Honeywell

4973 Series Conductivity Cells Installation and Maintenance Manual

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Total Plant

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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.

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
7079-17 Two-Wire Transmitter for Conductivity/Resistivity Operation and Maintenance Manual	70-82-25-51

Contacts

The following list identifies important contacts within Honeywell.

Organization	Telephone	Address
Honeywell TAC	1-800-423-9883	1100 Virginia Drive Fort Washington, PA 199034

Contents

Figures

1. Introduction

1.1 Overview

The 4973 Series 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 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.

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 in the 4973 Series 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.

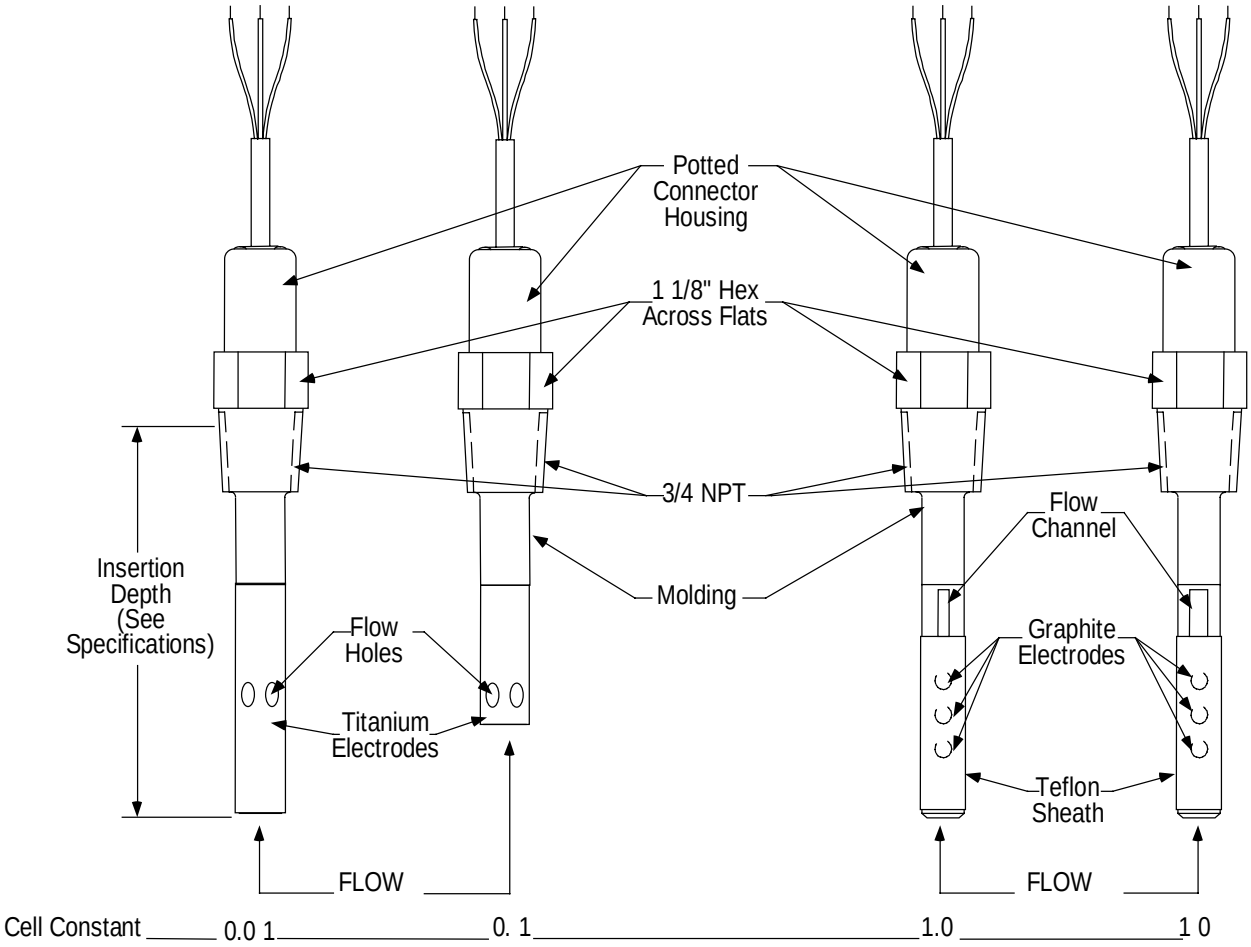
The physical appearance of the cells is shown in Figure 1-1. The 0.01, 0.1, 1 and 10 cell constants are similar in construction with differences as noted below.

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.



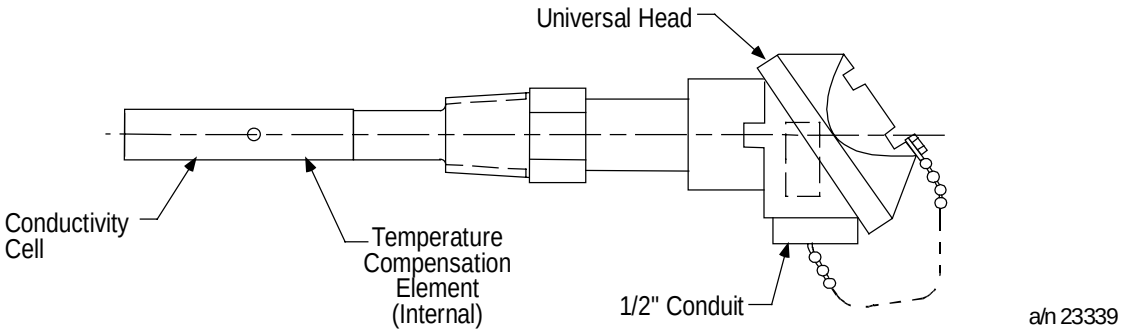


Figure 1-1 4973 Series Conductivity Cells, For flow- and insertion-type applications.

ATTENTION

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

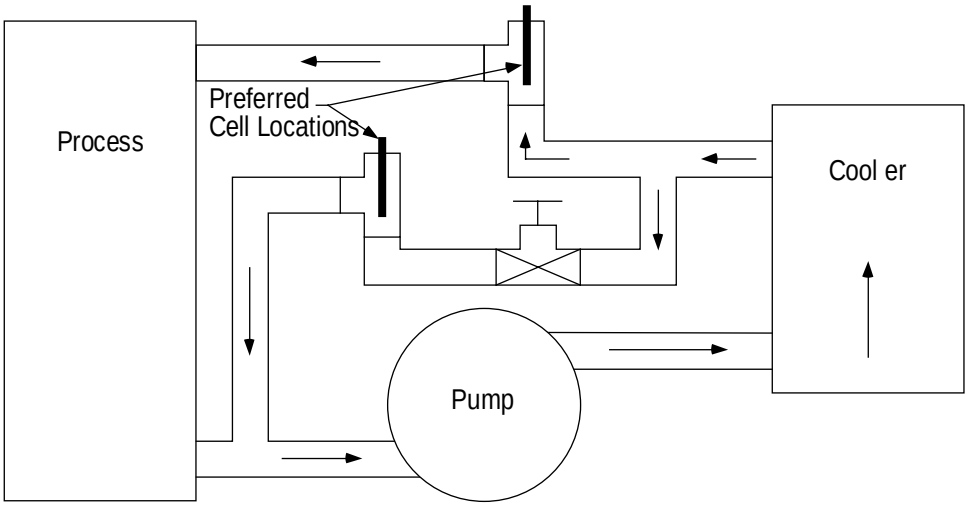


Figure 1-2 Recommended Locations for Mounting a Conductivity Cell

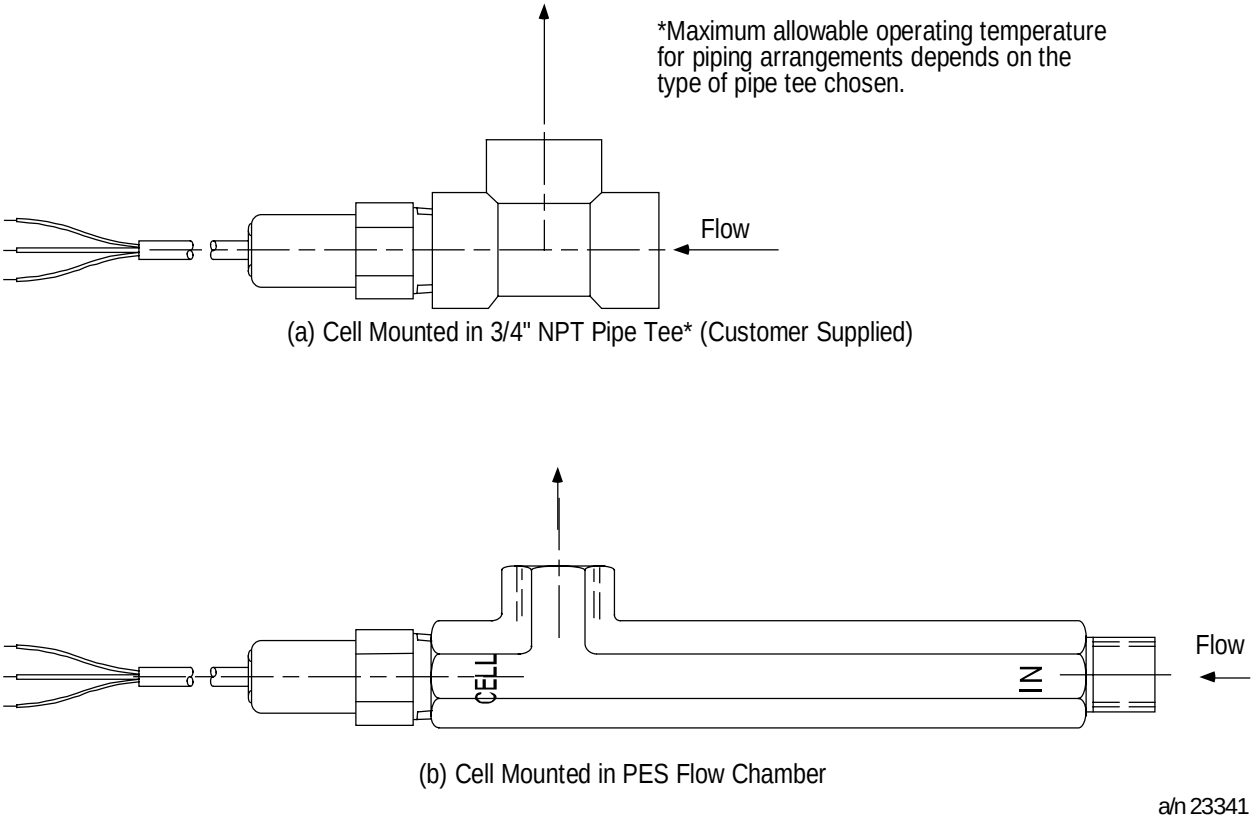


Figure 1-3 Two Piping Arrangements for the Cell

2. Specifications

2.1 4973 Series Cell

Automatic Temperature Compensation: Temperature sensor integral with all cells.

Cell Constants: 0.1, 0.1, 1.0, 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: Standard 7 foot lead, 3 ro 4 conductor, nonshielded 18-gage PVC insulated wire. Optional 20 foot lead, 3 or 4 conductor, nonshielded 18-gage PVC insulated wire, see Figure 5-3. Optional head-type junction box (universal head) with terminals for extension wire and ½" inch NPT conduit connection, see Figure 5-2.

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 0.1cell constant.

2.2 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 5-1

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 1or 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).

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. Figures 5-4 and 5-5 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 Figures 5-4 and 5-5 for connections to 7082 and 9782 Analyzers (Table III = 333) only.

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 megohms.

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
Table II=333, 7082 and 9782 Standard Ranges Up to 500 ft.	
Three conductor, 18 gage cable (Belden 9494)	834059
Coax Cable (Belden 9259)	835024
Up to 1000 ft.	
Four conductor (3 used), 16 gage cable (Belden 9494)	834055
Coax Cable (Belden 9259)	835024
7082-13 to –15 and 9782 Wide Ranges	
Up to 500 ft. - Four conductor, 18 gage	31834052
Up to 1000 ft. - Four conductor, 16 gage	834055

Note: For 10 constant cell, heat shrink the clear shield onto the cell using a 300°F max. temp.

5.7 Ordering Information

Instructions

- Consult Steps to Selecting Appropriate Conductivity Instrumentation and Cells 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.

Key Number ⌐ _ _ _ _ _ ¬ - **I** ⌐ _ _ _ ¬ - **II** ⌐ _ _ _ ¬ - **III** ⌐ _ _ ¬ - **IV** ⌐ _ _ ¬ - **V** ⌐ _ _ _ ¬

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 9782 & 7082 Only		333	**c**	**c**
		201	•	•
		202	•	•
		207	•	•
		209	•	•
		210	•	•
Available for 7079C Transmitter or already withdrawn analytical		300	•	•
		301	•	•
instruments. (Refer to Tables 1 and 6 under Steps to Selecting		302	•	•
		303	•	•
Appropriate Conductivity Instrumentation & Cells for available		304	•	•
		305	•	•
temp. compensator/conductivity range.)		306	•	•
		307	•	•
		309	•	•
		310	•	•
		314	•	•

TABLE III

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

TABLE IV		Selection	049 73	049 74
CIP Sanitary Fittings	None	00	•	
	1.5"	15		•
	2.0"	20		•

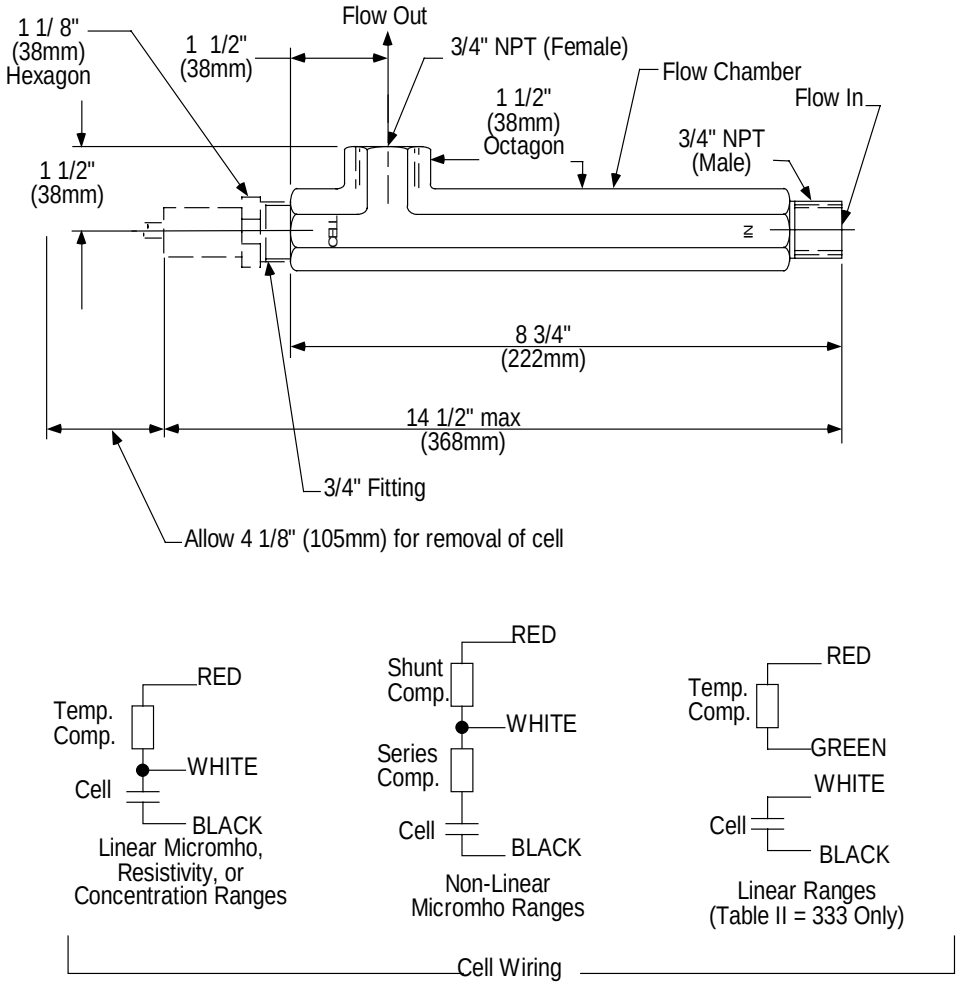
TABLE V - OPTIONS

Tagging	None		0 _ _	•	•
	Linen		L _ _	•	•
	Stainless Steel		S _ _	•	•
Certificate of Calibration	No	**Note 1**	_0_	•	•
	Yes	**Note 1**	_1_	•	•
Future			_ _0	•	•

RESTRICTIONS

Restriction Letter	Available Only With			Not Available With	
	Table	Selection		Table	Selection
c	II	For 7082 Analyzers only			

Note 1: The current selection system reguires that Yes be chosen if a Certificate of Calibration is to be sent along with any of the available 4973/4974 cells.



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.

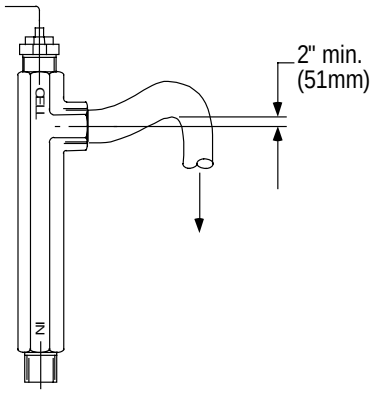


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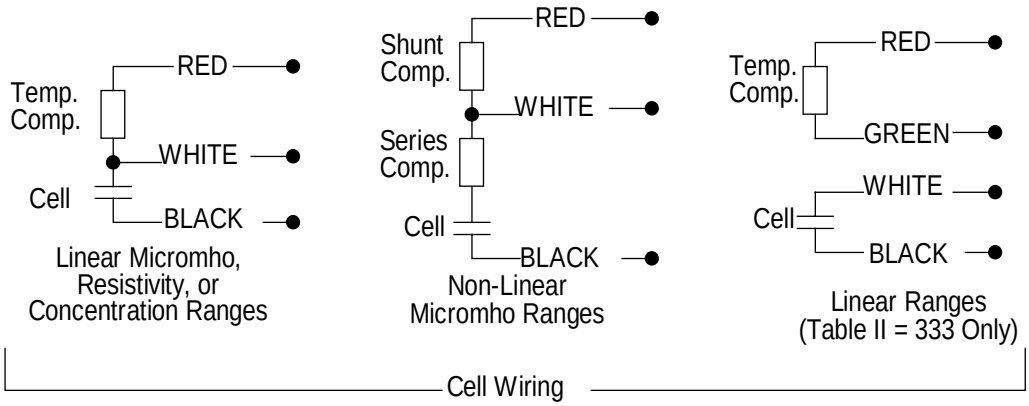
Figure 5-1 Dimension Drawing for 055919 Flow Chamber



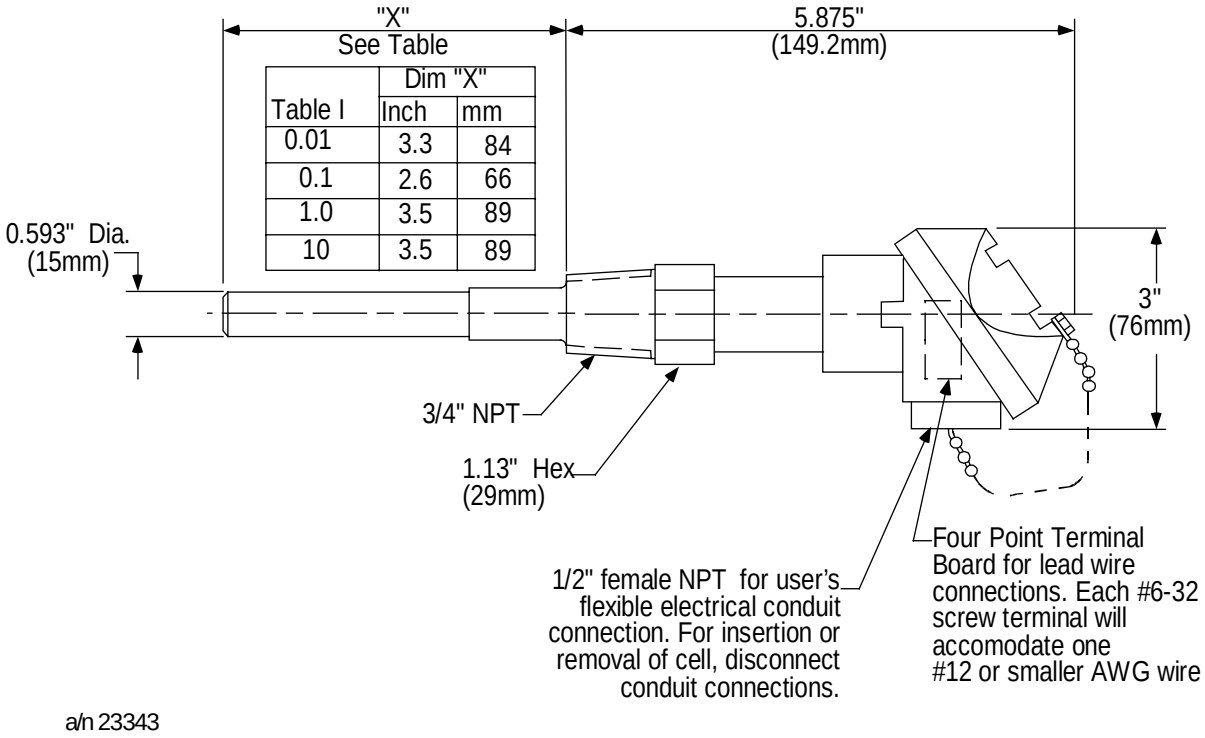
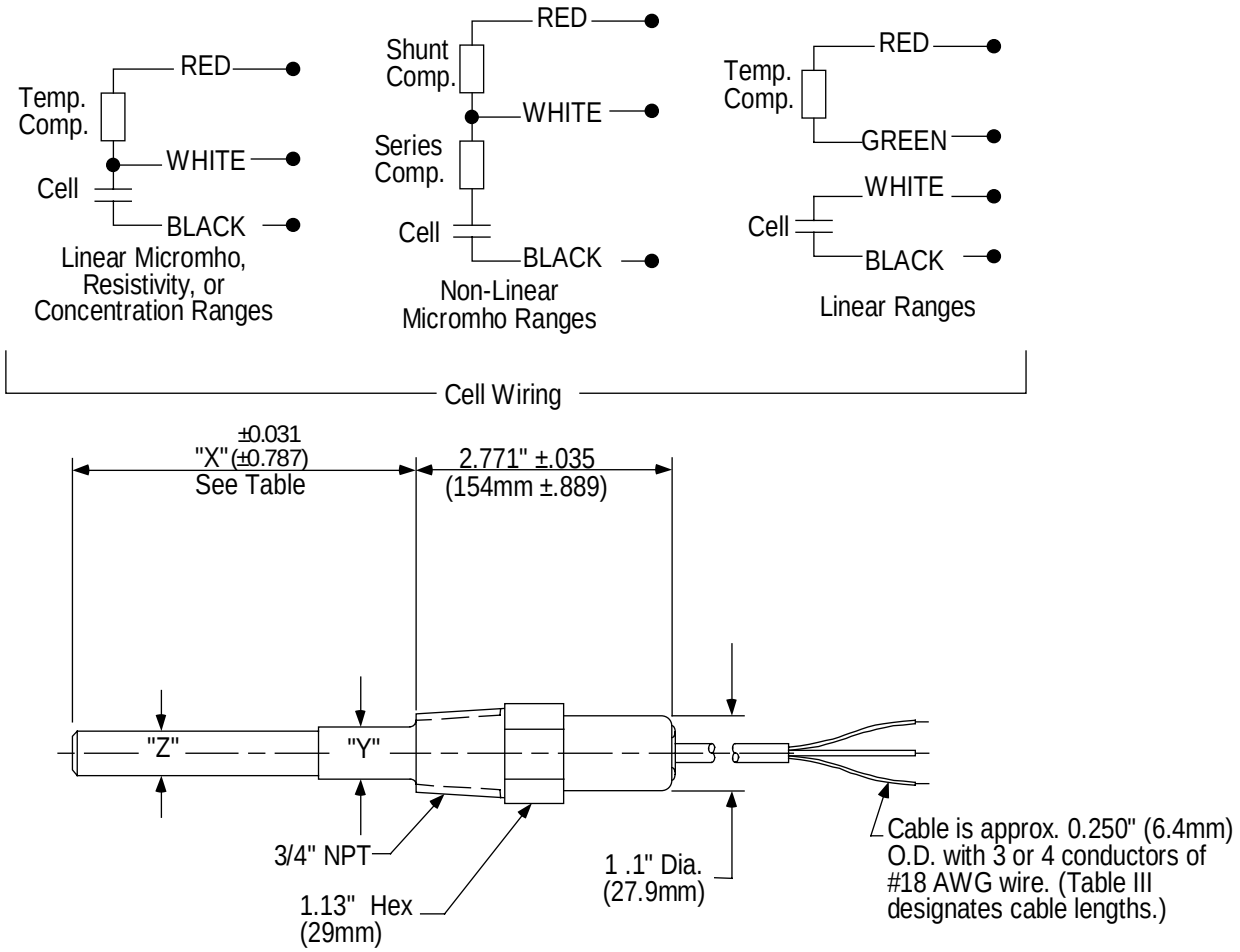


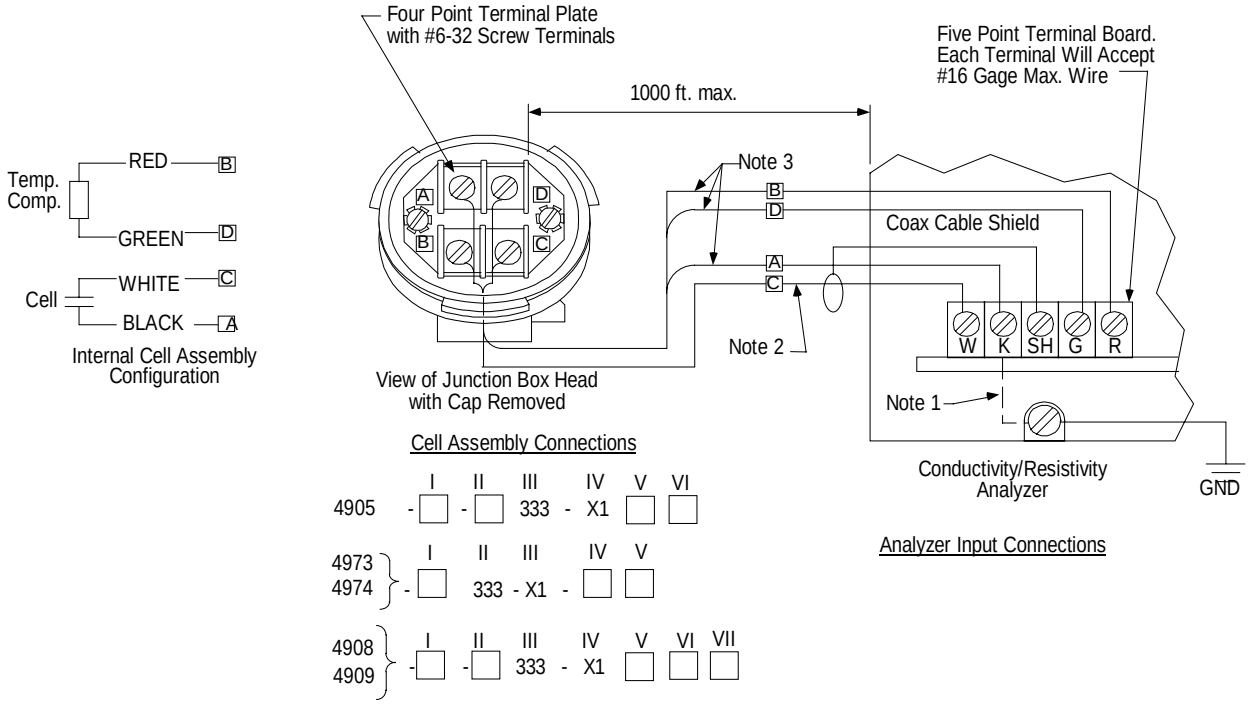
Figure 5-2 Outline and Dimensions for 4973-❑-❑-X1-00-❑ Conductivity Cell with Universal Head



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	1 5.06	.625	15.87
10	3.5	89	.593	1 5.06	.564	14.32

a/n 23344

Figure 5-3 Outline and Dimensions for 4973-❑-❑-X7/20-00-❑ Conductivity Cell



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. 7082-16, 17, 18, 19 (only)
   Use 22 gage minimum coaxial cable type RG59/U connecting shield to terminal "SH" only.

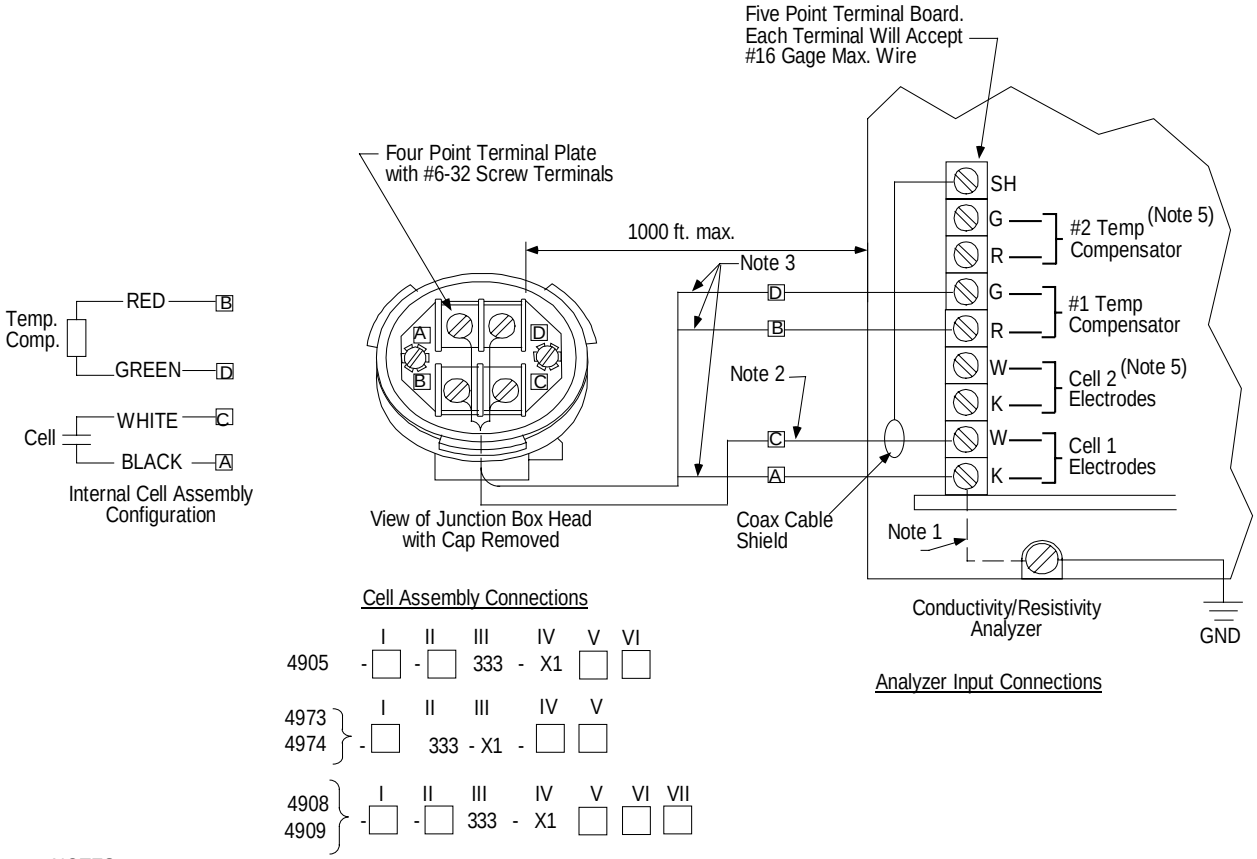
3. 7082-16, 17, 18, 19
   For cable runs of up to 500 ft., use: 18 gage minimum, three conductor cable.
   For cbale runs of 500 - 1000 ft., use: 16 gage minimum, three conductor cable.

   7082-13, 14, 15 [coax and shield (SH) not used]
   For cable runs of up to 500 ft., use: 18 gage minimum, four conductor cable.
   For cable runs of 500 - 1000 ft., use: 16 gage minimum, four conductor cable.

4. Cell to analyzer cables are considered low level. Run seperate from high level wiring.

a/n 23345

Figure 5-4 Installation Diagram, 4973 Cells, Table II=333, with junction box head connected to 7082 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.

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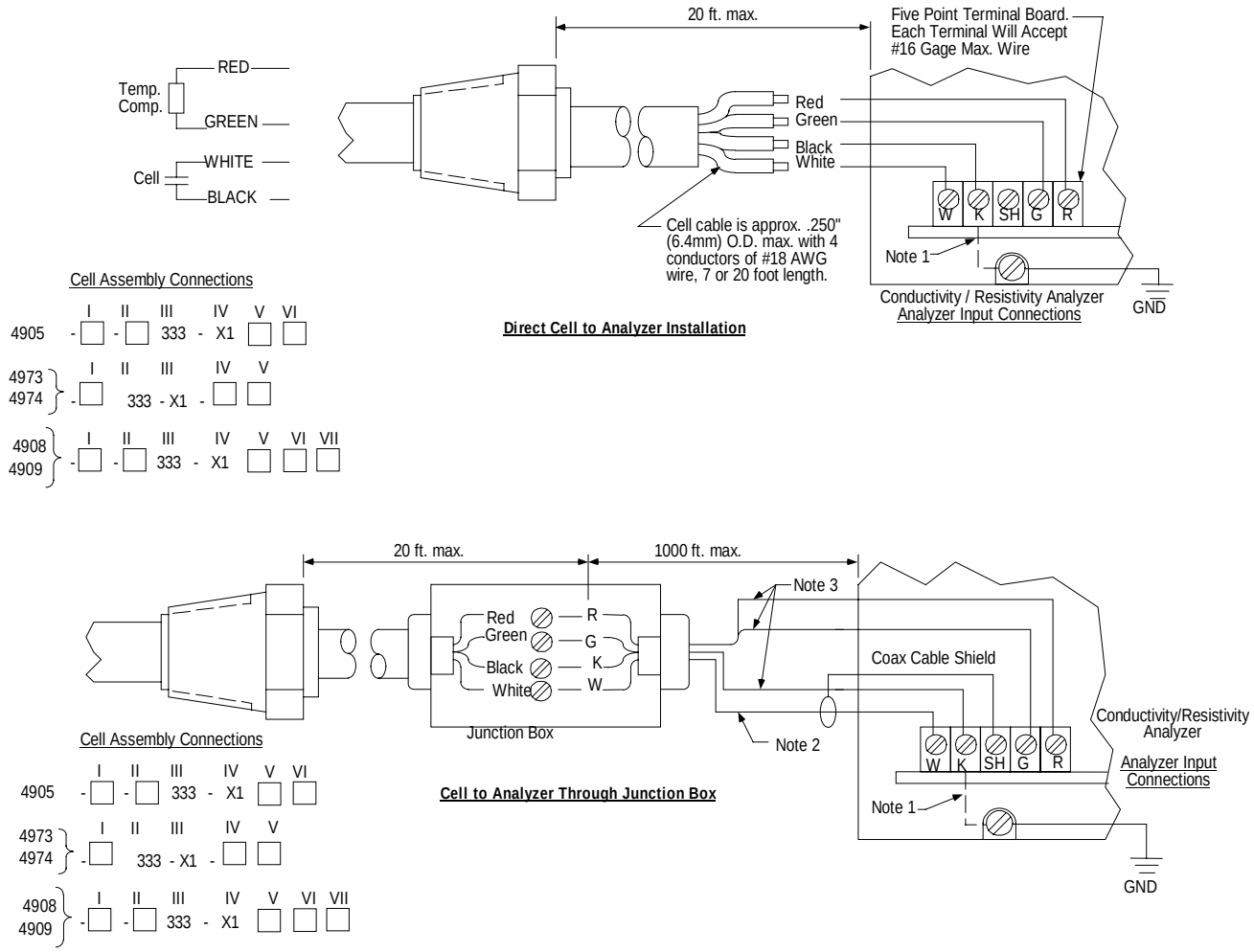
   For cable runs of 500 - 1000 ft., use: 16 gage minimum, three conductor cable.

   7082-13, 14, 15 [coax and shield (SH) not used]
   For cable runs of up to 500 ft., use: 18 gage minimum, four conductor cable.
   For cable runs of 500 - 1000 ft., use: 16 gage minimum, four conductor cable.

4. Cell to analyzer cables are considered low level. Run seperate from high level wiring.
5. If 2 Cells are to be appplied, the same wiring guidelines are applied to Cell 2 as are followed for Cell 1.

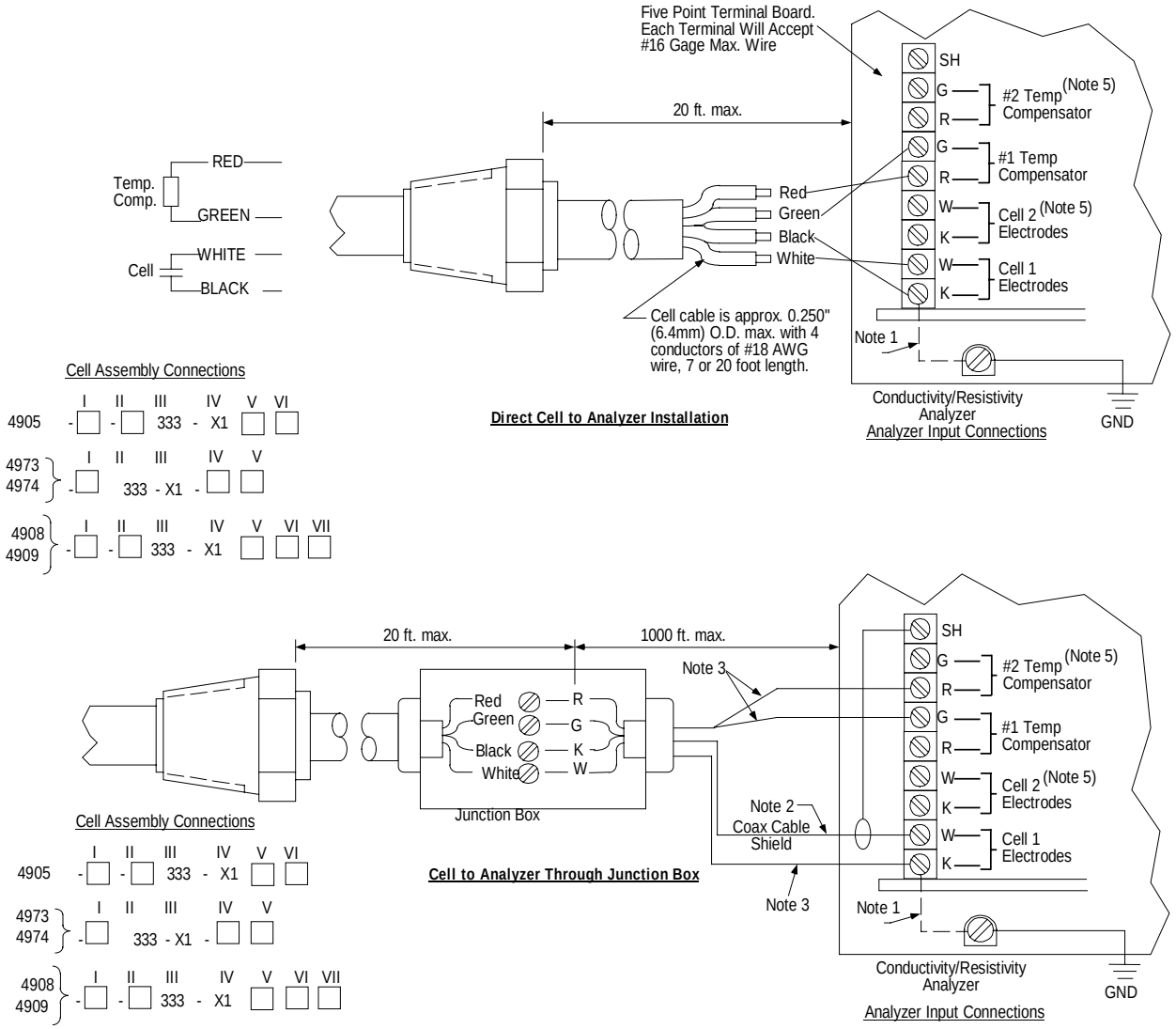
Figure 5-5 Installation Diagram, 4973 Cells, Table II=333, with junction box head connected to 9782 Analyzer



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. 7082-16, 17, 18, 19 (only)
   Use 22 gage minimum coaxial cable type RG59/U connecting shield to terminal "SH" only.
3. 7082-16, 17, 18, 19
   For cable runs of up to 500 ft., use: 18 gage minimum, three conductor cable.
   For cable runs of 500 - 1000 ft., use: 16 gage minimum, three conductor cable.
   7082-13, 14, 15 [coax and shield (SH) not used]
   For cable runs of up to 500 ft., use: 18 gage minimum, four conductor cable.
   For cable runs of 500 - 1000 ft., use: 16 gage minimum, four conductor cable.
4. Cell to analyzer cables are considered low level. Run seperate from high level wiring.

a/n 23346

Figure 5-6 Installation Diagram, 4973 Cells, with 7' or 20' leads directly connected to 7082 Analyzer or connected to junction box



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.
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   7082-13, 14, 15 [coax and shield (SH) not used]
   For cable runs of up to 500 ft., use: 18 gage minimum, four conductor cable.
   For cable runs of 500 - 1000 ft., use: 16 gage minimum, four conductor cable.
4. Cell to analyzer cables are considered low level. Run seperate from high level wiring.
5. If 2 Cells are to be applied, the same guidelines are applied to Cell 2 as were used for Cell 1.

a/n 23346

Figure 5-7 Installation Diagram, 4973 Cells, with 7' or 20' leads directly connected to 9782 Analyzer or connected to junction box

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