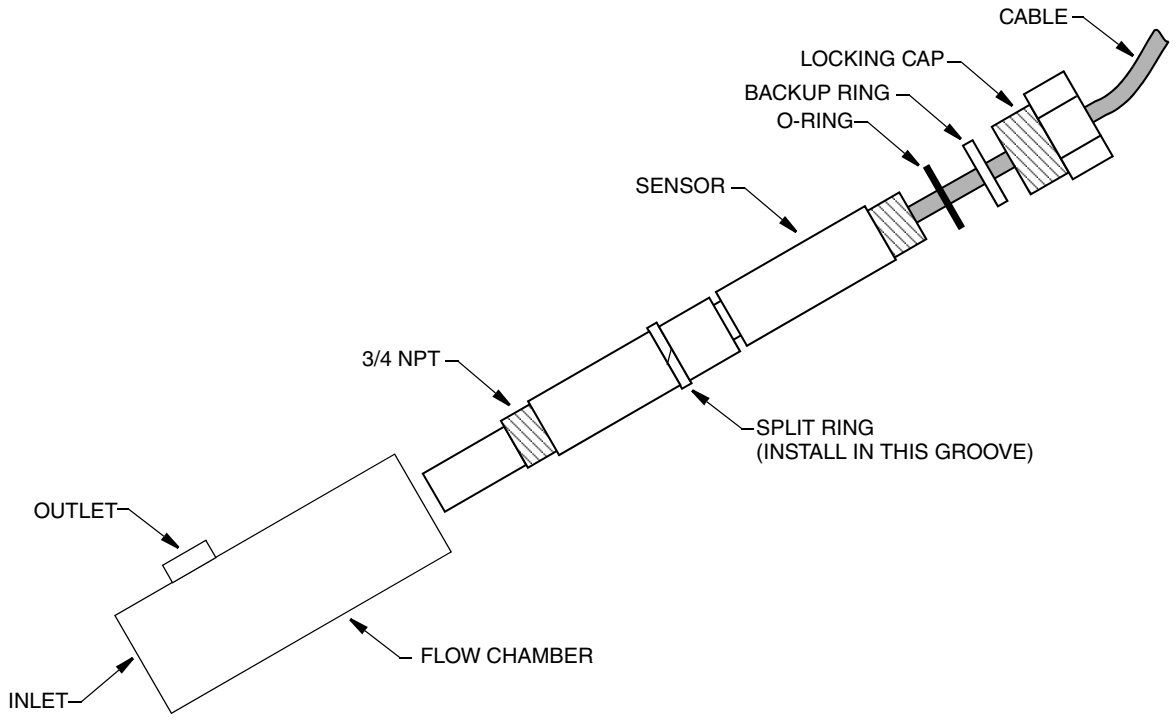
1. Mount the flow chamber to a rigid surface with U-bolts (user supplied).
2. Connect the two 1/2 NPT user-supplied inlet and outlet fittings.
3. Insert the sensor body through the locking cap. Push the locking cap to the far end of the sensor body. The threaded end of the locking cap should face the electrode end of the sensor body. Refer to Figure 12.
4. Add the backup ring and push it to the far end of the sensor body as well.
5. Lubricate the O-ring and position it just beyond the groove shown in Figure 12.
6. Position the split ring in the groove shown in Figure 12. Make sure the ring is fully seated in the groove.

CAUTION

There are two grooves in the sensor. The split ring goes in the groove shown in Figure 12. The O-ring **does not** go in the other groove.

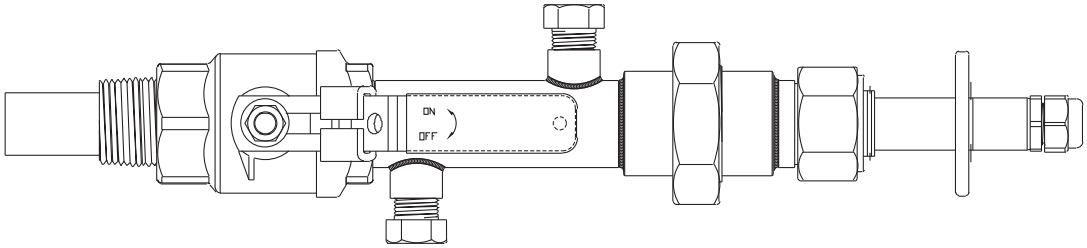
7. Bring the O-ring and backup ring down to meet the split ring.
8. Insert the sensor into the flow chamber. It will stop at the split ring.
9. Screw the locking cap into the flow chamber and tighten as required.

Figure 12. Flow Chamber With the Universal Sensor Mounting Assembly



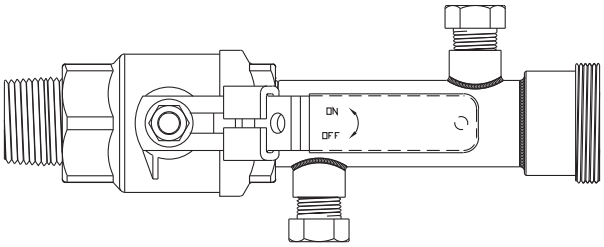
Installation in a BVA Series Ball Valve Insertion Assembly

Figure 13. BVA Series Ball Valve Insertion Assembly



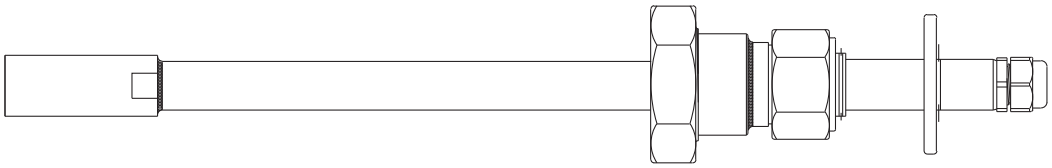
The BVA Series Ball Valve Insertion Assembly permits a DolpHin sensor to be inserted and removed from the process under rated pressure and temperature without draining the system, shutting down a line, or resorting to a bypass arrangement.

Figure 14. Ball Valve and Retraction Chamber



The ball valve and retraction chamber are mounted directly to the process. The insertion tube fits through the retraction chamber, using a ferrule compression seal to hold the shaft in place. Purge ports on the retraction chamber allow the operator to purge away hot, pressurized, or hazardous chemicals prior to opening the assembly and servicing the sensor.

Figure 15. Insertion Tube Assembly



The insertion tube assembly holds the sensor and allows a continuously adjustable immersion depth, up to the full length of the insertion shaft. This allows the installer to place the sensing end of the DolpHin probe at the optimum location for the application, and allows adjustment of the immersion depth in response to plumbing or hardware changes. A sealing feature in the insertion tube assembly prevents the process fluid from migrating out through the shaft, and possibly out the cable conduit to the transmitter, when the ball valve is open and the sensor and tube are still in the retraction chamber.

NOTE

These instructions describe the installation of a BVA Series Ball Valve Insertion Assembly. However, they also apply to the legacy model Insertion Tube Assembly and Ball Valve Assembly. For detailed dimensions, including maximum insertion depth and minimum clearance needed to remove the insertion tube and sensor, refer to DP 611-182 for BVA Series models and DP 611-172 for legacy models.

Table 8. Ball Valve and Insertion Tube Assembly Specifications

Parameter	Legacy Models	BVA Series		
Ball Valve Material	316 ss or Titanium	316 ss	Titanium	PVDF
Ball Seats	PTFE	PTFE	PTFE	PTFE
Insertion Tube Material	316 ss or Titanium	316 ss	Titanium	316 ss or Titanium
Connection	1 1/4 NPT	1 1/4 NPT	1 1/4 NPT	1 1/4 NPT
O-Ring Material	Viton	Chemraz, EPDM, Kalrez, Perfluoroelastomer (FFKM), or Viton		
Temperature/ Pressure Rating [a]	0.7 MPa (100 psi) at 121°C (250°F)	1.59 MPa (230 psi) at -29 to 66°C (-20 to 150°F) 1.35 MPa (195 psi) at 93°C (200°F) 1.28 MPa (185 psi) at 121°C (250°F) 1.21 MPa (175 psi) at 149°C (300°F)	1.90 MPa (275 psi) at -29 to 66°C (-20 to 150°F) 1.72 MPa (250 psi) at 93°C (200°F) 1.65 MPa (240 psi) at 121°C (250°F) 1.59 MPa (230 psi) at 149°C (300°F)	1.00 MPa (145 psi) at -20 to 25°C (-4 to 77°F) 0.75 MPa (109 psi) at 50°C (122°F) 0.37 MPa (54 psi) at 100°C (212°F) 0.15 MPa (22 psi) at 140°C (284°F)

a. These ratings may exceed the ratings of the sensor itself. Use the rating that is more restrictive.

WARNING

Do not exceed the sensor or mounting assembly temperature and pressure limits.

Initial Installation

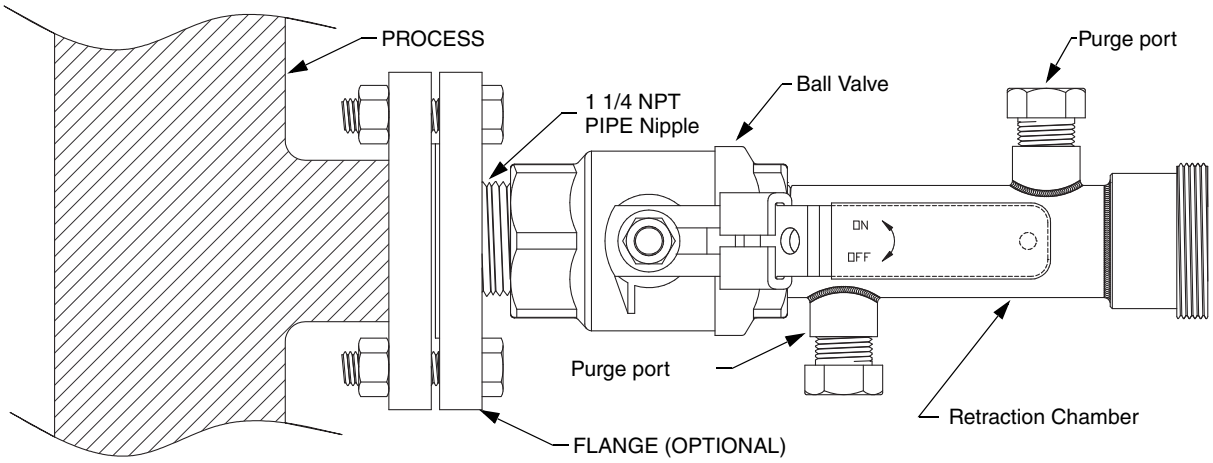
First-time installation of an insertion tube assembly or ball valve assembly consists of three major steps. These steps are summarized below and detailed in the following sections.

1. Connect the ball valve and/or retraction chamber to the process. Refer to "Connecting the Ball Valve/Retraction Chamber to the Process" on page 21.
2. Secure the sensor in the insertion tube. Refer to "Securing the Sensor in the Insertion Tube" on page 22.
3. Use the insertion tube to position the sensor in the process. Refer to "Positioning the Sensor in the Process" on page 22.

Connecting the Ball Valve/Retraction Chamber to the Process

If a ball valve is being used, connect the closed ball valve to the process, then connect the retraction chamber to the ball valve. If a ball valve is not being used, connect the retraction chamber directly to the process.

Figure 16. Connecting the Ball Valve and Retraction Chamber to the Process



WARNING

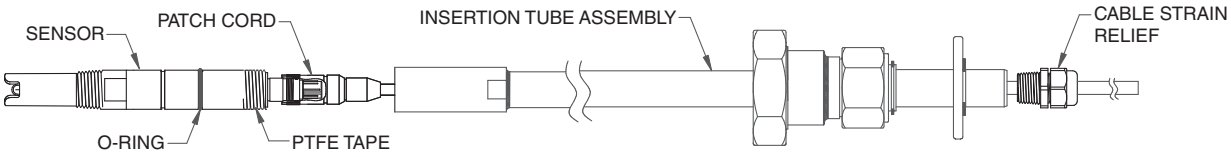
Shut down the process before proceeding.

1. If the insertion tube is already assembled to the retraction chamber, unscrew the chamber nut to disengage it. (See Figure 18.) Remove the insertion tube from the ball valve/retraction chamber.
2. Close the ball valve by disengaging the sliding lock mechanism (if applicable) and turning the handle clockwise until it is perpendicular to the housing.
   - If a ball valve is NOT being used, connect the 1 1/4 NPT end of the retraction chamber to the process vessel, or to a suitable shutoff mechanism that has already been mounted to the process vessel. Tighten as required and go to Step 5.
3. Use the 1 1/4 NPT pipe nipple to connect the ball valve to the process vessel. Tighten as required.

4. If the retraction chamber is not already connected to the ball valve, connect it now and tighten as required.
5. Connect the appropriate piping to the 1/2 NPT purge ports of the retraction chamber.

Securing the Sensor in the Insertion Tube

Figure 17. Securing the Sensor in the Insertion Tube



CAUTION

Perform the following steps carefully. If the seals are compromised, the sensor may fail.

1. Lubricate a **new** O-ring and place it in the groove closest to the cable end of the sensor. See Figure 17.
2. Wrap the 3/4 NPT thread on the cable end of the sensor with PTFE tape.
3. Remove the cable strain relief fitting from the insertion tube.
4. Insert the cable end of the sensor into the insertion tube. Feed the cable through the tube.
5. Slide the cable strain relief fitting onto the cable.
6. Screw the sensor into the insertion tube and tighten as required.

NOTE

To avoid twisting the cable, hold the sensor and turn the insertion tube.

7. Screw the cable strain relief fitting into the insertion tube.
8. Tighten the strain relief cap until it captures the cable.

Positioning the Sensor in the Process

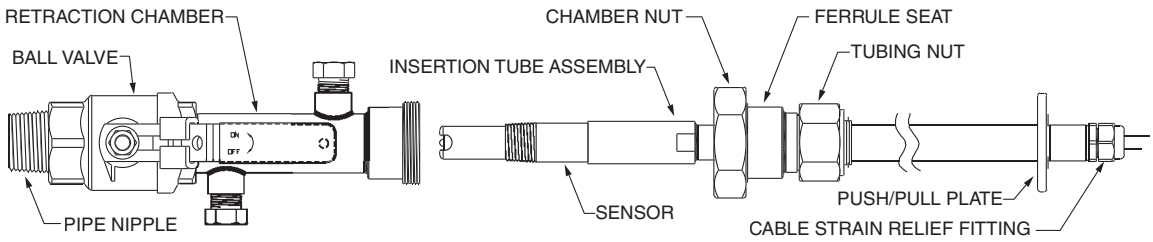
WARNING

Do not exceed the sensor or mounting assembly temperature and pressure limits.

NOTE

The sensor should be installed into the insertion tube, and the ball valve/retraction chamber installed into the process prior to performing this procedure. Refer to “Connecting the Ball Valve/Retraction Chamber to the Process” on page 21 and “Securing the Sensor in the Insertion Tube” on page 22 for details.

Figure 18. Positioning the Sensor in the Process



1. Loosen the tubing nut and slide the ferrule seat along the insertion tube towards the sensor end as far as it will go. Slightly tighten the tubing nut.

CAUTION

If a ball valve is being used, failure to perform Step 1 makes it possible for the sensor to contact the closed ball valve when performing Step 2. Such contact can damage the sensor.

2. Insert the sensor end of the insertion tube into the retraction chamber and tighten the chamber nut to secure the ferrule seat to the retraction chamber.
3. Seal the ferrule on the insertion tube by tightening the tubing nut.
4. **If a ball valve is NOT being used:** Shut down the process and continue to the next step.

   If a ball valve is being used: Slowly open the ball valve by disengaging the sliding lock mechanism (if applicable) and turning the handle counterclockwise until it is parallel to the housing.

CAUTION

Failure to open the ball valve causes the sensor to contact the closed ball valve in Step 5. Such contact can damage the sensor.

WARNING

Depending on the condition of the ferrule seat O-rings and split washer, process seepage is possible as you perform the next step. Take all necessary precautions.

5. Slightly loosen the tubing nut. Use the push/pull plate to position the insertion tube (with the sensor) to the required depth. Retighten the tubing nut.

CAUTION

Do not force the electrodes against the process wall.

NOTE

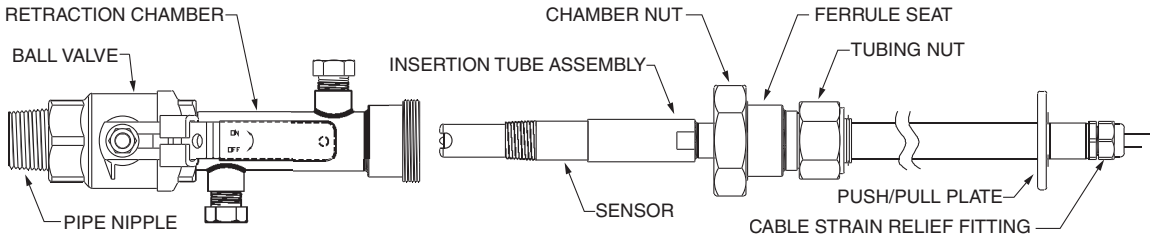
When the push/pull plate is in contact with the tubing nut, the sensor is inserted at the maximum depth. For maximum insertion depths, refer to DP 611-182 for BVA Series models and DP 611-172 for legacy models.

Removing the Sensor

WARNING

If process fluid is present, there may be some seepage as you perform these steps. Take all necessary precautions.

Figure 19. Removing the Insertion Tube from the Ball Valve and Retraction Chamber

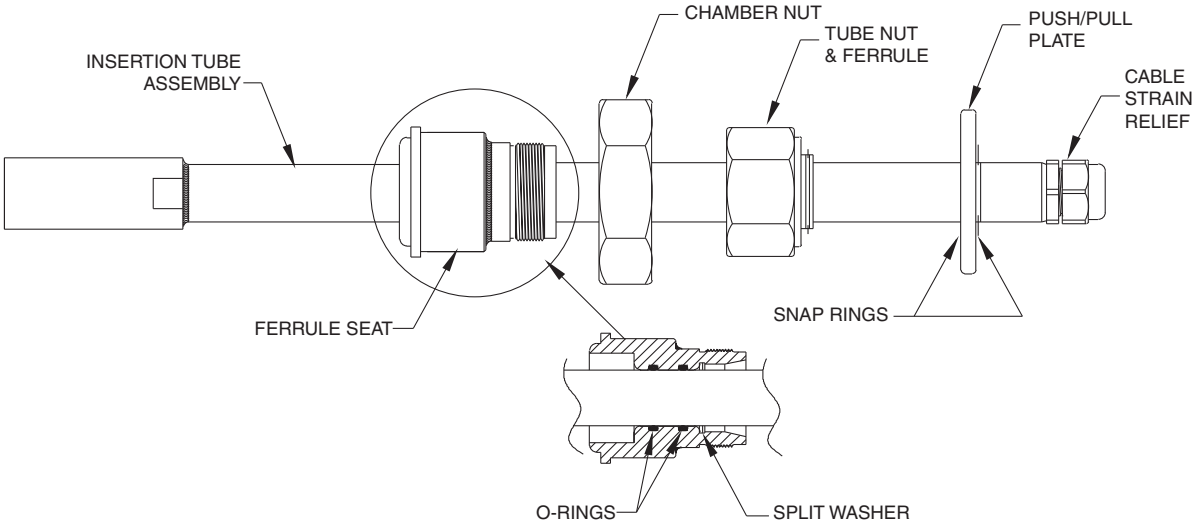


1. Slightly loosen the tubing nut.
2. Using the push/pull plate, slowly pull the insertion tube out of the process as far as it will go. Retighten the tubing nut to restore the ferrule seal.
3. **If a ball valve is NOT being used:** Shut down the process and continue to the next step.

   If a ball valve is being used: When the insertion tube and sensor are clear of the ball valve, close the ball valve by disengaging the sliding lock mechanism (if applicable) and turning the handle clockwise until it is perpendicular to the housing.
4. Flush and drain the purgeable retraction chamber. Then close the purge fittings.
5. Slowly unscrew the chamber nut. If fluid continues to leak, check ball valve closure and purge ports.
6. Fully remove the chamber nut and pull the insertion tube free of the retraction chamber.
7. Loosen the cable strain relief from the cable.
8. Remove the cable strain relief fitting from the insertion tube.
9. Unscrew and remove the sensor from the insertion tube. There may be resistance because of the O-ring seal.
10. Disconnect the sensor cable.
11. To replace or reinstall the sensor, refer to “Securing the Sensor in the Insertion Tube” on page 22 and “Positioning the Sensor in the Process” on page 22.

Replacing the O-Ring Seals and Split Washer in the Ferrule Seat

Figure 20. Replacing the O-Ring Seals and Split Washer in the Ferrule Seat



1. Remove the insertion tube and sensor from the process as described in "Removing the Sensor" on page 24.
2. Remove the two snap rings and the push/pull plate.
3. Remove the tubing nut (with ferrule), the chamber nut, and the ferrule seat.
4. Remove the two O-rings and the split washer from inside the ferrule seat.
5. Grease the new O-rings and split washer, and liberally grease the inside of the ferrule seat.
6. Insert the new O-rings and split washer into the ferrule seat.
7. Grease the insertion tube and reinstall the ferrule seat, chamber nut, tubing nut (with ferrule), the push/pull plate, and the snap rings.
8. To replace or reinstall the sensor, refer to "Securing the Sensor in the Insertion Tube" on page 22 and "Positioning the Sensor in the Process" on page 22.

Wiring

Cable Variations

Sensor cables are permanently attached to the sensor. Additional length can be achieved through the use of an extension cable (with straight pin lugs on each end) or a patch cord (with a Variopin connector on one end and straight pin lugs on the other). See Figure 21 and Figure 22 for typical sensor cable, extension cable, and patch cord configurations.

Cable Length

When a internal preamplifier is used, the analyzer/transmitter can be up to 152 m (500 ft) away from the sensor. If no preamplifier is used, the distance is limited to 15 m (50 ft).

Figure 21. Cable Lengths for Cable With Pin Lugs

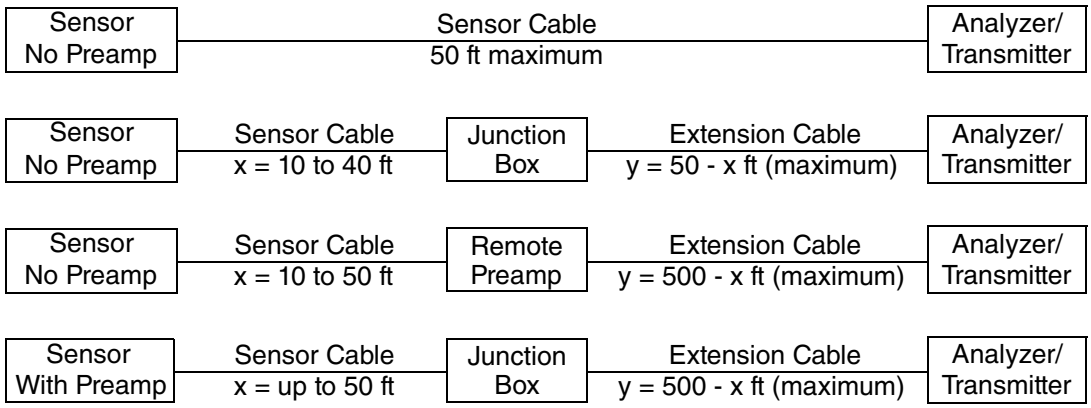
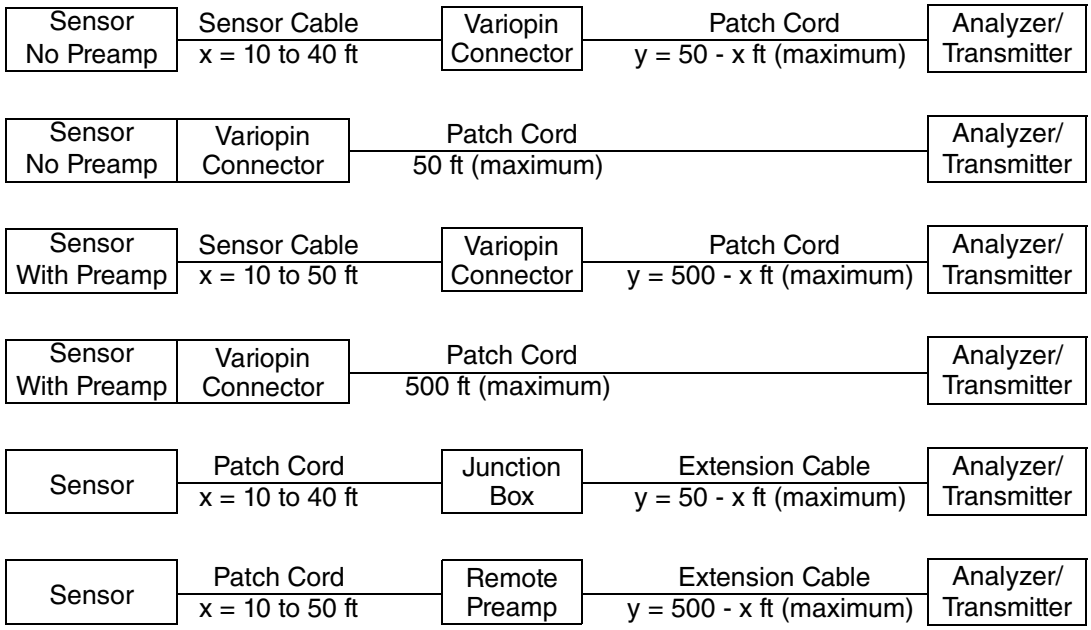


Figure 22. Cable Lengths for Cable With Variopin Quick Connector



Connections to Analyzer or Transmitter

Connect the numbered wires from the sensor to the appropriate terminals on the transmitter, analyzer, or junction box. For sensor connections to an analyzer or transmitter, refer to Table 9 through Table 12. Extension cables and patch cords have the same numbering and color coding as the sensor cables.

Table 9. Analyzer and Transmitter Connections

Instruction	Analyzer or Transmitter
MI 611-165	873PH Series Electrochemical Analyzers for pH or ORP Measurement
MI 611-190	873DPX Dual pH, ORP, or ISE Electrochemical Analyzers
MI 611-191	873APH Ace Series Electrochemical Analyzers for pH Measurement
MI 611-211	870ITPH pH and ORP Transmitters
MI 611-225	875PH pH and ORP Analyzers
MI 611-262	876PH Intelligent Transmitter for pH, ORP, and ISE Measurement

Table 10. High Temperature Cable Wiring - Sensor Without Preamplifier

Wire Number	Cable Color	Function
1	Black	RTD
2	Brown	RTD
2A	Orange	RTD 3-Wire [a]
3	White (Coax)	Measuring Electrode
3A	Clear (Coax Shield)	Coax Shield (screen) for Measuring Electrode
4	Green (Outer Shield)	Solution Ground
5	Red	Reference Electrode

a. Wire 2A is not present on the cable of a sensor with a 2-wire RTD.
Wire 2A on patch cords used with sensors without preamplifiers is only functional when the sensor contains a 3-wire RTD. Do **not** connect wire 2A to the analyzer/transmitter (tape it back) if the sensor does not contain a 3-wire RTD.
Wire 2A is not used with 873 Analyzers. In such applications, it should be taped back.

Table 11. Standard Temperature Cable Wiring - Sensor Without Preamplifier

Wire Number	Cable Color	Function
1	Black	RTD
2	Dark Green	RTD
2A	White	RTD 3-Wire [a]
3	Clear over Copper (Coax)	Measuring Electrode
3A	Clear over Silver (Shield)	Coax Shield (screen) for Measuring Electrode
4	Green (Outer Shield)	Solution Ground
5	Red	Reference Electrode

a. Wire 2A is not present on the cable of a sensor with a 2-wire RTD.
Wire 2A on patch cords used with sensors without preamplifiers is only functional when the sensor contains a 3-wire RTD. Do **not** connect wire 2A to the analyzer/transmitter (tape it back) if the sensor does not contain a 3-wire RTD.
Wire 2A is not used with 873 Analyzers. In such applications, it should be taped back.

Table 12. Cable Wiring - Sensor With Preamplifier

Wire Number	Cable Color	Function
1	Black	RTD
2	White	RTD
2A	Orange	RTD 3-Wire [a]
3	Red	Measuring Electrode
4	Clear	Solution Ground
5	Yellow	Reference Electrode
6	Brown	Power to Sensor (+)
7	Blue	Power to Sensor (-)
8	Green	Diagnostic Signal [b]

a. Patch cords used with sensors with preamplifiers do not have a 2A wire.

b. Not used with 873PH and 873DPX.

Variopin Connectors

Variopin cable connections must be completely protected from moisture. For a connector that is integral to the sensor, this includes any condensate that may form within the user-supplied conduit in a submersion/immersion installation. Refer to Figures 3 through 5 for detailed examples of proper protection in submersion/immersion installations.

Do **not** disconnect Variopin connectors in the rain or in condensing moisture environments, or otherwise allow moisture to get inside the connector.

Before reassembly, inspect the two parts of the connector for any sign of moisture or residue. Thoroughly remove any moisture or residue from all surfaces to ensure high performance.

3. Troubleshooting

Use the following procedure for diagnosing and correcting sensor problems:

1. Enable all sensor diagnostics when using an 875PH Analyzer or an 876PH or 870ITPH Transmitter. Check the diagnostic status for messages and corresponding actions.
2. Check RTD.

   DolpHin series sensors use 100 ohm 2-wire RTDs, 1000 ohm 3-wire RTDs, or Balco 3000 ohm 2-wire RTDs.

   For 2-wire, 100 Ω and Balco 3000 Ω RTDs, disconnect sensor leads 1 and 2 from the analyzer or transmitter and use an ohmmeter to measure the resistance between these leads. Resistance with temperature values for the two RTDs are shown in Table 13.

   For 3-wire, 1000 Ω RTDs, disconnect sensor leads 1, 2, and 2a from the analyzer or transmitter and use an ohmmeter to measure the resistance between 1 and 2 and 1 and 2a. Resistance with temperature values for the 1000 ohm RTD are shown in Table 13. Leads 2 and 2a are common; the resistance between them should be small or effectively zero.

   If these checks are OK, proceed to Step 3.

Table 13. Process Temperature vs. RTD Resistance

Process Temperature		100 Ω RTD Resistance	1000 Ω RTD Resistance	Balco 3000 Ω RTD Resistance
°C	°F	Ohms	Ohms	Ohms
0	32	100.00	1000.0	2663
10	50	103.90	1039.0	2798
20	68	107.79	1077.9	2933
25	77	109.73	1097.3	3000
30	86	111.67	1116.7	3067
40	104	115.54	1155.4	3202
50	122	119.40	1194.0	3337
60	140	123.24	1232.4	3472
70	158	127.07	1270.7	3607
80	176	130.89	1308.9	3742
90	194	134.70	1347.0	3877
100	212	138.50	1385.0	4013
110	230	142.28	1422.8	4148
120	248	146.06	1460.6	4283

3. Check power to the preamplifier (for sensor PH10-*P or ORP10-*P only).

   With all sensor leads connected to the analyzer or transmitter, use a voltmeter to measure the voltage between terminals 4 and 6 (clear and brown) and between terminals 4 and 7 (clear and blue). The voltage should be:

   a. With an 875PH Analyzer, the voltage should be approximately +5 V from 4 to 6, and -5 V from 4 to 7.

   b. With an 876PH or 870ITPH Transmitter, the voltage should be approximately +5 V from 4 to 6, and -2.5 V from 4 to 7.

   c. With an 873 Analyzer, the voltage should be approximately +6.2 V from 4 to 6, and -6.2 V from 4 to 7.

   If the above check is OK, proceed to Step 4. If check is not OK, continue as follows:

   Disconnect sensor leads 4, 6, and 7 from the analyzer or transmitter. Repeat the voltage checks above (measure at the analyzer or transmitter, not at the sensor leads). If voltage checks are now OK, the sensor must be replaced. If checks are not OK, there is a problem in the analyzer or transmitter.

4. Check the system with buffers.

   Conduct this check with all leads connected to the analyzer/transmitter and with the analyzer/transmitter power on. Clean the pH electrode and reference junction. Place sensor in a pH 7 buffer solution.

   a. With an 875PH Analyzer, or 876PH or 870ITPH Transmitter, use the Status menu to display the voltage of the sensor.

   b. With an 873 Analyzer, press SHIFT and mV.

   The reading should be approximately 0 mV in a pH 7 buffer and should change approximately 59 mV per pH unit (for example, in pH 4 buffer, the reading should be approximately +177 mV; in pH 10 buffer, the reading should be approximately -177 mV).

   If above check is OK and there is still a problem with the measurement, the problem resides in the analyzer or transmitter. If above check is not OK, proceed to Step 5.

5. Check the sensor alone with buffers (for sensors with a preamplifier).

   For sensors with a preamplifier (PH10-*P or ORP10-*P), disconnect sensor leads 3 and 5 from analyzer or transmitter. Repeat the voltage checks described in Step 4, except make the measurement at the sensor leads. if the voltage checks are OK, there is a problem in the analyzer or transmitter. If voltage checks are not OK, the sensor must be replaced or cleaned in a stronger cleaner.

Table 14. Sensor Troubleshooting

Problem	Possible Cause	Remedy
No response.	1. Broken measuring electrode. 2. Heavily coated electrodes.	1. Replace sensor. 2. Clean and/or replace.
Elongated span.	1. Incorrect instrument calibration 2. Instrument temperature compensation inactive or incorrectly configured. 3. Incorrect temperature measurement.	1. Recalibrate. 2. Refer to instrument manual for proper configuration. 3a. Check that analyzer/transmitter is configured for correct RTD. 3b. Check RTD resistance across leads 1 and 2 (see Table 13) 3c. if OK, calibrate instrument temperature circuit. If bad, replace sensor.
Sluggish response.	1. Aged or dehydrated measuring electrodes. 2. Coated or dirty electrode and reference junction.	1. If sensor is dehydrated, soak in pH 4 buffer or KCl solution.) 2a. Clean electrode and reference junction. 2b. Replace sensor.
Erratic or noisy measurement.	1. Fouled reference junction. 2. Air bubbles in the process.	1. Clean reference junction. 2. Arrange sensor mounting to avoid air bubbles.
Discrepancy between process reading and laboratory grab sample results.	1.Laboratory reading in error. 2. Change in grab sample temperature (that is, sample temperature changed before laboratory measurement was made — causing a change in pH). 3. Incorrect instrument calibration.	1. Verify calibration and/or operation of laboratory pH equipment. 2. Make off-line measurement as soon as possible after collecting gab sample. If sample cooling is inevitable, a change in pH from the process to the lab may be unavoidable. 3. Perform single point calibration to make readings agree.

4. Maintenance

Calibration

Your sensor and analyzer/transmitter system should be calibrated regularly. A sensor loses calibration for two general reasons: the slope changes or the offset changes. Slope changes are usually due to aging of the measuring electrode. Offset changes are often due to clogging and contamination of the reference junction. A single point calibration corrects the offset only. A two point calibration corrects both the offset and the slope. Frequency of calibration is dictated by the rigors of the process, such as temperature, pressure, abrasives, harsh chemicals, and so forth. It is also related to your requirement for accuracy. Many users do a single point, grab sample calibration frequently and a two point calibration only occasionally. Refer to your analyzer/transmitter instruction for specific calibration procedures.

Temperature Calibration

DolpHin sensors include a precision temperature measuring element. Foxboro analyzers and transmitters use this temperature measurement to provide automatic temperature compensation of the pH measurements. ORP measurements do not require temperature compensation.

For optimum pH measurement accuracy, the temperature measurement accuracy should be checked and adjusted if necessary. This is especially important when a long cable length is used with sensors that have 2-wire RTD elements. Sensors with 3-wire RTD elements automatically compensate for errors due to cable length. Refer to your analyzer/transmitter instruction for specific calibration procedures.

Electrode Inspection

Fouling (the build-up of a film) on the measuring electrode and the reference junction can cause erratic output.

Inspect the electrodes as needed. Once a week is recommended for new installations. If fouling is evident, clean the electrode as described in the following sections.

Electrode Cleaning

Cleaning a Glass Electrode

First, consider the contamination you are trying to remove. In what is it soluble? What will chemically attack it? Next, consider the sensor. What cleaner will have little or no effect on the sensor itself? Choose the solvent, soap, or chemical that is the mildest but removes the contamination. Caustic is a risky choice for glass electrodes. Stronger concentrations can attack the glass. Dilute HCl (muriatic acid) is frequently a good choice. The concentration of HCl should be as low as possible and still remove the contamination. Consider 4% or 1 N to be a maximum.

NOTE

Invensys offers an electrode reconditioning solution for very extreme applications. Contact Invensys for more information on when this solution should be used, and how to specify it.

CAUTION

Do not clean glass electrodes with abrasive cleaners or coarse wipers.

CAUTION

Handle the sensor very carefully to avoid damage to the glass electrode.

Rinse the electrode with distilled water. Blot the electrode and reference junction with a soft cloth.

In hard-water areas, dip the tip of the sensor in a 1 to 4% solution of HCl to remove surface film. Then rinse thoroughly.

If the electrode surface is oily, clean it with a mild detergent and fine bristle brush.

Cleaning an Antimony Electrode

WARNING

Antimony is a toxic material. When an antimony electrode is installed, avoid contact with the surface of the antimony pellet. If skin contact is made with the antimony pellet, wash the contacted skin area with soap and water. Refer to MSDS HS0051.

First consider the contamination you are trying to remove. In what is it soluble? What will chemically attack it? Next, consider the sensor. What cleaner will have little or no effect on the sensor itself? Choose the solvent, soap, or chemical that is the mildest but removes the contamination.

If the electrode surface remains black after cleaning, it may be due to self-fouling antimony oxide formation. Remove the oxide layer by scraping the surface with a knife blade. Remove as little material as possible to reveal a metallic luster while leaving the bulk of the electrode intact.

Cleaning an ORP Electrode

ORP electrodes rarely require cleaning. However when they do, first consider the contamination you are trying to remove. In what is it soluble? What will chemically attack it? Next, consider the sensor. What cleaner will have little or no effect on the sensor itself? Choose the solvent, soap, or chemical that is the mildest but removes the contamination. The electrode surface can also be polished with powdered alumina or a fine grained emery cloth.

Cleaning a Reference Junction

Carefully clean the reference junction with detergent and a fine bristle brush.

Storing a Sensor

The shelf life of your sensor depends on the storage conditions. Although Invensys does not specify a shelf life, a reasonable estimate is 6 to 12 months. Under the best conditions, sensors may last well over a year on the shelf.

The key to proper storage is keeping both the measuring electrode and the reference junction hydrated at normal room temperature. Store your PH10 or ORP10 Sensor in a 1 M (or higher) potassium chloride solution or a pH 4 or pH 7 buffer solution. Sensors should not be stored in distilled or deionized water. New sensor assemblies are shipped with the measuring and reference junction sealed in a protection cap containing liquid potassium chloride salt solution. The cap should remain in place until you are ready to install your sensor in the process. The protection cap can be reused to store a sensor by replenishing the solution and fitting it on to the sensor. Invensys recommends this if the sensor is removed from the process for more than a few hours. Proper storage maximizes both shelf life and service life of a sensor.

5. Parts List

Parts preceded by an asterisk (*) are recommended spare parts.
Give Instrument Model Number and Style when ordering.
See Recommended Spare Parts Summary section for quantities.

To order replacement sensors or parts, call Invensys at 1-866-746-6477.

MODEL CODE – PH SENSOR

Description	Model
DolpHin pH Sensor	PH10
pH Electrode Type	
Domed, High Temperature, Glass Bulb with Protective Guard	-1
Domed, High Temperature, Glass Bulb without Protective Guard	-2
Flat Ruggedized Glass	-3
Antimony	-4
Preamplifier	
None	N
Internal Preamplifier [a] [b]	P
Temperature Compensation	
2-Wire, 100 Ω Platinum RTD	1
3-Wire, 1000 Ω Platinum RTD [b]	2
2-Wire, 100 Ω Platinum RTD, Enhanced Response Speed	3
3-Wire, 1000 Ω Platinum RTD, Enhanced Response Speed [b]	4
2-Wire, 3 kΩ Balco RTD	5
Sensor Termination	
10 ft (3.05 m) Integral Cable Terminated with Crimped-on Straight Pin Lugs	A
10 ft (3.05 m) Integral Cable Terminated with Variopin Quick Connector [b] [c]	B
Variopin Quick Connector Integral to Sensor [b] [c]	Q
Optional Selections	
EPDM [d] O-Rings [e]	-E
Chemraz [f] O-Rings [e]	-C
Integral Std. Temp Sensor Cable, 20 ft (6.1 m) long [g]	-2
Integral Std. Temp Sensor Cable, 30 ft (9.1 m) long [g]	-3
Integral Std. Temp Sensor Cable, 40 ft (12.2 m) long [g]	-4
Integral Std. Temp Sensor Cable, 50 ft (15.2 m) long [g]	-5
Integral High Temp Sensor Cable, 10 ft (3.05 m) long [a] [g]	-1H
Integral High Temp Sensor Cable, 20 ft (6.1 m) long [a] [g]	-2H
Integral High Temp Sensor Cable, 30 ft (9.1 m) long [a] [g]	-3H
Integral High Temp Sensor Cable, 40 ft (12.2 m) long [a] [g]	-4H
Integral High Temp Sensor Cable, 50 ft (15.2 m) long [a] [g]	-5H
Examples: PH10-1N3B-E2H	

a. High Temperature cable not available with Preamplifier Code “P”.

b. Selection of Preamp (“P”), with 3-wire RTD (“2” or “4”) and with Variopin Quick Connector (“B” or “Q”) may not be made at the same time. Any two are allowed together, but not all three.

c. Requires mating patch cord with integral Variopin Quick Connector, if not customer supplied.

d. EPDM is ethylene-propylene terpolymer, also known as EPR (ethylene-propylene rubber).

e. Standard O-ring material is Viton.

f. Chemraz is a perfluoroelastomer.

g. Cable options applicable to Sensor Termination Codes “A” and “B” only.

MODEL CODE – ORP SENSOR

Description	Model
DolpHin ORP Sensor	ORP10
ORP Electrode Type	
Platinum	-1
Gold	-2
Preamplifier	
None	N
Internal Preamplifier [a] [b]	P
Temperature Compensation	
2-Wire, 100 Ω Platinum RTD	1
3-Wire, 1000 Ω Platinum RTD [b]	2
2-Wire, 100 Ω Platinum RTD, Enhanced Response Speed	3
3-Wire, 1000 Ω Platinum RTD, Enhanced Response Speed [b]	4
2-Wire, 3 kΩ Balco RTD	5
Sensor Termination	
10 ft (3.05 m) Integral Cable Terminated with Crimped-on Straight Pin Lugs	A
10 ft (3.05 m) Integral Cable Terminated with Variopin Quick Connector [b] [c]	B
Variopin Quick Connector Integral to Sensor [b] [c]	Q
Optional Selections	
EPDM O-Rings [d]	-E
Chemraz O-Rings [d]	-C
Integral Std. Temp Sensor Cable, 20 ft (6.1 m) long [e]	-2
Integral Std. Temp Sensor Cable, 30 ft (9.1 m) long [e]	-3
Integral Std. Temp Sensor Cable, 40 ft (12.2 m) long [e]	-4
Integral Std. Temp Sensor Cable, 50 ft (15.2 m) long [e]	-5
Integral High Temp Sensor Cable, 10 ft (3.05 m) long [a] [e]	-1H
Integral High Temp Sensor Cable, 20 ft (6.1 m) long [a] [e]	-2H
Integral High Temp Sensor Cable, 30 ft (9.1 m) long [a] [e]	-3H
Integral High Temp Sensor Cable, 40 ft (12.2 m) long [a] [e]	-4H
Integral High Temp Sensor Cable, 50 ft (15.2 m) long [a] [e]	-5H
Examples: ORP10-1P4A-C5	

a. High Temperature cable not available with Preamplifier Code “P”.

b. Selection of Preamp (“P”), with 3-wire RTD (“2” or “4”) and with Variopin Quick Connector (“B” or “Q”) may not be made at the same time. Any two are allowed together, but not all three.

c. Requires mating patch cord with integral Variopin Quick Connector, if not customer supplied.

d. Standard O-ring material is Viton.

e. Cable options applicable to Sensor Termination Codes “A” and “B” only.

MODEL CODE – BVA SERIES BALL VALVE INSERTION ASSEMBLY

Description	Model
Ball Valve Insertion Assembly	BVA
Sensor Type	
For use with DolpHin pH and ORP Sensors; 1 1/4 in NPT Full Port Valve [a]	-PHA
Process Wetted Material	
316 stainless steel	1
Titanium	2
O-Ring Material	
Chemraz [b]	C
EPDM [c]	E
Kalrez	K
Perfluoroelastomer (FFKM)	P
Viton	V
Insertion Depth (Applies to Versions That Include a Ball Valve and a Nipple) [d]	
0 to 20.3 cm (0 to 8 inches)	08
0 to 40.6 cm (0 to 16 inches)	16
0 to 61.0 cm (0 to 24 inches)	24
0 to 81.3 cm (0 to 32 inches)	32
Custom length in 20.3 cm (8 inch) increments [e]	XX
Optional Selections	
Insertion Assembly Only [d] [f]	-A
Safety Guard [g]	-S
PVDF Ball Valve [f] [h]	-K
Flanges	
1 1/2 inch ANSI 150# Flange	-C
2 inch ANSI 150# Flange	-D
3 inch ANSI 150# Flange	-F
4 inch ANSI 150# Flange	-H
Flat Face Flange (requires selection of a flange)	-J
Example: BVA-PHA1V08-FJ	

a. Legacy model ball valve assemblies and insertion tubes (ordered by part number) are also available. Contact Invensys for details.

b. Chemraz is a perfluoroelastomer.

c. EPDM is ethylene-propylene terpolymer, also known as EPR (ethylene-propylene rubber).

d. For versions without ball valve and nipple, select option -A (Insertion Assembly Only). When option -A is selected, add approximately 152 mm (6 inches) for 316 ss, or 178 mm (7 inches) for titanium, to the insertion depth dimensions shown in "Insertion Depth" above.

e. Prior approval required; contact Invensys.

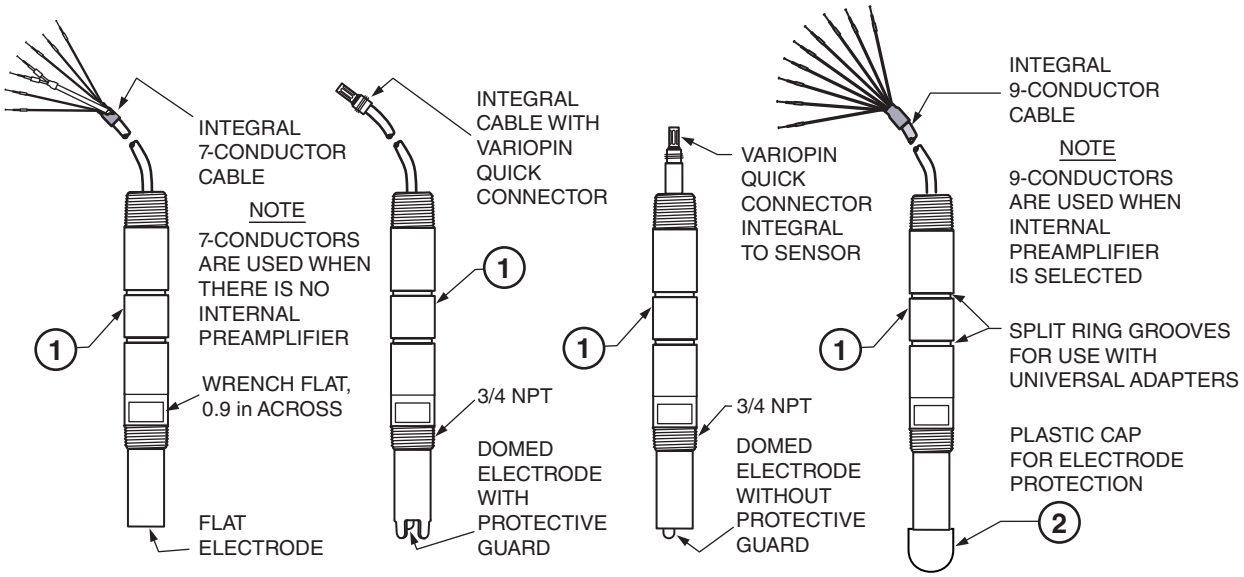
f. Options -A and -K are mutually exclusive.

g. Not available with Optional Selection -A (Insertion Assembly Only).

h. PVDF ball valve reduces the insertion depth by 4.14 cm (1.63 inches).

SENSOR ASSEMBLIES

Figure 23. Sensor Assemblies



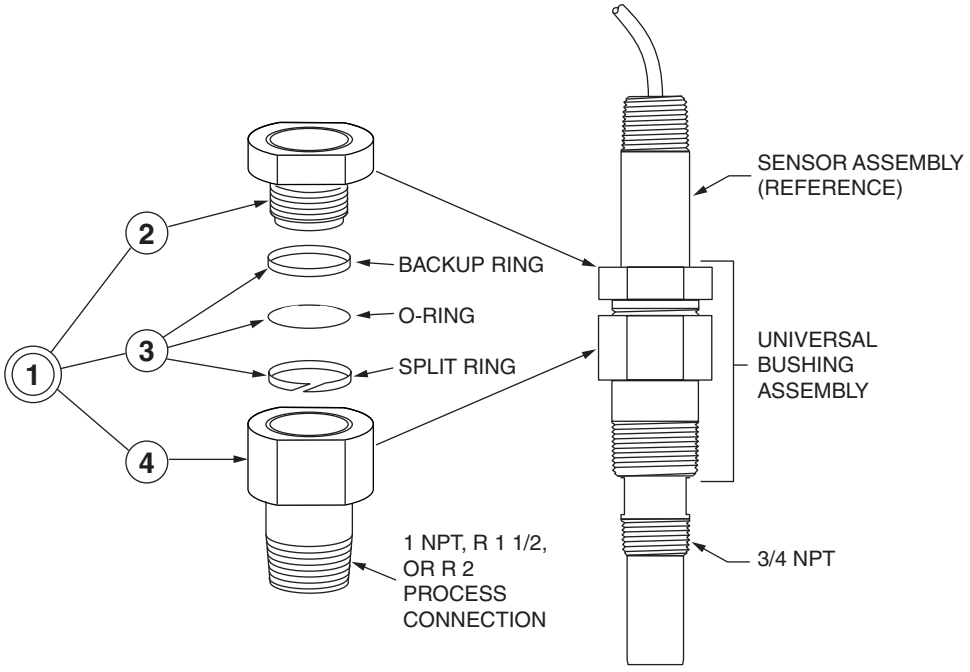
Item	Part No.	Qty.	Part Name
*1	Note 1	A/R	DolpHin pH or ORP Sensor Assembly
2	X0179JL	A/R	Cap, Protective Plastic (Note 3)

NOTE

1. The DolpHin sensor assembly has no internal replaceable parts, and must therefore, be replaced in its entirety. To order a replacement sensor assembly, specify the Model Number shown on the sensor cable label (on the connector immediately adjacent to the sensor body on some models), or alternatively, you can specify the Model Number by using the Model Codes shown on page 38 and page 39.
2. Seven conductor cables are used when there is no preamplifier; nine conductor cables are used when an internal preamplifier is required.
3. A plastic protective cap is provided installed with every shipped sensor assembly. This protective cap is removed prior to sensor installation. It is recommended that the cap be retained after installation for future use. The sensor should be stored “wet” in pH 7 buffer (using plastic cap) for increased life when temporarily removed from service.

ACCESSORY – UNIVERSAL BUSHING ASSEMBLY

Figure 24. Universal Bushing Assembly

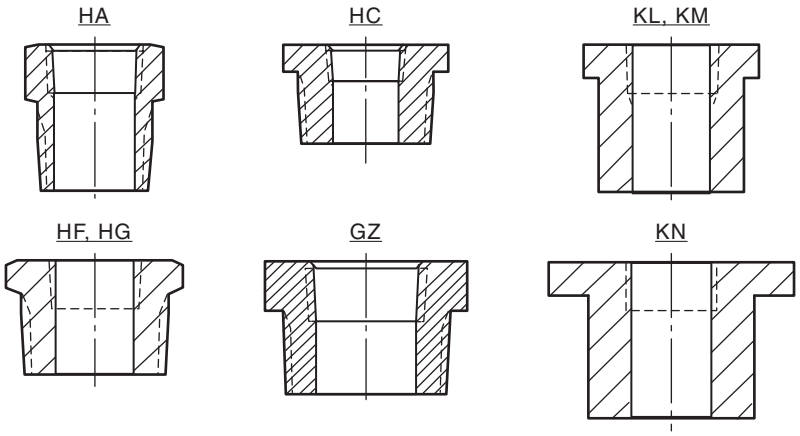


Item	Part No.	Qty.	Part Name
1	Below	1	Universal Bushing Assembly (Items 2, 3, and 4)
	BS810XB		PVDF[(a)] Body, 1 NPT Process Connection
	BS810XC		316 ss Body, 1 NPT Process Connection
	BS810XD		316 ss Body, R 1 1/2 Process Connection
	BS810XE		316 ss Body, R 2 Process Connection
2	Below	1	Locking Cap
	BS810EW		PVDF Body, 1.50 Across Flats
	BS810LG		316 ss Body, 1.50 Across Flats
*3	BS811HK	1	Kit, Seals for Universal Adapter Includes Kynar backup ring, Viton O-ring, Kynar split ring, and O-ring lubricant
4	Below	1	Universal Assembly Bushing
	BS810EX		PVDF body, 1 NPT Process Connection
	BS810LH		316 ss Body, 1 NPT Process Connection
	BS810WZ		316 ss Body, R 1 1/2 Process Connection
	BS810XA		316 ss Body, R 2 Process Connection

a. PVDF is polyvinylidene fluoride, commercially available as Kynar.

ACCESSORY – 3/4 NPT BUSHINGS

Figure 25. 3/4 NPT Bushings



— NOTE

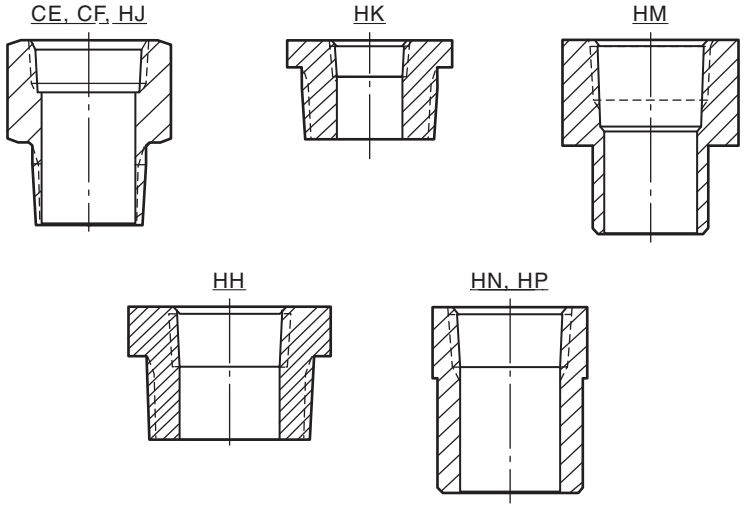
Typical bushing configurations are shown. The two-letter designation above each bushing corresponds to the last two letters of the part numbers listed below. For detailed bushing dimensions, see DP 611-173.

Item	Part No.	Qty.	Part Name
–	Below	A/R	316 ss Bushing
	BS810HA		3/4 x 1 NPT, 1.375 in Hex Head
	BS810HF		3/4 x 1 1/4 NPT, 1.75 in Hex Head
	BS810HG		3/4 x 1 1/2 NPT, 2 in Hex Head
–	Below	A/R	PVDF Bushing
	BS810HC		3/4 x 1 NPT, 1.312 in Wrench Flats
	BS810GZ		3/4 x 1 1/2 NPT, 2 in Wrench Flats
–	Below	A/R	CPVC Bushing [a]
	BS810KL		3/4 NPT x 1 in Solvent Weld, 1.5 in Round Head
	BS810KM		3/4 NPT x 1 1/4 in Solvent Weld, 1.75 in Hex Head
	BS810KN		3/4 NPT x 1 1/2 in Solvent Weld, 2.4 in Hex Head

a. CPVC is chlorinated polyvinyl chloride.

ACCESSORY – 1 NPT BUSHINGS

Figure 26. 1 NPT Bushings



NOTE

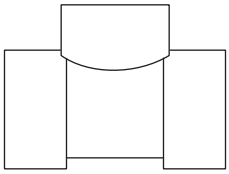
Typical bushing configurations are shown. The two-letter designation above each bushing corresponds to the last two letters of the part numbers listed below. For detailed bushing dimensions, see DP 611-173.

Item	Part No.	Qty.	Part Name
–	Below	A/R	316 ss Bushing
	BS810HJ		1 x 1 NPT, 1.625 in Hex Head
	X0177CF		1 x 1 1/4 NPT, 1.75 in Hex Head
	X0177CE		1 x 1 1/2 NPT, 2 in Hex Head
–	Below	A/R	PVDF Bushing
	BS810HK		1 x 1 NPT, 1.625 in Wrench Flats
	BS810HH		1 x 1 1/2 NPT, 2 in Wrench Flats
–	Below	A/R	CPVC Bushing [a]
	BS810HM		1 NPT x 1 in Solvent Weld, 1.625 in Wrench Flats
	BS810HN		1 NPT x 1 1/4 in Solvent Weld, 1.75 in Round Head
	BS810HP		1 NPT x 1 1/2 in Solvent Weld, 2 in Round Head

a. CPVC is chlorinated polyvinyl chloride.

ACCESSORY – TEES

Figure 27. Tees



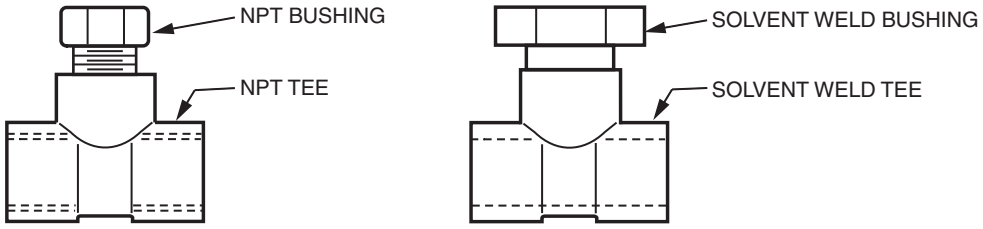
NOTE

All tee connections are female. All three connections on a given tee are the same nominal size. For detailed tee dimensions, see DP 611-173.

Item	Part No.	Qty.	Part Name
–	Below	A/R	316 ss Tee
	X0178JB		1 NPT
	X0178HW		1 1/4 NPT
	X0173JY		1 1/2 NPT
–	Below	A/R	PVDF Tee
	X0178HV		1 NPT
	X0178HX		1 1/2 NPT
–	Below	A/R	CPVC Tee
	X0178HY		1 in Solvent Weld
	X0178HZ		1 1/4 in Solvent Weld
	X0178JA		1 1/2 in Solvent Weld

ACCESSORY – TEE KITS

Figure 28. Tee Kits



Item	Part No.	Qty.	Part Name
–	Below	A/R	316 ss Tee Kit (See table for NPT Bushing and NPT Tee)
	BS810HS		3/4 x 1 x 1 NPT
	BS810HW		3/4 x 1 1/4 x 1 1/4 NPT
	BS810JA		3/4 x 1 1/2 x 1 1/2 NPT
	BS810JE		1 x 1 x 1 NPT
	BS810JJ		1 x 1 1/4 x 1 1/4 NPT
	BS810JN		1 x 1 1/2 x 1 1/2 NPT
–	Below	A/R	PVDF Tee Kit (See table for NPT Bushing and NPT Tee)
	BS810HV		3/4 x 1 x 1 NPT
	BS810JB		3/4 x 1 1/2 x 1 1/2 NPT
	BS810JF		1 x 1 x 1 NPT
	BS810JP		1 x 1 1/2 x 1 1/2 NPT
–	Below	A/R	CPVC Tee Kit (See table for Solvent Weld Bushing and Solvent Weld Tee)
	BS810HU		3/4 x 1 x 1 Solvent Weld
	BS810HZ		3/4 x 1 1/4 x 1 1/4 Solvent Weld
	BS810JD		3/4 x 1 1/2 x 1 1/2 Solvent Weld
	BS810JH		1 x 1 x 1 Solvent Weld
	BS810JM		1 x 1 1/4 x 1 1/4 Solvent Weld
	BS810JR		1 x 1 1/2 x 1 1/2 Solvent Weld

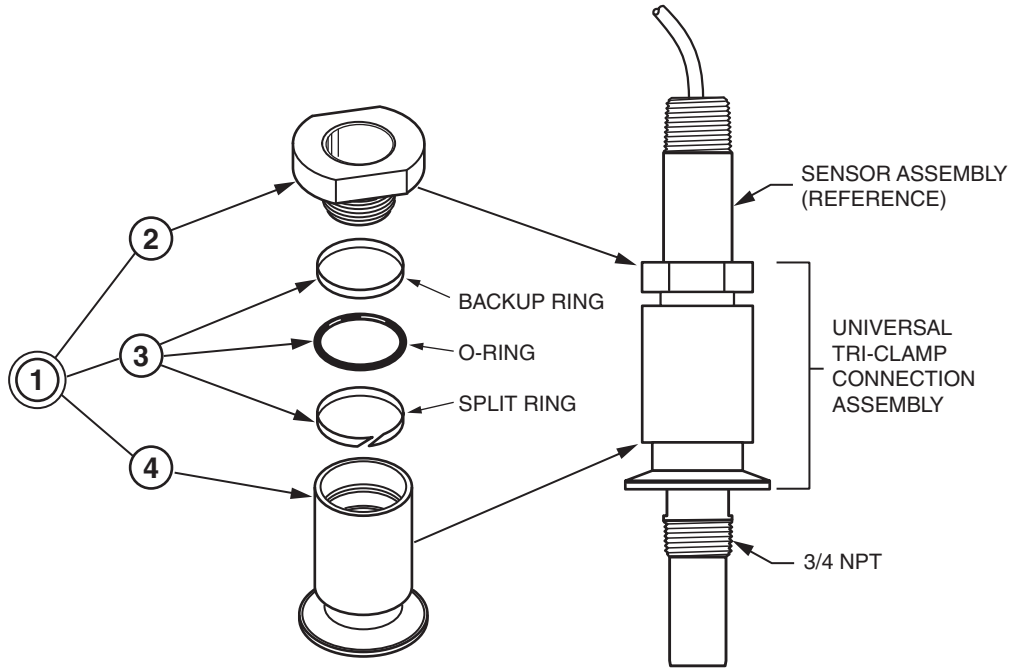
— NOTE

Each kit consists of a tee and a bushing. The table below identifies the tees and bushings used with each tee kit. Tees and bushings can also be purchased separately.

316 ss Tee Kit Parts (NPT)			PVDF Tee Kit Parts (NPT)			CPVC Tee Kit Parts (Solvent Weld)		
Kit	**Tee**	**Bushing**	**Kit**	**Tee**	**Bushing**	**Kit**	**Tee**	**Bushing**
BS810HS	X0178JB	BS810HA	BS810HV	X0178HV	BS810HC	BS810HU	X0178HY	BS810KL
BS810HW	X0178HW	BS810HF	BS810JB	X0178HX	BS810GZ	BS810HZ	X0178HZ	BS810KM
BS810JA	X0173JY	BS810HG	BS810JF	X0178HV	BS810HK	BS810JD	X0178JA	BS810KN
BS810JE	X0178JB	BS810HJ	BS810JP	X0178HX	BS810HH	BS810JH	X0178HY	BS810HM
BS810JJ	X0178HW	X0177CF	–	–	–	BS810JM	X0178HZ	BS810HN
BS810JN	X0173JY	X0177CE	–	–	–	BS810JR	X0178JA	BS810HP

ACCESSORY – UNIVERSAL TRI-CLAMP CONNECTION ASSEMBLY

Figure 29. Universal Tri-Clamp Connection Assembly

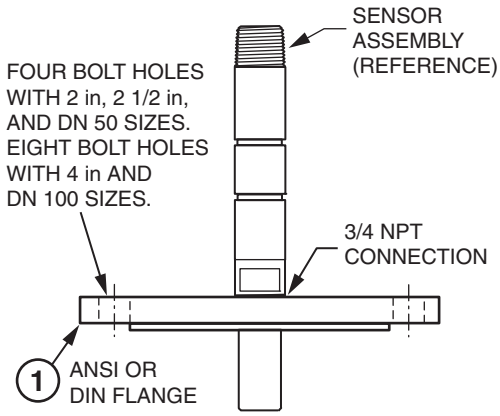


Item	Part No.	Qty.	Part Name
1	Below	Ref.	Universal Tri-Clamp Connection Assembly (Items 2, 3, and 4)
	BS810ZU		1.5 in Tri-Clamp End, 2 in O.D., 316 ss
	BS810ZT		2 in Tri-Clamp End, 2.5 in O.D., 316 ss
2	BS810LG	1	Locking Cap, 316 ss, Round Head, 1.50 Across Flats
*3	BS811HK	1	Kit, Seals for Universal Adapter Includes Kynar backup ring, Viton O-ring, Kynar split ring, and O-ring lubricant
4	Below	1	Variable Insertion Bushing with Tri-Clamp Connection
	BS810XF		1.5 in Tri-Clamp End, 2 in O.D., 316 ss
	BS810XG		2 in Tri-Clamp End, 2.5 in O.D., 316 ss

ACCESSORY – FLANGED CONNECTION ASSEMBLY

(With Sensor Assembly Threaded Directly to Flange)

Figure 30. Flanged Connection Assembly



Item	Part No.	Qty.	Part Name
1	Below	1	Flange, ANSI or DIN, 316 ss
	BS808MP		ANSI Class 150, 2 in Flange, 4 Bolt Holes
	BS809LZ		ANSI Class 150, 2 1/2 in Flange, 4 Bolt Holes
	BS808MA		ANSI Class 150, 4 in Flange, 8 Bolt Holes
	BS808MB		DIN PN 10, DN 50 Flange, 4 Bolt Holes
	BS809LW		DIN PN 10, DN 100 Flange, 8 Bolt Holes

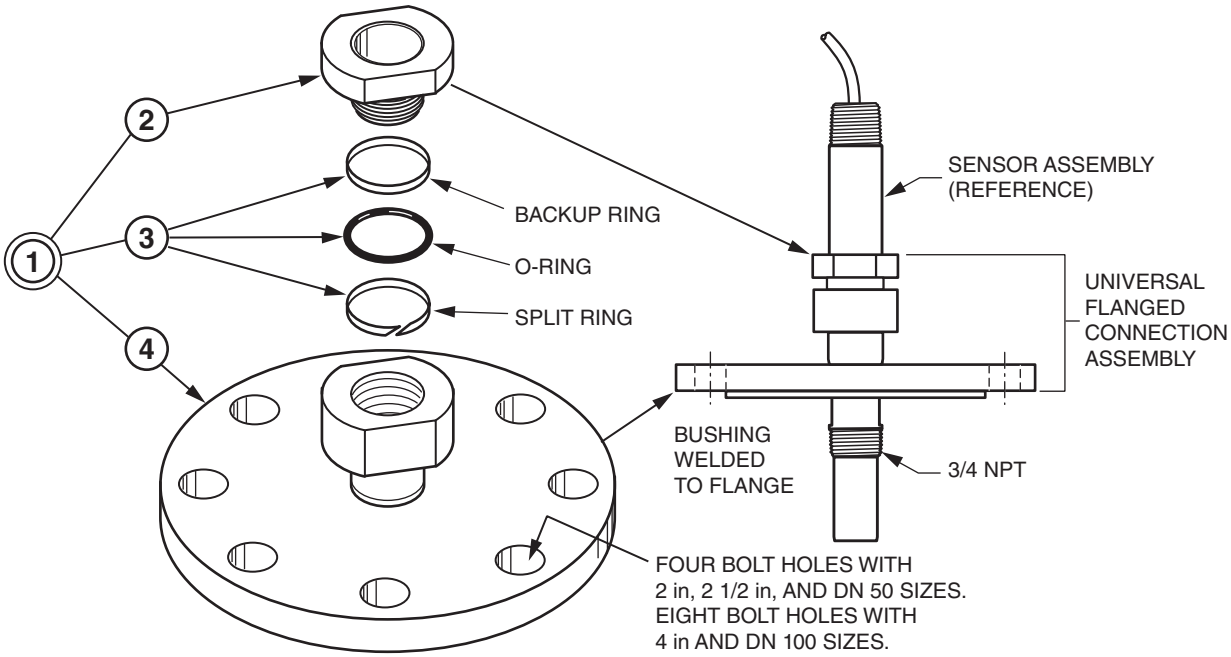
— NOTE

For flanged end connection assembly with universal bushing assembly welded directly to flange, refer to Figure 31.

ACCESSORY – UNIVERSAL FLANGED CONNECTION ASSEMBLY

(With Integral Universal Bushing)

Figure 31. Universal Flanged Connection Assembly



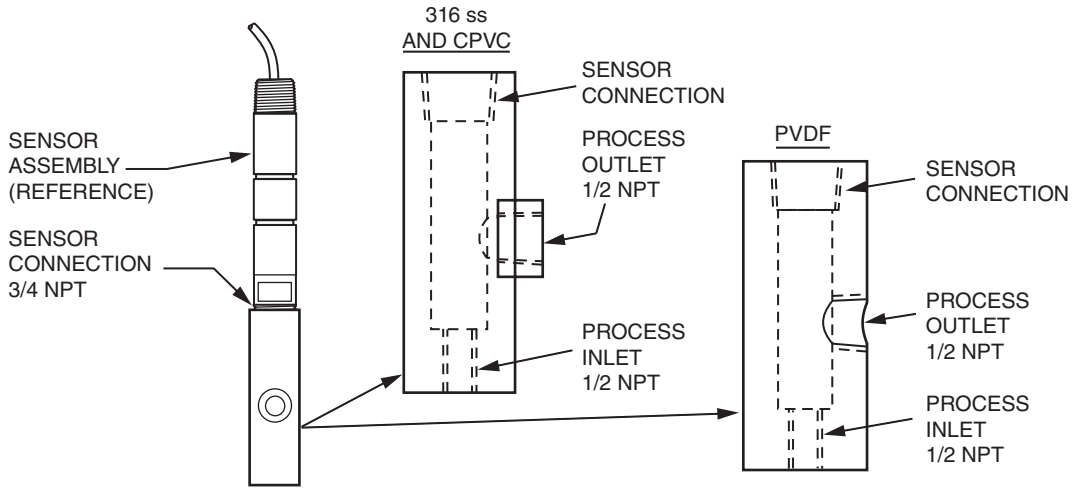
Item	Part No.	Qty.	Part Name
1	Below	Ref.	Universal Flanged Connection Assembly (Items 2, 3, and 4)
	BS810ZN		ANSI Class 150, 2 in Flange
	BS810ZP		ANSI Class 150, 2 1/2 in Flange
	BS810ZQ		ANSI Class 150, 4 in Flange
	BS810ZR		DIN PN 10, DN 50 Flange
	BS810ZS		DIN PN 10, DN 100 Flange
2	BS810LG	1	Locking Cap, 316 ss, Round Head, 1.50 Across Flats
*3	BS811HK	1	Kit, Seals for Universal Adapter Includes Kynar backup ring, Viton O-ring, Kynar split ring, and O-ring lubricant
4	Below	1	Variable Insertion Bushing with Integral Flange
	BS810XT		ANSI Class 150, 2 in Flange, 4 Bolt Holes, 316 ss
	BS810XS		ANSI Class 150, 2 1/2 in Flange, 4 Bolt Holes, 316 ss
	BS810XR		ANSI Class 150, 4 in Flange, 8 Bolt Holes, 316 ss
	BS810XQ		DIN PN 10, DN 50 Flange, 4 Bolt Holes, 316 ss
	BS810XP		DIN PN 10, DN 100 Flange, 8 Bolt Holes, 316 ss

NOTE

For connection with sensor assembly threaded directly to flange, refer to Figure 30.

ACCESSORY – FLOW CHAMBER

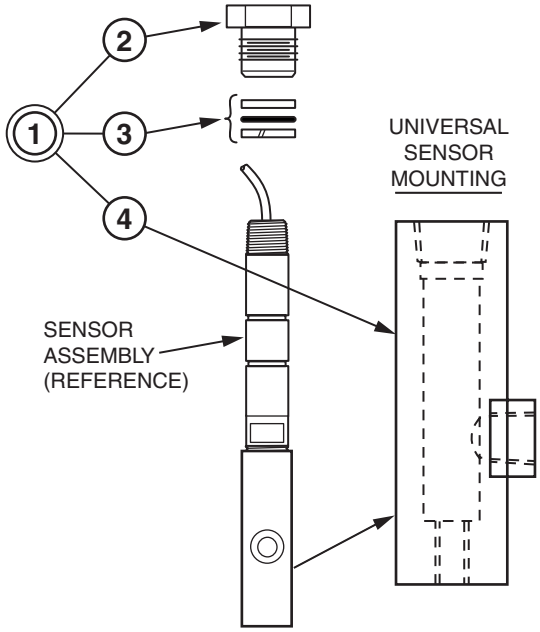
Figure 32. Flow Chamber for Standard Sensor Mounting



Item	Part No.	Qty.	Part Name
–	Below	A/R	Flow Chamber
	BS810SR		316 ss, 3/4 NPT Sensor Connection, 1/2 NPT Inlet/Outlet
	BS810SS		PVDF, 3/4 NPT Sensor Connection, 1/2 NPT Inlet/Outlet
	BS810SU		CPVC, 3/4 NPT Sensor Connection, 1/2 NPT Inlet/Outlet

ACCESSORY – FLOW CHAMBER - UNIVERSAL

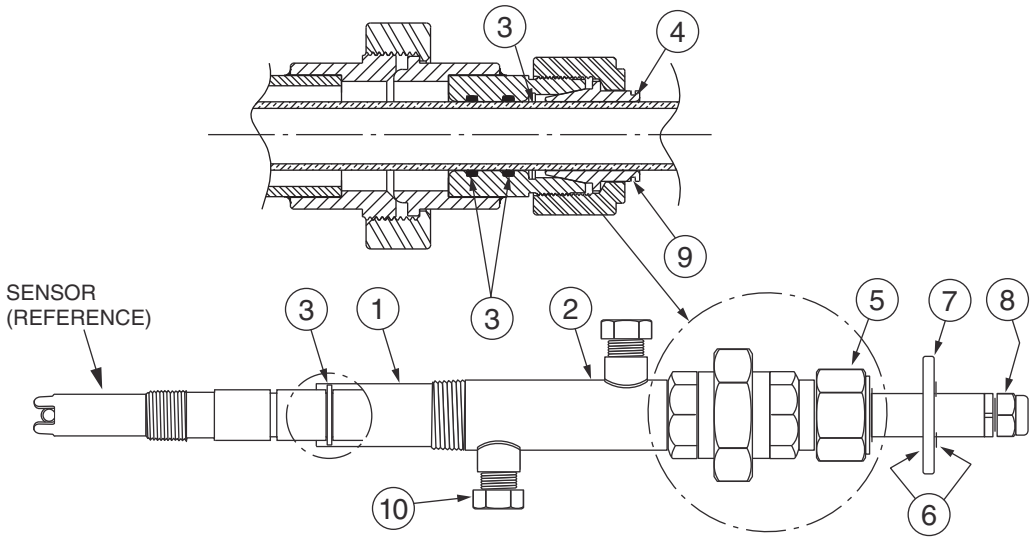
Figure 33. Flow Chamber for Universal Sensor Mounting



Item	Part No.	Qty.	Part Name
1	BS810ND	Ref	Flow Chamber, 316 ss, Universal Sensor Mounting, 1/2 NPT Inlet/Outlet
2	BS810LG	1	Locking Cap, 316 ss, Round Head, 1.50 Across Flats
*3	BS811HK	1	Kit, Seals for Universal Adapter Includes Kynar backup ring, Viton O-ring, Kynar split ring, and O-ring lubricant
4	BS810NC	1	Flow Chamber for Universal Sensor Mounting

ACCESSORY – INSERTION TUBE ASSEMBLY (LEGACY)

Figure 34. Insertion Tube Assembly (Legacy)



NOTE

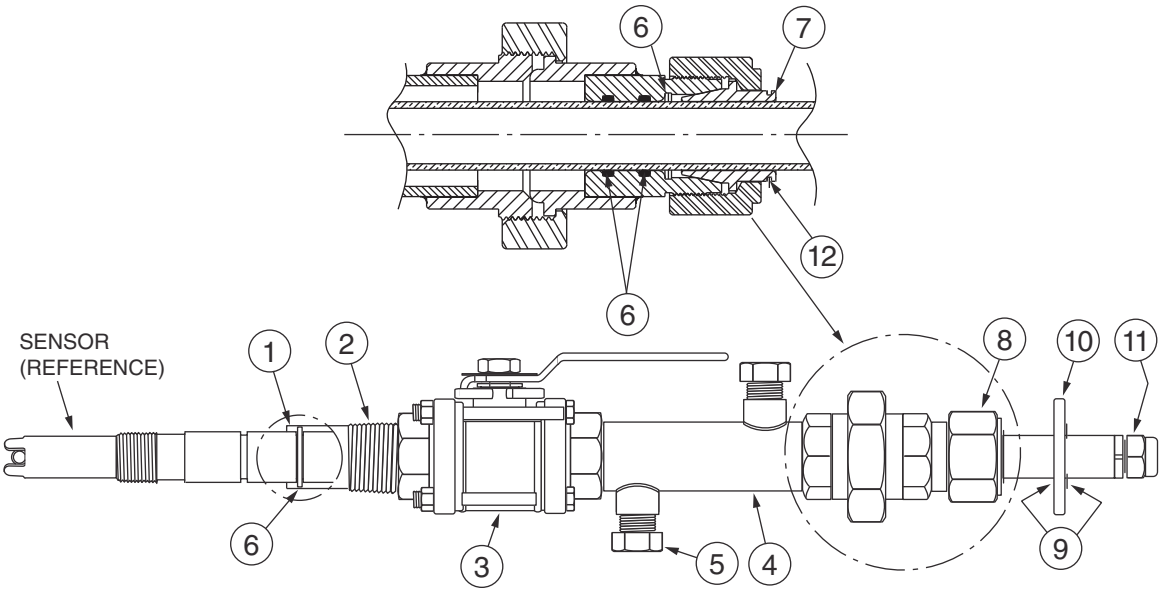
Refer to "ACCESSORY – BVA SERIES BALL VALVE INSERTION ASSEMBLY" on page 57 for additional options.

Item	Part No.	Qty.	Part Name
–	BS810JU	Below	Insertion Tube Assembly, 316 ss, 0 - 14 in insertion (Items 1 through 10)
–	BS811MB	Below	Insertion Tube Assembly, 316 ss, 0 - 22 in insertion (Items 1 through 10)
–	BS810MM	Below	Insertion Tube Assembly, Ti, 0 - 15 in insertion (Items 1 through 10)
–	BS811MC	Below	Insertion Tube Assembly, Ti, 0 - 23 in insertion (Items 1 through 10)
	Below	1	Insertion Shaft
1	BS810KF		With BS810JU Insertion Tube Assembly
	BS810JZ		With BS811MB Insertion Tube Assembly
	BS810MD		With BS810MM Insertion Tube Assembly
	BS810ME		With BS811MC Insertion Tube Assembly
2	Below	1	Retraction Chamber Assembly with Purge Ports includes Retraction Chamber, Chamber Nut, and Ferrule Seat
	BS810NH		With BS810JU and BS811MB Insertion Tube Assembly
	BS810NE		With BS810MM and BS811MC Insertion Tube Assembly

Item	Part No.	Qty.	Part Name
*3	Below	1	O-Ring Kit - includes one O-Ring for the Sensor, two O-Rings for the Ferrule Seat, and one Delrin Split Washer for the Ferrule Seat
	BS812PK		Viton (Standard)
	BS812PJ		EPDM (Option)
	BS812PL		Chemraz (Option)
	BS812PM		Kalrez (Option)
	BS815MW		Perfluoroelastomer (FFKM) (Option)
*4	BS810LD	1	Ferrule, Split
5	X0178KZ	1	Nut, Tube, 1 1/4 NPT
6	X0174BM	2	Retaining E-Ring, ss
7	BS810LJ	1	Plate, Push/Pull
8	X0172WG	1	Fitting, Liquid Tight
9	X0177DL	1	Retaining Ring, Crescent, ss
*10	Below	2	Plug, 1/2 NPT
	D0116KZ		With BS810JU and BS811MB Insertion Tube Assembly
	BS811MF		With BS810MM and BS811MC Insertion Tube Assembly

ACCESSORY – BALL VALVE ASSEMBLY (LEGACY)

Figure 35. Ball Valve Assembly (Legacy)



— NOTE

Refer to "ACCESSORY – BVA SERIES BALL VALVE INSERTION ASSEMBLY" on page 57 for additional options.

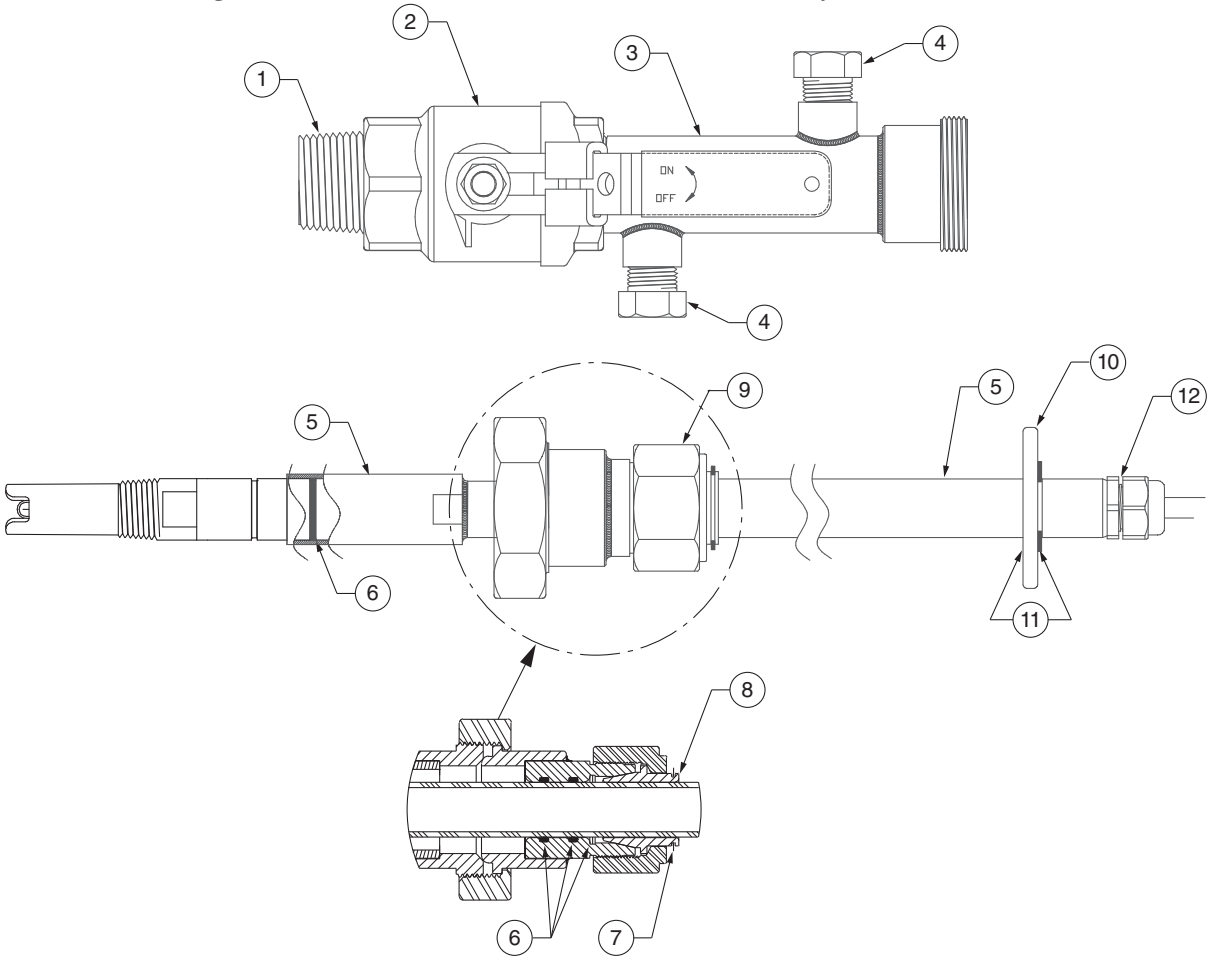
Item	Part No.	Qty.	Part Name
–	BS810LV	Below	Ball Valve Assembly, 316 ss, 0 to 8 in Insertion (Items 1 through 12 below)
–	BS810MJ	Below	Ball Valve Assembly, 316 ss, 0 to 16 in Insertion (Items 1 through 12 below)
–	BS810MT	Below	Ball Valve Assembly, Ti, 0 - 8 in insertion (Items 1 through 12 below)
–	BS810MQ	Below	Ball Valve Assembly, Ti, 0 - 16 in insertion (Items 1 through 12 below)
1	Below	1	Insertion Shaft
	BS810KF		With BS810LV Ball Valve Assembly
	BS810JZ		With BS810MJ Ball Valve Assembly
	BS810MD		With BS810MT Ball Valve Assembly
	BS810ME		With BS810MQ Ball Valve Assembly
2	Below	1	Pipe Nipple
	E0121FA		With BS810LV and BS810MJ Ball Valve Assembly
	BS810NF		With BS810MT and BS810MQ Ball Valve Assembly
3	Below	1	Ball Valve, 1 1/4 NPT
	X0176BV		With BS810LV and BS810MJ Ball Valve Assembly
	X0176CA		With BS810MT and BS810MQ Ball Valve Assembly

Item	Part No.	Qty.	Part Name
4	Below	1	Retraction Chamber Assembly with Purge Ports includes Retraction Chamber, Chamber Nut, and Ferrule Seat
	BS810NH		With BS810LV and BS810MJ Ball Valve Assembly
	BS810NE		With BS810MT and BS810MQ Ball Valve Assembly
*5	Below	2	Plug, 1/2 NPT
	D0116KZ		With BS810LV and BS810MJ Ball Valve Assembly
	BS811MF		With BS810MT and BS810MQ Ball Valve Assembly
*6	Below	1	O-Ring Kit - includes one O-Ring for the Sensor, two O-Rings for the Ferrule Seat, and one Delrin Split Washer for the Ferrule Seat
	BS812PK		Viton (Standard)
	BS812PJ		EPDM (Option)
	BS812PL		Chemraz (Option)
	BS812PM		Kalrez (Option)
	BS815MW		Perfluoroelastomer (FFKM) (Option)
*7	BS810LD	1	Ferrule, Split
8	X0178KZ	1	Nut, Tube, 1 1/4 NPT
9	X0174BM	2	Retaining E-Ring, ss
10	BS810LJ	1	Plate, Push/Pull
11	X0172WG	1	Fitting, Liquid Tight
12	X0177DL	1	Retaining Ring, Crescent, ss

ACCESSORY – BVA SERIES BALL VALVE INSERTION ASSEMBLY

(Model Code BVA-PHA****)

*Figure 36. BVA Series Ball Valve Insertion Assembly BVA-PHA****

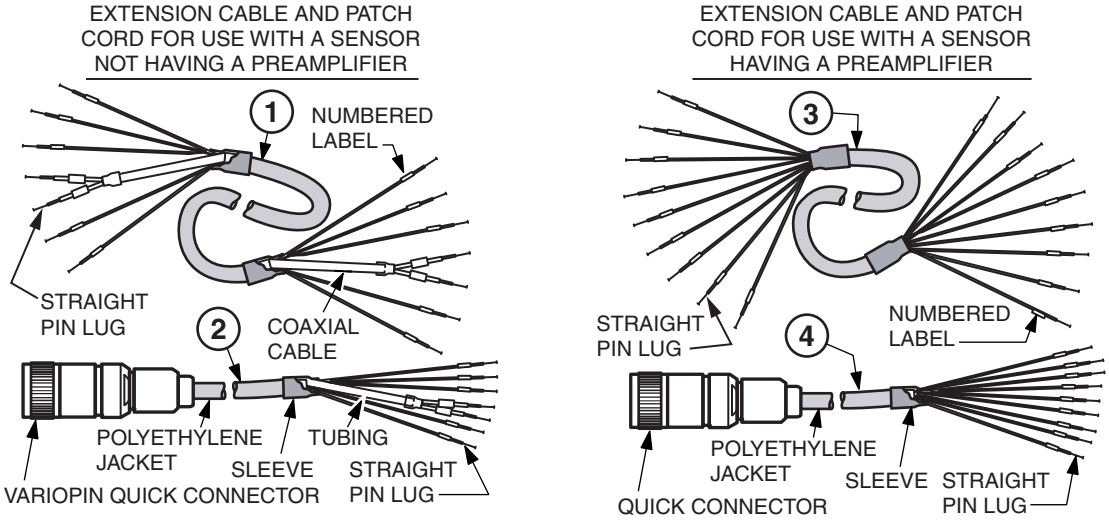


Item	Part No.	Qty.	Part Name
–	BVA-PHA****	Below	Refer to "MODEL CODE – BVA SERIES BALL VALVE INSERTION ASSEMBLY" on page 40 for ordering instructions.
1	Below	1	Pipe Nipple
	E0121FA		For Stainless Steel Models
	BS810NF		For Titanium Models
2	Below	1	Ball Valve, 1 1/4 NPT
	X0176BV		For Stainless Steel Models
	X0176CA		For Titanium Models
	X0176BH		For PVDF Ball Valve Option

Item	Part No.	Qty.	Part Name
3	Below	1	Retraction Chamber Assembly with Purge Ports includes Retraction Chamber, Chamber Nut, and Ferrule Seat
	BS810NH		For Stainless Steel Models
	BS810NE		For Titanium Models
*4	Below	2	Plug, 1/2 NPT
	D0116KZ		For Stainless Steel Models
	BS811MF		For Titanium Models
5	Below	1	Insertion Shaft
	BS810KF		8" Insertion Depth, 316 ss
	BS810JZ		16" Insertion Depth, 316 ss
	BS814BK		24" Insertion Depth, 316 ss
	BS814BL		32" Insertion Depth, 316 ss
	BS814BM		XX" Insertion Depth per Sales Order, 316 ss
	BS810MD		8" Insertion Depth, Titanium
	BS810ME		16" Insertion Depth, Titanium
	BS814BN		24" Insertion Depth, Titanium
	BS814BP		32" Insertion Depth, Titanium
	BS814BQ		XX" Insertion Depth per Sales Order, Titanium
*6	Below	1	O-Ring Kit - includes one O-Ring for the Sensor, two O-Rings for the Ferrule Seat, and one Delrin Split Washer for the Ferrule Seat
	BS812PL		Chemraz
	BS812PJ		EPDM
	BS812PM		Kalrez
	BS815MW		Perfluoroelastomer (FFKM)
	BS812PK		Viton
7	X0177DL	1	Retaining Ring, Crescent, ss
*8	Below	1	Ferrule, Split
	BS810LD		For Stainless Steel Models
	BS810MP		For Titanium Models
9	X0178KZ	1	Nut, Tube, 1 1/4 NPT
10	BS810LJ	1	Plate, Push/Pull
11	X0174BM	2	Retaining E-Ring, ss
12	X0172WG	1	Fitting, Liquid Tight
–	BS811NY	1	BV Safety Interlock (not shown)

ACCESSORY – EXTENSION CABLES AND PATCH CORDS

Figure 37. Extension Cables And Patch Cords

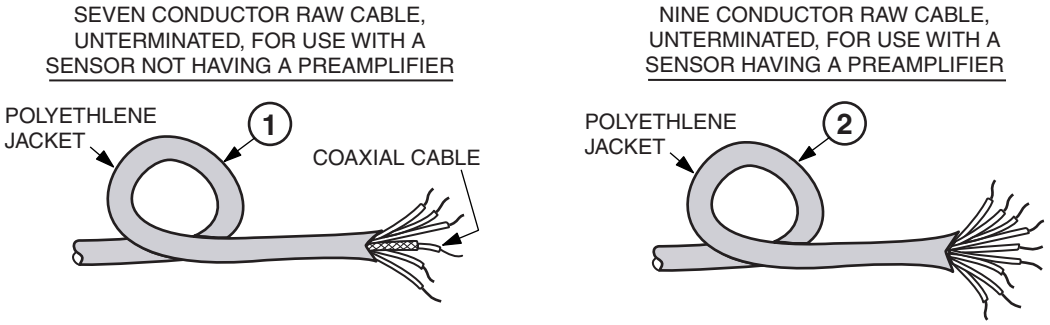


Item	Part No.	Qty.	Part Name[a]
1	Below	1	Extension Cable; Seven Terminals on Each End
	BS811HE		11 ft (3.35 m) long; +1 ft (+0.3 m), –0 ft (–0 m), Std. Temp
	BS811HF		21 ft (6.40 in) long; +1 ft (+0.3 m), –0 ft (–0 m), Std. Temp
	BS811HG		31 ft (9.45 in) long; +1 ft (+0.3 m), –0 ft (–0 m), Std. Temp
	BS811HH		41 ft (12.50 in) long; +1 ft (+0.3 m), –0 ft (–0 m), Std. Temp
	BS811HJ		51 ft (15.54 in) long; +1 ft (+0.3 m), –0 ft (–0 m), Std. Temp
	BS810ZV		11 ft (3.35 m) long; +1 ft (+0.3 m), –0 ft (–0 m), High Temp
	BS810ZW		21 ft (6.40 in) long; +1 ft (+0.3 m), –0 ft (–0 m), High Temp
	BS810ZX		31 ft (9.45 in) long; +1 ft (+0.3 m), –0 ft (–0 m), High Temp
	BS810ZY		41 ft (12.50 in) long; +1 ft (+0.3 m), –0 ft (–0 m), High Temp
	BS810ZZ		51 ft (15.54 in) long; +1 ft (+0.3 m), –0 ft (–0 m), High Temp
2	Below	1	Patch Cord; 7 Terminals and Variopin Quick Connector
	BS811GU		11 ft (3.35 m) long; +1 ft (+0.3 m), –0 ft (–0 m), Std. Temp
	BS811GV		21 ft (6.40 in) long; +1 ft (+0.3 m), –0 ft (–0 m), Std. Temp
	BS811GW		31 ft (9.45 in) long; +1 ft (+0.3 m), –0 ft (–0 m), Std. Temp
	BS811GX		41 ft (12.50 in) long; +1 ft (+0.3 m), –0 ft (–0 m), Std. Temp
	BS811GY		51 ft (15.54 in) long; +1 ft (+0.3 m), –0 ft (–0 m), Std. Temp
	BS810QA		11 ft (3.35 m) long; +1 ft (+0.3 m), –0 ft (–0 m), High Temp
	BS810QB		21 ft (6.40 in) long; +1 ft (+0.3 m), –0 ft (–0 m), High Temp
	BS810QC		31 ft (9.45 in) long; +1 ft (+0.3 m), –0 ft (–0 m), High Temp
	BS810QD		41 ft (12.50 in) long; +1 ft (+0.3 m), –0 ft (–0 m), High Temp
	BS810QE		51 ft (15.54 in) long; +1 ft (+0.3 m), –0 ft (–0 m), High Temp
3	BS811HW	1	Extension Cable; 9 Terminals on Each End, Std. Temp Specify Length up to 500 ft (152 m) maximum on Sales Order
4	BS811JB	1	Patch Cord; 9 Terminals and Variopin Quick Connector, Std. Temp Specify Length up to 500 ft (152 m) maximum on Sales Order

a. Standard temperature up to 85°C (185°F); High temperature up to 125°C (257°F).

ACCESSORY – RAW CABLE - UNTERMINATED

Figure 38. Raw Cable - Unterminated



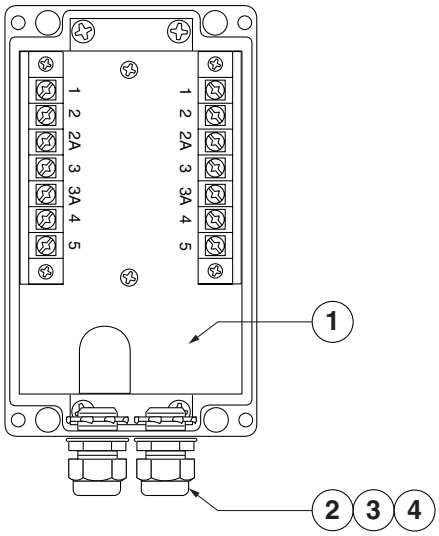
Item	Part No.	Qty.	Part Name
1	Below	A/R	Seven Conductor Extension Cable for Sensor without Preamp
	P0170UA		High Temperature Cable - to 125°C (257°F)
	P0170UU		Standard Temperature Cable - to 85°C (185°F)
2	Below	A/R	Nine Conductor Extension Cable for Sensor with Preamp
	P0170UV		Standard Temperature Cable - to 85°C (185°F)

— NOTE

Raw, unterminated cable is offered in continuous lengths up to 1000 ft (305 m). Specify both the applicable cable part number, and the length required in feet or meters. Cable terminations are to be provided by the user.

ACCESSORY – JUNCTION BOX ASSEMBLY

Figure 39. Junction Box Assembly



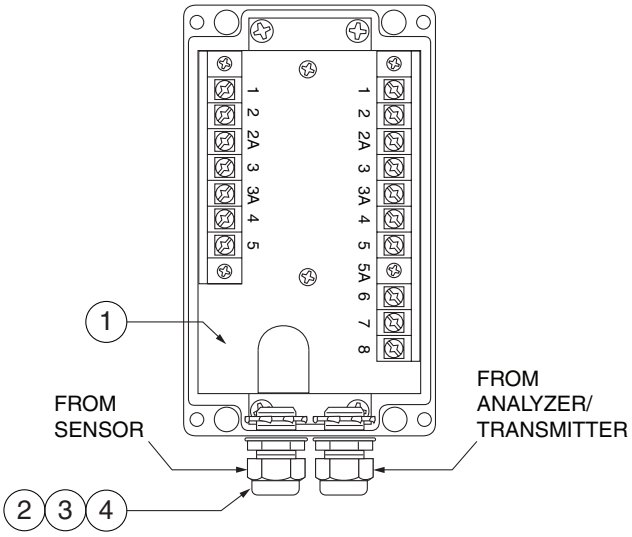
Item	Part No.	Qty.	Part Name
–	BS813XN	Below	Junction Box Assembly; No Amplifier
1	BS813XM	1	Terminal Block Assembly; No Amplifier (see Note)
2	X0172WG	2	Bushing Assembly; Liquid Tight
3	BS800AH	2	O-Ring, Sealing; Buna-N
4	2800041	2	Locknut, Conduit; 3/4 NPT

NOTE

Item 1 may be ordered separately.

ACCESSORY – REMOTE PREAMPLIFIER JUNCTION BOX ASSEMBLY

Figure 40. Remote Preamplifier Junction Box Assembly



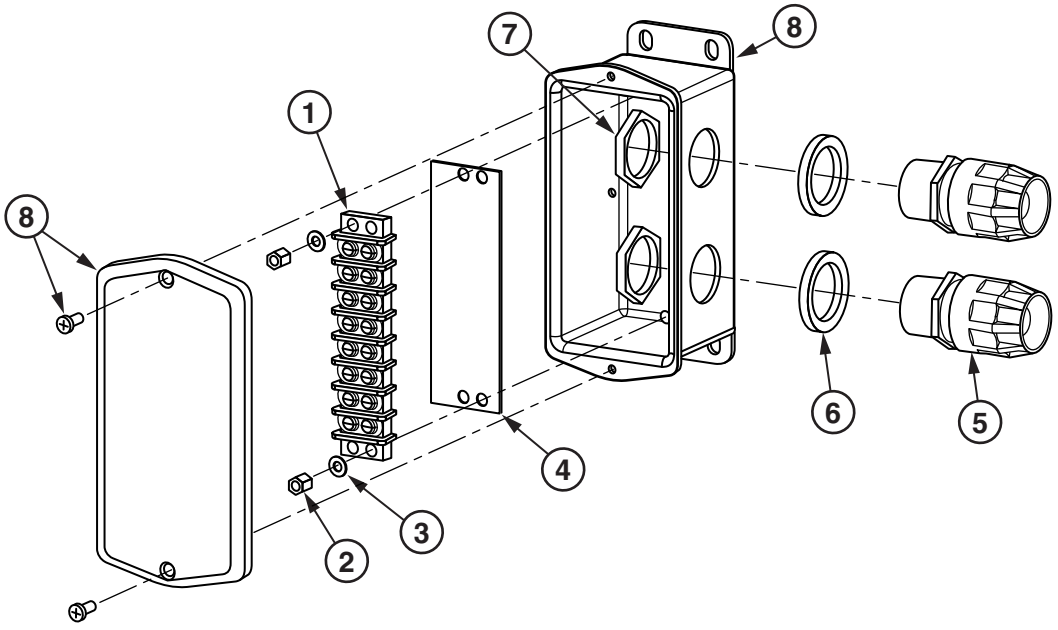
Item	Part No.	Qty.	Part Name
–	BS811MR	Below	Junction Box Assembly; With Amplifier
1	BS811ND	1	Terminal Block Assembly; With Amplifier (see Note)
2	X0172WG	2	Bushing Assembly; Liquid Tight
3	BS800AH	2	O-Ring, Sealing; Buna-N
4	2800041	2	Locknut, Conduit; 3/4 NPT

— NOTE

Item 1 may be ordered separately.

ACCESSORY – JUNCTION BOX ASSEMBLY FOR SENSORS WITH PREAMPLIFIER

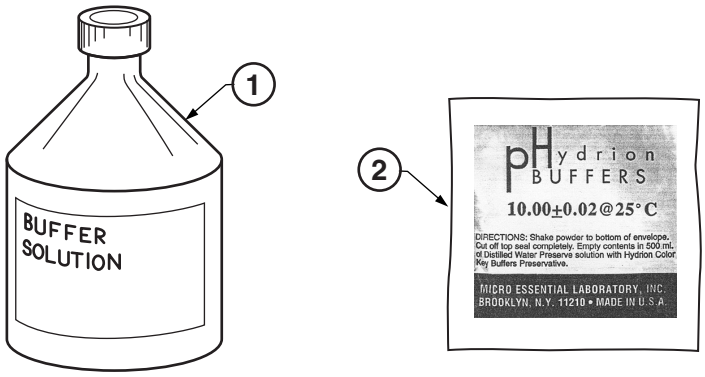
Figure 41. Junction Box Assembly for Use with Sensors Having a Preamplifier



Item	Part No.	Qty.	Part Name
–	BS807BZ	Below	Junction Box Assembly, Items 1 to 8 (For Sensors having a Preamplifier)
1	2100105	1	Terminal Block Assembly Includes sixteen 0.138-32 Binder Head Screws
2	2800712	2	Nut (Spacer), Hex Head, 0.138-32 x 0.25
3	2800375	2	Washer, Lock, 0.138
4	XS004GY	1	Marker Strip
5	2100108	2	Cable Gland (Connector)
6	BS800AH	2	Seal, Buna N
7	2800041	2	Nut, Lock, Conduit, 3/4 NPT
8	BS807JL	1	Junction Box Enclosure Includes Cover and Cover Screws

ACCESSORY – BUFFER SOLUTION AND SALT PACKET

Figure 42. Buffer Solution and Salt Packet for Model PH10



Item	Part No.	Qty.	Part Name
*1	Below	A/R	Buffer Solution; 4, 7, and 10 pH
	Q0104KC		pH 4.00 ±0.01 at 25°C (77°F), Potassium Hydrogen Phthalate
	Q0104KB		pH 7.00 ±0.02 at 25°C (77°F), Potassium Phosphate Monobasic/Sodium Hydroxide
	Q0104KA		pH 10.00 ±0.02 at 25°C (77°F), Potassium Carbonate/Potassium Borate/Potassium Hydroxide
*2	Below	A/R	Hydrion Buffer Salt Packet; 4, 7, and 10 pH
	1600100		pH 4.00, 6 grams per Packet (see Note below), Potassium Biphthalate Dry Powder
	1600101		pH 7.00, 6 grams per Packet (see Note below), Sodium Phosphate Dibasic/Potassium Phosphate Monobasic
	1600102		pH 10.00, 6 grams per Packet (see Note below), Sodium Carbonate/Sodium Bicarbonate

— NOTE

To convert the salt packet to a buffer solution, mix the packet contents with 0.47 liters (16 fluid ounces) of distilled water, and stir thoroughly.

RECOMMENDED SPARE PARTS SUMMARY

Figure Number [a]	Item Number	Part Number	Part Name	Number of Parts Recommended for		
				1 Inst.	5 Inst.	20 Inst.
23	1	Model No.	Sensor Assembly [b]	A/R	A/R	A/R
24 29 31 33	3 3 3 3	BS811HK	Kit, Seals for Universal Adapter Kit includes a Kynar split ring, Viton O-ring, Kynar backup ring, and O-ring lubricant	1	2	5
34	3	Below BS812PK BS812PJ BS812PL BS812PM BS815MW	O-Ring Kit [c] Viton (Standard) EPDM (Option) Chemraz (Option) Kalrez (Option) Perfluoroelastomer (FFKM) (Option)	2	4	10
	4	BS810LD	Ferrule, Split	2	4	10
	10	Below D0116KZ BS811MF	Plug, 1/2 NPT For 316 ss models For titanium models	2	4	10
35	5	Below D0116KZ BS811MF	Plug, 1/2 NPT For 316 ss models For titanium models	2	4	10
	6	Below BS812PK BS812PJ BS812PL BS812PM BS815MW	O-Ring Kit [c] Viton (Standard) EPDM (Option) Chemraz (Option) Kalrez (Option) Perfluoroelastomer (FFKM) (Option)	2	4	10
	7	BS810LD	Ferrule, Split	2	4	10
36	4	Below D0116KZ BS811MF	Plug, 1/2 NPT For 316 ss models For titanium models	2	4	10
	6	Below BS812PL BS812PJ BS812PM BS815MW BS812PK	O-Ring Kit [c] Chemraz EPDM Kalrez Perfluoroelastomer (FFKM) Viton	2	4	10
	8	Below BS810LD BS810MP	Ferrule, Split For 316 ss models For titanium models	2	4	10
42	1	Below Q0104KC Q0104KB Q0104KA	Buffer Solution (16 Fluid Ounces) for Model PH10 pH 4.00 at ±0.01 at 25°C (77°F) pH 7.00 at ±0.02 at 25°C (77°F) pH 10.00 at ±0.02 at 25°C (77°F)	A/R	A/R	A/R
	2	Below 1600100 1600101 1600102	Hydrion Buffer Salt Packet for Model PH10 pH 4.00 (16 fluid ounces when mixed) pH 7.00 (16 fluid ounces when mixed) pH 10.00 (16 fluid ounces when mixed)	A/R	A/R	A/R

a. Figures 24 through 42 represent accessories used with the DolpHin sensor assembly.
b. The sensor assembly has no individual replaceable parts, and must be replaced in its entirety by specifying the Model Number.
c. The O-ring kit consists of two O-rings for the ferrule seat, one Delrin split washer for the ferrule seat, one O-ring for the sensor, and O-ring lubricant.

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