Conductivity

DOC316.53.01199

USEPA[1] Direct Measurement Method[2] **Method 8160**

(0.01 µS/cm to 200.00 mS/cm) **Conductivity Meter**

Scope and Application: For water and wastewater

[1] USEPA accepted for reporting for Standard method 2510-B

[2] Procedure is equivalent to Standard Method 2510-B for wastewater.

Test preparation

How to use instrument-specific information

The *Instrument-specific information* table displays requirements that may vary between instruments. To use this table, select an instrument then read across to find the corresponding information required to perform this test.

Table 441 Instrument-specific information

Meter	Standard probe	Rugged probe[1]
HQ40d	CDC40101 CDC40103	CDC40105 CDC40110 CDC40115 CDC40130
HQ30d	CDC40101 CDC40103	CDC40105 CDC40110 CDC40115 CDC40130
HQ14d	CDC40101 CDC40103	CDC40105 CDC40110 CDC40115 CDC40130
sension™ 5	5197500 5197503	—
sension™ 7	5197500 5197503	—

[1] Designed for field use.

Before starting the test:

Collect samples in clean plastic or glass bottles.
Analyze samples as soon as possible after collection. However, samples may be stored at least 24 hours by cooling to 4 °C (39 °F) or below (all storage temperatures have changed to 0 to 6 °C as per the EPA MUR, March 2007). When measuring solutions that are not at the reference temperature, the meter automatically adjusts the conductivity value to the reference temperature from 20 or 25 °C.
Water samples containing oils, grease, or fats will coat the electrode and affect the accuracy of the readings. If this occurs, clean the probe with a strong detergent solution, then thoroughly rinse with deionized water.
Mineral build-up on the probe can be removed with a diluted 1:1 Hydrochloric Acid Solution. Refer to the meter user manual.
Calibration instructions are given in the operation section of the meter manual. For most accurate results calibrate before use, or check the accuracy of the meter with a known conductivity standard.
Measurement errors can occur if the appropriate temperature correction value is not chosen. Refer to the *Temperature correction* table for typical correction values.

Collect the following items:

Description	Quantity
One of the following meter/sensor combinations:	1
HQd meter and conductivity IntelliCAL™ probe	
sension meter and conductivity electrode	1
One of the following Hach standards:	
NaCl Standard Solution, 180 ± 10 µS/cm	1
NaCl Standard Solution, 1000 ± 10 µS/cm	1
NaCl Standard Solution, 1990 ± 10 µS/cm	1
NaCl Standard Solution, 18 ± 10 mS/cm	1
Radiometer Analytical Certified Conductivity Standards:	
KCl, 1 Demal, 111.3 mS/cm ± 0.5% at 25 °C	500 mL
KCl, 0.1 Demal, 12.85 mS/cm ± 0.35% at 25 °C	500 mL
KCl, 0.01 Demal, 1408 S/cm ± 0.5% at 25 °C	500 mL
NaCl, 0.05%, 1015 S/cm ± 0.5% at 25 °C	500 mL
KCl Conductivity Standards:	
0.1 Molar KCl, 12.88 mS/cm at 25 °C	500 mL
0.01 Molar KCl, 1413 S/cm at 25 °C	500 mL
0.001 Molar KCl, 148 S/cm at 25 °C	500 mL
Beaker, poly, 100-mL	1

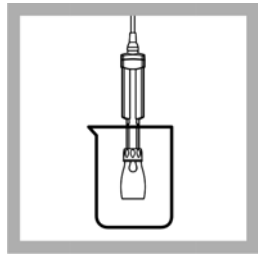
See *Consumables and replacement items* for reorder information.

Conductivity

1. Refer to the operation section of the meter manual to prepare the conductivity electrode and meter.

The meter will select the range automatically.

For most accurate results, calibrate the meter before use or check the accuracy of the meter with a known conductivity standard. Refer to the meter user manual for calibration and measurement options.



2. Laboratory tests: Immerse the probe in a beaker containing the sample solution. Move the probe up and down and tap it on the beaker to remove bubbles from the electrode.

Field tests: Immerse the probe in the sample solution. Move the probe up and down to remove bubbles from the electrode.

The vent holes should be completely submerged.

3. Turn the meter on. Make sure that the meter is set to measure conductivity.

4. Rinse the probe thoroughly with deionized water after each measurement.

To display other units such as TDS, salinity or resistivity (HQd only), refer to the meter user manual.

Conversions

The *Unit conversion* table provides equations for converting the conductivity readings to other units of measure.

Table 442 Unit conversion

From	To	Use this Equation
mS/cm	µS/cm	mS/cm x 1000
µS/cm	mS/cm	µS/cm x 0.001
µS/cm	µmhos/cm	µS/cm x 1
mS/cm	mmhos/cm	mS/cm x 1
µS/cm	mg/L TDS	µS/cm x 0.5[1]
g/L TDS	mg/L TDS	g/L TDS x 1000
mS/cm	g/L TDS	mS/cm x 0.5
mg/L TDS	g/L TDS	mg/L TDS x 0.001
mg/L TDS	gpg TDS	mg/L TDS x 0.05842
g/L TDS	gpg TDS	g/L TDS x 58.42
µS/cm	ohms cm	1,000,000 ÷ µS/cm
mS/cm	ohms cm	1,000 ÷ mS/cm

[1] TDS is an empirically-derived value from the conductivity measurement. A value of 0.5 is selected here for simplicity and suitability to a wide variety of waters. The *sension* 5 uses a more complex algorithm, based on additional factors, such as temperature, to determine TDS.

The *Temperature correction* table shows typical temperature correction values for selected solutions using the linear temperature correction option.

Table 443 Temperature correction

Solution	Percent per °C
Ultrapure Water	4.55
Salt (NaCl)	2.125
NaOH	1.72
Dilute Ammonia	1.8810
10% HCl	1.325
5% Sulfuric Acid	0.9698

Interferences

When measuring conductivity, the following items should be considered in order to ensure accurate results:

- If measuring very low levels of conductivity, protect the sample from atmospheric gases (carbon dioxide, ammonia). These gases dissolve readily in water and may cause a rapid change in conductivity. To minimize these effects, boil the sample, then place in a covered container, such as a Low Ionic Strength (LIS) chamber for cooling.
- To remove the conductivity with hydroxide ions, neutralize by adding 4 drops of Phenolphthalein Indicator Solution to 50 mL of sample, then adding Gallic Acid Solution, drop-wise, until the pink color completely disappears.

Accuracy check

Pour a Sodium Chloride Standard Solution (with a conductivity value in the same range as the sample) into a beaker. Perform the conductivity measurements as described above. The conductivity reading should be the same (within accuracy limits) as listed on the Standard Solution label if the meter is calibrated correctly. Calibration can be performed using this solution. Refer to the meter user manual.

Method performance

The accuracy of a conductivity measurement is dependent on many factors associated with the overall system, including the meter, meter settings, choice of electrode and conductivity standards being used during calibration. Refer to the appropriate electrode, meter manual and standard certificate of analysis to help determine system performance.

Summary of method

Electrolytic conductivity is the capacity of ions in a solution to carry electrical current and is the reciprocal of the solution resistivity. Current is carried by inorganic dissolved solids (e.g., chloride, nitrate, sulfate, and phosphate anions) and cations (e.g., sodium, calcium, magnesium, iron, and aluminum). Organic material like oils, phenols, alcohols, and sugars do not carry electrical current well and thus do not have enough conductivity for a useful estimate of concentration.

Measuring conductivity is done by measuring the resistance occurring in an area of the test solution defined by the probe's physical design. Voltage is applied between the two electrodes immersed in the solution, and the voltage drop caused by the resistance of the solution is used to calculate conductivity per centimeter. The basic unit of measure for conductivity is the Siemen (or mho), the reciprocal of the ohm in the resistance measurement. Because ranges normally found in aqueous solutions are small, milliSiemens/cm (10^{-3} S or S/cm) and microSiemens/cm (10^{-6} S or µS/cm) are most commonly used.

Consumables and replacement items

Required apparatus

Description	Quantity	Unit	Catalog number
Select one meter and probe combination:			
HQ40d Meter	1	each	HQ40d53000000
HQ30d Meter	1	each	HQ30d53000000
HQ14d Meter	1	each	HQ14d53000000
IntelliCAL Conductivity Probe, standard, with 1m cable	1	each	CDC40101
IntelliCAL Conductivity Probe, standard, with 3m cable	1	each	CDC40103
IntelliCAL Conductivity Probe, rugged, with 5m cable	1	each	CDC40105
IntelliCAL Conductivity Probe, rugged, with 10m cable	1	each	CDC40110
IntelliCAL Conductivity Probe, rugged, with 15m cable	1	each	CDC40115
IntelliCAL Conductivity Probe, rugged, with 30 m cable	1	each	CDC40130
sens*ion* meters and probes. Select one meter and probe combination:			
*sens**ion*** 5	1	each	5180000
*sens**ion*** 7	1	each	5450000
Conductivity probe, with 1 m cable	1	each	5197500
Conductivity probe, with 3 m cable	1	each	5197503

Recommended standards

Description	Unit	Catalog number
Hach, NaCl Conductivity Standards:		
Sodium Chloride Standard Solution, 180 ±10 mS/cm, 90 ±1 mg/L TDS	100 mL	2307542
Sodium Chloride Standard Solution, 1000 ±10 mS/cm, 500 ±5 mg/L TDS	100 mL	1440042
Sodium Chloride Standard Solution, 1990 ±20 mS/cm, 995 ±10 mg/L TDS	100 mL	210542
Sodium Chloride Standard Solution, 18,000 ±50 mS/cm, 9000 ±25 mg/L TDS	100 mL	2307442
Radiometer Analytical, Certified Conductivity Standards:		
KCl, 1 Demal, 111.3 mS/cm ± 0.5% at 25 °C	500 mL	S51M001
KCl, 0.1 Demal, 12.85 mS/cm ± 0.35% at 25 °C	500 mL	S51M002
KCl, 0.01 Demal, 1408 µS/cm ± 0.5% at 25 °C	500 mL	S51M003
NaCl, 0.05%, 1015 µS/cm ± 0.5% at 25 °C	500 mL	S51M004
KCl Conductivity Standards:		
0.1 Molar KCl, 12.88 mS/cm at 25 °C	500 mL	C20C250
0.01 Molar KCl, 1413 µS/cm at 25 °C	500 mL	C20C270
0.001 Molar KCl, 148 µS/cm at 25 °C	500 mL	C20C280

Optional reagents and apparatus

Description	Unit	Catalog number
Beaker, poly, 100-mL	each	108042
Gallic Acid Solution	50 mL SCDB	1442326
Hydrochloric Acid Solution, 1:1	500 mL	88449
Low Ionic Strength Chamber (LIS)	each	5189900
Phenolphthalein Indicator Solution	15 mL SCDB	16236
Wash Bottle, 125-mL	each	62014
Water, deionized	4 L	27256

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