SLOVENSKI STANDARD
SIST EN 27888:1998

01-januar-1998

Kakovost vode - Določanje električne prevodnosti (ISO 7888:1985)

Water quality - Determination of electrical conductivity (ISO 7888:1985)

Wasserbeschaffenheit - Bestimmung der elektrischen Leitfähigkeit (ISO 7888:1985)

Qualité de l'eau - Détermination de la conductivité électrique (ISO 7888:1985)

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English version

Water quality - Determination of electrical conductivity (ISO 7888:1985)

Qualité de l'eau - Détermination de la conductivité électrique (ISO 7888:1985)

Wasserbeschaffenheit - Bestimmung der elektrischen Leitfähigkeit (ISO 7888:1985)

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The European Standards exist in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart,36 B-1050 Brussels

Foreword

This European Standard has been taken over by CEN/TC 230 "Water quality" from the work of ISO/TC 147 "Water quality" of the International Organization for Standardization (ISO).

It was decided by the Resolution BTS 3 35/1990 to submit the Final Draft to the CEN members for voting by Unique Acceptance Procedure (UAP).

The result of the Unique Acceptance Procedure was positive.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 1994, and conflicting national standards shall be withdrawn at the latest by March 1994.

In accordance with the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard:

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

Endorsement notice

The text of the International Standard ISO 7888:1985 was approved by CEN as a European Standard without any modification.

International Standard ISO 7888

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

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.

International Standard ISO 7888 was prepared by Technical Committee ISO/TC 147, *Water quality*.

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 µS/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.

5.2 Electrodes.

Whenever platinum electrodes are used for precision measurements the electrodes shall be platinized (see the note).

Unplatinized electrodes may be used only for field and routine laboratory testing.

NOTE — If platinization is necessary, the manufacturer's instructions should be followed, or proceed as follows.

Platinize the electrodes of the cell with platinizing solution (4.5). A suitable plating apparatus consists of a 6 V d.c. supply, a variable resistor, a milliammeter, and an electrode. The procedure for platinizing is not critical. Good platinized coatings are obtained using from 1,5 to 3 C/cm^2 of electrode area. For example for an electrode having a total area (both sides) of 10 cm^2, the plating time at a current of 20 mA would be from 12,5 to 25 min. The current density may be from 1 to 4 mA/cm^2 of electrode area. Plate the electrodes one at a time with the aid of an extra electrode. During the plating, agitate the solution gently. When not in use, fill the cells with water to prevent the drying out of the electrodes while in storage.

5.3 Thermometer, accurate to ± 0,1 °C, within the temperature range of measurement, shall be used for precise determinations. For routine measurements, a thermometer accurate to ± 0,5 °C is satisfactory.

5.4 Thermostatic bath, capable of being maintained at 25,0 ± 0,1 °C. For routine measurements, a tolerance of ± 0,5 °C is satisfactory.

6 Sampling and samples

Collect the laboratory sample in a polyethylene bottle completely filled and tightly stoppered. Soda glass bottles shall not be used. Measurement of conductivity should be performed as soon as practicable, particularly when there is a possibility of an exchange of gases such as carbon dioxide or ammonia with the atmosphere, or a possibility of biological activity. Biological activity can be reduced by storing the samples in the dark at 4 °C; however, samples shall be brought to equilibrium at the reference temperature of 25 °C before the conductivity is measured. No suitable preservative is known for samples taken for conductivity measurements.

7 Procedure

7.1 General

Prepare the equipment for use as instructed by the manufacturer and ensure that an electrode cell of known cell constant appropriate to the desired measuring range is fitted (see table 2). The test portion depends on the equipment used.

If the cell constant is not accurately known, determine the constant as given in clause 5 using the potassium chloride standard solutions (4.2 to 4.4) appropriate to each desired measuring range. Check the cell constant at least once every 6 months.

Many instruments incorporate cell constant correction as an integral function and thus a direct reading of electrical conductivity is obtained. Otherwise multiply the conductance value obtained by the cell constant to obtain electrical conductivity.

For high precision work, carry out the measurement of electrical conductivity when the sample and apparatus in direct contact with it has attained equilibrium at 25,0 ± 0,1 °C. Thus all sources of error that may arise from the use of temperature compensators, or from mathematical correction techniques, are eliminated.

7.2 Temperature correction

If measurement at 25,0 ± 0,1 °C is not possible, for example in field or plant work, measure the electrical conductivity of the sample at a known temperature, θ °C. Many instruments are fitted with temperature compensation devices, and with reference to the temperature coefficient of samples, may automatically correct measurements obtained over a range of temperatures to electrical conductivity at 25,0 °C. Such instruments shall be calibrated strictly in accordance with the manufacturer's instructions.

If the temperature coefficient of the sample is not known, it may be derived by substituting electrical conductivity values experimentally determined at 25,0 ± 0,1 °C and temperatures θ ± 0,1 °C (see 2.3).

Where instruments do not incorporate a temperature compensation device, the electrical conductivity measured at θ °C shall be corrected to 25,0 °C using the appropriate correction factor taken from table 3.

Whichever form of temperature compensation is applied to the measurement of electrical conductivity at θ °C, the result will be less accurate than that actually measured at the reference temperature of 25,0 °C.

In some aspects of routine field work, it may not be necessary to transpose values measured at θ °C to 25,0 °C. However, such measurements should be interpreted with great care and comparison with other values may be difficult or even meaningless.