International Standard ISO 7888

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Water quality — Determination of electrical conductivity

Qualité de l'eau — Détermination de la conductivité électrique

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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Water quality — Determination of electrical conductivity

1 Scope and field of application

This International Standard specifies a method for the measurement of the electrical conductivity of all types of water.

Electrical conductivity can be used to monitor the quality of

a) surface waters;

b) process waters in water supply and treatment plants;

c) waste waters.

The completeness of analysis for ionic constituents [1 to 3] can be checked using this method.

In some cases absolute values are important, in other cases only relative changes are of concern.

For interferences, see clause 9.

2 Definitions

2.1 specific conductance; electrical conductivity, γ: The reciprocal of the resistance, measured under specified conditions, between the opposite faces of a unit cube of defined dimensions of an aqueous solution. For water quality examination, this is often expressed as "electrical conductivity" and may be used as a measure of the concentration of ionizable solutes present in the sample.

(Definition taken from ISO 6107/2.)

It is expressed in siemens per metre.[1)]

NOTE — The symbols σ and κ are also used for electrical conductivity (see ISO 31/5).

2.2 cell constant, K: Quantity, in reciprocal metres, given by the equation

$$K = \frac{l}{A}$$

where

l is the length, in metres, of an electrical conductor;

A is the effective cross-sectional area, in square metres, of an electrical conductor.

The cell constant results from the geometry of the cell; it can be empirically determined.

2.3 temperature coefficient of electrical conductivity,[2)] α: The temperature coefficient of conductivity $\alpha_{\theta,25}$,[4, 5] is given by the equation

$$\alpha_{\theta,25} = \frac{1}{\gamma_{25}} \left(\frac{\gamma_\theta - \gamma_{25}}{\theta - 25} \right) \times 100$$

where 25 and θ °C are the temperatures at which the electrical conductivities γ_{25} and γ_θ respectively were measured.

2.4 temperature correction factors, f: Factors used to correct for the temperature dependence of electrical conductivity.

In order to make comparisons, it is essential that measurements are corrected to a chosen reference temperature, usually 25,0 °C, even if the temperature of the water sample differs only slightly from that temperature.

Conversions to the electrical conductivity at 25 °C, γ_{25}, can be made using the equation

$$\gamma_{25} = \frac{\gamma_\theta}{1 + (\alpha/100)(\theta - 25)}$$

where

α is the temperature coefficient of electrical conductivity;

γ_θ is the electrical conductivity at the measured temperature, θ;

θ is the measuring temperature, in degrees Celsius, of the sample.

1) $1\ S/m = 10^4\ \mu S/cm = 10^3\ mS/m$

2) The temperature coefficient of electrical conductivity can be expressed in reciprocal kelvin or % per °C.

3 Principle

Direct determination, using an appropriate instrument, of the electrical conductivity of aqueous solutions. The electrical conductivity is a measure of the current conducted by ions present in the water ("phenomenon of conductors of the second kind"), and depends on

a) the concentration of the ions;

b) the nature of the ions;

c) the temperature of the solution;

d) the viscosity of the solution.

Pure water as a result of its own dissociation has an electrical conductivity at 25 °C of 5,483 µS/m [6] (0,005 483 mS/m).

4 Reagents

During the analysis, unless otherwise stated, use only reagents of recognized analytical grade.

4.1 Water for preparing solutions and dilutions. Double distilled or de-ionized water; the electrical conductivity shall be $\gamma_{25} \leqslant 0{,}1$ mS/m.

4.2 Potassium chloride standard solution A, [7] $c(KCl) = 0{,}1$ mol/l.

Dry a few grams of potassium chloride at 105 °C for 2 h, and dissolve 7,456 g in water (4.1). Dilute to 1 000 ml.

The conductivity of this solution at 25 °C, γ_{25}, is 1 290 mS/m.

4.3 Potassium chloride standard solution B, $c(KCl) = 0{,}01$ mol/l.

Dilute 100 ml of solution A (4.2) with water (4.1) to 1 000 ml.

The conductivity of this solution at 25 °C, γ_{25}, is 141 mS/m.

4.4 Potassium chloride standard solution C, $c(KCl) = 0{,}001$ mol/l.

Dilute 100 ml of solution B (4.3) with water (4.1) to 1 000 ml. Immediately before preparing this solution the water shall be freed from carbon dioxide by purging with pure nitrogen or by boiling. During work with these solutions any contact with the atmosphere shall be minimized.

Prepare this solution shortly before use.

The conductivity of this solution at 25 °C, γ_{25}, is 14,7 mS/m.

NOTE — Table 1 gives alternative concentrations of potassium chloride that can be used as standards of conductivity. [8, 9]

Table 1 — Electrical conductivity of potassium chloride solutions

Concentration of potassium chloride, $c(KCl)$	Electrical conductivity at 25 °C, γ_{25}
mol/l	mS/m
0,000 5	7,4
0,001	14,7
0,005	72
0,01	141
0,02	277
0,05	670
0,1	1 290
0,2	2 480

4.5 Platinizing solution.

Dissolve 1,5 g of hydrogen hexachloroplatinate(IV) hexahydrate ($H_2PtCl_6 \cdot 6H_2O$) in 50 ml of water containing 0,012 5 g of lead(II) acetate [$Pb(C_2H_3O_2)_2$].

5 Apparatus

5.1 Instruments for measurement of electrical conductivity.

The instrument may be of either of the following types:

a) instrument equipped with a flow- or dip-type conductivity cell fitted with two or more electrodes;

b) instrument fitted with electrodes of the induction type.

Preferably instruments should be capable of discrete and continuous measurement both in the laboratory and in the field.

A flow-type conductivity cell from which air is excluded is essential for measurements of conductivities of less than 1 mS/m.

The recommended electrode cell constant can be chosen from table 2 for each measuring range.

Table 2 — Recommended cell constants for different ranges of electrical conductivity

Measuring range	Recommended cell constant
mS/m	m^{-1}
$\gamma < 2$	1
$0{,}1 < \gamma < 20$	10
$1 < \gamma < 200$	100
$10 < \gamma < 2 \times 10^3$	1 000
$100 < \gamma < 20 \times 10^3$	5 000

Some instruments are equipped with a cell constant control. If this is not the case, the reading must be multiplied by the cell constant.

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