

4973 Type Conductivity Cells for 04973 Series and DL4-3xx DirectLine® Series Installation and Maintenance Manual

70-82-25-17

6/04

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Revision 3 – 6/04

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About This Document

Abstract

The purpose of this manual is to support the installation and maintenance of the 4973 Series Conductivity Cells (Also DL43XX Cells for DirectLine® Modules).

Revision Notes

The following list provides notes concerning all revisions of this document.

Rev. ID	Date	Notes
0	10/96	This document is the initial release of the Honeywell version of the 4973 Series Conductivity Cell Installation and Maintenance Manual. This publication was originally released under the L&N system as 277067 Rev. N1.
1	6/99	Edits were made to add information for the 9782C and to correct some erroneous information.
2	6/03	Edits were made to add information for the DL43XX Cells for DirectLine Modules
3	6/04	Edit text and update the Installation drawings to remove 7082 information.

References

Honeywell Documents

The following list identifies all Honeywell documents that may be sources of reference for the material discussed in this publication.

Document Title	ID #
9782 Series Two Cell Conductivity/Resistivity Analyzer/Controller Operator's Manual	70-82-25-74
APT2000CC Transmitter User Manual	70-82-25-95
APT4000CC Analyzer User Manual	70-82-25-104
DirectLine® Module for Conductivity User Manual	70-82-25-112

Contacts

World Wide Web

The following lists Honeywell's World Wide Web sites that will be of interest to our customers.

Honeywell Organization	WWW Address (URL)
Corporate	http://www.honeywell.com
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		1-800-525-7439	<i>Service</i>

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1. Introduction

1.1 Overview

The **4973 Type cells**, Figure 1-1, have a rugged configuration for reliable, continuous measurements of electrolytic conductivity in industrial water processes at temperatures up to 140°C at 250 psig. They are applicable to such measurements as the effluent of distillation equipment; anion, cationic and mixed bed ion exchangers; monitoring and controlling of washing electronic components; plating rinse tank control; boiler water condensate; boiler hot well measurements and cooling tower blowdown, and many others.

Made of polyethersulfone (PES) construction for high-corrosion resistance, the cells are supplied with 0.01 and 0.1 cell constants having titanium electrodes, and 1.0 and 10.0 cell constants with high-density, graphite electrodes.

The 4973 Cells used with 9782 Series or APT2000/4000 Series are equipped with an integral standard 7 foot lead or optional 20 foot lead, and may be equipped with a junction box type (universal) head with terminal connections for longer lead lengths.

The **DL43XX Cells** used with the DirectLine[®] Module can be specified for either integral or remote mounting of the module. The integral mount cell has a PC board connector so that the Directline[®] Module can mount right on the cell. Cells for the remotely mounted DirectLine Module have a 20' cable that is an integral part of the cell. This cable is connected to a DirectLine remote connector.

ATTENTION

The DL43XX cells have an EEPROM device for automatic download of cell constant and cell calibration factors. During installation, proper ESD protection is required so that the memory device is not damaged.

For insertion applications, the 3/4" NPT male thread permits permanent installation in a pipe or tank; the cell may also be used as a laboratory dip-type cell for batch sampling.

For flow applications, the cell can be installed directly into a process stream as shown in Figure 1-2 by using the 055919 Flow Chamber or a 3/4" pipe tee as shown in Figure 1-3. These arrangements are designed to keep both the temperature compensator and cell in the main stream flow so that the cell will respond more quickly and accurately to process changes of both solution concentration and temperature.

1.2 Description

All conductivity cells of the 4973 Type are suitable for use in both flow - and insertion - type installations. They are one-piece molded units that cannot come apart and therefore have no replacement parts. Each has a 3/4" NPT thread.

The physical appearance of the cells is shown in Figure 1-1. The 0.01, 0.1, 1 and 10 cell constants are similar in construction with differences as noted below.

0.01 and 0.1 Cell Constants

The 0.01 cell differs from the others only by its outer electrode length of 2-3/4". The temperature compensation sensor is located inside the inner electrode. The holes in the outer electrode provide passage for the solution being measured. The 0.1 cell is similar to the 0.01 type except that its outer electrode length is 2". The temperature compensation sensor is located inside the inner electrode.

1 and 10 Cell Constants

The 1 and 10 cell constant types are similar but differ in the width of flow channel (that serves to conduct the solution being measured past the electrodes of the cell) as well as size and spacing of the electrodes. The electrodes are graphite, 1/4" D for the 1 cell constant and 1/8" D for the 10 cell constant. The temperature compensating sensor is integral with the cell body.

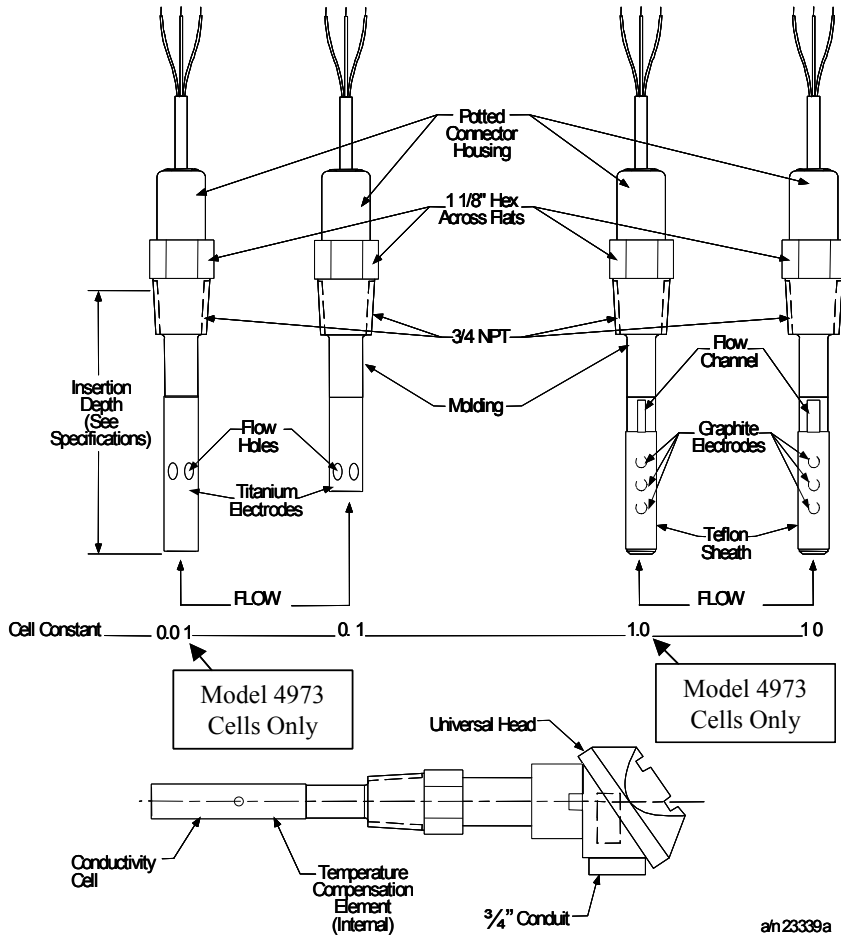
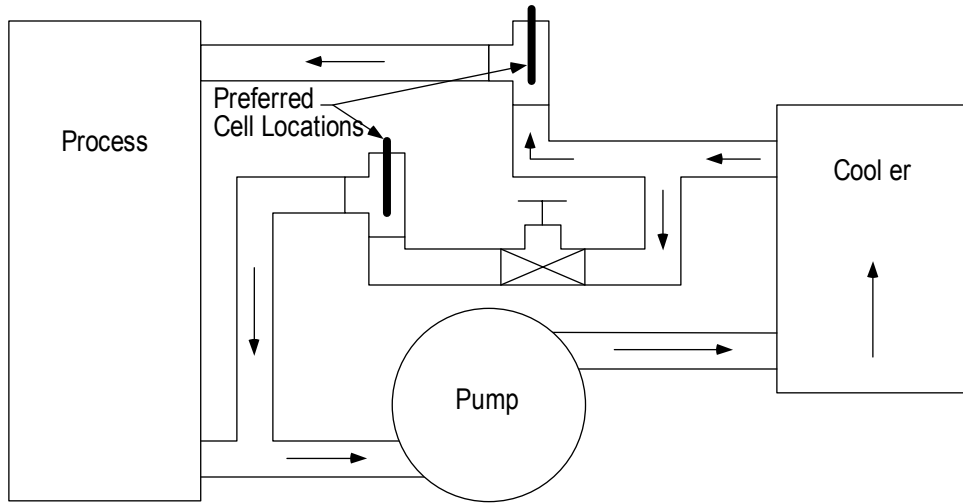


Figure 1-1 4973 Series Conductivity Cells, For flow- and insertion-type applications.

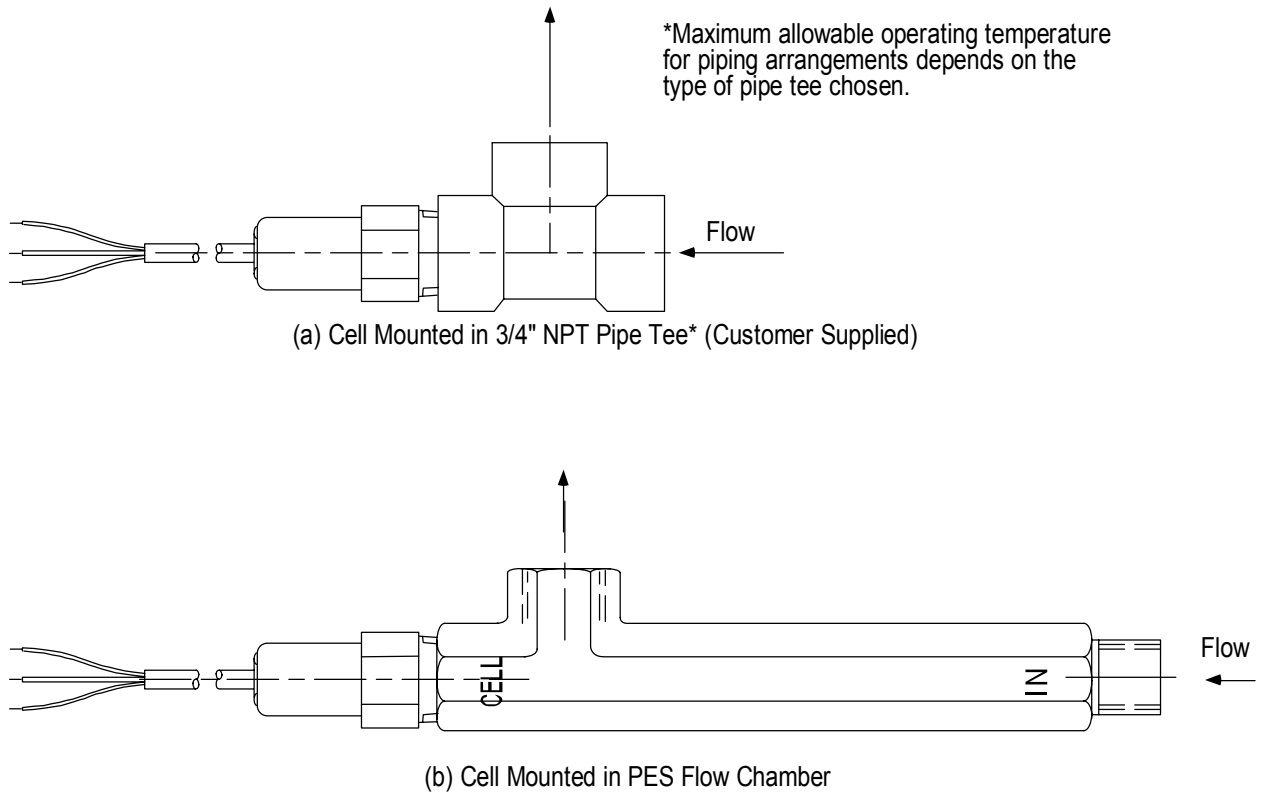
ATTENTION

Do not remove the Teflon sheath on 1.0 and 10 constant cells.



a/n 23340

Figure 1-2 Recommended Locations for Mounting a Conductivity Cell



a/n 23341

Figure 1-3 Two Piping Arrangements for the Cell

2. Specifications

2.1 Ordering Information - Model 4973

Instructions

<ul style="list-style-type: none"> Consult <u>Steps to Selecting Appropriate Conductivity Instrumentation and Cells</u> before making selections below. Select the desired key number. The arrow to the right marks the selection available. Make one selection from each Table using the column below the proper arrow. A dot (•) denotes unrestricted availability. <p>Key Number I II III IV V</p> <p> <input type="text"/> - <input type="text"/> - <input type="text"/> - <input type="text"/> - <input type="text"/> - <input type="text"/> </p>
--

KEY NUMBER	Description	Selection	Availability	
04973	Conductivity Cell	04973	↓	
04974	Sanitary Conductivity Cell	04974		↓

TABLE I

Cell Constant				
	0.01	001	•	•
	0.1	X01	•	•
	1	XX1	•	•
	10	X10	•	•

TABLE II

Automatic Temperature Compensator (ATC)				
Available for APT2000/4000CC, 9782C or Withdrawn 7082 Only		333	c	c
Available for all other already withdrawn analytical instrumentation.		202	•	•
		302	•	•
		303	•	•
		304	•	•
		305	•	•
		306	•	•

TABLE III

Leadwire Length				
	7 ft. Leadwire	X7	•	•
	20 ft. Leadwire	20	•	•
	Junction Box Head-Aluminum	X1	•	•

TABLE IV

CIP Sanitary Fittings				
	None	00	•	
	1.5"	15		•
	2.0"	20		•

continued next page


049


TABLE V - OPTIONS

		Selection	73	74
Tagging	None	0 __	•	•
	Linen	L __	•	•
	Stainless Steel	S __	•	•
Certificates	None	_0_	•	•
	Calibration	_1_	•	•
	Conformance	_2_	•	•
	Calibration & Conformance	_3_	•	•
Future		_ _0	•	•

RESTRICTIONS

Restriction Letter	Available Only With		Not Available With	
	Table	Selection	Table	Selection
c	II	For APT2000/4000CC, 9782C, or 7082 Only		

Note 1: The current selection system requires that Option 1 or 2 be chosen if a certificate is to be sent along with any of the available 4973/4974 cells.

2.2 Ordering Information - DL4000 DirectLine® Conductivity Cells

Instructions

- Select the desired key number. The arrow to the right marks the selection available.
- Make the desired selections from Table I using the column below the proper arrow.
A dot (•) denotes availability. No () dot denotes not available.

Key Number

I	II	III
[] - [] - [] - []		

Key Number - Mounting/Electrode Only (Specify DL423 separately) **Selection** **Availability**

Contacting Conductivity Probes/Mountings	Probes/Mountings for use with DL423	DL4	↓
--	-------------------------------------	-----	---

TABLE I - Mounting Type, Construction, Cell Constant, DirectLine Connection

Cell/Mounting Type	Material of Construction	Cell Constant	DirectLine Connection	Internal EEPROM			
High Purity In-line (4973-style)	Titanium	0.1	Integral	Yes	301	•	
	Graphite	10			302	•	
	Titanium	0.1	Remote ¹		311	•	
	Graphite	10			312	•	
General Purpose (4905-style)	Nickel	0.1	Integral	Yes	501	•	
	Platinum	0.1			502	•	
	Nickel	10			503	•	
	Platinum	10			504	•	
	Nickel	50			505	•	
	Platinum	50	506		•		
	Stainless Steel Insertion/Removal Assembly With Cell (4909-style)	Nickel	0.1		Remote ¹	511	•
		Platinum	0.1			512	•
		Nickel	10			513	•
		Platinum	10			514	•
Nickel		50	515	•			
Stainless Steel Insertion/Removal Replacement Cell (4908-style)	Platinum	50	Remote ¹	516	•		
	Nickel	0.1		811	•		
	Platinum	0.1		812	•		
	Nickel	10		813	•		
	Platinum	10		814	•		
Stainless Steel Insertion/Removal Replacement Cell (4908-style)	Nickel	50	Remote ¹	815	•		
	Platinum	50		816	•		

Notes:

1. Remote conductivity cells are supplied with a integral 20' sensor cable which must be wired to the DL423 remote connector (supplied with DL423 Sensor Module).

continued next page

TABLE II - Special Cell Constructions

Cell Type	Special Construction	Selection	Availability
ALL	None	000	•
4905	Extra 4.4" of cell length	440	
4909/4908	316 SS Support Tube	316	

TABLE III - Options

Tagging	None	00 __	•
	Linen Customer I.D. Tag - 3 lines w/22 characters/line	LT __	•
	Stainless Steel Customer I.D. Tag -3 lines with 22 characters per line	SS __	•
Calibration	None	-- 00	•
Certificate	Calibration certificate to be supplied w/shipment	-- 10	•

2.3 4973 Series Cell

Automatic Temperature Compensation: Temperature sensor integral with all cells.

Cell Constants:

Model 4973: 0.01, 0.1, 1.0, and 10 cm⁻¹.

Model DL43XX: 0.1 and 10 cm⁻¹

Wetted Parts:

Cell Body: PES (polyethersulfone).

Electrodes: 0.01 and 0.1 constant, titanium

1.0 and 10 constant, high density graphite with Teflon sheath.

Maximum Temperature: 140°C (284°F) at rated pressure.

Temperature limit for PVC wire is 105°C (221°F).

Maximum Pressure: 250 psig (1724 kPa) at rated temperature.

Electrical Connections:

Model 4973 Cells: Standard 7 foot lead, 3 to 4 conductor, non-shielded 18-gage PVC insulated wire. Optional 20 foot lead, 3 or 4 conductor, non-shielded 18-gage PVC insulated wire, see Figure 3-3. Optional head-type junction box (universal head) with terminals for extension wire and 3/4" NPT conduit connection, see Figure 3-2.

Model DL43XX: PC board connector for integral DirectLine[®] Module mounting, 20' potted cable for remote mounting of DirectLine[®] Module.

Insertion: 3/4 inch NPT, male for Schedule 40 and 80 pipes.

Insertion Depth: 3-1/2" (89 mm) for 1, 10, and 0.01 cell constants from solution end of 3/4" NPT male thread; 2-1/2" (64mm) for 0.1 cell constant.

2.4 Flow Chamber 055919

Material:	Polyethersulfone.
Maximum Flow:	5gpm @ 40 psig and atmospheric discharge.
Maximum Pressure:	200 psig @ 25°C.
Maximum Temperature:	140°C @ atmospheric pressure.
Dimensions:	See Figure 3-1

3. Installation

3.1 General Requirements

Observe the following before installing a conductivity cell. Specific requirements for particular types of installation are given in Sections 3.2 and 3.3.

- Do not remove the Teflon sheath on 1 or 10 constant cells, as this will change the cell constant value.
- Do not use the cell in solutions which can affect the fittings or the cell materials. If in doubt, contact Honeywell.
- Avoid all chlorinated hydrocarbons.
Titanium and PES (0.01 and 0.1 cell constants) and Graphite, Teflon and PES (1.0 and 10 cell constants) are the only cell materials in contact with measured solutions. These materials are inert to corrosive chemicals such as mineral acids, oxidizing agents and caustic solutions.
- Avoid trapped air; see that air is not trapped in the cell flow channels.
- Do not use the cell in solutions having temperatures or pressures greater than the maximum limits stated in the Specifications.
- Avoid locations where the operator must take an awkward position to install or remove the cell.
- When tightening, do not exceed the torque limits provided in Section 3.4. Over-tightening can break the cell or severely stress it causing cracks to develop, leading to eventual malfunction.

3.2 Insertion-Type Mounting

In addition to the General Requirements outlined above, note the following with regard to insertion-type mounting:

- Make certain the liquid head is above the cell location during measurement. A vertical insertion (from above) or a horizontal insertion can be used.
- Allow at least one-half inch clearance beyond the end of the cell and 1/8 to 3/16 inch radius clearance to permit circulation of the solution.
- It is usually best to have the solution flow up into the end of the cell since it is less likely to result in clogging by solids settling in the cell channels.
- To be sure that a representative sample is being measured at all times, the solution must continuously move through the cell channels. In a rapidly moving solution, the assembly may be mounted so that the existing circulation forces the solution through the channels. When measurements are made in quiescent solutions, artificial means must be provided to force the solution through the cell. In some cases, this may be accomplished by moving the cell up and down.

Installation

1. Tighten the cell into a 3/4" NPT threaded opening (do not exceed a tightening torque greater than that indicated in Section 3.4) using a Teflon thread compound (preferably Teflon tape).

3.3 Flow-Type Mounting

In addition to the General Requirements outlined in Section 3.1, note the following with regard to flow-type mounting:

- When mounting the cell in a pipe tee or flow chamber such as shown in Figure 1-3, have the solution enter the tee from below and exit to the side or from side and exit top. Be sure the electrodes are always as far as possible below the horizontal pipe run so that they are always covered to insure flooding of the cell under all conditions; otherwise, the conductivity reading may indicate a value that is lower than expected.
- In general, the cell should be mounted so that the sample will flow through the channel toward the mounting end of the cell, exiting through the other channel hole or through the outer electrode holes. See Figure 1-1.
- Locate the cell on the pressure side, not the vacuum side, of pumps. See Figure 1-2.
- Avoid a horizontal cell mounting having the flow channel, see Figure 1-1, opposite to the flow exit of the pipe line, especially for the 1 and 10 constant cells. If necessary, refer to Section 5.5.
- The 3/4" tee arrangement, Figure 1-3, assures that the cell is immersed well into the flow stream to obtain a representative sample. The tee is not supplied.

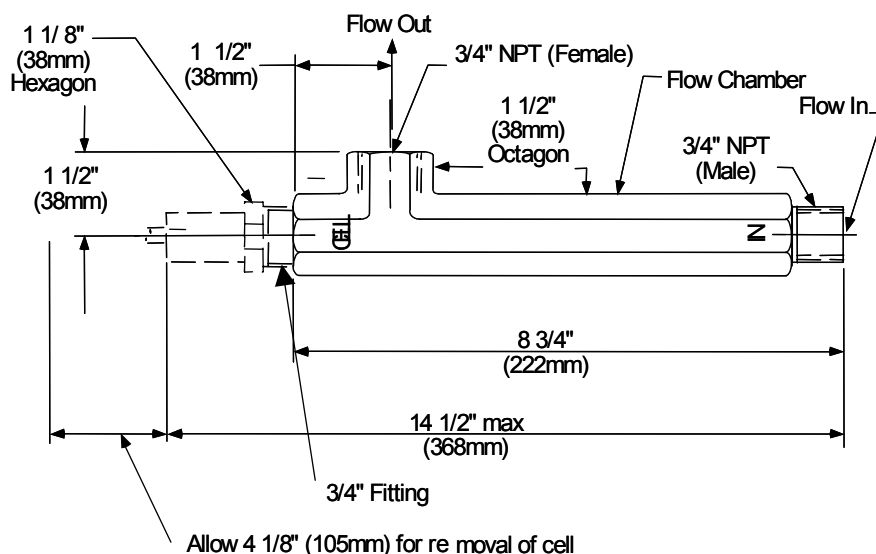
Installation

1. Tighten the cell into a 3/4" pipe tee (do not exceed a tightening torque greater than that indicated in Section 3.4).
2. If the flow-cell housing is used, assemble the cell and housing and install it in the process flow line or in a bypass line as indicated in Figure 1-2.
3. To avoid cracking the 055919 flow chamber, use Teflon tape on cell threads and tighten cell only enough to prevent leakage.

3.4 Torque Recommendations

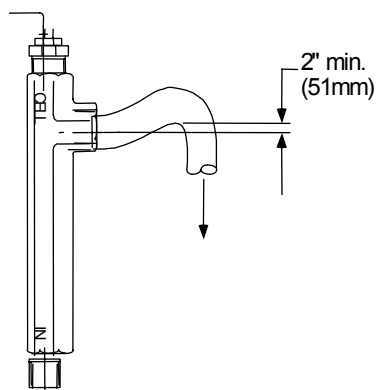
For inserting a cell in metal fittings or bushings - 40 ft-lb maximum. For inserting a cell in plastic fittings or bushings - 10 ft-lb maximum. Always use pipe sealant (preferably Teflon tape).

3.5 Dimension Drawings



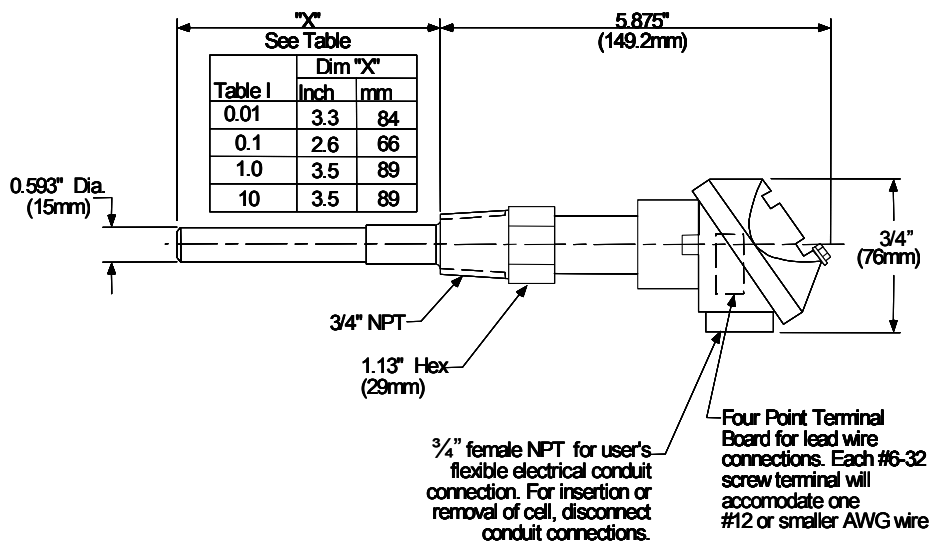
Notes:

1. Mount cell and flow chamber horizontally as shown above with flow exit up to eliminate possible air gap around cell body.
2. If cell and flow chamber must be mounted vertically, attach a short length of tubing to flow exit as shown below and form a trap to ensure filling of flow chamber, especially at low flow.



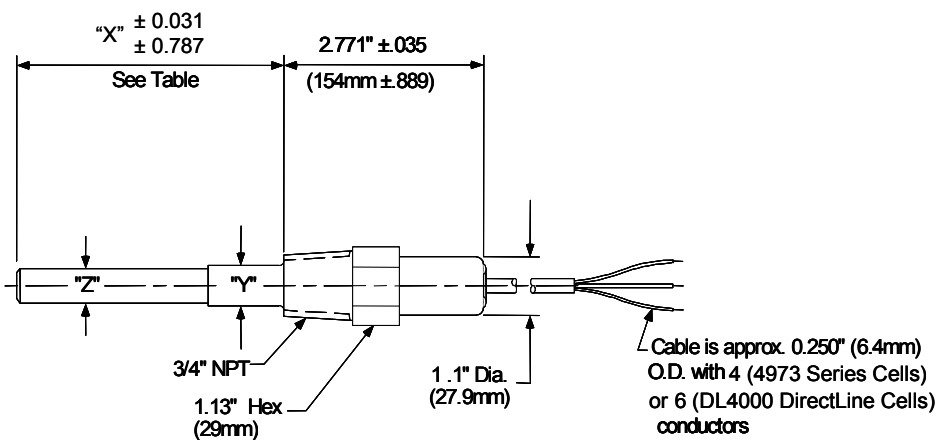
ah23342

Figure 3-1 Dimension Drawing for 055919 Flow Chamber



NOTE: For existing users with conduit, a 3/4" x 1/2" adapter bushing will be required to use existing conduit.

Figure 3-2 Outline and Dimensions for 4973-□-□-X1-00-□ Conductivity Cell with Universal Head



Suffix A	Dim "X"		Dim "Y"		Dim "Z"	
	Inch	mm	Inch	mm	Inch	mm
00.1	3.3	84	.703	17.85	.542	13.76
0.1	2.6	66	.703	17.85	.542	13.76
1.0	3.5	89	.593	15.06	.625	15.87
10	3.5	89	.593	15.06	.564	14.32

Figure 3-3 Outline and Dimensions for Model 4973-□-□-X7/20-00-□ Conductivity Cell and DL43XX Conductivity Cell

4. Electrical Connections

4.1 Overview

The terminal board connections for the measuring instruments are given in the appropriate directions furnished with the measuring instrument. Figure 4-1 and Figure 4-2 illustrate the cells' internal arrangement. There are three leads: black, red, and white. The cell (and a series compensator for nonlinear ranges) is connected between black and white and the compensator is between red and white. For cells with Table II = 333, the cell is connected between black and white and the compensator is between red and green.

To avoid the possibility of AC pickup in the cell leads, separate them from all AC line-voltage wiring or run them in a separate grounded conduit.

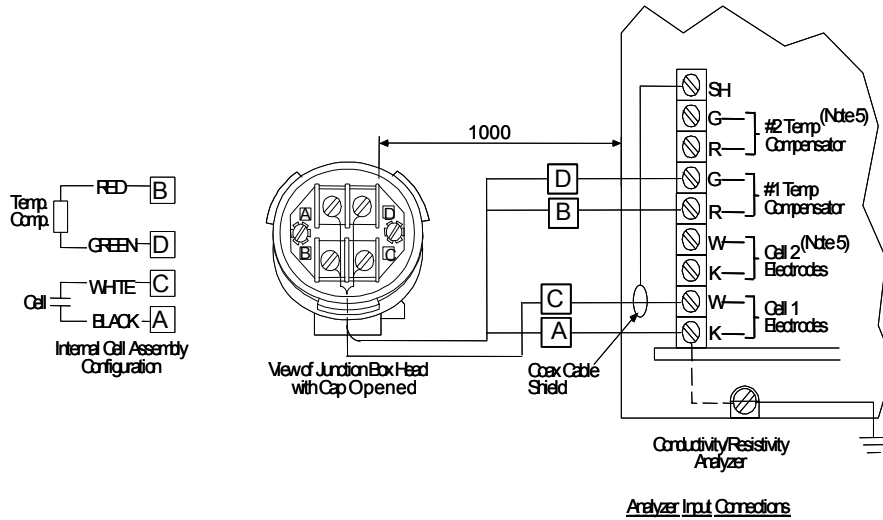
ATTENTION

Do not use shielded cable except where shown in Figure 4-1 and Figure 4-2 for connections to 7082 and 9782 Analyzers (Table III = 333) only.

ATTENTION

The DL43XX cells have an EEPROM device for automatic download of cell constant and cell calibration factors. During installation, proper ESD protection is required so that the memory device is not damaged.

4.2 Installation Diagrams

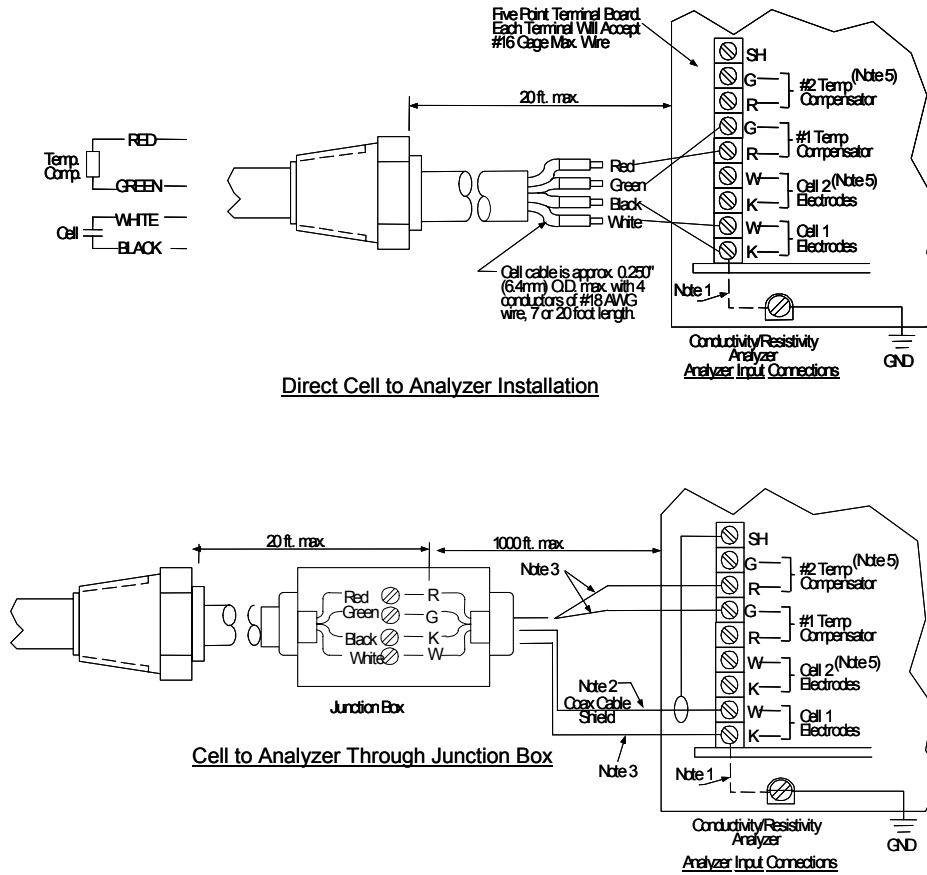


NOTES:

1. For pure water samples in non-conductive (plastic, glass, etc.) piping, ground the black cell electrode lead near the cell. Alternatively, connect to the 7082 ground screw as shown dotted. Do not ground 10, 25, or 50 constant cells.
2. 9782C-S0-xx-E0000-BD (Standard Range Only)
Use 18 gage minimum coaxial cable type RG6/U connecting shield to terminal "SH" only.
3. 9782C-S0-xx-E0000-BD
For cable runs of up to 500 ft., use 18 gage minimum, three conductor cable
For cable runs of 500 - 1000ft., use 16 gage minimum, three conductor cable

9782C-W0-xx-E0000-BD [coax and shield (SH) not used]
For cable runs of up to 500 ft., use 18 gage minimum, three conductor cable
For cable runs of 500 - 1000ft., use 16 gage minimum, three conductor cable
4. Cell to analyzer cables are considered low level. Run separate from high level wiring.
5. If 2 cells are to be applied, the same wiring guidelines are applied to Cell 2 as are followed for Cell 1.

Figure 4-1 Installation Diagram, 4973 Cells, Table II=333, with junction box head connected to 9782 Analyzer



NOTES:

1. For pure water samples in non-conductive (plastic, glass, etc.) piping, ground the black cell electrode lead near the cell. Alternatively, connect to the 7082 ground screw as shown dotted. Do not ground 10, 25, or 50 constant cells.
2. 9782C – S0 – xx – Exxxx – BD (Standard Range Only)
Use 22 gage minimum coaxial cable type RG59/U connecting shield to terminal "SH" only.
3. 9782C – S0 – xx – EOOOO – BD
For cable runs of up to 500 ft., use 18 gage minimum, three conductor cable
For cable runs of 500 - 1000ft., use 16 gage minimum, three conductor cable

9782C – W0 – xx – EOOOO – BD [coax and shield (SH) not used]
For cable runs of up to 500 ft., use 18 gage minimum, three conductor cable
For cable runs of 500 - 1000ft., use 16 gage minimum, three conductor cable
4. Cell to analyzer cables are considered low level. Run separate from high level wiring.
5. If 2 cells are to be applied, the same wiring guidelines are applied to Cell 2 as are followed for Cell 1.

Figure 4-2 Installation Diagram, 4973 Cells, with 7' or 20' leads directly connected to 9782 Analyzer or connected to junction box

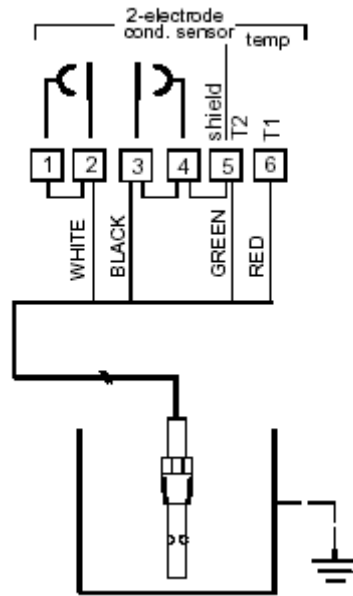


Figure 4-3 04973 series cells with 7' or 20' leads connected to an APT4000

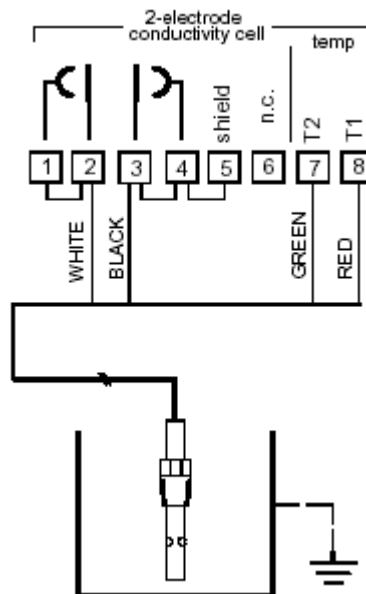


Figure 4-4 04973 series cells with 7' or 20' leads connected to an APT2000

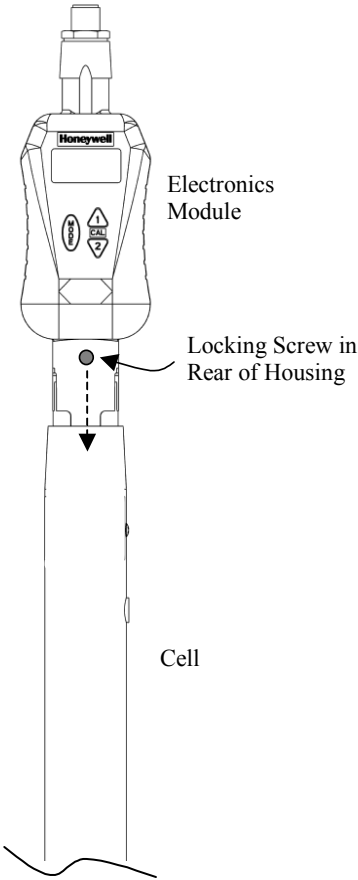


Figure 4-5 Integral DirectLine Mounting with DL4-3xx

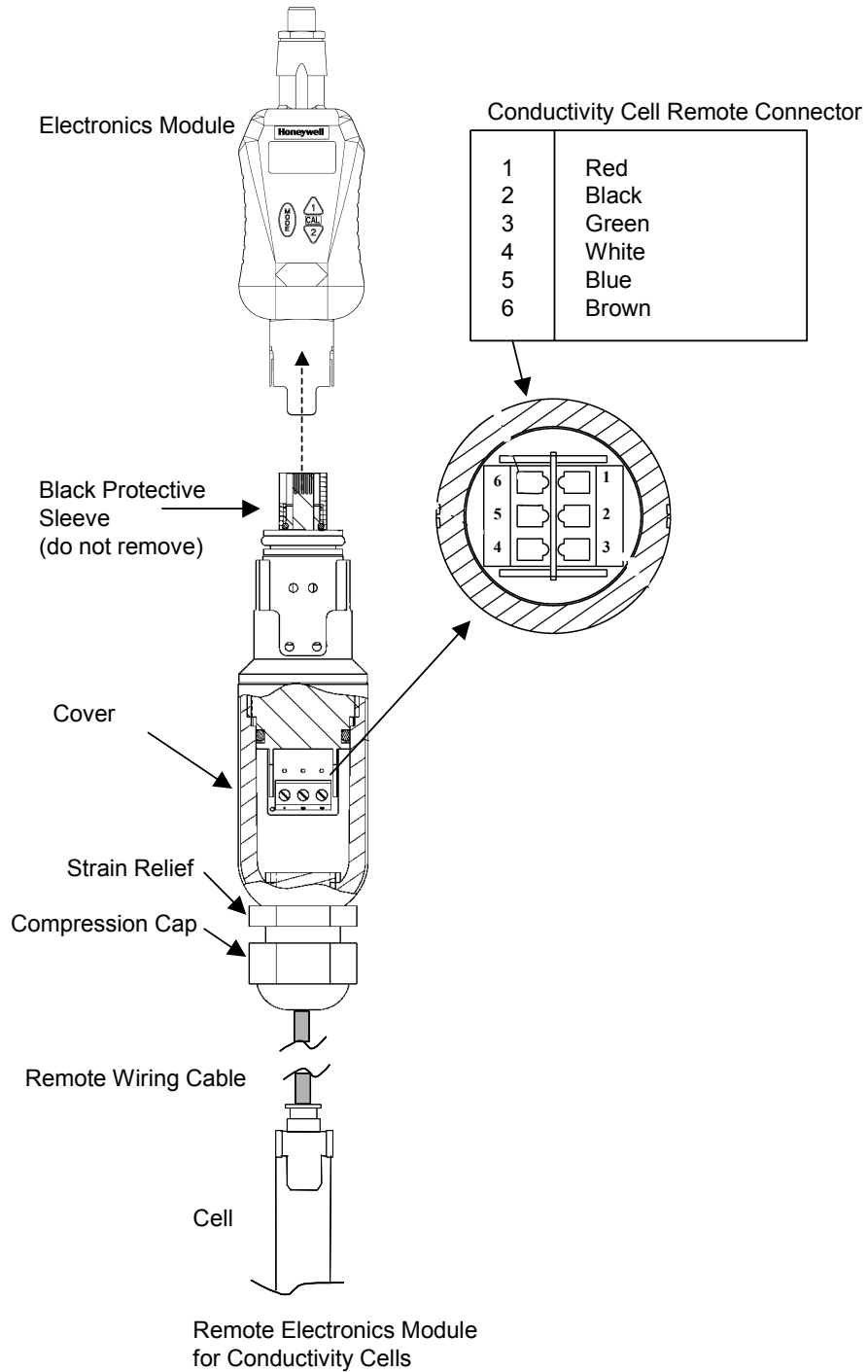


Figure 4-6 Remote DirectLine DL4-3xx series with 20' lead connected to a DL423 Modbus (through the use of the Remote Connector Assembly)

5. Maintenance

5.1 Overview

The only maintenance that may be required is occasional cleaning. When cleaning, avoid scratching electrode surfaces. Do not use a brush or pipe cleaner.

5.2 To Clean The Cell

The cell will require cleaning if sludge, slime, etc., accumulate in the flow channels. Since the materials of construction are chemically inert, chemical agents may be used and are recommended for cleaning the cells. The particular cleaning agent used must be selected according to the type of contamination to which the cell is exposed.

The cell housing is made of a polyethersulfone, PES, and must not be cleaned with acetone, chloroform, toluene, benzene, or other chlorinated hydrocarbons.

In general, a “quick” rinse in a 10% inorganic acid is effective and often adequate. Another method is to use a strong stream of water to dislodge particles; then reverse flush. After cleaning, rinse the cell thoroughly in tap water and then distilled water, if available. Take care not to scratch electrode surfaces.

5.3 Check Conductivity System

To check the conductivity system comprising the conductivity cell, leadwires, and measuring instrument, make a measurement in a reference solution of known conductivity. Alternatively, use a second cell having the same constant and temperature compensation and compare the two readings. Be sure the cells are not touching the bottom or sides of the container for this test.

If Table II of the conductivity cell model number is 333, the normal resistance of the temperature sensor as measured across the red (B) and green (D) leads is 8550 ohms at 25 C.

To check the electrode insulation, connect an ohmmeter across the black (A) and white (C) leads. With a dry and clean cell, the resistance should be greater than 50 megaohms.

5.4 Troubleshooting

A series of below normal conductivity readings could indicate that the cell is not filled with solution resulting in a lack of response.

If the plastic surface of the cell has a grayish dull appearance instead of its normal glassy appearance, the cell has been exposed to temperature above its specified maximum. Check the solution temperature and replace the conductivity cell.

5.5 Air Entrapped in Cell Flow Channel

If measurement errors appear for horizontal mountings of a 1 or 10 constant cell, it may be that air is entrapped in the cell flow channel. Take one of the following actions to eliminate this problem:

- Increase flow to at least 1 gpm.
- Rotate the cell mounting so that its flow channel faces the same direction as the pipeline flow exit.
- Install the cell and/or flow chamber vertically.

5.6 Accessories and Parts

Description	Part Number
Flow Cell Housing (PES)	055919
Junction Box	31316260
Teflon Tape (200" Roll)	31811069
Teflon Shield	
White for 1 const. cell	31021599
Clear for 10 const. cell (see note below)	31018760
Adapter bushings for connecting the cell housing in 1/4" bypass line	
3/4" male to 1/4" female	276315
3/4" female to 1/4" female	276316
9782 Standard Ranges Up to 500 ft.	
Three conductor, 18 gage cable (Belden 9494)	834059
Coax Cable (Belden 9259) – 22 AWG Coax Cable (Belden 9290) – 18 AWG	835024 -----
Up to 1000 ft.	
Four conductor (3 used), 16 gage cable (Belden 9494)	834055
Coax Cable (Belden 9259) – 22 AWG Coax Cable (Belden 9290) – 18 AWG	835024 -----
9782 Wide Ranges	
Up to 500 ft. - Four conductor, 18 gage	31834052
Up to 1000 ft. - Four conductor, 16 gage	834055
DirectLine DL423	
Remote Connector	51500768-004

Note: For 10 constant cell, heat shrink the clear shield onto the cell using a 300°F max. temp. (Cal Factor may change)

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