

## **04973 Series Conductivity Cells Installation and Maintenance Manual**

70-82-25-17

September 2011

Revision 7

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Revision 7– September 2011

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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.

## 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.
4	10/05	Edit text and add electrical connection drawings for UDA2182 analyzer
5	10/07	Edit text, add CRN approval, add quick disconnect info.
6	June 09	Consolidation
7	September 2011	

## 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 #
APT2000CC Transmitter User Manual	70-82-25-95
APT4000CC Analyzer User Manual	70-82-25-104
UDA2182 Analyzer User Manual	70-82-25-119

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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 UDA2182 Series or APT2000/4000 Series are equipped with the choice of:

- integral standard 20 or 50 foot lead
- quick disconnect cable option
- junction box type (universal) head with terminal connections for longer lead lengths.

For in-line 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 a 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.

A 316SS (P/N 31079198) and a PES (P/N 055919) Flow Chamber is available from Honeywell.

### ATTENTION

Conductivity Cells are manufactured with an embedded EEPROM that contains the cell constant and cell factor information. When the EEPROM leads (Brown and Blue), junction box head terminals (E) and (F) are connected to a UDA2182 Analyzer these parameters are automatically uploaded into the analyzer.

## 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.

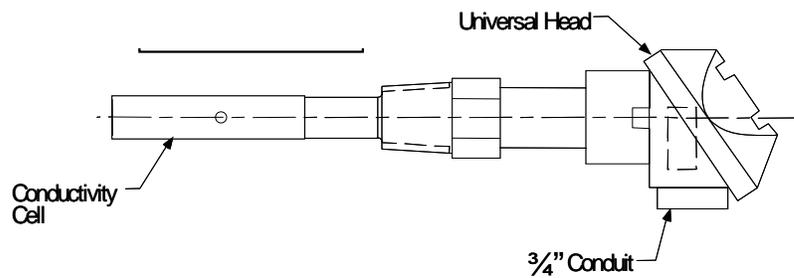
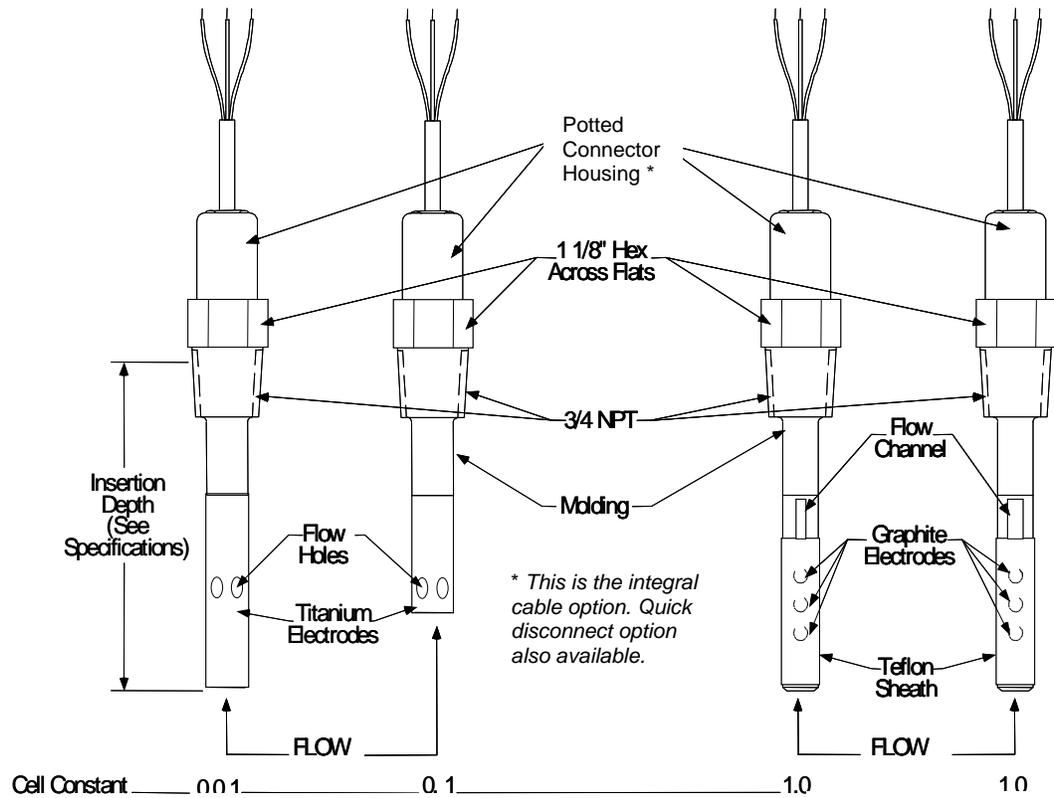
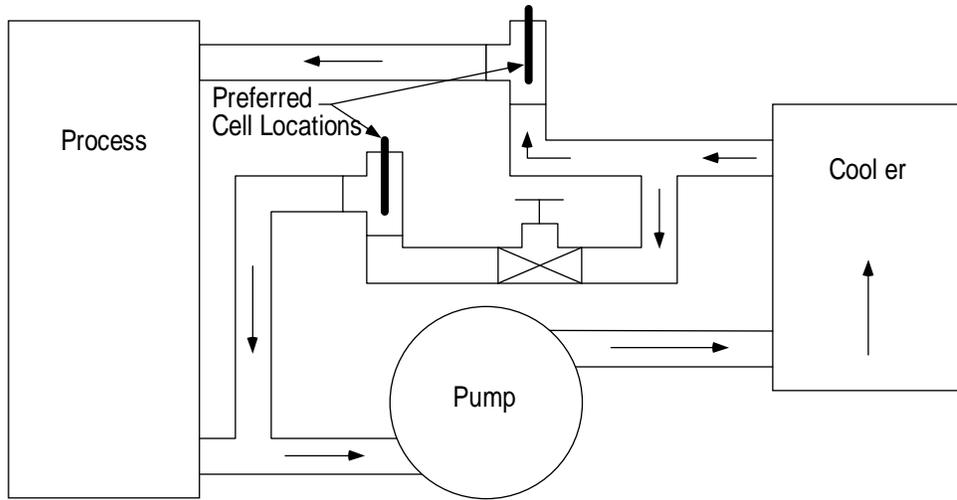


Figure 1-1 4973 Type Conductivity Cells, for Flow and Insertion-type Applications.

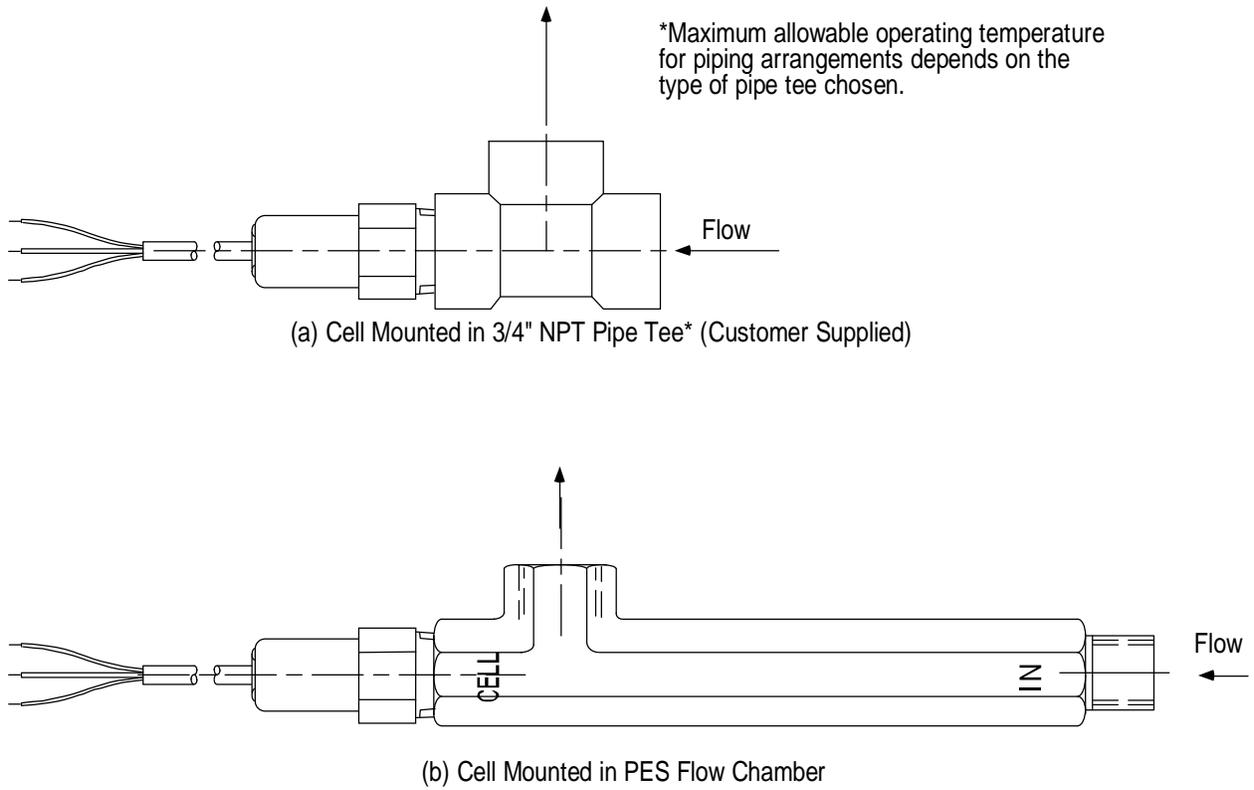
#### ATTENTION

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 Specifications for 04973 Series

Parameter	Description
Cell Constant	<b>04973 Series:</b> 0.01, 0.1, 1.0 and 10 as specified
Electrode Material	<b>0.01 and 0.1 constant</b> , titanium <b>1.0 and 10 constant</b> , high density graphite with Teflon sheath
Maximum Pressure Limit	1724 kPa (250 psig) at rated temperature
Maximum Continuous Temperature Limit	140°C (284°F) at rated pressure <b>For PVC wire:</b> 105°C (221°F)
Materials of Construction	<b>Cell Body:</b> PES (polyethersulfone) <b>Electrodes:</b> see 'Electrode Material'
Cable Options	<b>Leadwire:</b> PVC insulated 22 gage cable 20 and 50 feet lengths available <b>Quick Disconnect Option</b> <b>Universal Head (Aluminum)</b>
Approvals	Manufactured to comply with ASME boiler and pressure vessel code Section III, Div.1, UG-101 CRN #0F11607.5C
Insertion	3/4" NPT male, 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" MNPT 2-1/2" (64mm) for 0.1 cell constant

### 2.2 Specifications for 055919 Flow Chamber

Parameter	Description
Maximum Flow	2 gpm @ 40psig and atmospheric discharge
Maximum Pressure	200 psig @ 25°C
Maximum Temperature	140°C (284°F) at atmospheric pressure
Dimensions	See Figure 3-1
Materials of Construction	Polyethersulfone (PES)

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## 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 3.3 and 3.4.

- 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 3.5. Over-tightening can break the cell or severely stress it causing cracks to develop, leading to eventual malfunction.

### 3.2 The Differences between the Quick Disconnect and Integral Cable Option

The cable options of quick disconnect and integral cable do not affect the performance of the cell. These options only relate to how the cell is connected to the instrument.

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#### ATTENTION

- The electrical connections are different for these options. Please refer to Section 4 for instructions.
  - The wire colors for the integral cable and quick disconnect option are not the same.
- 

- Integral cable means the cable is potted into the cell. The cable and cell are one entity and cannot be separated.
  - The quick disconnect option means the cell is connected to the cell by a receptacle on the top of the cell. The cell and the cable are separate entities. When the time comes to replace the cell, the cable does not have to be replaced. The cable can simply be mated with another cell that has the quick disconnect option. This option can not be used in immersion applications.
- 

#### ATTENTION

The quick disconnect cable can be purchased from Honeywell.

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### 3.3 In-Line 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

Tighten the cell into a 3/4" NPT threaded opening (do not exceed a tightening torque greater than that indicated in Section 3.5) using a Teflon thread compound (preferably Teflon tape).

### 3.4 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.

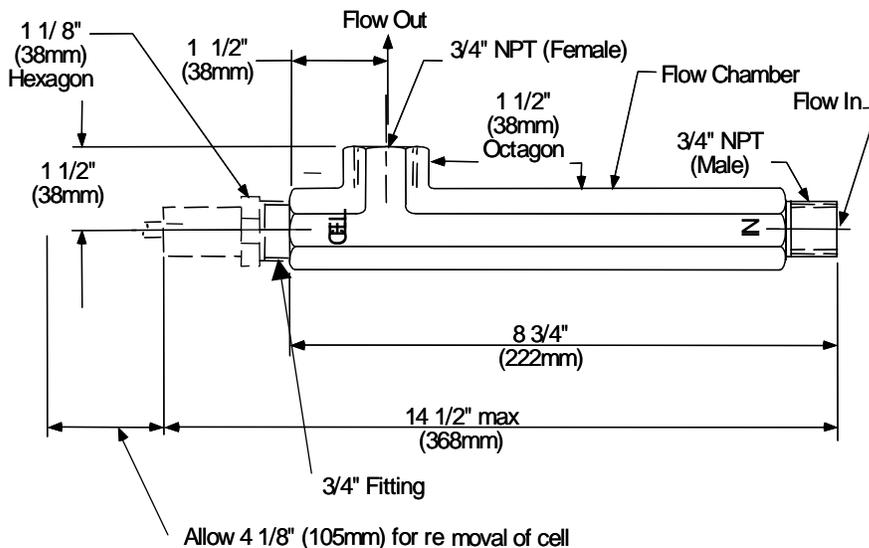
#### Installation

1. Tighten the cell into a 3/4" pipe tee (do not exceed a tightening torque greater than that indicated in Section 3.5).
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.

### 3.5 Torque Recommendations

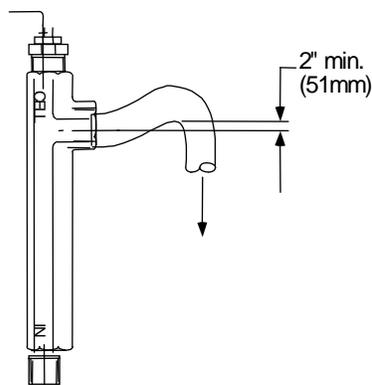
For inserting a cell in metal fittings or bushings - 40 ft-lb maximum. For inserting a cell in plastic fittings or bushings - 10 ft-lb maximum. Always use pipe sealant (preferably Teflon tape).

### 3.6 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.



ah 23342

Figure 3-1 Dimension Drawing for 055919 Flow Chamber

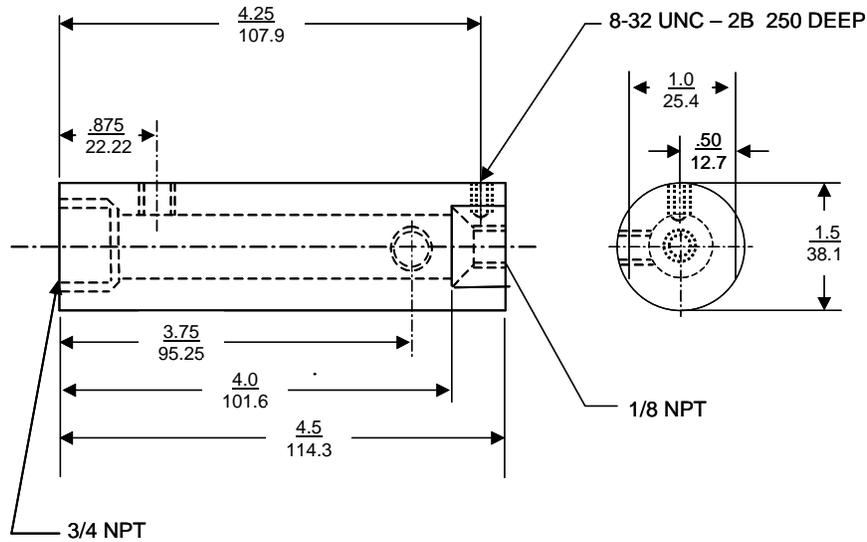
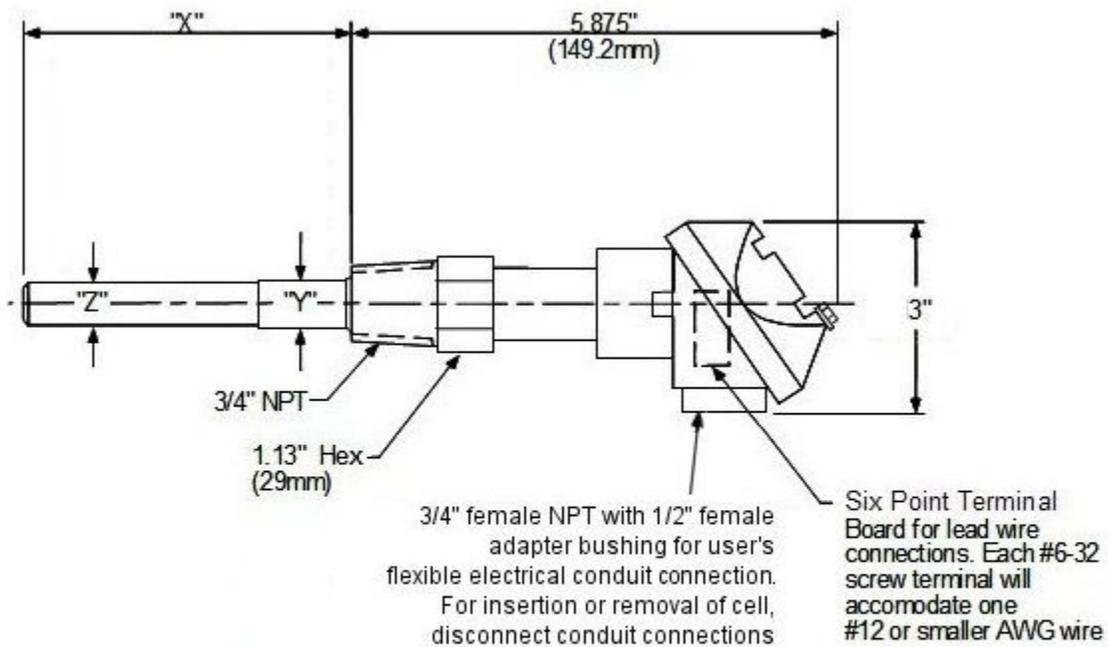
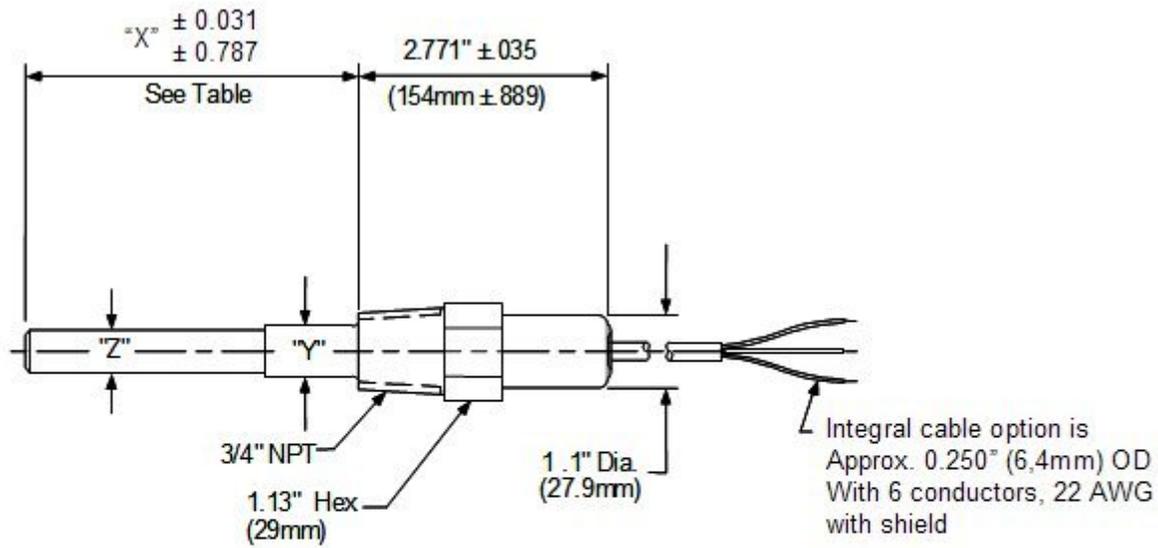


Figure 3-2 Dimension Drawing for 31079198 Flow Chamber



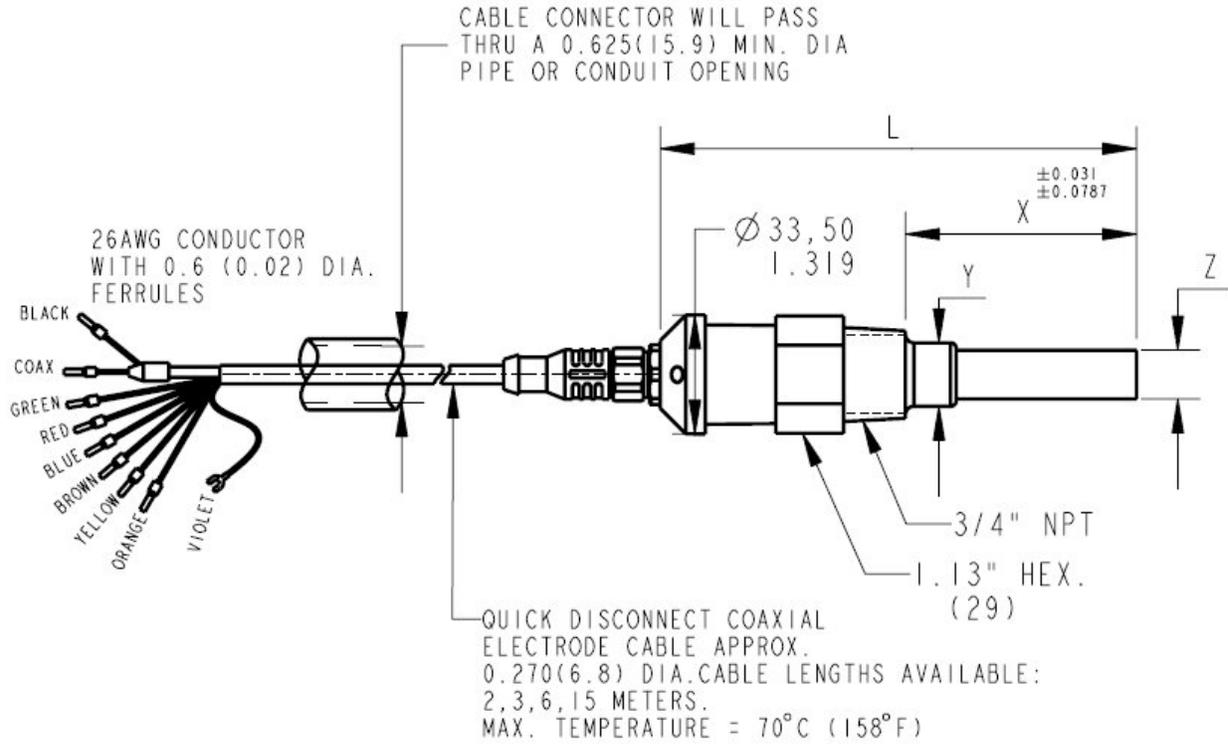
Suffix A	Dim "X"		Dim "Y"		Dim "Z"	
	Inch	mm	Inch	mm	Inch	mm
00.1	3.3	84	.703	17.85	.542	13.76
0.1	2.6	66	.703	17.85	.542	13.76
1.0	3.5	89	.593	15.06	.625	15.87
10	3.5	89	.593	15.06	.564	14.32

Figure 3-3 Outline and Dimensions for 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 3-4 Outline and Dimensions for Conductivity Cell with Integral Cable



SUFFIX A	DIM"X"		DIM"Y"		DIM"Z"		DIM"L"	
	INCH	MM	INCH	MM	INCH	MM	INCH	MM
0.01	3.3	84	0.703	17.85	0.542	13.76	6.026	153.08
0.1	2.6	66	0.703	17.85	0.542	13.76	5.318	135.08
1.0	3.5	89	0.593	15.06	0.625	15.87	6.223	158.08
10	3.5	89	0.593	15.06	0.564	14.32	6.223	158.08

Figure 3-5 Outline and Dimensions for Conductivity Cell with Quick Disconnect

## 4. Electrical Connections

### 4.1 Overview

The terminal board connections for the various Honeywell measuring instruments are given in the appropriate Figures in this section.

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.

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#### **ATTENTION**

Do not use shielded cable except where shown in the following figures.

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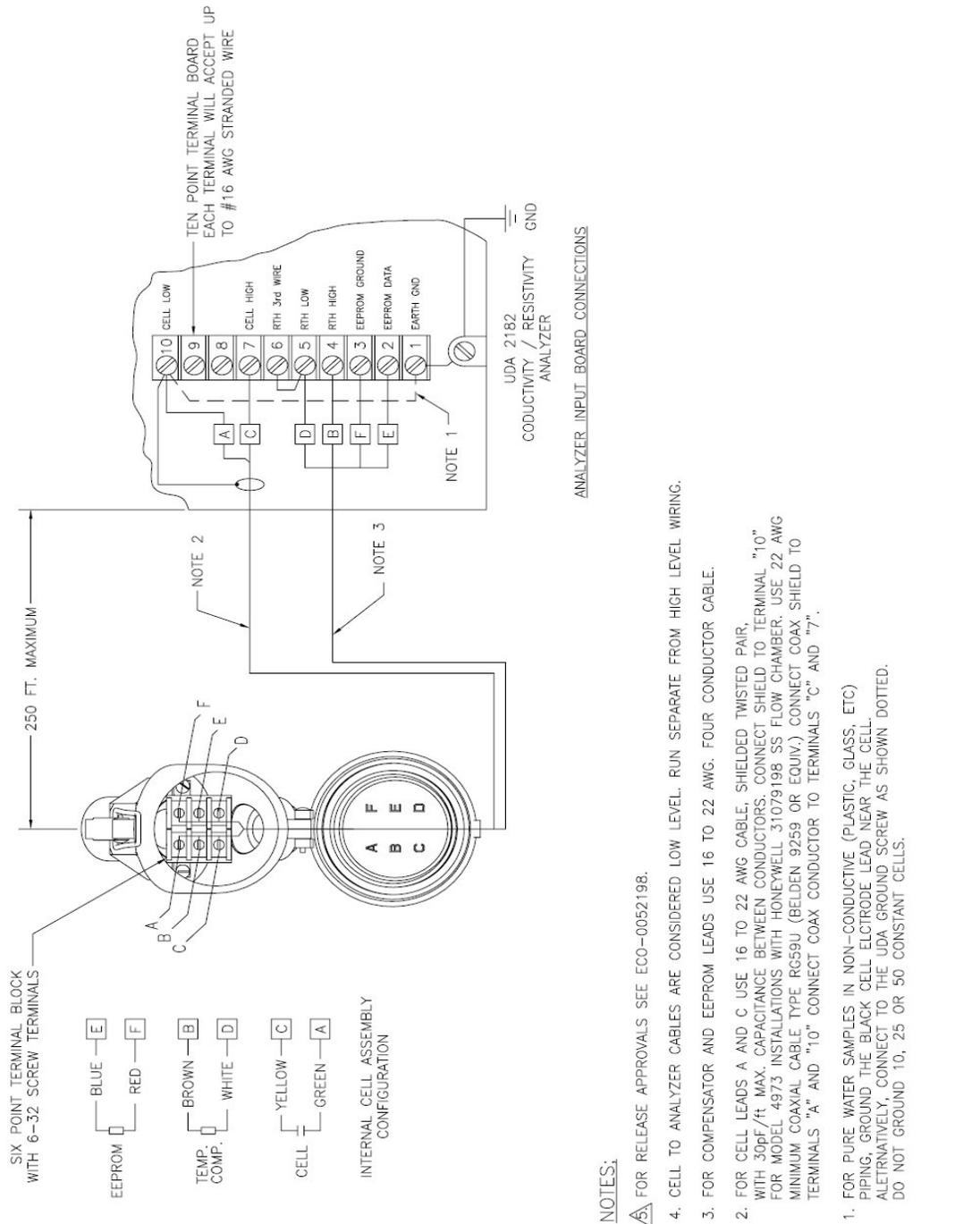
#### **WARNING**

For 6 conductor cells, EEPROM memory device is ESD sensitive- blue and brown leads; junction box head terminals (E) and (F)

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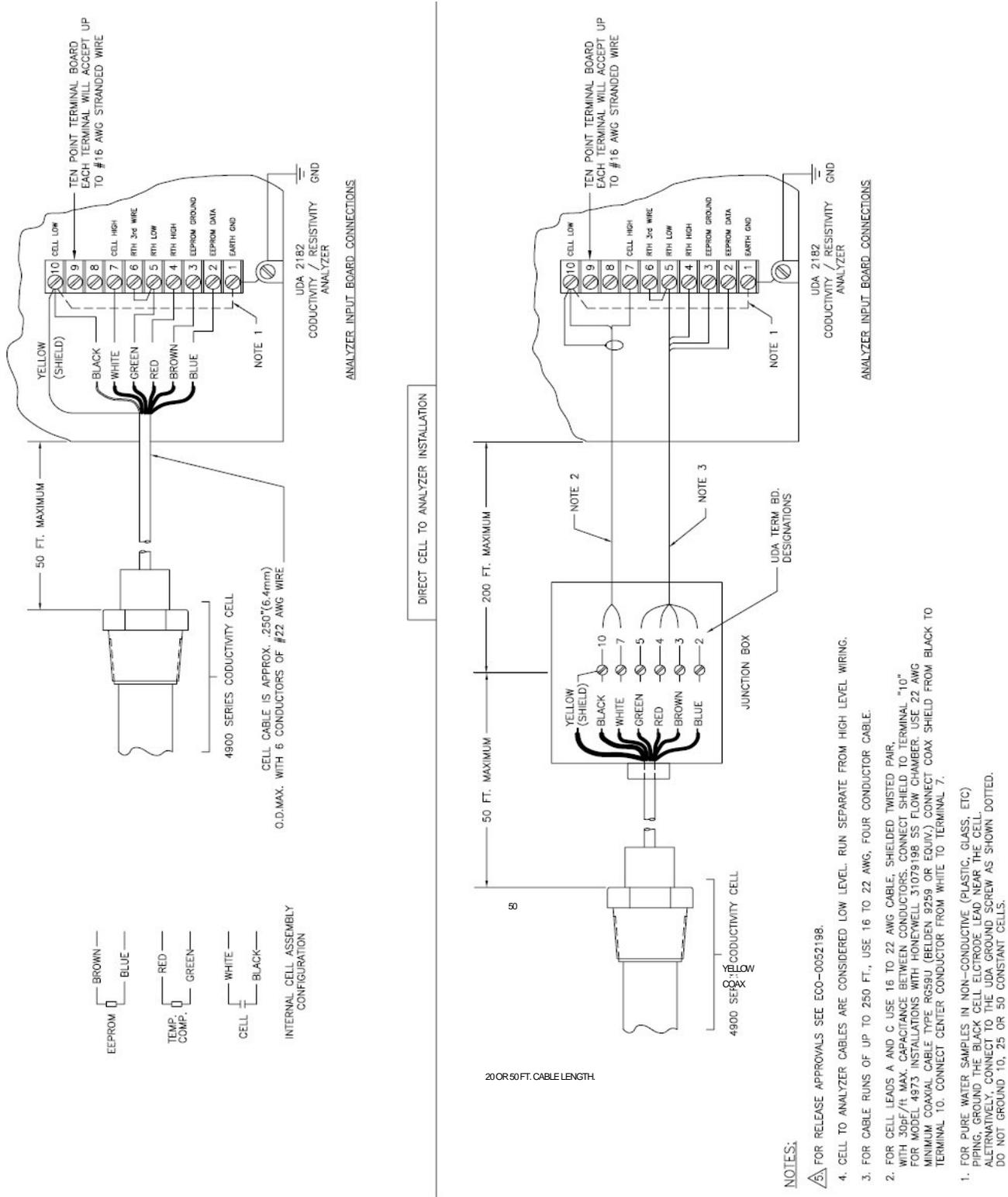
## 4.2 Instrument Wiring for 4973 Cells with Integral Cable or Junction Box

### 4.2.1 Model 4973 Series with Integral Cable or Junction Box to UDA2182 Analyzer



DRAWING 50043652

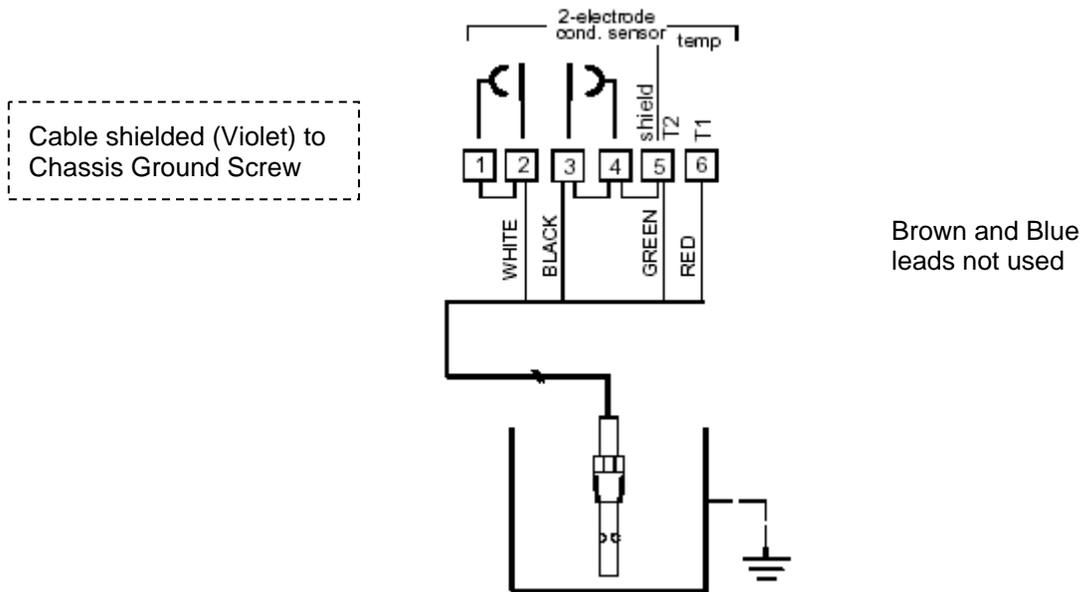
Figure 4-1 Installation Diagram, 4973 Cells, with junction box head connected to UDA2182 Analyzer



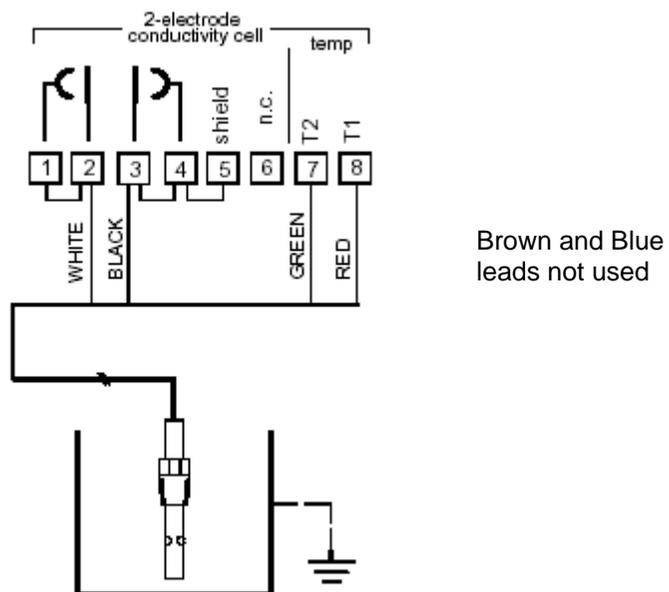
DRAWING 50043654

Figure 4-2 Installation Diagram, 4973 Cells, with Integral Cable Leads Directly Connected to UDA2182 Analyzer or Connected to Junction Box

### 4.2.2 Model 4973 Series with Integral Cable to APT Series Analyzer/Transmitter



04973 series cells with integral cable leads connected to an APT4000



04973 series cells with integral cable leads connected to an APT2000

Figure 4-3 Model 4973 Series to APT Series Analyzer/Transmitter

### 4.3 Instrument Wiring for 4973 Cells with Quick Disconnect Cable

#### 4.3.1 Wiring Model 4973 with Quick Disconnect Cable to UDA2182

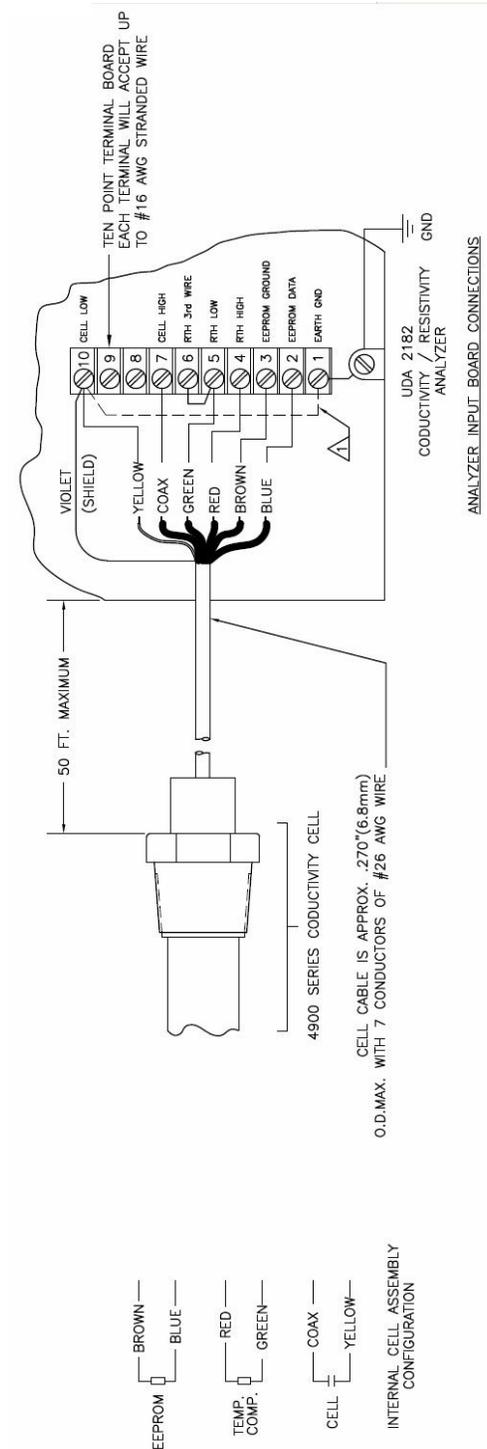


Figure 4-4 Wiring Diagram for 4973 Cells with Quick Disconnect Cable Connected to UDA2182 Analyzer

### 4.3.2 Wiring Model 4973 with Quick Disconnect Cable to Junction Box

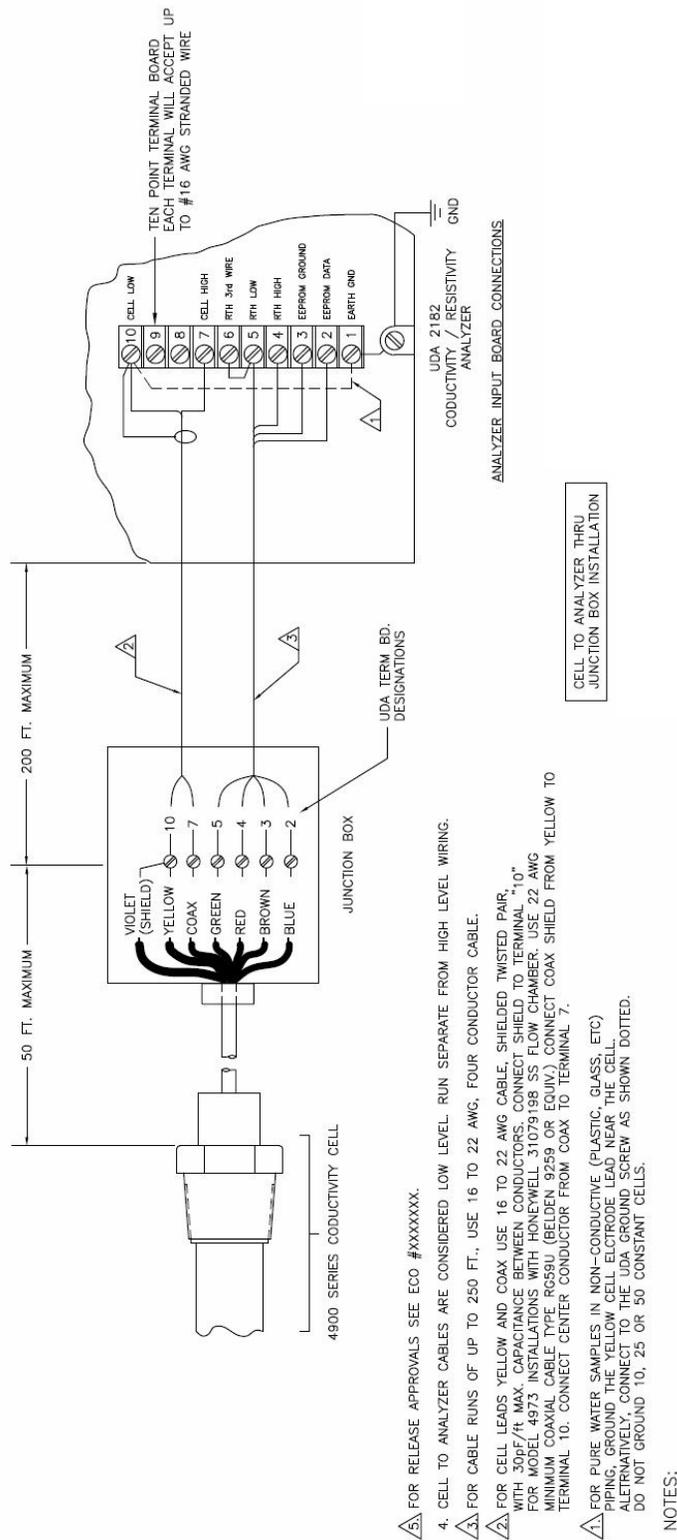


Figure 4-5 Installation diagram for 4973 cells with Quick Disconnect Cable connected to junction box

### 4.3.3 Wiring Model 4973 with Quick Disconnect Cable to APT

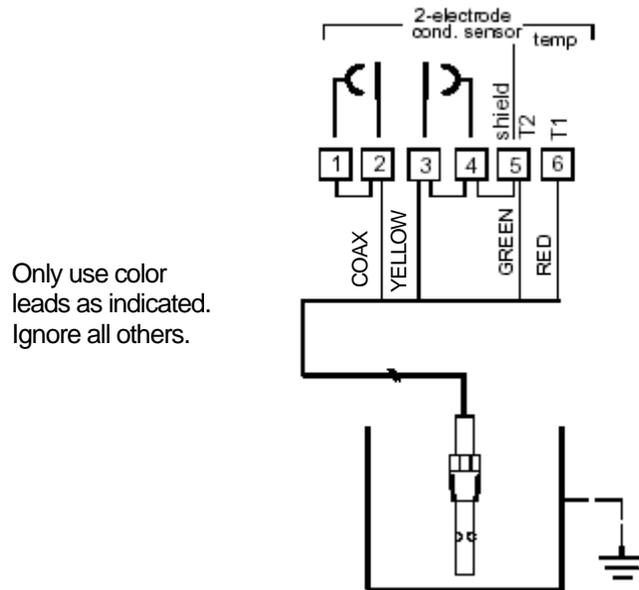


Figure 4-6 Wiring Diagram for 4973 Cells with Quick Disconnect Cable Connected to APT4000

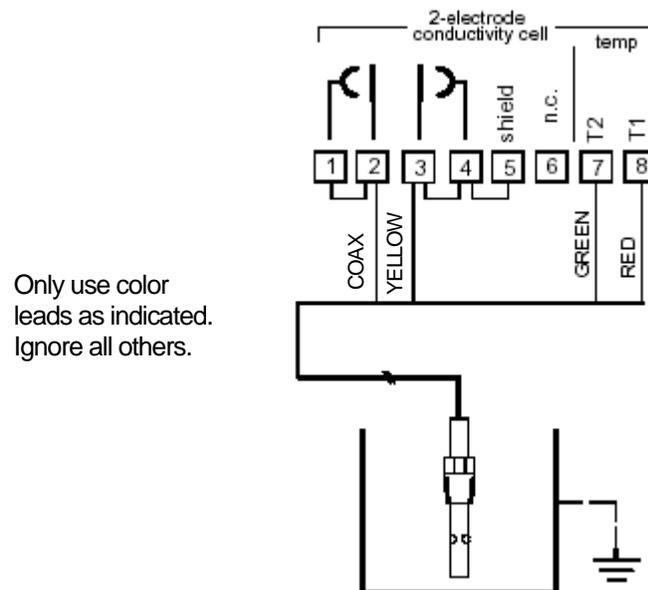


Figure 4-7 Wiring Diagram for 4973 Cells with Quick Disconnect Cable Connected to APT2000

## 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 (coax and yellow for QD option). With a dry and clean cell, the resistance should be greater than 50 megohms.

**NOTE: Never connect a test instrument across the Blue (E) and Brown (F) leads. Damage to the cell memory device may occur.**

### 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.

## 6. Accessories and Spare Parts

Description	Part Number
Flow Cell Housing (PES)	055919
Flow Cell Housing (316 SS)	31079198
Junction Box	31316260
<b>Teflon Shield</b>	
White for 1 const. cell	31021599
Clear for 10 const. cell (see note below)	31018760
<b>Extension Cables for Sensors with Quick Disconnect Option</b>	
2 m (6.56 ft.)	50024092-001
3 m (9.84 ft.)	50024092-002
6 m (19.69 ft.)	50024092-003
15 m (49.21 ft.)	50024092-004
Extension Cable must be purchased from Honeywell	
<b>Cell Extension Leadwire (see Fig 4.1 &amp; 4.2 for required cables)</b>	
18 AWG, Low capacitance shielded twisted pair	BELDEN 8760 or equivalent
22 AWG, Coax RG59U	BELDEN 9259 or equivalent
18 AWG, 4 conductor	BELDEN 8489 or equivalent

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



## Sales and Service

For application assistance, current specifications, pricing, or name of the nearest Authorized Distributor, contact one of the offices below.

### Asia Pacific Global Technical Support Field Instruments

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Fax: +65 6445-3033

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