

## **871DO Dissolved Oxygen Sensors and Accessories**

### **Installation and Maintenance**





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# General Precautions

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**⚠ WARNING**

1. When performing maintenance, wear appropriate protective clothing, including gloves and safety goggles.
  2. Use care when connecting and disconnecting high-pressure service connection. Use proper gloves and goggles and follow the recommended procedure to avoid severe injury to personnel or damage to equipment.
  3. When processing hazardous liquids, follow the recommended procedures. Failure to do so could result in injury to personnel and damage to equipment.
  4. Use only the replacement parts recommended by the company. Substitution parts could result in injury to personnel, damage to equipment, and damage to the process.
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**⚠ CAUTION**

1. The 871DO-C Sensor is shipped with a protective cap that must be removed before installing in process. Carefully remove this cap from the sensor's membrane and inspect membrane. No tears or electrolyte leakage should be visible. See Maintenance section of this document if any is observed. Replace the protective cap until sensor is ready for installation.
  2. Use care when handling sensitive sensor components (e.g., membrane), to prevent damage.
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# 1. Introduction

## General

The 871DO-C Sensor (cover photo and Figure 1) and accessories are used with Foxboro 873DO Electrochemical Analyzers, and are suitable for aqueous dissolved oxygen measurements (ppm range) in waste water applications.

**⚠ CAUTION**

The software version on the model 873DO Analyzer must be 5200 or greater. Check Setup parameter SFt.

The 871DO-C Sensor can be mounted to the process in a number of ways. The sensor has a 1-inch external MNPT connection on both the electrode and cable end. Using this connection, the sensor can be inserted directly into the process line or adapted to other standard pipe sizes by utilizing a variety of accessories. In situ mounting into aeration basins, ponds, and tanks is achieved by coupling the 1-inch MNPT connection at the cable end of the sensor to a section of 1-inch pipe and immersing the sensor in the process (user-supplied coupling and pipe).

## Reference Documents

Document	Description
MI 611-203	871DO-C Membrane Kit Replacements
MI 611-169	873DO Electrochemical Analyzer
MI 611-125	Electrode Cleaning Systems
PSS 6-1C1 E	873 Electrochemical Analyzers
PSS 6-1A2 C	Electrode Cleaning Systems
PSS 6-9B1 A	871DO-C Sensor
DP 611-162	873 Electrochemical Analyzer
DP 611-149	871DO-C Sensor
DP 611-145	871DO-C Accessories
DP 611-157	Ball Valve Assy for use with 871DO Sensors
PL 611-016	873 Series Electrochemical Analyzers
PL 611-121	871DO-C Sensor
PL 611-125	Electrode Cleaning System

# Model Code

	<b><u>Model</u></b>
Dissolved Oxygen Sensor	871DO
Membrane Composite	-C
Optional Selections	
Nonstandard cable length with seven wires stripped and tinned; specify length required, not to exceed 150 m (500 ft)	-3
Nonstandard cable length with male connector, specify length required, not to exceed 150 m (500 ft.)(a)	-5
Standard cable length with male connector, 9 m (30 ft.)(a)	-7

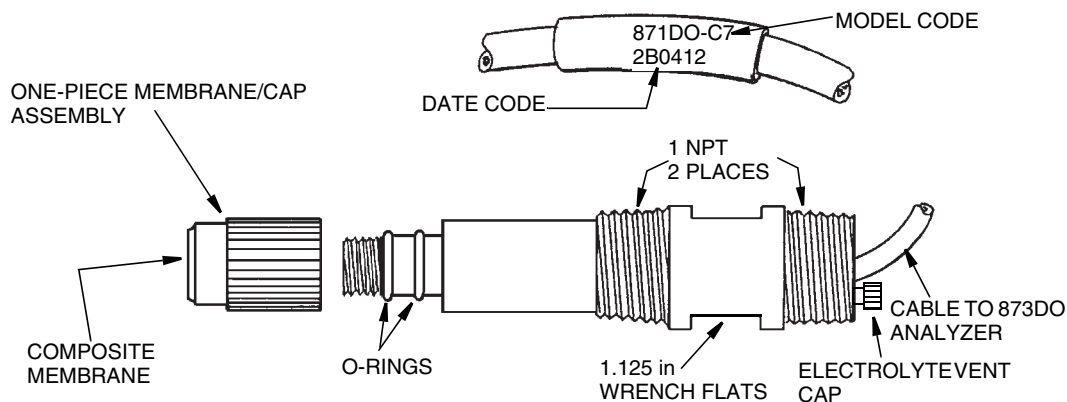
(a) Requires patch cord for mating to 873DO Analyzer.

# Standard Specifications

<b>Sensor Type</b>	Polarographic Clark Cell with four electrodes
<b>Working</b>	Gold
<b>Auxiliary</b>	Silver
<b>Reference</b>	Silver/Silver Chloride
<b>Test</b>	Gold
<b>Process Wetted Parts</b>	
<b>Sensor Body</b>	
Upper Body	Kynar
Lower Body	Noryl
<b>Cap Material</b>	Noryl
<b>Membrane Material</b>	Composite Dimethyl Silicone Rubber
<b>O-rings</b>	Silicone rubber, Viton, EPR
<b>Vent Cap</b>	Acetal
<b>Sensor Immersion Depth</b>	2.5 cm (1 in) minimum 21.3 m (70 ft) maximum
<b>Sensor Temperature Limits</b>	0 and 50 °C
<b>Temperature Measurement and Compensation</b>	Uses integral 100 kΩ thermistor.

*Table 1. Electrical Safety Specifications*

<b>Testing Laboratory, Type of Protection, and Area Classification</b>	<b>Application Conditions</b>	<b>Electrical Safety Design Code</b>
CSA ordinary locations.	Connect to M/873DO. For use with Enclosure P, W, X, Y, and Z. Supply voltage -A, -J, and -E.	CS-E/CGZ
CSA Class I, Division 2, Groups A, B, C, and D hazardous locations.	Connect to M/873DO. For use with Enclosure W, X, Y, and Z. Supply voltage -A, -J, and -E.	CS-E/CNZ
FM; ordinary locations.	Connect to M/873DO. For use with Enclosure P, W, X, Y, and Z.	CS-E/FGZ
FM; n.	Connect to M/873DO. For use with Enclosure W, X, Y, and Z.	CS-E/FNZ



*Figure 1. 871DO-C Dissolved Oxygen Sensor*

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**NOTE**

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The 871DO-C Sensor data labels (see Figure 1) are located approximately 30 cm (12 in) from either end of the sensor cable. The Model Code (the alphanumeric number to be used when ordering a replacement) is the top number (example, 871DO-C7). The bottom number (example, 2B0412) is the manufacturing date code.

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## Principle of Operation

A sample contains a quantity of dissolved oxygen. The exact quantity per unit volume depends primarily on the chemical nature of the sample, the temperature of the absorbing liquid, and the partial pressure of oxygen in the oxygen carrying solution (i.e., air, water). A common approach to analysis of an aqueous sample such as this utilizes a polarographic oxygen sensor based upon the Clark principle. An example of this technology is the Foxboro 871DO-C sensor (see Figure 2).

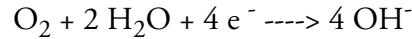
The 871DO-C Sensor is a **three electrode polarographic** sensor type; a very stable external polarizing voltage from an 873DO Analyzer is applied between the working and reference electrodes. The applied voltage is selective for the reduction of oxygen. Current results from the reaction and is measured between the auxiliary and working electrodes.

The 871DO-C Sensor is based upon the **Clark principle**. The membrane covering the electrode elements also controls selectivity for oxygen. The membrane is permeable to gases only, so proteins, micro-organisms, and ions cannot interfere with the oxygen measurement. The membrane used on 871DO-C sensors is a composite membrane made of Teflon, stainless steel mesh and dimethyl silicone rubber.

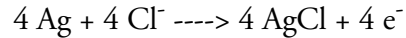
Oxygen from the process sample permeates the membrane material and diffuses through a very thin layer of electrolyte to the gold working electrode where it is reduced to hydroxyl ions. Electrons necessary for the reaction are provided by the silver auxiliary electrode. A potassium chloride electrolyte is utilized in the 871DO-C sensor.

The resulting sensor reactions are:

**Work Electrode:**

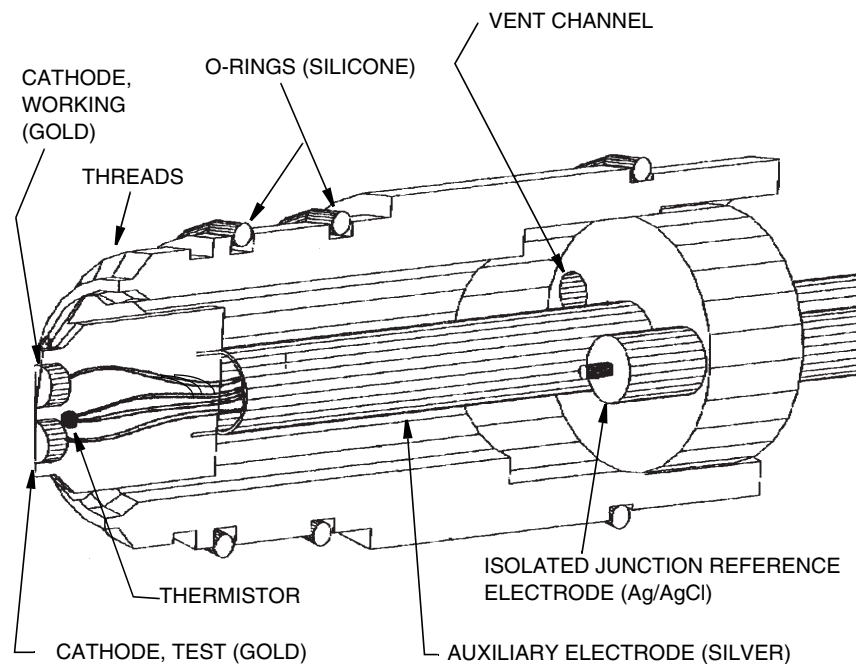


**Auxiliary Electrode:**



The partial pressure of oxygen at the membrane surface determines the rate of diffusion, and consequently the rate of reduction, and the current output from the sensor. At any given temperature, the current which is measured is directly proportional to the oxygen outside of the membrane. A 100 k $\Omega$  thermistor is also incorporated into the sensor. The signal from this transducer is used for temperature measurement and compensations. The 873DO Analyzer uses this signal to provide corrected ppm values based on fresh or salt water samples.

The 871DO-C Sensor also utilizes a fourth electrode, a Test electrode, to provide sensor diagnostic capabilities. When used with the 873DO Analyzer, membrane fouling may be detected. The 873DO Analyzer may also define and interpret changes in the DO electrolyte resulting from membrane breakage. A third diagnostic in the analyzer circuitry can detect the presence of excess trapped air bubbles in the electrolyte or a buildup of excess AgCl on the auxiliary electrode.



*Figure 2. 871DO-C Dissolved Oxygen Sensor (Shown with Membrane Cap Removed) - Internal Components*



# 2. Installation

## Sensor Mounting

### General Installation Guidelines

— **NOTE** —

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All piping techniques should be in compliance with standard and acceptable practices.

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

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 (the membrane should stay wetted at all times).
- ◆ Flow velocity at the sensing area does not cause cavitation at the membrane. Placement of a sensor in a weir is recommended in extremely turbulent aeration basin installations.
- ◆ Position and orientation of the sensor does not trap air bubbles within the sensing area.
- ◆ Orientation of the sensor is in the vertical position (with the membrane at the bottom). However, the sensor will operate up to 50° from vertical (do *not* install the sensor in upside-down position).
- ◆ Accessibility for maintenance is considered. A flow-type installation must have blocking valves (user supplied) to allow for maintenance.
- ◆ Deposits of sediment or other foreign material do not accumulate within the membrane area.
- ◆ If cable is installed in metal conduit (recommended), either flexible conduit should be used or some other provision made for the removal of the sensor from the process.
- ◆ During the electrochemical reduction of oxygen, the sensor consumes oxygen. An adequate exchange volume must be maintained in the vicinity of the membrane to prevent local depletion of oxygen and erroneously low readings. Between 2 and 4 meters/minute is the minimum recommended linear flow velocity in tees, tanks, or weirs. Between 1 and 1-1/2 liters/minute is the minimum flow required in a flow cell installation.

## Submersion/Immersion Installations

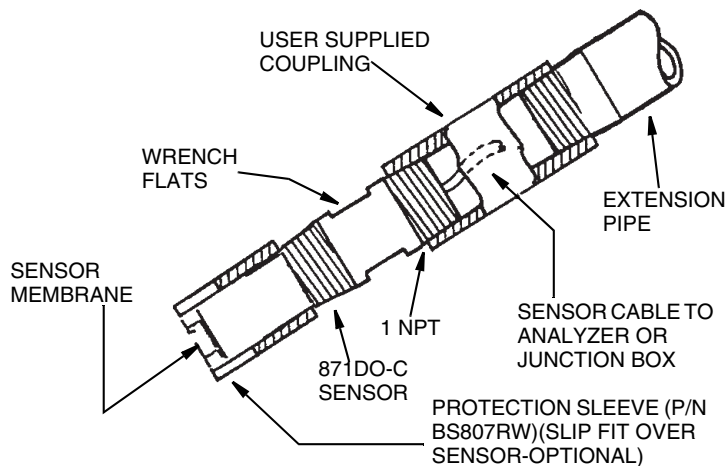
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### NOTE

All piping techniques should be in compliance with standard and acceptable practices.

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The electrode protection sleeve (Figure 3) protects the membrane from contacting the bottom or side of a tank. This PVDF sleeve is applicable to submersible installations.



*Figure 3. Submersion/Immersion Mounting*

1. Slide an electrode protection sleeve (optional) over the electrode end of sensor and tighten set screw.

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### NOTE

Do not use electrode protection sleeve if ECS cleaner is used.

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2. Wrap Teflon tape around the upper and lower 1 NPT threads of the sensor.
3. Attach a user-supplied 1-in (internally threaded on both ends) coupling to the upper threads on the sensor. The maximum torque specification for the 871DO-C sensor is 31 N·m (23 lb-ft).
4. Feed the sensor cable (and connector, if used) through length of 1 NPT externally threaded pipe (user supplied).

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### NOTE

A metal pipe is recommended when a submersible ECS cleaner is used. PVC pipe (schedule 80) is acceptable for single sensor submersion or immersion applications.

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5. Thread the pipe into the upper threads of the coupling attached to the sensor.
6. It is suggested that a second coupling (1 inch to desired size internally threaded) be installed on the upper end of the extension pipe. The upper portion of the pipe should be sealed to prevent ingress of water if installation is outdoors. Half-inch flexible conduit is recommended for use with the 873 Analyzer.
7. See “Analyzer Wiring” on page 29 for sensor lead connections to the analyzer.



## Assembly and Installation of Extension Pipe With Stainless Steel Rail Mounting Assembly (Part No. BS806KN)

1. Assemble each extension arm to rail mounting plate using the hardware provided. Each arm should use 2 hex bolts, 2 flat washers, 2 lock-washers, and 2 hex nuts. The extension arms must be assembled with the row of 6 holes placed on the bottom. The flat side (without flange) of the rail mounting plate should face the extension arms. The rail mounting plate should be assembled with 6 holes on top (see Figure 4). Tighten all nuts home with socket wrench.
2. Using two 2-in U-bolts and hardware provided (flat washer, lockwasher, and hex nuts), attach mounting assembly to upper horizontal rail loosely. The rail mounting plate with extension arms should face the tank and be located on the inside of the rail (tank side). See Figure 5.

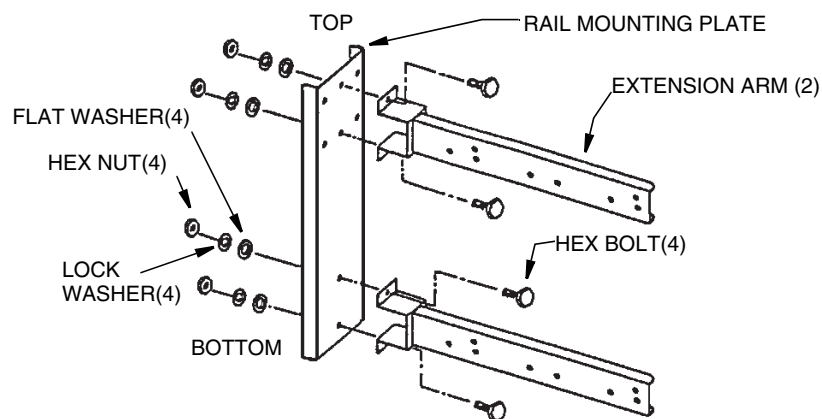
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### NOTE

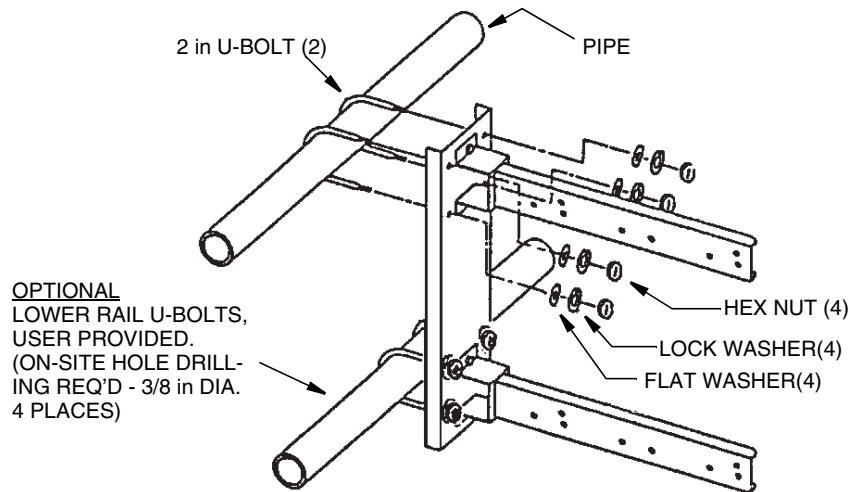
In aeration basins with turbulent flow, additional lower rail clamping is strongly advised.

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3. Determine which set of holes on extension arms will provide adequate clearance of tank wall when extension pipe is installed. The extension pipe may be mounted in a vertical position, or at a 21° angle from the vertical. For angle mounting, use inner holes on upper extension arm, and outermost holes on lower arm.
4. Pivot rail mounting assembly 90°; the extension arms should be directed upright over the rail.

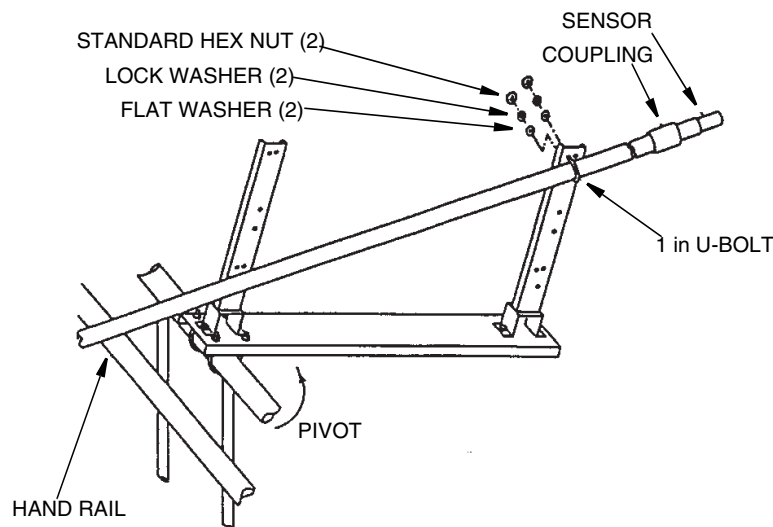


*Figure 4. Assembly of Extension Arm to Rail Mounting Plate*



*Figure 5. Assembly of Rail Mounting*

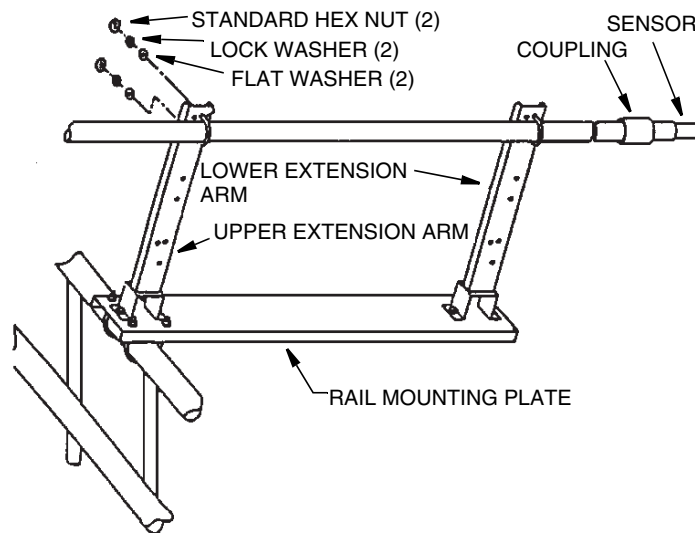
5. Bring extension pipe with installed sensor toward lower extension arm (flat side). Fasten 1-in U-bolt around extension pipe (behind coupling) to lower extension arm (in desired location) with hardware provided (flat washer, split lockwasher, standard hex nut). Fasten loosely to allow for depth adjustment. See Figure 6.



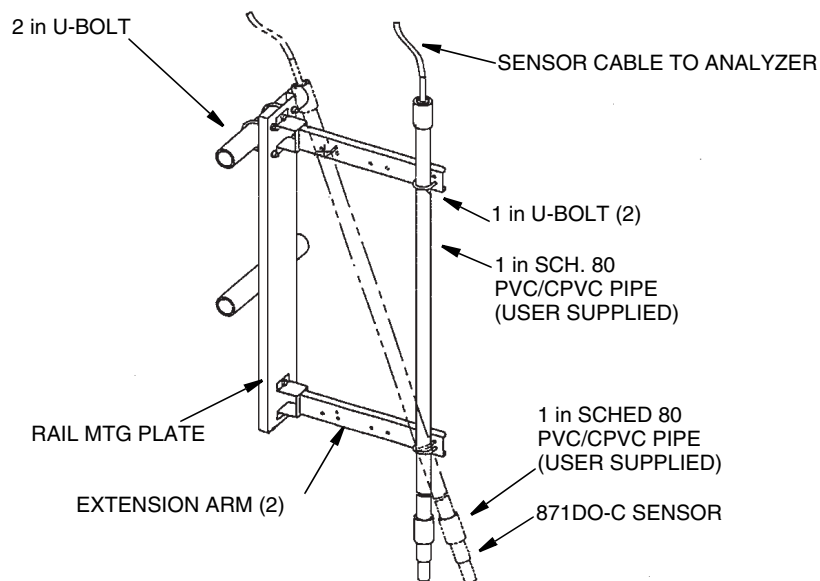
*Figure 6. Attachment of Pipe to Lower Extension Arm*

6. Lift extension pipe to desired position beside upper extension arm. Fasten to extension arm loosely using 1-in U-bolt and hardware provided (flat washer, split lockwasher, standard hex nut). Fasten loosely to allow for insertion depth adjustment. See Figure 7.
7. Slide extension pipe and sensor half way down length of extension pipe and tighten upper extension arm U-bolt.

8. Pivot attached extension pipe and rail mounting assembly forward until the bottom of the rail plate rests on the lower rails. Ensure adequate clearance has been determined while pivoting the assembly.
9. Tighten upper rail U-bolt clamps (2).
10. Carefully loosen upper extension arm U-bolt clamp and adjust sensor height immersion to proper depth. It is recommended that the sensor be submersed one foot beneath the water's surface.
11. Tighten standard nuts on upper and lower U-bolt clamps to affix extension pipe at desired position. See Figure 8.



*Figure 7. Attachment of Pipe to Upper Extension Arm*



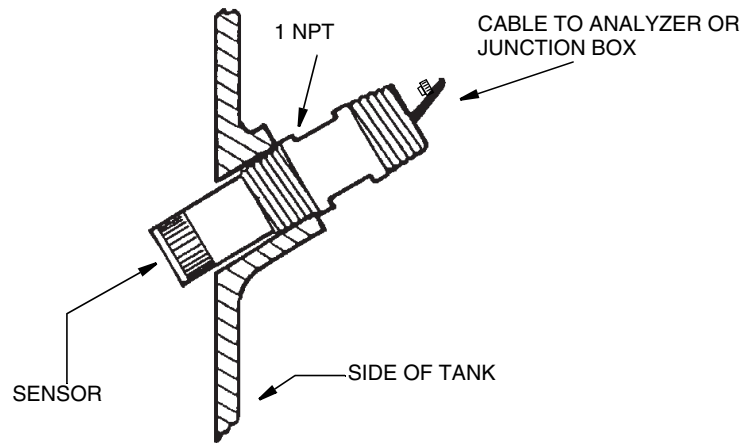
*Figure 8. Completed Assembly*

## Insertion Installations Using Lower Sensor Threads

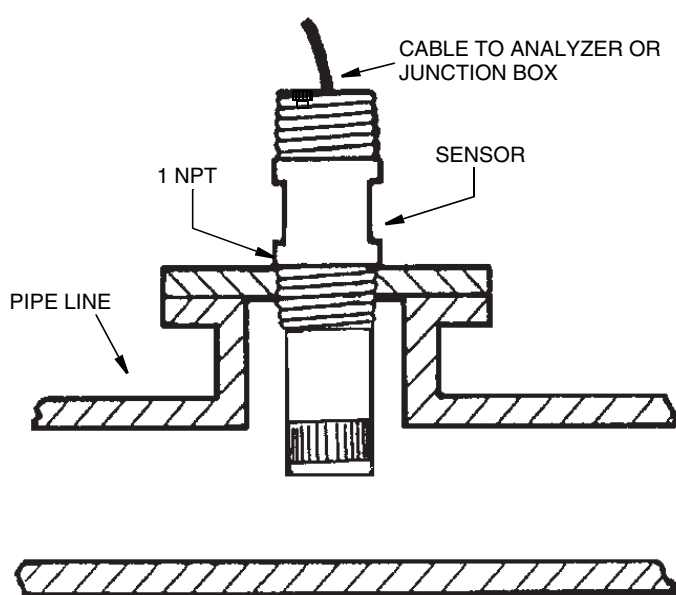
### — NOTE —

All piping techniques should be in compliance with standard and acceptable practices.

1. Wrap Teflon tape on 1 NPT threads of sensor.
2. The maximum torque specification for the 871DO-C Sensor (see Figure 9 and Figure 10) is 31 N·m (23 lb·ft).
3. Leave sensor leads unconnected until sensor is installed.
4. See “Analyzer Wiring” on page 29 for sensor lead connections.



*Figure 9. Side of Tank/Vessel Mounting*



*Figure 10. Pipe Mounting*

# Insertion Installation Using Bushing

**— NOTE**

All piping techniques should be in compliance with standard and acceptable practices.

Bushings (Figure 11 and Figure 12) are used to mount sensors in a system that has process piping larger than the external 1 NPT connection of the sensor. Bushings are offered with external 1-1/4 in or 1-1/2 in external NPT connections, and are available in either 316 ss, PVDF, or CPVC. Refer to Table 2 for bushing specifications.

1. Wrap Teflon tape on 1 NPT threads of sensor.
2. The maximum torque specification for the 871DO-C Sensor is 31 N·m (23 lb·ft).
3. Leave sensor leads unconnected until sensor is installed.
4. See “Analyzer Wiring” on page 29 for sensor lead connections.

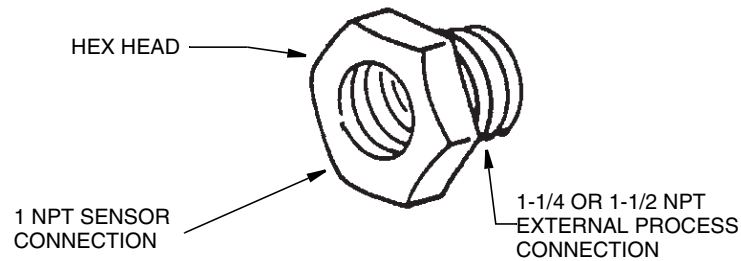


Figure 11. Bushing Specifications

Table 2. Foxboro Bushings

Bushing Material	Process Connection	Part Number
316 ss	1 1/4 NPT	BS805TD
	1 1/2 NPT	BS805TF
PVDF	1 1/2 NPT	BS805TG
CPVC	1 1/4 NPT	BS805TE
	1 1/2 NPT	BS805TH

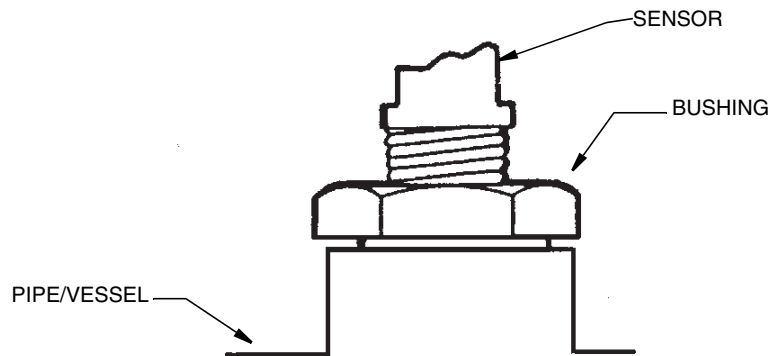


Figure 12. Bushing Installation

# Flow-Through Installation Using Tee

**NOTE**

All piping techniques should be in compliance with standard and acceptable practices.

A tee (Figure 13) is used for flow-through installations in a pipe line. The sensor connection end and process inlet and outlet ports have internally threaded ends for the 316 ss and PVDF Tee materials, and internal pipe socket weld connections for the CPVC Tee material. Reducing bushings are used on the sensor end, and also on the process ends (as required) to accommodate the 1 NPT sensor and various process connection sizes. Refer to Table 3 for Tee specifications.

1. Wrap Teflon tape on 1 NPT threads of sensor.
2. The maximum torque specification for the 871DO-C Sensor is 31 N·m (23 lb·ft).
3. Leave sensor leads unconnected until sensor is installed.
4. See “Analyzer Wiring” on page 29 for sensor lead connections.

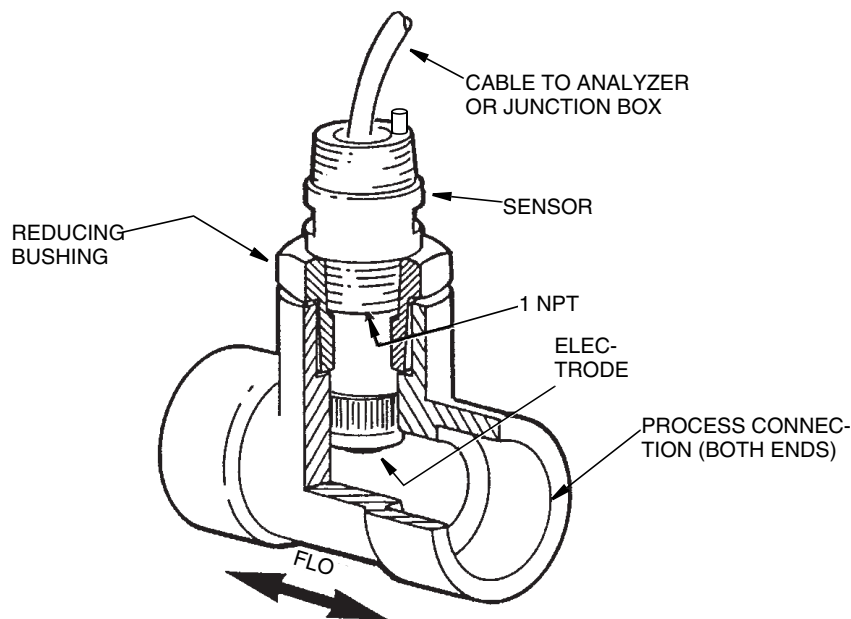


Figure 13. Tee Application

Table 3. Foxboro Tees

Tee Material	Process Connections	Part No.
316 ss	1 NPT 1 1/4 NPT 1 1/2 NPT	BS805SV BS805SY BS805TA
PVDF	1 NPT 1 1/2 NPT	BS805SW BS805TB
CPVC	33 mm (1.3 in) I.D.(a) 41 mm (1.6 in) I.D.(a) 48 mm (1.9 in) I.D.(a)	BS805SX BS805SZ BS805TC

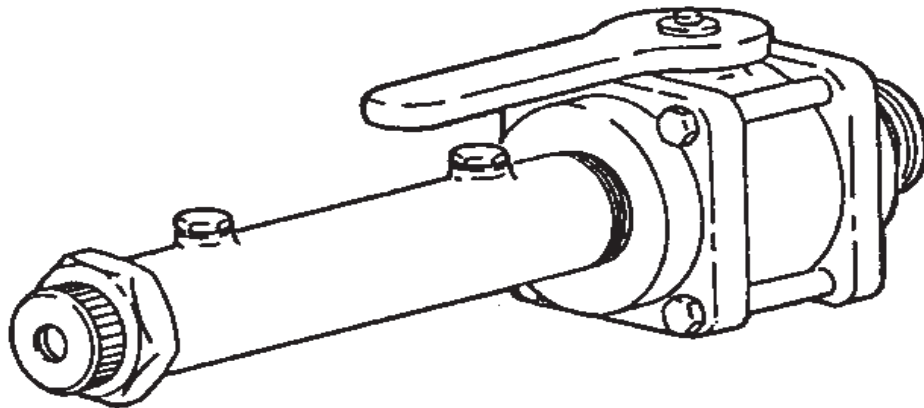
(a) Pipe socket weld.

## Installation Using Ball Valve Assembly

The ball valve assembly (Figure 14) permits an 871DO-C Sensor to be inserted and removed from a process stream or tank under rated temperature and pressure without draining the system or resorting to a bypass arrangement. A ball valve assembly consists of the ball valve unit and an insertion shaft assembly; both support a sensor in a stream. A standard flexible conduit (user provided) can be used for cable protection. For additional information, refer to Table 4.

A ball valve assembly installation must meet mounting arrangements specified under “General Installation Guidelines” on page 15 as well as the following requirements:

- ◆ Direct the flow of the solution (as much as possible) toward the sensing area.
- ◆ Provide space for removal of the sensor from the ball valve unit. Refer to applicable dimensional prints.



*Figure 14. Purgeable Ball Valve Assembly (Part No. BS806AN Illustrated)*

# Assembly of Sensor to Shaft Assembly

**NOTE**

This procedure is for a **new** installation. The process stream, or tank, is unfilled and unpressurized.

1. Feed the sensor cable through the shaft assembly, wrap Teflon tape on the threads of the shaft assembly, and join (finger tighten) the shaft assembly to the end of the sensor (see Figure 15).
2. Lightly lubricate the shaft with silicone grease (or equivalent).

**CAUTION**

Do not nick the O-rings. Do not get oil on membrane.

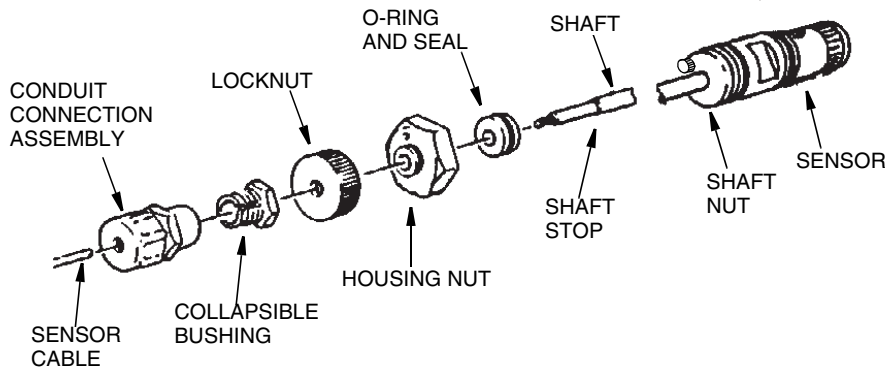


Figure 15. Assembly of Shaft Assembly

Table 4. Ball Valve Assembly Specifications

Materials of Process Wetted Parts(a)				Rated Pressure(b)		Maximum Temperature (b) at Rated Pressure		Process Line Connection	Part Number
Process Connection and Housing	Ball Seat	Ball Valve	O-Ring						
316 ss	ptfe	Glass-Filled Polypropylene	Viton	0.7	100	20	70	1 1/2 NPT	BS806AN
				0.52	75	65	150		
Titanium	ptfe	Kynar	Viton	1.6	230	20	68	1 1/2 NPT	BS806EP
				1.0	145	60	140		
				0.35	50	140	284		

(a) Refer to Global Customer Support for other materials.

(b) Actual application rating may be reduced by sensor pressure/temperature rating.



## Ball Valve Assembly Installation Procedure

### ⚠ WARNING

Personnel should stand to the side, not directly behind the assembly, during insertion and removal of the sensor.

1. Turn the handle on top of the ball valve unit (see Figure 17) to the **close** position (indicated by an arrow on the handle).
2. Fill and pressurize the process line or tank as required. Check for and eliminate leaks.

### ⚠ CAUTION

Do not exceed the sensor or ball valve temperature and pressure limits.

3. Gently insert the sensor into the housing isolation chamber until the O-ring and seal are seated into the end of the isolation chamber (see Figure 16).

### ⚠ CAUTION

Do not nick the O-rings. Do not force the electrodes against the closed ball valve.

4. Tighten the housing nut onto the end of the isolation chamber.

### — NOTE

The housing nut is supplied lubricated and should be relubricated periodically to prevent galling.

5. Slowly turn the handle on top of the ball valve unit (see Figure 17) to the **open** position (indicated by the arrow on top of the handle).
6. Check for and eliminate leaks.
7. Insert the shaft slowly until the locknut reaches the housing nut. Tighten the locknut onto the housing nut.
8. Tighten the collapsible bushing against the locknut.
9. Assemble the conduit connection assembly to the collapsible bushing.

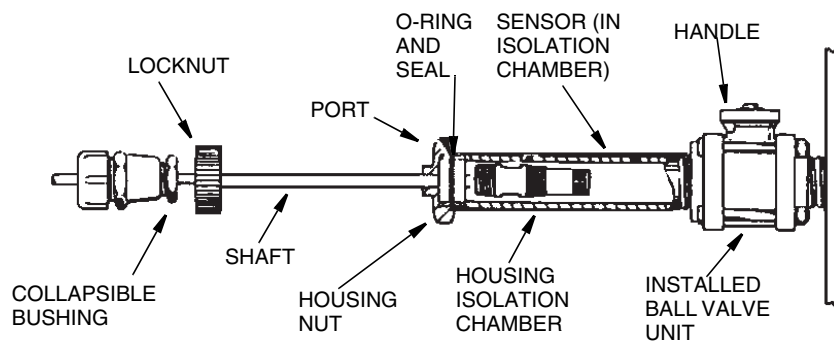
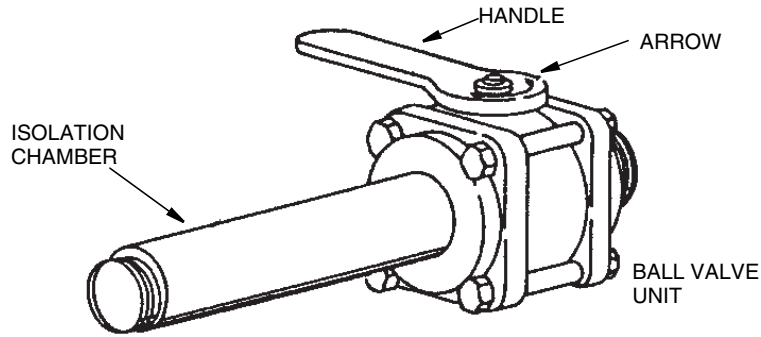


Figure 16. Ball Valve Shaft Installation



*Figure 17. Closing Ball Valve*

## Removal of Ball Valve Shaft and Sensor

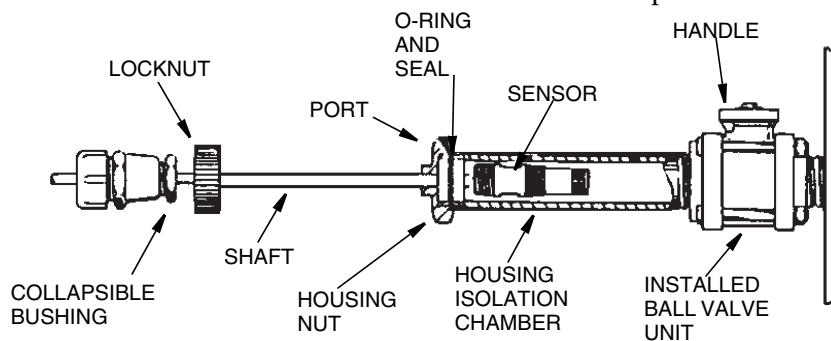
### **⚠ WARNING**

Do not loosen the **housing nut** (see Figure 18) when the ball valve unit is open and the process line or tank is filled and pressurized.

### **⚠ WARNING**

Personnel should stand to the side, not directly behind the assembly, during insertion and removal of the sensor.

1. Carefully loosen and detach the locknut only.
2. Position the sensor in the ball valve unit housing isolation chamber (see Figure 18). Draw the sensor back until it reaches a mechanical stop.



*Figure 18. Ball Valve Shaft Removal*

3. Turn the handle on top of the ball valve unit (see Figure 18) to the close position (indicated by the arrow on top of the handle).

### **⚠ CAUTION**

Do **not** loosen the housing nut if a continuous leakage is observed through the port on the housing nut.

4. Slowly loosen and detach the housing nut. Withdraw the shaft assembly from the housing isolation chamber.

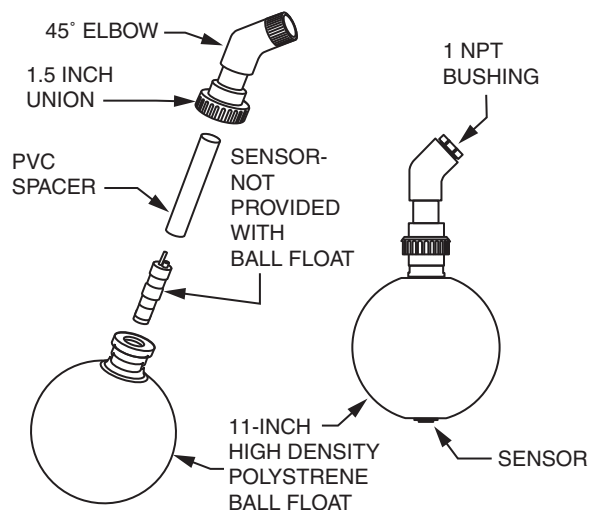
### **CAUTION**

The housing isolation chamber is normally filled with process during operation. Be careful when removing the sensor.

## Installation Using Ball Float Accessory

The BS808NT Ball Float Assembly is comprised of an 11 inch (280 mm) polystyrene ball float, a PVC spacer, and a 45° elbow fitting for threading onto a pipe. See Figure 19. To install your sensor into this accessory:

1. Feed the sensor cable through the spacer and the elbow fitting.
2. Insert the sensor and then the spacer into the ball float as far as possible.
3. Attach the elbow fitting using its 1.5 inch union.



*Figure 19. Ball Float Accessory*

4. Feed the cable through the (user supplied) extension piping.
5. Thread the pipe into the 1 NPT bushing using care to ensure full thread engagement.
6. Using rail mounting (see page 17) or other method, attach the extension pipe to the handrail. The pipe must be able to float freely with changes in tank height. It is also recommended that you provide hardware to prevent the pipe with attached float from rolling left or right.



# 3. Sensor Wiring

## Analyzer Wiring

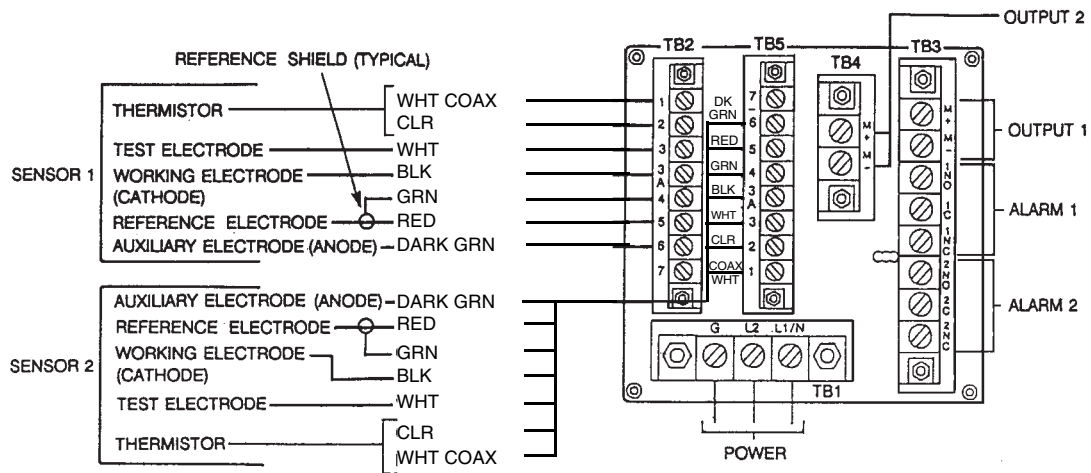


Figure 20. Analyzer Wiring - Plastic Version

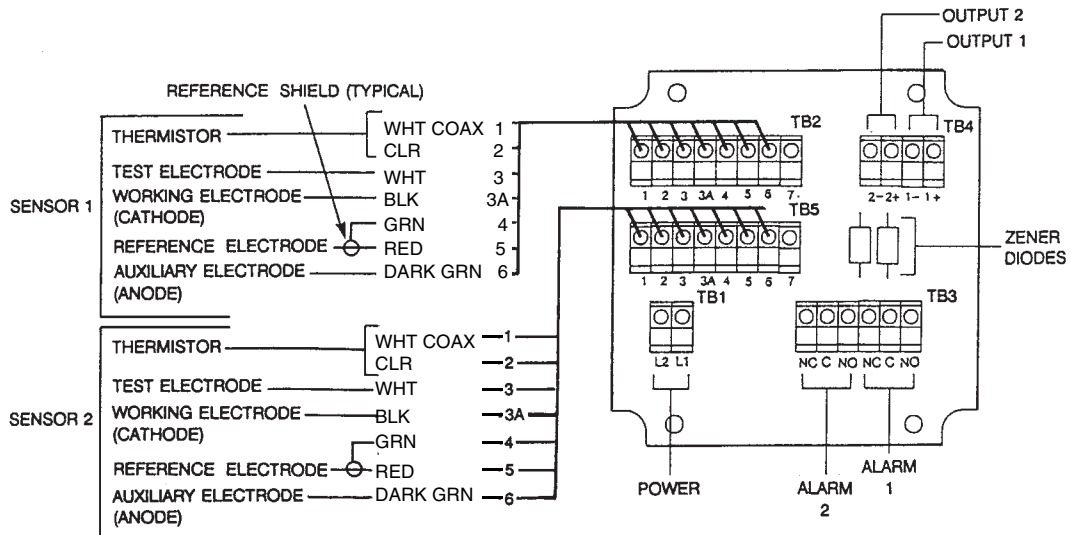


Figure 21. Analyzer Wiring - Metal Version

# Cable Configurations

Figure 22 shows that the maximum allowable cable length when wiring the 871DO-C Sensor with extension cables, junction box, or extension cables with connectors is 150 m (500 ft) total.

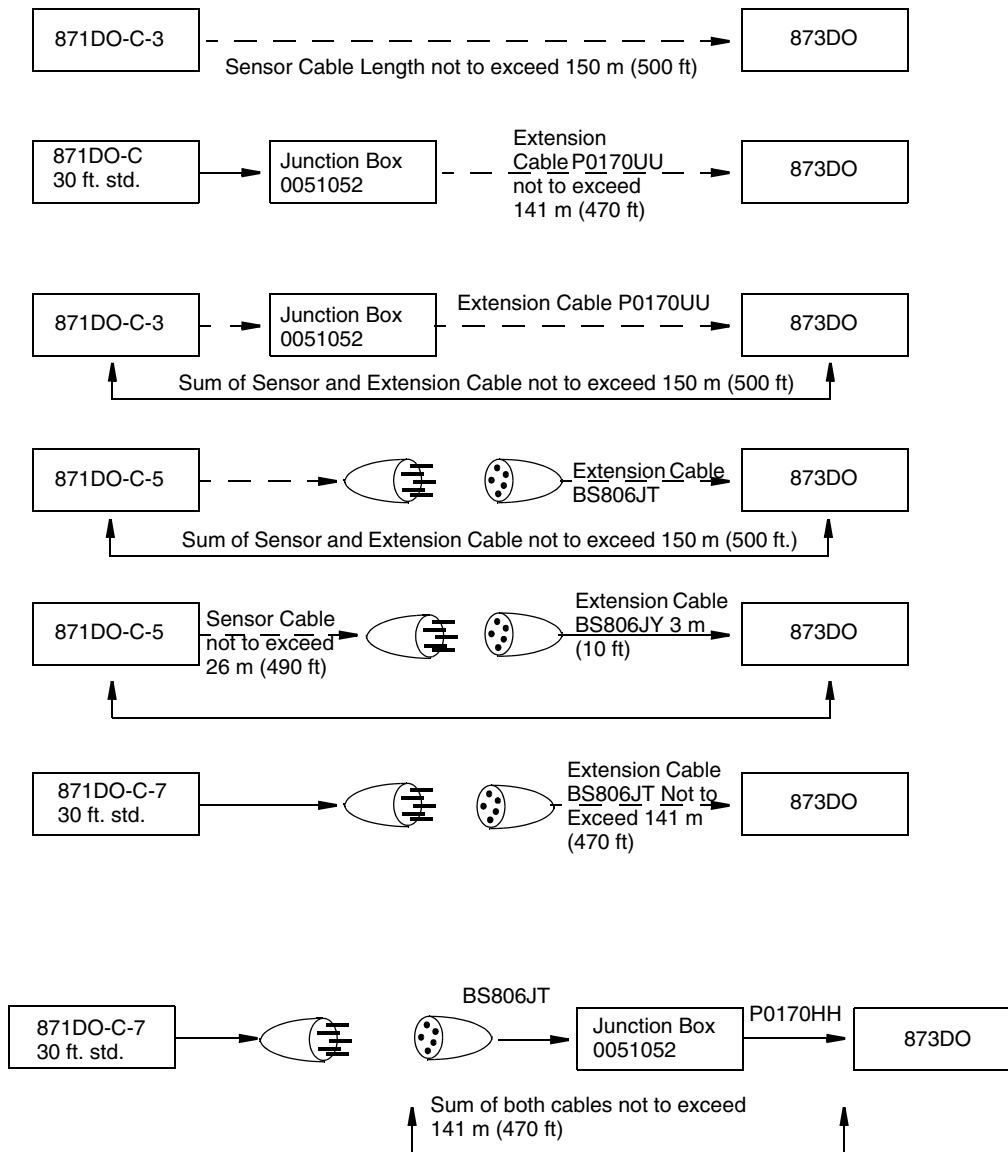
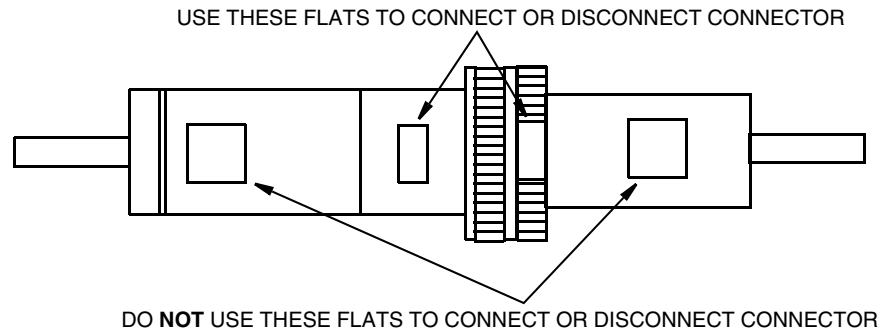


Figure 22. Cable Configurations

## Extension Cable With Connectors

When connecting or disconnecting sensor and extension cable connectors, only use the flats closest to the connection (specified in Figure 23). Using the flats closest to the cable can damage the connection and voids the warranty.



*Figure 23. Cable Connectors*

## Junction Box

The junction box (Figure 24) provides for connecting the sensor assembly cable to the extension cable. See previous section. These junction boxes are weatherproof and dusttight as defined by IEC IP65 and provide the watertight protection of NEMA Type 4. Specify Part No. 0051052.

## Junction Box Mounting

### **CAUTION**

Cable length must be considered so that connections can be made without exposing the cable to damage.

1. Select a rigid surface and a position protected from damage or exposure to excessive moisture or corrosive fumes.
2. Position junction box against mounting surface and mark location of mounting holes.
3. Drill mounting holes on the marked centers.
4. Mount the junction box with appropriate hardware (user supplied).

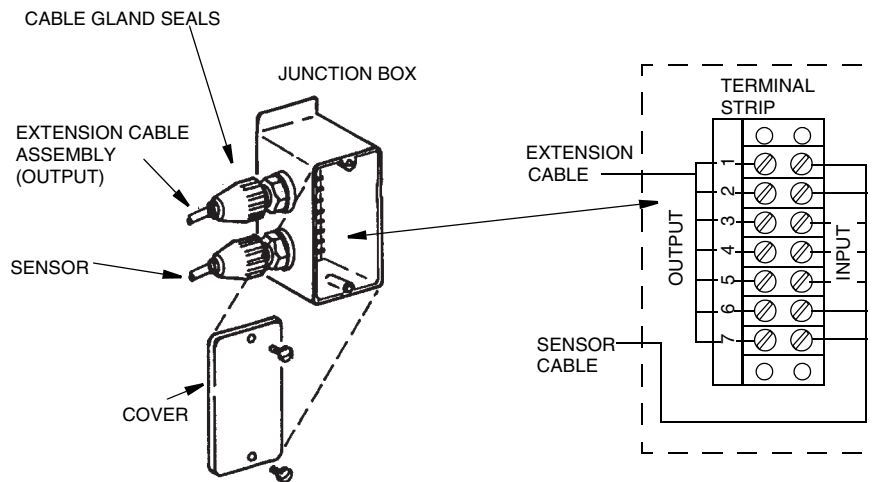
# Junction Box Wiring

1. Remove the junction box cover and loosen the cable connectors (see Figure 24).
2. Insert sensor cable through the appropriate gland seal and connect numbered terminals of the sensor cable to numbered terminals on the terminal strip as shown in Table 5.

*Table 5. Wiring Connections*

Cable No.	Sensor Wire Color	Extension Cable Color	Function	Junction Box Terminal No.
1	White Coax	White Coax	Thermistor	1
2	Clear	Coax Shield	Thermistor	2
3	White	White	Test Electrode	3
3A	Black	Black	Working Electrode	4
4	Green	Outer Shield	Ground	5
5	Red	Red	Reference Electrode	6
6	Dark Grn	Dark Green	Auxiliary Electrode	7

3. Insert extension cable assembly through appropriate connector and connect the numbered terminals of extension cable assembly as shown in Figure 24.



*Figure 24. Junction Box Wiring*



# 4. Maintenance

## Sensor Inspection

Fouling (the buildup of a film) on the sensor membrane can cause a decrease in output current or an erratic signal. Torn or broken membranes may cause high and erratic output currents. It is suggested that an inspection of the sensor once a week for new installations until the required maintenance schedule for the particular installation is established. Inspect the sensor when readings are suspect. If fouling of the membrane is evident, clean the sensor as described in “DO Sensor/Membrane Cleaning” on page 34. If membrane damage (tears, pinholes, rips) are observed, replace the membrane cap assembly.

*Table 6. Membrane Replacement Kits*

<b>Kit Number B5807RU - 1 Membrane Kit</b>	
<b>Quantity</b>	<b>Description</b>
1	membrane
1	50 ml bottle electrolyte with MSDS <sup>a</sup>
1	vent cap
1	polishing disc
1	instruction
1	membrane protection cap
<b>Kit Number B5807RV - 3 Membrane Kit</b>	
<b>Quantity</b>	<b>Description</b>
3	membranes
3	50 ml bottle electrolyte with MSDS <sup>a</sup>
3	vent caps
3	polishing disc
1	instruction
3	membrane protection caps

(a) MSDS = Material Safety Data Sheet

## DO Sensor/Membrane Cleaning

### **CAUTION**

Handle the sensor and membrane carefully to avoid damage to the composite membrane.

Rinse the sensor, with membrane cap assembled, with clean water. Blot the electrode with a soft cloth or tissue. Inspect the membrane.

Coatings of foreign material may be removed by gently wiping the electrodes with a soft tissue or cloth. Inspect the membrane.

More tenacious coatings may be removed by soaking the assembled sensor in a dilute detergent/water mixture. Gently rinse and blot the sensor with a soft cloth or tissue. Inspect the membrane.

### **NOTE**

Mechanical cleaning of the membrane with abrasives is not recommended.

If coating persists, or membrane damage is evident, membrane and electrolyte replacement is required.

## Membrane and Electrolyte Replacement

The membrane cap and electrolyte are designed to provide troublefree operation for up to three months. To ensure maximum life and optimum performance, It is also recommended that the sensor be inspected, cleaned, and calibrated at one month intervals.

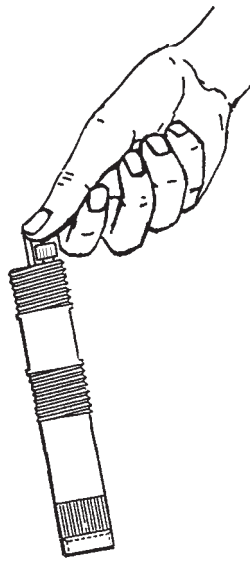
Membrane and electrolyte changes are required when:

- ◆ the response of the sensor is slower than usual, especially after many months of use;
- ◆ the dissolved oxygen sensor calibration or readings exhibit greater than normal drift, especially after many months of use;
- ◆ the dissolved oxygen sensor is stored for any length of time at temperatures in excess of its operating limits;
- ◆ the membrane of the dissolved oxygen sensor is physically damaged;
- ◆ the membrane of the dissolved oxygen sensor remains fouled after cleaning procedures were implemented.

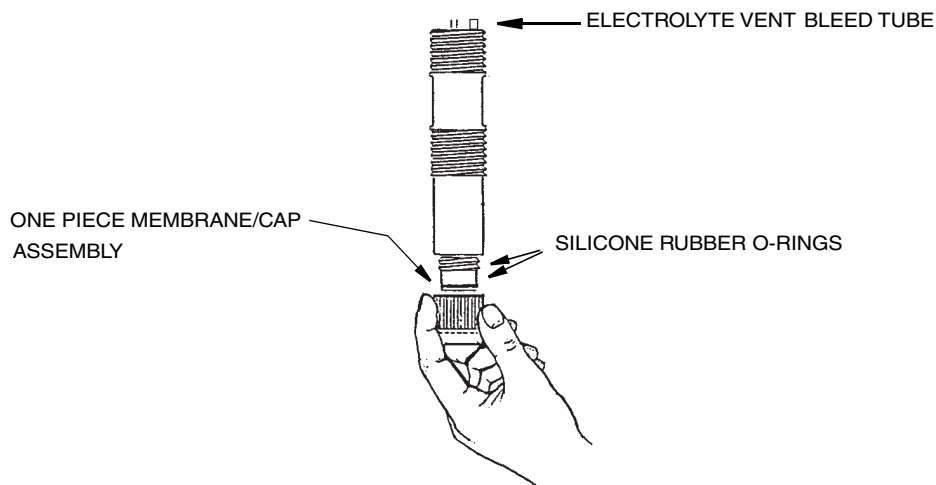
When it is necessary to change the membrane or electrolyte, the following procedure should be used.

1. Remove sensor from installation.
2. Unscrew and remove electrolyte vent cap located on top of sensor body. See Figure 25. The electrolyte vent bleed tube will be exposed.
3. While holding the sensor assembly vertical (see Figure 26), unscrew the membrane cap assembly from the sensor body. Discard the old membrane cap assembly. To remove old electrolyte, shake sensor down (like a clinical thermometer).

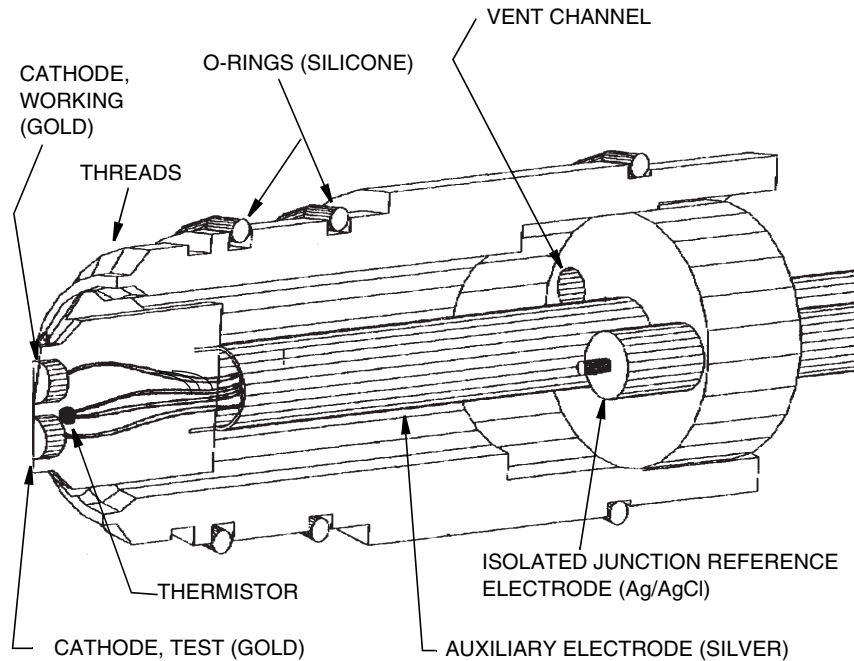
4. Flush the sensor body and electrolyte vent bleed tube (shown in Figure 26) with clean tap water. Ensure that the vent bleed tube is free flowing by seeing that water flows easily through the electrode. Dry assembly with a lintfree cloth or tissue.
5. Inspect O-rings for nicks or wear. Remove and discard damaged O-ring(s) (Part No. X0145CL). (See Figure 26.)
6. Before installing a new O-ring or membrane cap, inspect the Test and Working electrodes for nicks or tarnish. (See Figure 27 for location of Test and Working electrodes.) If either is present, remove by polishing with a wet polishing disc (Part No. XS004DX). Rub gently in a single linear direction. Turn 90° and repeat procedure. A crosshatch pattern should result. Rinse with clean water. Dry assembly with a lintfree cloth or tissue.
7. Replace O-rings (Part No. X0145CL) if necessary. Place O-rings in grooves, ensuring proper seating.



*Figure 25. Removal of Vent Screw*



*Figure 26. Membrane Cap Removal*



*Figure 27. Location of Work and Test Electrodes and Vent Channel*

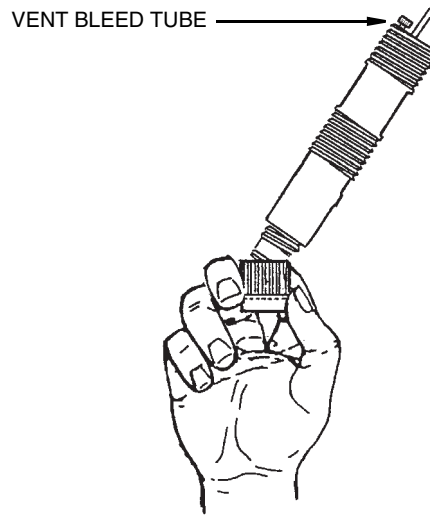
8. Fill a new membrane cap assembly with fresh electrolyte. Tap the cap to release any trapped air bubbles. Allow them to rise to the surface. Refill cap to the top. The sensor holds approximately 9 ml electrolyte.

**CAUTION**

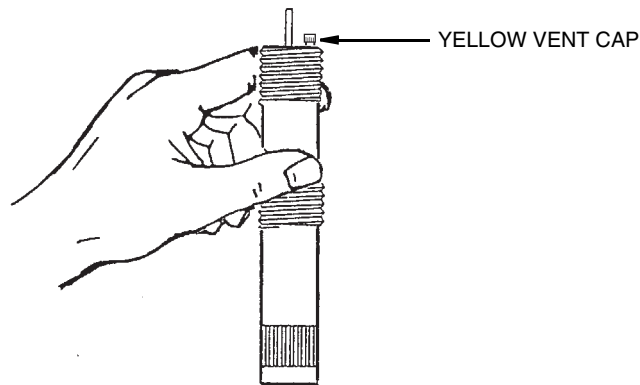
Proper operation of probe requires that no air be entrapped in the probe when filled.

9. Holding the sensor at a slight angle with the vent bleed tube aligned upright, slowly insert the sensor body into the membrane cap so excess electrolyte and any remaining trapped air escapes through the vent hole. See Figure 28.
10. Straighten the sensor body and screw the membrane cap to the sensor body; snug to finger-tight. Check the membrane for evidence of trapped particles. (Silver chloride may flake off of the auxiliary electrode.) If any particles appear, remove the membrane cap assembly, rinse with clean water, shake to remove excess water, and refill with fresh electrolyte. Repeat Steps 8 and 9.
11. Install vent cap on vent bleed tube and tighten down finger tight (see Figure 29).
12. Leaving sensor wired to powered 873DO, allow sensor to “polarize” at least 15 minutes before attempting to standardize. During this period, excess oxygen in the thin film between the membrane and working electrode is electrochemically reduced. Ensure that the sensor current is stable before standardization is attempted. Shelter sensor from direct sunlight during this period and during air calibration to minimize temperature fluctuations.

13. Consult your analyzer instructions for complete calibration/standardization procedures. **The Sensor must be recalibrated after replacing the electrolyte and/or membrane.**



*Figure 28. Replacement Membrane Installation and Venting*



*Figure 29. Replacement of Vent Cap*



# 5. Troubleshooting

## Troubleshooting Using the 873DO Analyzer

When the 871DO-C Sensor is used with the 873DO Analyzer, troubleshooting is simple. Various error codes alert the user to sensor problems. If diagnostics on the 873DO are used, refer to Table 7 to aid in remedying the problem.

*Table 7. 873DO Error Codes*

Error Code	Cause	Remedy
COAt	Sensor membrane has become coated with a film.	1. Clean membrane. 2. Replace membrane (see Maintenance section).
CAP	Sensor membrane has become damaged. Ingress of process into electrolyte reservoir.	1. Replace membrane (see Maintenance section). 1. Examine membrane; replace if necessary. 2. Replace electrolyte (see Maintenance section).
bubL	Loss of electrolyte.  Excess AgCl buildup on auxiliary electrode.	1. Examine membrane; replace if necessary. 2. Replace electrolyte.  1. Replace sensor (see Maintenance section).

# Additional Sensor Troubleshooting

Additional problems may occur with the 871DO-C Sensor that might be undetectable using the 873DO Analyzer alone. For identification of these problems and corrective actions, see Table 8.

*Table 8. Problem Identification and Correction*

<b>Problem</b>	<b>Possible Cause</b>	<b>Remedy</b>
Reading Sensitive to Sensor Motion	Recent membrane cap replacement, bubble present	1. Allow more time before standardizing sensor.
Temperature Reading is Incorrect	Calibration incorrect on 873DO  Thermistor or broken wire in sensor  873DO Analyzer problem	1. Adjust tCF in 873DO software.  1. Check sensor leads 1 and 2. 2. Replace sensor if necessary.  1. Verify using resistance values given in Table 9 and Wiring in Section 3.
Slow Response	Electrolyte depleted Stretched membrane Sensor inoperative	1. Replace electrolyte. 1. Replace membrane cap. 1. Replace sensor.
Reading extremely high	Damaged membrane Application Interferent Ground Loop	1. Replace membrane cap. See below. 1. Replace electrolyte and membrane cap. 1. See below.
Reading extremely low	Cathode surface too smooth	1. Polish electrodes as described in “Membrane and Electrolyte Replacement” on page 34.
Sensors (dual). Calibrate ok in air but are erratic in process. May be reading much higher than expected.	Ground loop	1. Check membrane for leakage. Replace cap. 2. Check electrolyte vent tube for leakage. Reseal vent screw.

If you suspect a temperature problem, check thermistor resistance per Table 9. Measure resistance across leads 1 and 2 with an ohmmeter.

*Table 9. Thermistor Resistance*

<b>°C</b>	<b>°F</b>	<b>100 kΩ Thermistor Resistance</b>
-5	23	461.550 k Ω
0	32	351.020 k Ω
10	50	207.850 k Ω
20	68	126.740 k Ω
25	77	100.000 k Ω
30	86	79.422 k Ω
40	104	51.048 k Ω
50	122	33.591 k Ω
60	140	22.590 k Ω
70	158	15.502 k Ω
80	176	10.837 k Ω
90	194	7.077 k Ω
100	212	5.5693 k Ω
105	221	4.7604 k Ω
110	230	4.0829 k Ω
120	248	3.0334 k Ω
130	266	2.2811 k Ω
150	302	1.3319 k Ω





**ISSUE DATES**

FEB 1993	APR 2001
JUL 1995	JUL 2005
APR 1996	FEB 2016
JAN 1997	

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