FOXBORO®

Instruction

MI 611-151
July 1997

871CC Contacting Conductivity/Resistivity Sensors and Accessories

SIEBE®
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1. Introduction

General

The 871CC Sensors are used with Foxboro 873RS, 873CC, 873ARS and 873ACC Analyzers, 870ITCR Intelligent Transmitters, and 872 and 874 Electrochemical Monitors, or 870CC Contacting Conductivity Transmitters. These sensors measure the conductivity or resistivity of a solution by applying alternating wave and form across a set of electrodes which are in actual contact with the process fluid.

Reference Documents

Document Number*	Description
MI 611-157	870CC Transmitters (Contacting Conductivity)
MI 611-166	873CC Series Electrochemical Analyzer for Contacting Conductivity
MI 611-168	873RS Series Electrochemical Analyzer for Resistivity Measure
MI 611-192	Ace Series Electrochemical Analyzer for Contacting Conductivity
MI 611-194	Ace Series Electrochemical Analyzer for Resistivity
DP 611-131	871CC Contacting Conductivity Sensor 3/4 NPT Threaded Bushing (-A, -H)
DP 611-132	871CC Contacting Conductivity Sensor Universal Mounted (-B, -J)
DP 611-133	871CC Contacting Conductivity Sensor Sanitary Flange Mounted (-C)
DP 611-134	871CC Contacting Conductivity Sensor Insertion Type (-D)
DP 611-135	871CC Contacting Conductivity Sensor Twist-Lock Mounted (-E)
DP 611-091	Flow Chambers Used With Conductivity Sensors
DP 611-092	Flanges (316 ss) Used With Conductivity Sensors
DP 611-093	Twist-Lock Bushing (316 ss**) Used With Conductivity Sensors
DP 611-094	Twist-Lock Bushing (PVC) Used With Conductivity Sensors
DP 611-105	Universal Mounting Bushing Used With Conductivity Sensors
DP 611-117	Gate-Valve Assembly (GVI - 2)
DP 611-120	Gate-Valve Assembly
DP 611-136	871CC Contacting Conductivity Sensor With 3/4 NPT Threaded Bushing and 1/2 NPT Conduit Connection (-F)

* MI = Instruction; DP = Dimensional Print
**AISI Type 316 stainless steel.

Model Code

871CC=Contacting Conductivity or Resistivity Sensor(a)

Sensor Mounting and Transducer

–A	= Threaded Bushing, 3/4 NPT	Thermistor, 100 kΩ
–B	= Universal	Thermistor, 100 kΩ
–C	= Sanitary	Thermistor, 100 kΩ
–D	= Insertion	Thermistor, 100 kΩ
–E	= Twist-Lock	Thermistor, 100 kΩ
–F	= Threaded Bushing, 3/4 NPT with 1/2 NPT Conduit Connector	Thermistor, 100 kΩ
–G	= Dip Sensor	Thermistor, 100 kΩ
–K	= Threaded Bushing, 3/4 NPT, High Temperature(b)	RTD, 100 Ω
–L	= Sanitary, High Temperature(b)	RTD, 100 Ω
–M	= Insertion, High Temperature(b)	RTD, 100 Ω

Cell Factor and Electrode Material

2 = 0.1 cm^{-1}, Titanium
4 = 10 cm^{-1}, Graphite
6 = 0.1 cm^{-1}, Monel (Mounting Codes -A, -G, and -K only)

Optional Selections(c)

–3=Nonstandard Cable Length (Specify Length)(d)
–4=No Spade Lug Terminals Attached to End of Cable
–5=Nonstandard Length Integral Cable Terminated in Connector. Specify Length. For Mounting Codes -A and -G only.(d),(e)
–6=Integral Connector on Sensor. For Mounting Code -A only.(e),(f)
–7=Standard Length (6 m [20 ft]) Integral Cable Terminated in Connector. For Mounting Codes -A and -G only.(e),(f)
–9=Cell Factor Determined in Foxboro Pure Water Loop

Examples: 871CC-B2, 871CC-A4-34 (40 ft)

(a) When 871CC Series Sensor is used with 873RS, 873ARS, 873CC, or 873ACC Series Analyzer, or with 874RS or 874CC Monitor, Option Code –4 must be specified.
(b) The –K, –L, and –M sensors contain an integral 100 Ω RTD for automatic temperature compensation. This RTD is compatible with 873RS, 873ARS, 873CC, and 873ACC Series Analyzers, 870ITCR Series Transmitters, and the 872-30 Monitor. No temperature compensation can be applied when used with 870 Series Transmitters or 874 Series Monitors.
(c) Except for Option Codes -3 and -4 which may be combined (e.g. -34), only one Option Code may be specified. Option Code -9 can be combined with all other options.
(d) Maximum cable length for 870CC Transmitters: 30 m (100 ft): for 873RS, 873ARS, 873CC, and 873ACC Analyzers: 150 m (500 ft); for 874CC, 874RS, and 872-30 Monitors: 150 m (500 ft).
(e) Requires use of Patch Cord Part No. BS805UA or BS805UB.
(f) Not recommended for resistivity measurement.

Standard Specifications

Sensor Type	Electrode Contacting Conductivity or Resistivity Sensor
Cell Factor	0.1 cm^{-1} or 10 cm^{-1}, as specified
Measurement Range	See Table 1.
Cable Length	
Standard	6 m (20 ft)
Other lengths	
873A, 873, 872 or 874 Monitor,	Up to 150 m (500 ft)
870CC Transmitter	Up to 30 m (100 ft)
Temperature and Pressure Limits	See Table 1.
Temperature Compensation	See Table 1.
Process-Wetted Materials	See Table 2.

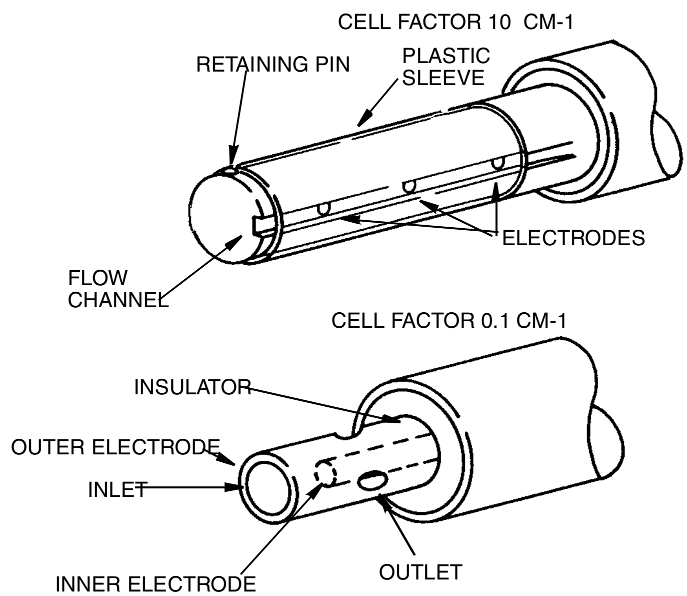

Figure 1. Sensors

Theory of Operation

871CC Sensors are "two electrode contacting conductivity sensors" used to measure conductivity or resistivity of process fluids. These measurement techniques are nonspecific; they cannot distinguish one ion type from another, but this technique has been used effectively, for example, to measure water purity or in the analysis of binary mixtures of electrolytes.

Conductance (or its reciprocal, Resistance) is an electrical property of solutions that arises from the presence of electrically charged ions in electrolytes. When a conductance cell is placed in this solution and an electrical potential is applied across its electrodes, a current flows as the ions migrate; the cations to the positively charged anode and the anions to the negatively charged cathode. In practice, a small amplitude alternating voltage is applied to prevent measurement errors due to electrolysis. The magnitude of the resulting alternating current flow is related to the number of charge carriers present and therefore the concentration of the electrolyte may be inferred from the conductance measurement.

Conductivity and resistivity are the more familiar terms used in the measurements of solutions. Specific conductivity, or more commonly conductivity, is the conductance as measured between opposite faces of a 1-cm cube of the solution. Bulk material measurements utilize this "reference state" and conductivity rather than conductance. The conductivity reading shows an almost direct relationship with impurities in the water and is the technique commonly seen in feedwater and pretreatment processes.

For Ultrapure and pure water applications, a cell factor of 0.1 cm^{-1} is selected and measurements are usually expressed as resistivity in units of MΩ• cm or in conductivity in units of uS/cm. Ultrapure water applications benefit from resistivity measurements because it more effectively resolves the range of interest. For more conductive solutions, a cell factor of 10 cm-1 is used and measurements are expressed in mS/cm. When cells are interfaced to Foxboro Analyzers or Transmitters, effects of temperature on measurements can be compensated and readout in appropriate units can be displayed.

The 0.1 cm^{-1} cell has two electrodes constructed with concentric cylinders which must be in contact with the solution being measured. The two electrodes are separated by an insulator inside the electrode. The 10 cm^{-1} cell utilizes two graphite buttons for its measurement electrodes. A third electrode in the electrode eliminates a parallel measurement path that could occur outside of the electrode.

Table 1. Temperature/Pressure Limits, Measurement Ranges, and Temperature Compensation

<table>
<tr><th rowspan="3">Sensor Body Code</th><th rowspan="3">Temperature Limits (a)(b)</th><th rowspan="3">Pressure Limits</th><th colspan="2">Applicable Conductivity and Resistivity Ranges</th><th rowspan="3">Temperature Compensator (Integral)</th></tr>
<tr><th>Cell Factor 0.1 cm⁻¹(c)</th><th>Cell Factor 10 cm⁻¹</th></tr>
<tr></tr>
<tr><td>-A to -G</td><td>0 and 120°C (32 and 250°F)</td><td>-0.1 and +1.4 MPa (-15 and +200 psi)</td><td>0 to 1 through 0 to 200 µS/cm Conductivity Range
———</td><td rowspan="2">0-100 uS through 0-20 mS/cm Conductivity Range</td><td>100 kΩ Thermistor for use with 873RS, 873CC, 873ACC Analyzers; 870CC Transmitters; 872-30, 874CC, 874RS Monitors.</td></tr>
<tr><td>-K to M</td><td colspan="2">120°C at 3.4 MPa (250°F at 500 psi)
150°C at 2.5 MPa (300°F at 375 psi)
175°C at 1.7 MPa (350°F at 250 psi)(d)</td><td>0 to 2 through 0 to 20 MΩ•cm Resistivity Range(e)</td><td>100Ω Platinum RTD for use with 873RS, 873CC, 873ACC Analyzers; 870ITCR Transmitters; 872-30 Monitor.(f)</td></tr>
</table>

(a) Temperature limits for optimum performance and compensation: 871-A through 871-G = 15 and 40 °C (60 and 105°F); 871-K through 871-M = 15 and 80°C (60 and 175°F).

(b) Recalibration is recommended for 10 cm^{-1} cell factor sensors after exposure to elevated temperatures.

(c) All 0.1 cm^{-1} cell factor sensors with Body Codes A through M are labeled with the exact cell factor and temperature cell factor. All 0.1 cm^{-1} cell factor sensors are constructed and tested for an accuracy of better than ±2%.

(d) Specifications are for 0.1 cm^{-1} cell factor sensors only. Maximum temperature for 10 cm^{-1} cell factor is 150 °C at 2.5 MPa (300°F at 375 psi).

(e) Specify option code -9 for resistivity cell calibration.

(f) If -K, -L, or -M sensor is to be used with either 870CC Series Transmitters, 874CC, 874RS Series Monitors, no automatic temperature compensation can be applied. RTD are not supported on these instruments.

Table 2. Process Wetted Parts

Cell Factor	Sensor Body Code	Seals/ O-Rings	Insulator	Removable Sheath	Bushing	Electrodes
Sensors with 3/4 NPT Bushing or Twist-Lock Process Connection						
0.1 cm^{-1}	-A	EPDM	Ryton (a)	None	Teflon-S Coated 300 Grade ss	Titanium or Monel, as specified by Model Code
	-F	EPDM	Ryton	None		
	-K	EPDM	pctfe (a)	None		
	-E	EPDM	Ryton	None	None (Twist Lock)	
10 cm^{-1}	-A	EPDM	Noryl	ptfe (a)	Teflon-S Coated 300 Grade ss	High density graphite encapsulated in gold-plated cups
	F	EPDM	Noryl	ptfe		
	K	EPDM	pctfe	ptfe	None (Twist Lock)	
	E	EPDM	Noryl	ptfe		
Universal Mount, Insertion, and Dip Sensors						
0.1 cm^{-1}	-B	EPDM	Ryton	None	316 ss	Titanium or Monel, as specified by Model Code
	-G	EPDM	Ryton	None	Noryl	
	-D	EPDM	Ryton	None	316 ss (Includes insertion shaft)	
	-M	EPDM	pctfe	None		
10 cm^{-1}	-B	EPDM	Noryl	ptfe	316 ss	High density graphite encapsulated in gold-plated cups
	-G	EPDM	Noryl	ptfe	Noryl	
	-D	EPDM	Noryl	ptfe	316 ss (Includes insertion shaft)	
	-M	EPDM	pctfe	ptfe		
Sensors with Sanitary Fittings						
0.1 cm^{-1}	-C	EPDM	Ryton	None	316 ss	Titanium or Monel, as specified by Model Code
	-L	EPDM	pctfe	None	316 ss	
10 cm^{-1}	-C	EPDM	Noryl	ptfe	316 ss	High density graphite encapsulated in gold-plated cups
	-L	EPDM	pctfe	ptfe	316 ss	

(a) Ryton is polyphenylene sulfide; ptfe is polytetrafluoroethylene; pctfe is polychlorotrifluorethylene.

Sensor Certification Specifications

Testing Laboratory, Types of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
CENELEC intrinsically safe EEx ia, Zone 0.	Connect to any approved "i" circuit.	CS-E/KA-E
CSA intrinsically safe Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G hazardous locations.	Connect to 870CC transmitter per TI 005-105.	CS-E/CB-A
CSA ordinary locations.	Connect to 873CC or 873ACC Analyzer with Supply Voltage Code -A, -E or -J, and Enclosure Code P, W, X, Y, or Z.	CS-E/CG-A
CSA Class I, Division 2, Groups A, B, C, and D hazardous locations.	Connect to 873CC or 873ACC Analyzer with Supply Voltage Code -A, -E, or -J, and Enclosure Code W, X, Y, or Z. Connect per TI 005-105.	CS-E/CN-A
European nonincendive Zone 2.	Connect to any nonincendive circuit. Use on nonhazardous pipeline only.	CS-E/XN-F
FM intrinsically safe Class I, II, and III, Division 1, Groups A, B, C, D, E, F, and G hazardous locations..	Connect to 870 transmitters per TI 005-101.	CS-E/FB-A
FM ordinary locations.	Connect to 873CC or 873ACC Analyzers with Enclosure Code P, W, X, Y, or Z.	CS-E/FG-A

Sensor Identification

Sensor identification is contained within the suffix of the sensor model number. The first character in the suffix (a letter) refers to the type of mounting of the sensor (See "Sensor Applications" on page 8.). The second character (either 2, 4, or 6) refers to the cell factor and electrode material; 2 = a cell factor of 0.1 cm^{-1} made of titanium, and 4 = a cell factor of 10 cm^{-1} made of graphite; 6 refers to 0.1cm^{-1} made with Monel electrodes.

The complete sensor model number is either marked on a label attached to the sensor cable or is found on the top of the sensor.

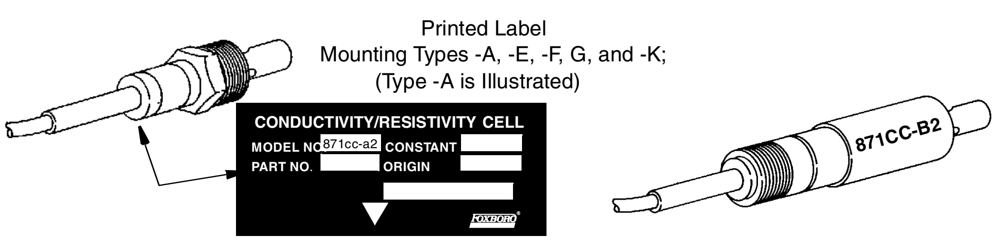

Figure 2. Sensor Identification

Sensor Applications

Refer to table below.

Sensor Body Code*	Application	Sensor
-A	Standard sensors incorporating a 3/4 NPT Teflon S coated bushing process connection offer a wide variety of installation configurations. Mating cell holders are available.	
-B	Universal-mount sensors designed to utilize Foxboro flanges and hex-head bushings. Used in larger diameter piping and in the sides of tanks.	
-C	Sensors with sanitary fittings mate with 50 mm (2 in) Tri-Clamp sanitary fitting. A 1-1/2 in Tri-Clamp fitting is also available. Contact Foxboro.	
-D	Insertion sensors are used with gate-valve insertion systems that allow the sensor to be inserted or removed from the system while it is operating, without shutting down the System.	
-E	Twist-Lock sensors are used with mating cell holders. A quarter turn by hand permits removal of the sensor for inspection and cleaning, or an occasional grab sample.	
-F	Threaded bushings, 3/4 NPT Teflon S coated bushing with 1/2 NPT conduit connector.	
-G	Dip sensors are used manually for occasional checks in exposed liquids. (871CL-G4 shown)	

Sensor Body Code*	Application	Sensor
-K	Threaded bushing, 3/4 NPT Teflon S coated bushing, high temperature with 100 Ω RTD. Same application as for -A above.	
-L	Sanitary fitting, high temperature, 100 Ω RTD. Same application as for -C. A 1-1/2 in Tri-Clamp fitting is also available. Contact Foxboro.	
-M	Insertion, high temperature. Same application as for -D above.	

*Also referred to as Sensor Mounting Design or Sensor Type.

2. Installation

General Installation Guidelines

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

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

1. Sample at the electrodes must be representative of solution.
2. Solution circulates actively and continuously past the electrodes area.
3. Flow velocity at sensing area does not cause cavitation or cell damage.
4. Position and orientation of the sensor does not trap air bubbles within the sensing area. A horizontal installation is suggested. Flow should go into the bottom of the electrode and exit through holes in the outer body.
5. Deposits of sediment or other foreign material do not accumulate on the active electrodes or the insulator. Do not install sensors with cable end down..
6. 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.

Installation of Sensor Types -A, -F, and -K

These sensors have a 3/4 NPT male process connection (see Figure 3). These sensors can also be installed in a flow chamber available from Foxboro (installation is similar to that shown in Figure 6).

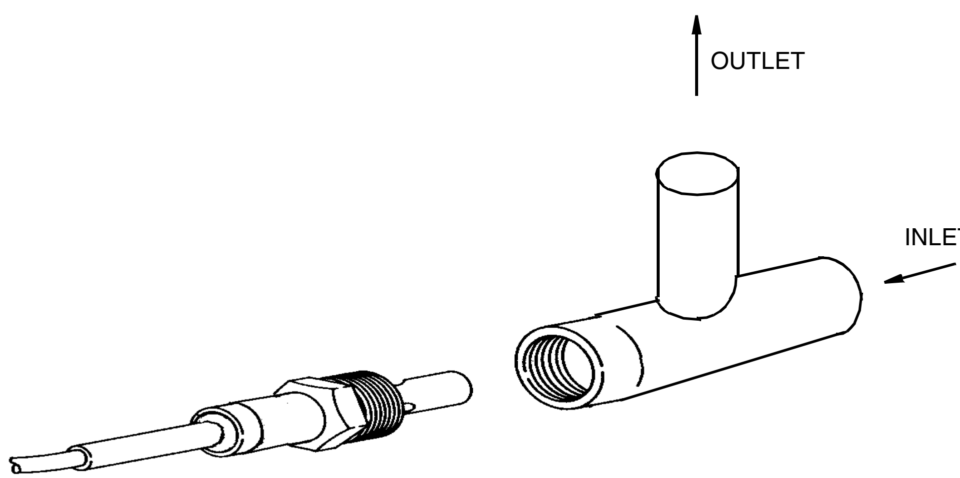

Figure 3. Installation of Sensor Types -A, -F, and -K

Installation of Sensor Type -B

This sensor can be connected to either a 2 through 4 in ANSI Class 150 flange or 1-1/4 through 2 NPT female process connection (see Figure 4) using a Foxboro threaded bushing. DIN flanges and metric process connections can also be achieved. Sensor mounting parts are available for each type of installation (these mounting parts are specified and ordered separately by part number). Other mating parts are supplied by user. See Table 3 for hex-head bushing specifications. The cable end of the sensor is pushed through the mounting flange or bushing from the process side, and is locked in place by threading the locknut on the top of the sensor and tightening.

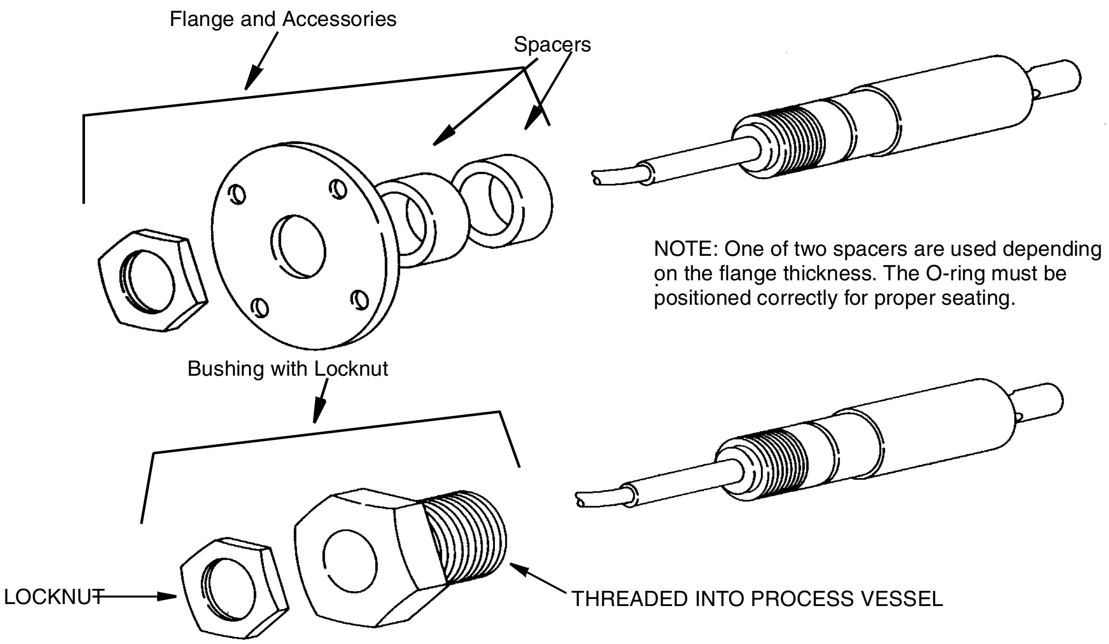

Figure 4. Installation of Sensor Type -B

Table 3. Hex-head Bushing Specifications

Sensor Connection	Thread Size (in)	Material	Rated Pressure at Rated Temperature				Used with Sensor Body Code
			MPa	psi	ºC	ºF	
Twist-Lock	1-1/4 NPT	PVC	0.4	60	50	120	-E
	1-1/4 NPT	PVC	.02	30	80	175	
Twist-Lock	1-1/4 NPT	316 SS	1.4	200	125	260	-E
	1-1/2 NPT	316 SS	1.4	200	125	260	

Table 3. Hex-head Bushing Specifications (Continued)

Sensor Connection	Thread Size (in)	Material	Rated Pressure at Rated Temperature				Used with Sensor Body Code
			MPa	psi	°C	°F	
Universal	1-1/4 NPT	316 SS	1.4	200	125	260	-B
	1-1/2 NPT	316 SS	1.4	200	125	260	
	R 1-1/2	316 SS	1.4	200	125	260	
	2 NPT	316 SS	1.4	200	125	260	
	R2	316 SS	1.4	200	125	260	
Universal	1-1/4 NPT	Carpenter 20 Cb	1.4	200	125	260	-B
	1-1/2 NPT	Carpenter 20 Cb	1.4	200	125	260	
	R 1-1/2	Carpenter 20 Cb	1.4	200	125	260	
	2 NPT	Carpenter 20 Cb	1.4	200	125	260	
	R2	Carpenter 20 Cb	1.4	200	125	260	

Installation of Sensor Types -C and -L

These sensors mate with a 2-in Tri-Clamp flange (see Table 5). The flange on the process tank, the gasket, and the clamp are supplied by the user.

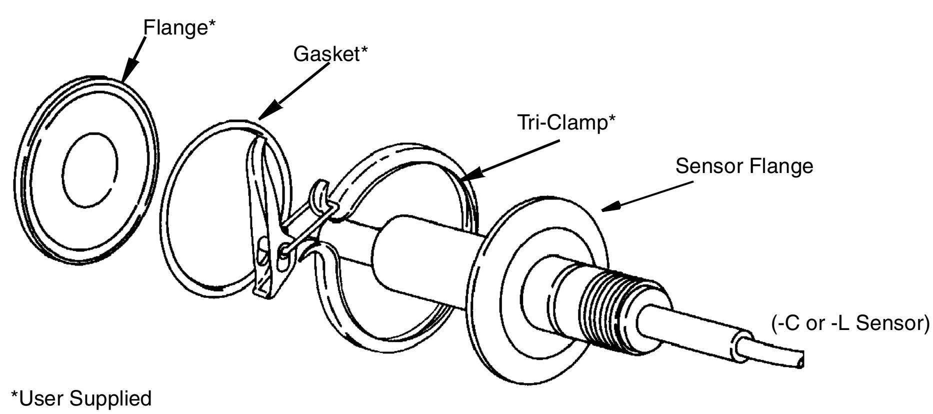

Figure 5. Installation of Sensor Types -C and -L

Installation of Sensor Type -E

This sensor connects to either a Twist-Lock flow chamber (see Table 4 and Figure 6), or a 1-1/4 or 1-1/2 NPT Twist-Lock bushing (Table 3) available from Foxboro. With the Twist-Lock bushing, the sensor can be connected to the user's 1-1/4 or 1-1/2 NPT internal process connection. With flow cell installations, vertical alignments are not recommended. Tilt output port upward and install sensor and flowchamber at a 45° angle.

NOTE: Sensor Types -A, -F, and -K can be installed in flow chambers having a 3/4 NPT sensor connection (in place of the Twist-Lock connection illustrated in Figure 6). All other flow chamber installation details are the same.

Table 4. Flow Chamber Specifications

Sensor Connection	Material	Rated Pressure at Rated Temperature				Used with Sensor Body Code
		MPa	psi	°C	°F	
Twist-Lock	PVC	0.4 0.2	60 30	50 80	120 175	-E
Twist-Lock	316 ss	1.4	200	125	260	-E
3/4 NPT Threaded	PVC	0.4 0.2	60 30	50 80	120 175	-A
3/4 NPT Threaded	316 ss	14	2000	175	350	-A -K
3/4 NPT Threaded	Sygef	0.4 0.2	60 30	50 80	120 175	-A

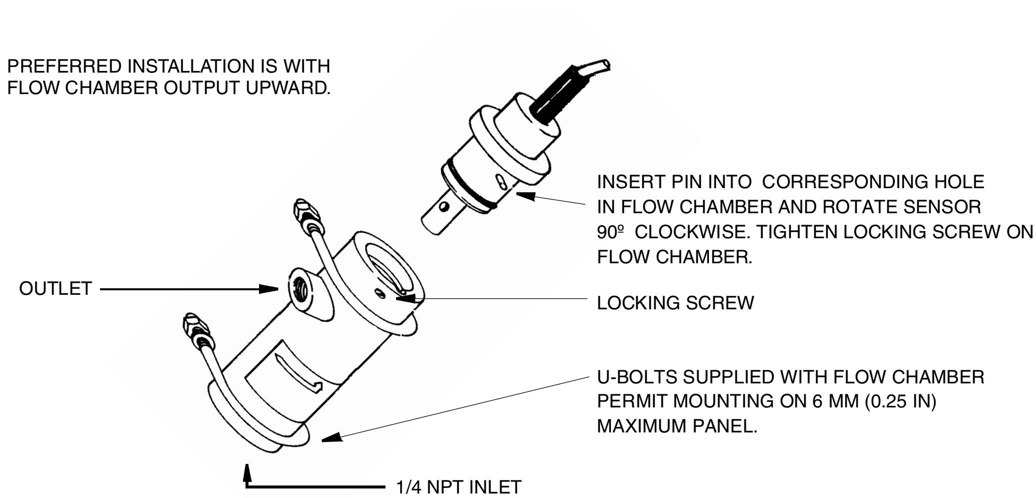

Figure 6. Installation of Sensor Type -E

Installation of Sensor Types -D and -M

These sensors work with a 1 NPT gate-valve assembly, which is available from Foxboro. When the gate valve is installed, the sensor can be inserted or removed without disturbing the process. For gate-valve assembly specifications, refer to Table 5 and DPs 611-120 and 611-117.

Table 5. Gate-Valve Specifications

Type	Process Line Connection (in)	Process-Wetted Parts Material			Rated Pressure at Rated Temperature				Used with Sensor Body Code
		Gate Valve	Shock Absorber	O-Ring	MPa	psi	°C	°F	
Standard	1 NPT	316 ss	ptfe	Viton	1.4	200	120	250	-D, -M
High Temperature	1 NPT				3.4	500 250	120 175	250 350	-M

A gate-valve assembly installation must meet mounting arrangements specified in "General Installation Guidelines" on page 11 as well as the following requirements:

- Install the gate-valve assembly in a tee, boss, or flange that will accept a 1 NPT connection. The sensor should be positioned horizontally.
- Direct the flow of the solution (as much as possible) into the bottom opening of the sensor.
- Provide space for removal of the sensor in the gate-valve assembly. Refer to DPs 611-120 and 611-117.

WARNING: *If gate valve is installed in an application where the process stream is filled and pressurized, perform "Removal of Gate-Valve Insertion Sensor" on page 18 before proceeding.*

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1. Disassemble the locknut and the housing nut from the installed gate-valve assembly housing (see Figure 7).

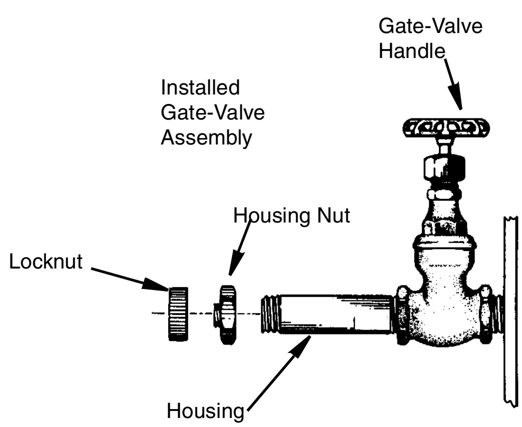

Figure 7. Disassembly of Locknut and Housing Nut

2. Select the appropriate Mounting Design (-D or -M) gate-valve insertion sensor for the application.
3. Assemble parts onto the gate-valve insertion sensor cable as shown in Figure 8.

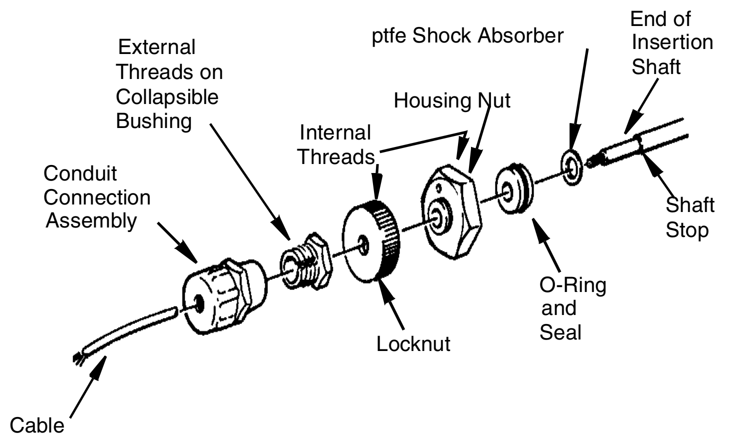

Figure 8. Assembly of Parts Onto Gate-Valve Insertion Sensor Cable

4. Lightly lubricate insertion shaft with silicone grease (or equivalent).
5. Slide the ptfe shock absorber and the O-ring and seal onto the insertion shaft until the shock absorber is against the sensor assembly (see Figure 9).

CAUTION: Do not nick the O-rings.

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6. Slide housing nut onto the shaft to a position just beyond the shaft stop.
7. Slide the locknut against the shaft stop.
8. Slide the collapsible bushing and conduit connection onto the end of the shaft. (Do not tighten.)

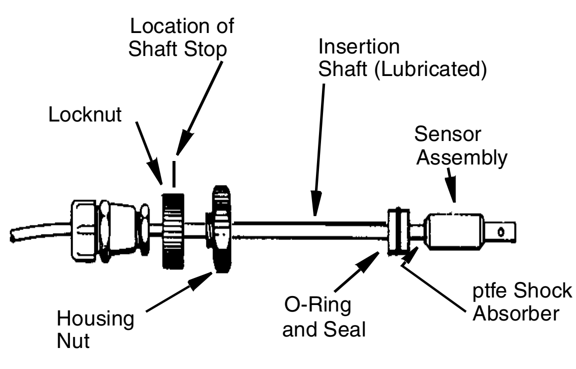

Figure 9. Assembly of Gate-Valve Insertion Sensor

9. Turn the gate-valve handle clockwise (see Figure 10) until the valve is completely seated (closed).

10. Fill and pressurize the process line or tank as required. Check for and eliminate leaks.

CAUTION: Do not exceed the sensor temperature and pressure limits.

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11. Insert the gate-valve insertion sensor into the housing isolation chamber until the O-ring and seal are seated into the end of the housing (see Figure 10).

CAUTION: Do not nick the O-rings.

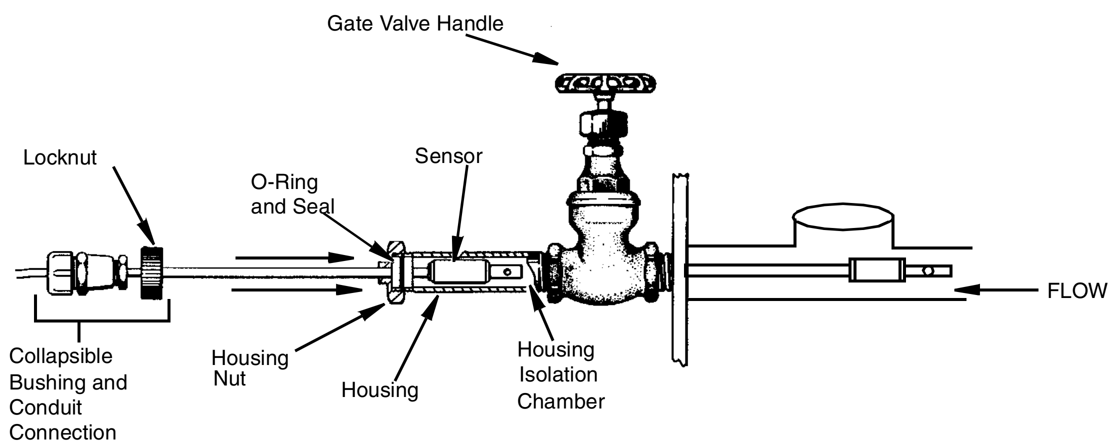

Figure 10. Installation of Insertion Sensor into Gate Valve and Process

12. Tighten housing nut onto end of housing.

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

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13. Slowly turn the gate-valve handle counterclockwise to fully open the valve.

CAUTION: Gate-valve insertion sensor may retract while opening the valve due to process flow.

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14. Check for and eliminate leaks.
15. Insert the sensor into the process and tighten the locknut onto the housing nut.
16. Slide the collapsible bushing against the locknut.
17. Assemble the conduit connection assembly onto the collapsible bushing and secure the bushing onto the shaft of the gate-valve insertion sensor.

Removal of Gate-Valve Insertion Sensor

WARNING: Do not loosen housing nut (Figure 11) when the gate-valve unit is in the open position and the process line or tank is filled and pressurized.

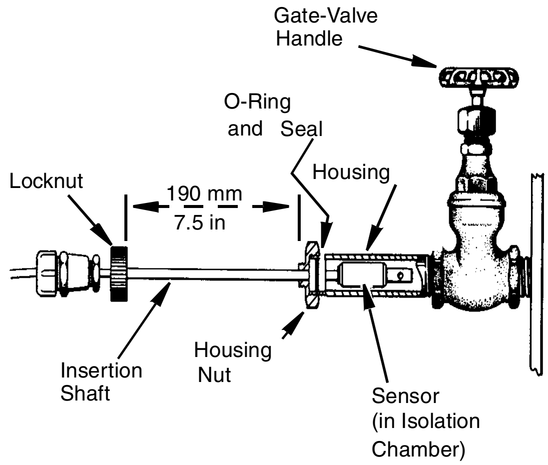

Figure 11. Removal of Gate-Valve Insertion Sensor

1. Carefully loosen and detach the locknut only.

WARNING: Gate-valve insertion sensor may retract rapidly.

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2. Allow the sensor to enter into the gate-valve housing isolation chamber (see Figure 11). Expose the insertion shaft 190 mm (7.5 in) minimum.
3. Turn the gate-valve handle clockwise until valve is completely seated (closed).

WARNING: Do not loosen the housing nut if there is a continuous leak through the port on the housing nut.
Check to be sure the valve is completely closed. If the leak continues, the gate valve is not seating. The process line or tank may have to be emptied and depressurized.

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4. Loosen the housing nut and withdraw the insertion sensor shaft assembly from the housing isolation chamber.

Junction Box Installation

Junction Box Mounting

The junction box provides watertight (Nema 4X) protection and can be used to increase distance between sensor and analyzer by facilitating a juncture between standard cable terminals and extension cable.

CAUTIONS:
1. Accuracy of measurements are affected by the use of extension cables. Temperature bias corrections must be made in the analyzer (873, tCF parameter) to correct for additional resistance that has been added by the addition of cable and terminals.
2. Cable length must be considered so that connections can be made without exposing the cable to damage.

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1. Select a rigid surface and a position protected from damage or exposure to excessive moisture or corrosive fumes.
2. Position the junction box against the mounting surface and mark the location of the mounting holes.
3. Drill the 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 12).
2. Insert the sensor cable through the appropriate connector and connect the numbered terminals of the sensor cable to the corresponding numbered terminals on the terminal strip.
3. Insert extension cable assembly through appropriate connector and connect the numbered terminals of extension cable assembly opposite the corresponding numbered terminals of the sensor cable.

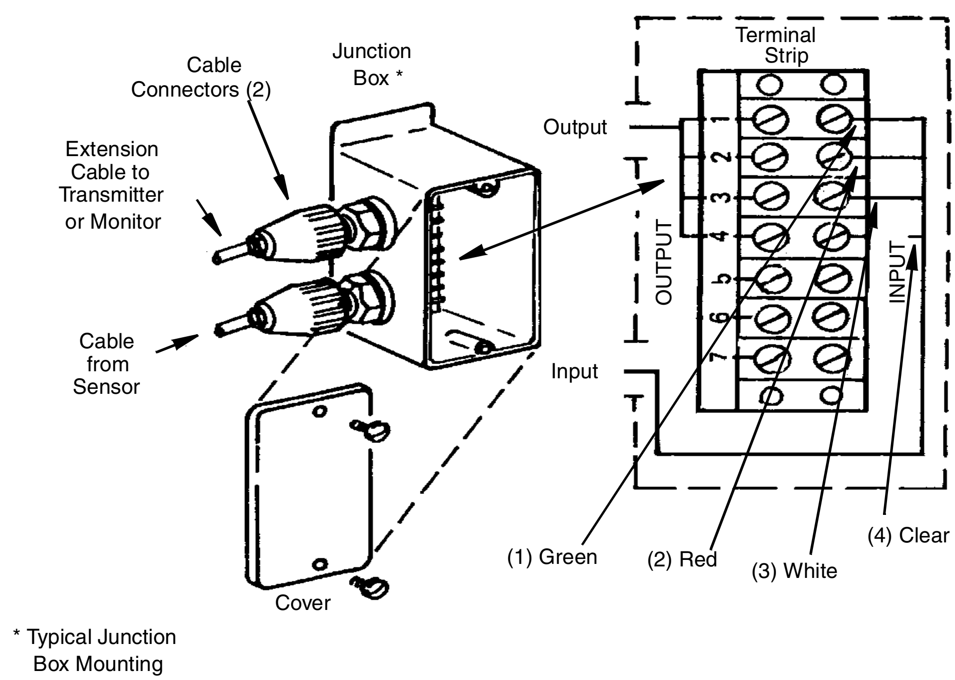
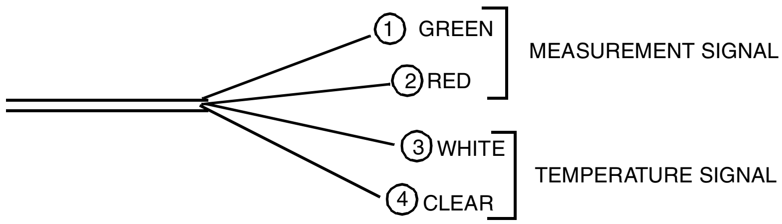


Figure 12. Junction Box Wiring

Wiring



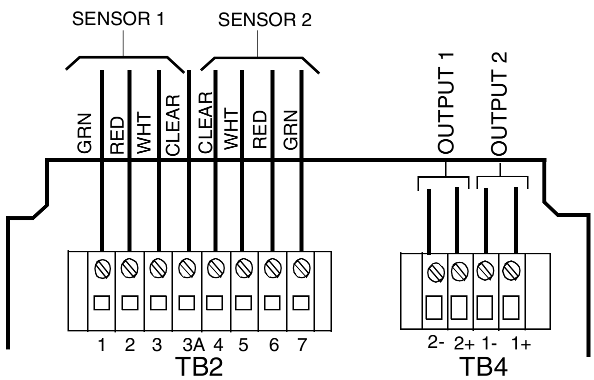


Figure 13. Metal Rear Panel Wiring - 873RS or CC

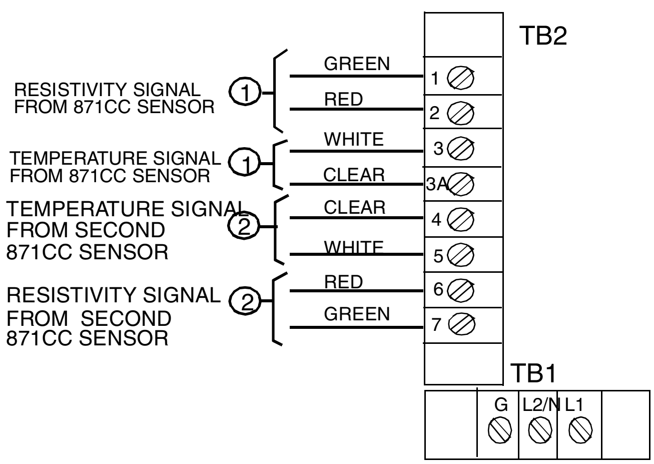


Figure 14. Plastic Rear Panel Wiring - 873RS or 873CC

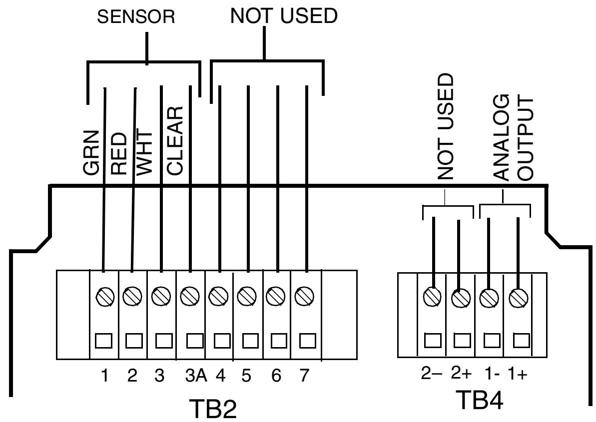


Figure 15. Metal Rear Panel Wiring - 873ARS or 873ACC

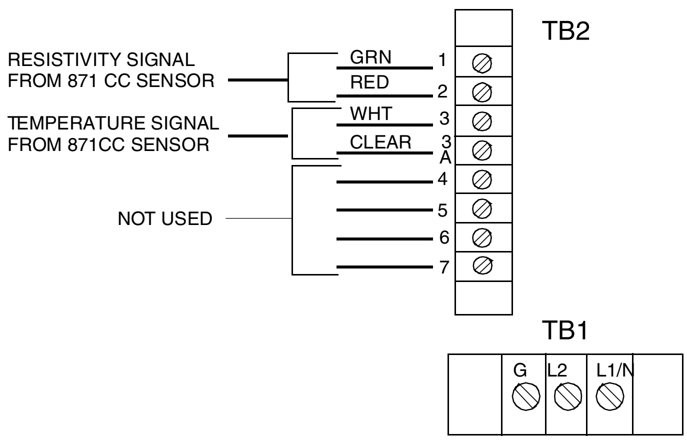


Figure 16. Plastic Rear Panel Wiring - 873ARS or 873ACC

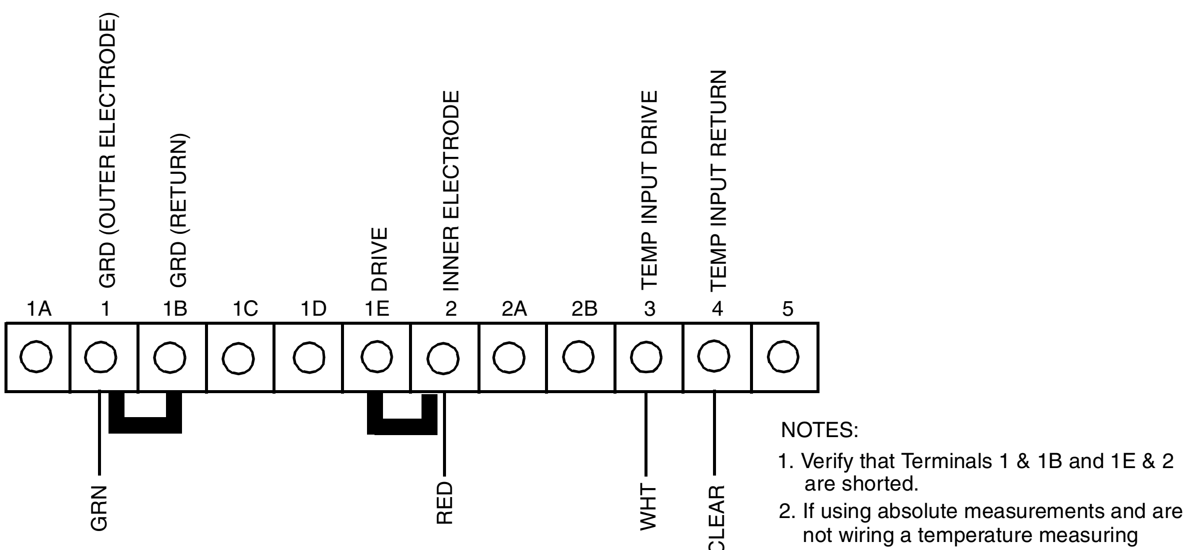


Figure 17. 870ITCR

3. Calibration

Foxboro conductivity sensors are manufactured under strict guidelines for quality and uniformity. Even with the stringent specifications of our assembly procedures, small offsets from theoretical values are possible. In many applications, the sensor can be connected to the analyzer and used without further calibration. For the best possible system accuracy of an 871CC sensor, additional calibrations are required to standardize these small offsets.

Sensors with a Cell Factor of 0.1 cm^{-1}

An accurate temperature signal is required for proper temperature compensation, especially when measuring resistivity or when measuring conductivity over a large temperature gradient. For any sensor having a cell factor of 0.1 cm^{-1} the Temperature Cell Factor (tCF) is used to offset a small deviation from the ideal. The tCF **must** be used when longer cables are ordered.

Additionally, individual sensors with 0.1 cm^{-1} cell factors may differ slightly from their nominal constant of 0.1000 cm^{-1}. The Cell Factor adjustment (CF) is used to offset the small deviation of the sensor from the ideal.

871CC Sensors with 0.1 cm^{-1} nominal cell constants are stamped with a 4-digit number (e.g., .1001), which is the Cell Factor (CF) of that particular cell when tested in our factory. These cells are also stamped with a temperature value (tCF) (e.g., 24.97°C), which is the temperature at which that particular transducer read its theoretical resistance value. See Figure 18. When the sensor is connected directly to the Analyzer, these factors may be input directly into the 873CC, 873ACC, 873RS, or 873ARS Analyzer to correct for these offsets. See appropriate analyzer instruction for details of how to enter these values.

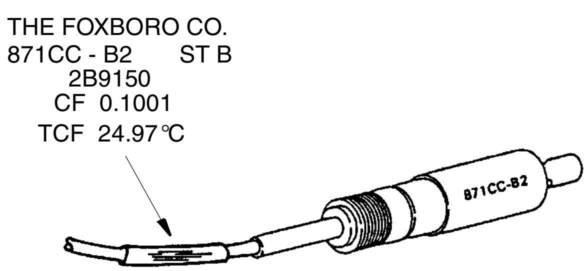


Figure 18. Sensor Identification

Alternatively, for conductivity applications, the following procedure may be used to determine the temperature cell factor, and ***must*** be used when additional cable lengths are used with the sensors, if cable lengths were altered, or if junction boxes were added or deleted.

Determining Temperature Cell Factor (tCF)

1. Connect your conductivity sensor to the appropriate analyzer.
2. Place the sensor and an accurate Celsius thermometer (with 0.01°C resolution) into a container of liquid. Allow the system to reach thermal equilibrium.
3. Read the temperature as displayed on the analyzer with resolution to the hundredths place. For details of how to do this, see the appropriate analyzer instruction.
4. Determine the temperature difference of the two devices by subtracting the analyzer reading from the thermometer reading; e.g., the thermometer reads 24.70°C and the analyzer says 25.20°C; the difference is 24.70°C – 25.20°C = –0.50°C.
5. Add this value to 25.00°C (e.g., 25.00°C + (–0.50°C) = 24.50°C. This is your temperature cell factor. Now that you've determined the tCf, enter it as described in your analyzer instruction.
6. Recheck temperatures and repeat the procedure.

Sensors with a Cell Factor of 0.1cm^{-1} or 10 cm^{-1}

Your analyzer-sensor system may be standardized by performing a simple single point solution calibration. See your analyzer instruction for detailed procedures.

NOTE: This procedure should follow, not precede, the entering of a tCF as explained above.

4. Maintenance

Process Temperature versus Temperature Sensor Resistance

Table 6 lists process temperature value and corresponding resistance value of the RTD or thermistor. Resistance of RTD or thermistor should approximate value given in Table 6 for appropriate temperature (see applicable Monitor or Transmitter MI). If not, replace sensor.

Table 6. Process Temperature vs. Temperature Sensor Resistance

Process Temperature		RTD Resistance	100 KΩ Thermistor Resistance
°C	**°F**	**Ω ±0.1%**	**Ω ±0.1%**
-5	+20	98.04	461 550
0	32	100.00	351 020
10	50	103.90	207 850
20	68	107.79	126 740
25	75	109.73	100 000
30	86	111.67	79 422
40	104	115.54	51 048
50	122	119.40	33 591
60	140	123.24	22 590
70	158	127.07	15 502
80	176	130.89	10 837
90	194	134.70	7 707.7
100	212	138.50	5 569.3
105	225	140.39	4 760.3
110	230	142.28	4 082.9
120	248	146.06	3 033.3
130	266	149.82	2 281.0
160	320	161.04	

Electrode Inspection

The accuracy of the sensor may be affected by deposits from process liquid. Therefore, sensor may require cleaning on a scheduled basis.

Inspect the electrodes as needed. The electrode should be cleaned periodically.

To Clean Electrode

Deposits on the electrode (immersion portion of the sensor, Figure 19) can seriously affect the sensor's accuracy.

A tentative schedule for cleaning the electrode should be established. The time interval between cleanings can be increased or decreased (depending on the nature of process liquid or the difference between conductivity/resistivity readings before and after cleaning).

1. Remove the sensor from the process.
2. Flush the sensor by flowing deionized water through the electrode with a forceful jet.
3. If deposits are still visible, gently move the immersion portion of sensor in a dilute solution of a suitable acid or base (to agitate solution) until the deposits are loosened.
   Choice of cleaning solution depends on nature of the process liquid and deposits. Generally use the mildest cleaner capable of dissolving the deposit.
4. Use a soft brush (e.g., toothbrush) to wipe away external deposits.
5. Repeat Steps 2-4 until sensor is clean.
6. With a sensor having a cell factor of 10^{-1} cm, slide the plastic sleeve over retaining pin and remove sleeve (see Figure 19). Clean both sides of the plastic sleeve.
7. Sensors with a 0.1 cm^{-1} cell factor are made with a nonremovable outer electrode. Care should be taken to prevent skin oils from contacting either the inner or outer electrodes. Rough handling of these components could alter the cell factors.
8. Rinse sensor thoroughly in distilled water, reinstall plastic sleeve (if removed), and return sensor to process.

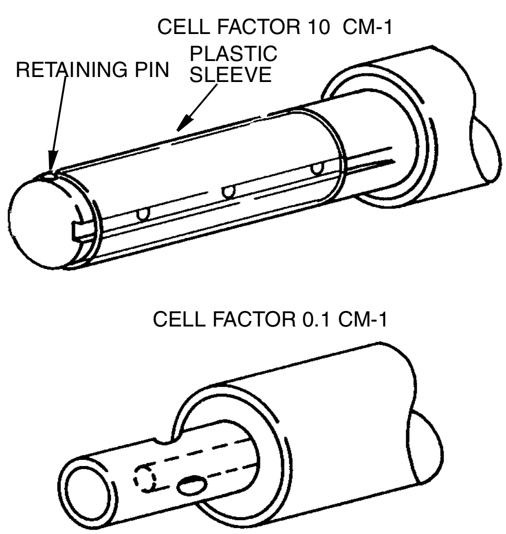


Figure 19. Immersion Portion of Sensors

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The Foxboro Company
33 Commercial Street
Foxboro
Massachusetts 02035-2099

Telephone: 1-888-FOXBORO
(1-888-369-2676)

Facsimile: (508) 549-4999

A Siebe Group Company

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