Thermo Scientific Orion Conductivity Cells

Background/Theory

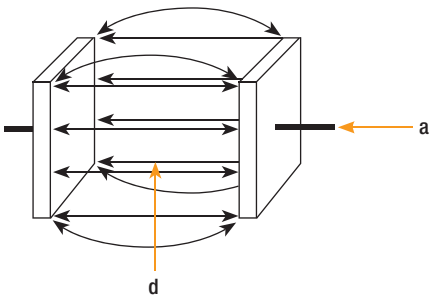
Electrical conductivity is an inherent property of most materials, and ranges from extremely conductive materials such as metals to non-conductive materials like plastic or glass. In between the two extremes are aqueous solutions, such as sea water and plating baths. In metals, the electrical current is carried by electrons while in water it is carried by charged ions. In both cases, the conductivity is determined by the number of charge carriers, how fast they move, and how much charge each one carries. Thus for most water solutions, the higher the concentration of dissolved salts, which will lead to more ions, the higher the conductivity. This effect continues until the solution gets too crowded, restricting the freedom of the ions to move and the conductivity may actually decrease with increasing concentration. This can result in two different concentrations of a salt having the same conductivity.

Conductance is defined as the reciprocal of resistance and is measured in Siemens (S), which was formerly referred to as mhos. Conductivity is an inherent property of any given solution and is derived from conductance by the geometry of the measuring cell. A measurement results in the conductance of the sample and it is converted to conductivity. This is done by measuring the cell constant (K) for each setup using a solution of known conductivity.

Cell conductance X Cell constant (K) = Conductivity

The Cell constant is related to the physical characteristics of the measuring cell. K is defined for 2 flat parallel measuring electrodes as the electrode separation distance (d) divided by the electrode area (a). In practice, the measured cell constant value is entered into the meter and the conversion from conductance to conductivity is done automatically.

$K = d/A = 1\ cm^{-1}$



Temperature

Temperature can have a substantial effect on conductivity. Raising the temperature makes water less viscous, and the ions can move faster. Because the ions are of different sizes, and carry different amounts of water with them as they move, the temperature effect is different for each ion. Typically the conductivity varies by 1-3 % per degree C.

Storage

Conductivity cells require minimal storage compared to other electrodes. They can be stored in deioinzed water in-between measurements. For storage overnight or longer, conductivity cells should be rinsed thoroughly in deionized water and stored dry.

Maintenance

Conductivity cells should be cleaned periodically to maintain maximum performance. If they become contaminated they should be cleaned. Refer to user guides for specific instructions for different electrode materials.

Contaminant	Cleaning Solution
Water soluble contaminants	Deionized water
Lubricants and oils	Warm water and liquid detergent or ethanol or acetone
Lime or hydroxide	10 % acetic acid or 10 % hydrochloric acid

Calibration

Cell constants at time of manufacture are listed on many conductivity cells. Calibration is essential since the cell constant can vary by 10 % or more from the nominal value and they do change over time. Once calibrated, they do not change quickly and do not require frequent calibration like a pH electrode. It is important to calibrate 25 ºC or know the value of your calibration standard at different temperatures. Thermo Scientific Orion conductivity standards have tables for actual values at different temperatures.

Benefits of Thermo Scientific Orion 2-Electrode Cells and 4-Electrode Cells

2-Electrode Cell Benefits	4- Electrode Cell Benefits
Available in glass, allows use in most samples	All have durable epoxy bodies
Best for ultra pure water measurements	No error from cable resistance, allowing for longer cable lengths
Multiple cell materials available, graphite, platinum or stainless steel	Minimum effect on accuracy from electrode polarization and contamination
Different cells designed to measure multiple specific ranges	Wide measurement range
Option for flow cell or flow-thru design	Unaffected by deposits on cell surface

Please visit **www.thermoscientific.com/waterlibrary** for more product information.

Thermo Scientific Orion Conductivity Cell Families

A wide range of conductivity cells are available for every application. These conductivity cells feature built-in temperature compensation; high, standard, and low conductivity measuring ranges; cell constants from 0.1 to 10 cm^{-1} and a variety of probe materials including epoxy/graphite, glass/platinum, and stainless steel.

DuraProbe™ 4-Electrode Conductivity Cells

DuraProbe 4-electrode cells provide the highest accuracy for demanding laboratory or field applications. The 4-electrode design compensates for electrode fouling, cable and connector resistance, polarization errors, and fringe field interference errors. The epoxy/graphite cell material is extremely durable and chemically resistant. DuraProbe conductivity cells are ideal for high and standard conductivity samples and difficult samples such as wastewater, runoff water, and mud.

2-Electrode Conductivity Cells

The 2-electrode cells are able to measure low, standard, and high conductivity samples, depending on the cell constant. Cells with a 0.1 cm^{-1} cell constant are ideal for low ionic strength solutions, deionized water, and ultra pure water. Glass/platinum cells are the best for chemically reactive conductivity samples, since the cell material is highly chemical resistant.

Rugged DuraProbe 4-electrode conductivity cell

BEST

013005MD [A]
013010MD [A]
013020MD [A]
013025MD [A]
013005A [F]
013010A [F]
013005D [B]

- Widest conductivity range
- For lab and field applications
- Rugged epoxy/graphite body
- Cable lengths from 1.5 to 10 meters

Reliable DuraProbe 4-electrode conductivity cell

BEST

013605MD [A]
013610MD [A]
013610 [F]

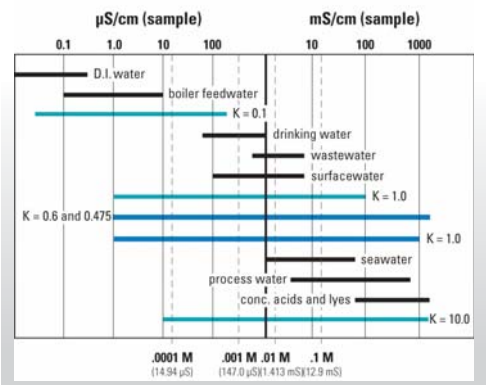
- Wide conductivity range
- For lab and field applications
- Rugged epoxy/graphite

2-electrode conductivity cell for ultra-pure water

BEST

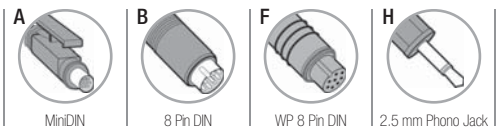
013016MD [A]
013016A [F]
013016D [B]

- Low conductivity range
- For ultra pure water applications
- Includes detachable glass flow cell



Cell Selection
Sample Conductivity Range

- Conventional 2-Electrode Cells
- Conventional 4-Electrode Cells



Key Information
A MiniDIN connector (Star) **B** 8 Pin DIN connector (A+ Series)
F 8 Pin Waterproof DIN connector (A Series)
H BNC and 2.5 mm Phono Jack connector (Russell)
*Conductivity cell does not have temperature compensation
**3-Electrode Conductivity Cell

Thermo Scientific Orion Conductivity Cell Families

Platinized 2-electrode conductivity cell

BETTER

011020 [B]
011020A [F]

- Low conductivity range
- For ultra pure water applications
- Platinized glass/platinum

Chemical resistant 2-electrode conductivity cell

BETTER

011010 [B]
011010A [F]

- Standard conductivity range
- For lab applications
- Chemical resistant glass body

Precise 2-electrode conductivity cell

BETTER

011050MD [A]
011050 [B]

- Standard conductivity range
- For lab and field applications
- Platinized epoxy/platinum

Rugged 2-electrode conductivity cell

BETTER

011510MD [A]
011510-WA [B]

- Standard conductivity range
- For lab and field applications
- Rugged epoxy/graphite

High range 2-electrode conductivity cell

BETTER

018020MD [A] *

- High conductivity range
- For lab applications
- Chemical resistant glass body
- Flow through or dip cell

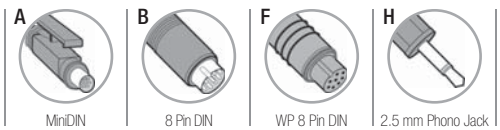
Chemical resistant 3-electrode conductivity cell

GOOD

014005 [H] **

- Rugged epoxy/ stainless steel
- Removable guard

See page 104 for a full offering of conductivity cell accessories



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Thermo Scientific Orion Conductivity Cell Selection Guide

4-Electrode Conductivity Cells

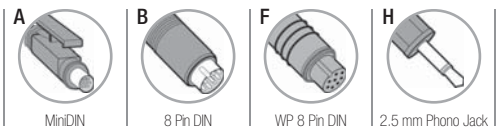
Cat. No.	Cable Length	Meter Compatibility	Measurement Range	Application	Approximate Cell Constant	Cell Material	Dimensions	Min/Max Immersion
013005MD [A]	1.5 m	Star Series	1 µS/cm to 200 mS/cm	Lab and field	0.475 cm^{-1}	Epoxy/ graphite	Dia - 15 mm Length - 120 mm	35/NA mm
013010MD [A]	3 m							
013020MD [A]	6 m							
013025MD [A]	10 m							
013605MD [A]	1.5 m	Star Series	10 µS/cm to 200 mS/cm	Lab and field	0.55 cm^{-1}	Epoxy/ graphite	Dia - 12 mm Length - 120 mm	35/NA mm
013610MD [A]	3 m							
013005A [F]	1.5 m	1230, 555A, 550A, 550, 162A, 162, 142, 136S, 135A, 131S,130A, 128	1 µS/cm to 200 mS/cm	Lab and field	0.475 cm^{-1}	Epoxy/ graphite	Dia - 15 mm Length - 120 mm	35/NA mm
013010A [F]	3 m							
013005D [B]	1.5 m	150 Aplus, 125 Aplus						
013610 [F]	3 m	555A, 550A, 162A, 136S, 135A, 131S, 130A	10 µS/cm to 200 mS/cm	Lab and field	0.55 cm^{-1}	Epoxy/ graphite	Dia - 12 mm Length - 120 mm	35/NA mm

3-Electrode Conductivity Cells

Cat. No.	Cable Length	Meter Compatibility	Measurement Range	Application	Approximate Cell Constant	Cell Material	Dimensions	Min/Max Immersion
014005 [H**]	1 m	RL060C Russell	0 µS/cm to 200 µS/cm	Field	1.0 cm^{-1}	Epoxy/steel	Dia - 13 mm Length - 120 mm	25/120 mm

2-Electrode Conductivity Cells

Cat. No.	Cable Length	Meter Compatibility	Measurement Range	Application	Approximate Cell Constant	Cell Material	Dimensions	Min/Max Immersion
013016MD [A]	1.5 m	Star Series	0.01 µS/cm to 300 µS/cm	Boiler feed water, ultra-pure water Includes flow cell	0.1 cm^{-1}	Steel, V4A	Dia - 13 mm Length - 120 mm Flow cell volume - 8-12 mL	35/110 mm
013016A [F]	1 m	555A, 550A, 162A, 136S, 135A, 131S, 130A						
013016D [B]	1 m	150Aplus, 145Aplus, 125Aplus, 115Aplus, 105Aplus						
011510MD [A]	3 m	Star Series	10 µS/cm to 200 mS/cm	Lab and Field	1.0 cm^{-1}	Epoxy/ graphite	Dia - 18 mm Length - 134 mm	35/NA mm
011510-WA [B]	3 m	150Aplus, 145Aplus, 125Aplus, 115Aplus, 105Aplus						
018020MD [A]	1.5 m	Star Series	10 µS/cm to 2000 mS/cm	High electrolyte concentrations, acids, lyes, industrial process water, sea water	10 cm^{-1}	Glass/ platinum, platinized	Dia - 16 mm Length - 115 mm	55/110 mm
011050MD [A]	1.5 m	Star Series	1 µS/cm to 20 mS/cm	Lab and Field	1.0 cm^{-1}	Epoxy/ platinum, platinized	Dia - 12 mm Length - 120 mm	20/90 mm
011050 [B]	1 m	150Aplus, 145Aplus, 125Aplus, 115Aplus, 05Aplus						
011020 [B]	1 m	150Aplus, 145Aplus, 125Aplus, 115Aplus, 05Aplus	0.1 µS/cm to 100 µS/cm	Boiler feed water, ultra-pure water	0.1 cm^{-1}	Glass/ platinum, platinized	Tip dia - 17 mm Tip length - 22 mm Dia - 13 mm Length - 120 mm	25/120 mm
011020A [F]	1 m	555A, 550A, 162A, 136S, 135A, 131S, 130A						
011010 [B]	1 m	150Aplus, 145Aplus, 125Aplus, 115Aplus, 05Aplus	1 µS/cm to 200 mS/cm	Lab	1.0 cm^{-1}	Glass/ platinum, platinized	Dia - 13 mm Length - 120 mm	25/120 mm
011010A [F]	1 m	555A, 550A, 162A, 136S, 135A, 131S, 130A						



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