



## Thermo Scientific Orion Conductivity Cells

### Background/Theory

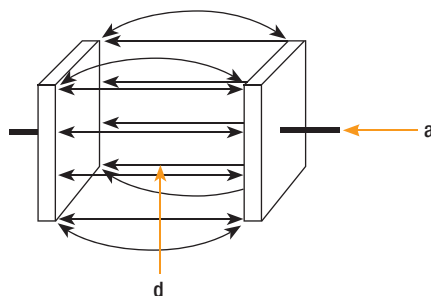
Electrical conductivity is an inherent property of most materials, and ranges from extremely conductive materials such as metals to non-conductive materials like plastic or glass. In between the two extremes are aqueous solutions, such as sea water and plating baths. In metals, the electrical current 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.

$$\text{Cell conductance} \times \text{Cell constant (K)} = \text{Conductivity}$$

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.

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



### 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 deionized 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 °C 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                                   |

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 for more product information.



# Thermo Scientific Orion Conductivity Cell Families

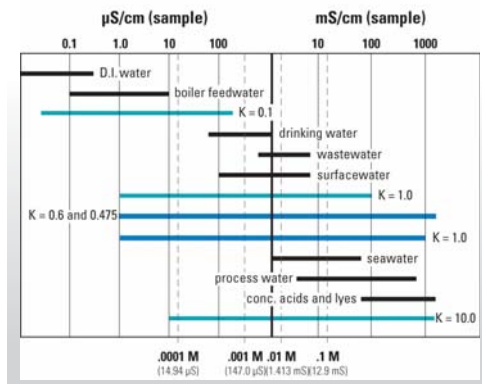
A wide range of conductivity cells are available for every application. These conductivity cells feature built-in temperature compensation; high, standard, and low conductivity measuring ranges; cell constants from 0.1 to 10 cm<sup>-1</sup> and a variety of probe materials including epoxy/graphite, glass/platinum,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



- 013005MD<sup>A</sup>
- 013010MD<sup>A</sup>
- 013020MD<sup>A</sup>
- 013025MD<sup>A</sup>
- 013005A<sup>F</sup>
- 013010A<sup>F</sup>
- 013005D<sup>B</sup>

- 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



- 013605MD<sup>A</sup>
- 013610MD<sup>A</sup>
- 013610<sup>F</sup>

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

### 2-electrode conductivity cell for ultra-pure water



- 013016MD<sup>A</sup>
- 013016A<sup>F</sup>
- 013016D<sup>B</sup>

- 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

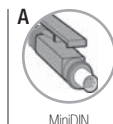
**A** MiniDIN connector (Star) **B** 8 Pin DIN connector (A+ Series)

**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

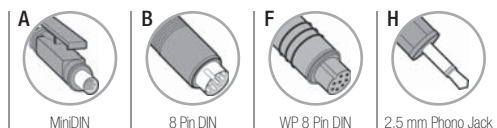
\*\*3-Electrode Conductivity Cell



## Thermo Scientific Orion Conductivity Cell Families

| Platinized 2-electrode conductivity cell   | Chemical resistant 2-electrode conductivity cell   | Precise 2-electrode conductivity cell   | Rugged 2-electrode conductivity cell   | High range 2-electrode conductivity cell  | Chemical resistant 3-electrode conductivity cell  |
|--|--|---|--|---|---|
|   |   |    |    |    |    |
| <b>BETTER</b>  | <b>BETTER</b>  | <b>BETTER</b>   | <b>BETTER</b>  | <b>BETTER</b>   | <b>GOOD</b>   |
| <p><b>011020<sup>B</sup></b><br/><b>011020A<sup>F</sup></b></p> <ul style="list-style-type: none"> <li>• Low conductivity range</li> <li>• For ultra pure water applications</li> <li>• Platinized glass/platinum</li> </ul> | <p><b>011010<sup>B</sup></b><br/><b>011010A<sup>F</sup></b></p> <ul style="list-style-type: none"> <li>• Standard conductivity range</li> <li>• For lab applications</li> <li>• Chemical resistant glass body</li> </ul> | <p><b>011050MD<sup>A</sup></b><br/><b>011050<sup>B</sup></b></p> <ul style="list-style-type: none"> <li>• Standard conductivity range</li> <li>• For lab and field applications</li> <li>• Platinized epoxy/platinum</li> </ul> | <p><b>011510MD<sup>A</sup></b><br/><b>011510-WA<sup>B</sup></b></p> <ul style="list-style-type: none"> <li>• Standard conductivity range</li> <li>• For lab and field applications</li> <li>• Rugged epoxy/graphite</li> </ul> | <p><b>018020MD<sup>A *</sup></b></p> <ul style="list-style-type: none"> <li>• High conductivity range</li> <li>• For lab applications</li> <li>• Chemical resistant glass body</li> <li>• Flow through or dip cell</li> </ul> | <p><b>014005<sup>H **</sup></b></p> <ul style="list-style-type: none"> <li>• Rugged epoxy/stainless steel</li> <li>• Removable guard</li> </ul> |

See page 104 for a full offering of conductivity cell accessories



### 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 Selection Guide

## 4-Electrode Conductivity Cells

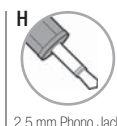
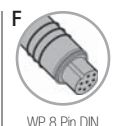
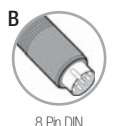
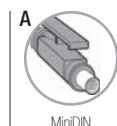
| Cat. No.              | Cable Length | Meter Compatibility  | Measurement Range     | Application   | Approximate Cell Constant | Cell Material  | Dimensions                     | Min/Max Immersion |
|-----------------------|--------------|--|-----------------------|---------------|---------------------------|----------------|--------------------------------|-------------------|
| 013005MD <sup>A</sup> | 1.5 m        | Star Series  | 1 µS/cm to 200 mS/cm  | Lab and field | 0.475 cm <sup>-1</sup>    | Epoxy/graphite | Dia - 15 mm<br>Length - 120 mm | 35/NA mm          |
| 013010MD <sup>A</sup> | 3 m          |  |                       |               |                           |                |                                |                   |
| 013020MD <sup>A</sup> | 6 m          |  |                       |               |                           |                |                                |                   |
| 013025MD <sup>A</sup> | 10 m         |  |                       |               |                           |                |                                |                   |
| 013605MD <sup>A</sup> | 1.5 m        | Star Series  | 10 µS/cm to 200 mS/cm | Lab and field | 0.55 cm <sup>-1</sup>     | Epoxy/graphite | Dia - 12 mm<br>Length - 120 mm | 35/NA mm          |
| 013610MD <sup>A</sup> | 3 m          |  |                       |               |                           |                |                                |                   |
| 013005A <sup>F</sup>  | 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 <sup>-1</sup>    | Epoxy/graphite | Dia - 15 mm<br>Length - 120 mm | 35/NA mm          |
| 013010A <sup>F</sup>  | 3 m          |  |                       |               |                           |                |                                |                   |
| 013005D <sup>B</sup>  | 1.5 m        |  |                       |               |                           |                |                                |                   |
| 013610 <sup>F</sup>   | 3 m          | 555A, 550A, 162A, 136S, 135A, 131S, 130A                           | 10 µS/cm to 200 mS/cm | Lab and field | 0.55 cm <sup>-1</sup>     | Epoxy/graphite | Dia - 12 mm<br>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 <sup>H**</sup> | 1 m          | RL060C Russell      | 0 µS/cm to 200 µS/cm | Field       | 1.0 cm <sup>-1</sup>      | Epoxy/steel   | Dia - 13 mm<br>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 <sup>A</sup>  | 1.5 m        | Star Series                                      | 0.01 µS/cm to 300 µS/cm | Boiler feed water, ultra-pure water<br>Includes flow cell                         | 0.1 cm <sup>-1</sup>      | Steel, V4A                 | Dia - 13 mm<br>Length - 120 mm<br>Flow cell volume - 8-12 mL            | 35/110 mm         |
| 013016A <sup>F</sup>   | 1 m          | 555A, 550A, 162A, 136S, 135A, 131S, 130A         |                         |   |                           |                            |   |                   |
| 013016D <sup>B</sup>   | 1 m          | 150Aplus, 145Aplus, 125Aplus, 115Aplus, 105Aplus |                         |   |                           |                            |   |                   |
| 011510MD <sup>A</sup>  | 3 m          | Star Series                                      | 10 µS/cm to 200 mS/cm   | Lab and Field   | 1.0 cm <sup>-1</sup>      | Epoxy/graphite             | Dia - 18 mm<br>Length - 134 mm  | 35/NA mm          |
| 011510-WA <sup>B</sup> | 3 m          | 150Aplus, 145Aplus, 125Aplus, 115Aplus, 105Aplus |                         |   |                           |                            |   |                   |
| 018020MD <sup>A</sup>  | 1.5 m        | Star Series                                      | 10 µS/cm to 2000 mS/cm  | High electrolyte concentrations, acids, lyes, industrial process water, sea water | 10 cm <sup>-1</sup>       | Glass/platinum, platinized | Dia - 16 mm<br>Length - 115 mm  | 55/110 mm         |
| 011050MD <sup>A</sup>  | 1.5 m        | Star Series                                      | 1 µS/cm to 20 mS/cm     | Lab and Field   | 1.0 cm <sup>-1</sup>      | Epoxy/platinum, platinized | Dia - 12 mm<br>Length - 120 mm  | 20/90 mm          |
| 011050 <sup>B</sup>    | 1 m          | 150Aplus, 145Aplus, 125Aplus, 115Aplus, 05Aplus  |                         |   |                           |                            |   |                   |
| 011020 <sup>B</sup>    | 1 m          | 150Aplus, 145Aplus, 125Aplus, 115Aplus, 05Aplus  | 0.1 µS/cm to 100 µS/cm  | Boiler feed water, ultra-pure water   | 0.1 cm <sup>-1</sup>      | Glass/platinum, platinized | Tip dia - 17 mm<br>Tip length - 22 mm<br>Dia - 13 mm<br>Length - 120 mm | 25/120 mm         |
| 011020A <sup>F</sup>   | 1 m          | 555A, 550A, 162A, 136S, 135A, 131S, 130A         |                         |   |                           |                            |   |                   |
| 011010 <sup>B</sup>    | 1 m          | 150Aplus, 145Aplus, 125Aplus, 115Aplus, 05Aplus  | 1 µS/cm to 200 mS/cm    | Lab   | 1.0 cm <sup>-1</sup>      | Glass/platinum, platinized | Dia - 13 mm<br>Length - 120 mm  | 25/120 mm         |
| 011010A <sup>F</sup>   | 1 m          | 555A, 550A, 162A, 136S, 135A, 131S, 130A         |                         |   |                           |                            |   |                   |



### 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 Standards and Accessories



| Cat. No. | Description   |
|----------|---|
| 011008   | 100 µS/cm conductivity/TDS standard, 5 x 60 mL  |
| 01100910 | 147 µS/cm conductivity standard, 10 pouches   |
| 011007   | 1413 µS/cm conductivity/TDS standard, 5 x 60 mL   |
| 01100710 | 1413 µS/cm conductivity/TDS standard, 10 pouches  |
| 011006   | 12.9 mS/cm conductivity/TDS standard, 5 x 60 mL   |
| 01100610 | 12.9 mS/cm conductivity/TDS standard, 10 pouches  |
| 011005   | 111.9 mS/cm conductivity standard, 5 x 60 mL  |
| 01100510 | 111.9 mS/cm conductivity standard, 10 pouches   |
| 990106   | 0.1 M KCl conductivity standard, 475 mL   |
| 011001   | Conditioning solution for 011050, 011050A, and 011050MD conductivity cells  |
| 1010001  | Conductivity calibration resistor kit for Orion Star and Orion Star A Series conductivity meters, MiniDIN                                   |
| 013017   | Replacement flow cell for 013016A, 013016D, and 013016MD  |
| 080045   | Stainless steel and plastic protective probe guard (for 013005MD, 013010MD, 013025MD, 013005A, 013010A, 013030A, 013060A, 013005D, 013010D) |
| 081045   | Plastic protective probe guard (for 013005MD, 013010MD, 013025MD, 013005A, 013010A, 013030A, 013060A, 013005D, 013010D)                     |
| 090044   | 5 electrode holder (4 X 12 mm and 1 X 15 mm) to be used with 090043 electrode swing arm and 15 mm conductivity cells                        |

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