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Soil quality -- Determination of the specific electrical conductivity

Qualité du sol -- Détermination de la conductivité électrique spécifique

Ta slovenski standard je istoveten z: **ISO 11265:1994**

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13.080.20 Fizikalne lastnosti tal Physical properties of soils

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INTERNATIONAL STANDARD

ISO 11265

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Soil quality — Determination of the specific electrical conductivity

Qualité du sol — Détermination de la conductivité électrique spécifique

Reference number
ISO 11265:1994(E)

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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 11265 was prepared by Technical Committee ISO/TC 190, *Soil quality*, Subcommittee SC 3, *Chemical methods and soil characteristics*.

Annex A of this International Standard is for information only.

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Soil quality — Determination of the specific electrical conductivity

1 Scope

This International Standard specifies an instrumental method for the routine determination of the specific electrical conductivity in an aqueous extract of soil. The determination is carried out to obtain an indication of the content of water-soluble electrolytes in a soil.

This International Standard is applicable to all types of air-dried soil samples.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3696:1987, *Water for analytical laboratory use — Specification and test methods.*

ISO 7888:1985, *Water quality — Determination of electrical conductivity.*

ISO 11464:1994, *Soil quality — Pretreatment of samples for physico-chemical analyses.*

3 Principle

Air-dried soil is extracted with water at 20 °C ± 1 °C at an extraction ratio of 1:5 (m/V), to dissolve the electrolytes. The specific electrical conductivity of the filtered extract is measured and the result is corrected to a temperature of 25 °C.

NOTE 1 For definitions of the concepts used, see ISO 7888.

4 Reagents

Use only reagents of recognized analytical grade.

4.1 Water, with a specific electrical conductivity not higher than 0,2 mS/m at 25 °C (grade 2 water according to ISO 3696).

4.2 Potassium chloride solution, c(KCl) = 0,1 mol/l.

Dissolve 7,456 g of potassium chloride, previously dried for 24 h at 220 °C ± 10 °C in water (4.1), and dilute to 1 000 ml at 20 °C. The specific electrical conductivity of this solution is 1 290 mS/m at 25 °C.

4.3 Potassium chloride solution, c(KCl) = 0,020 0 mol/l.

Pour 200,0 ml of the potassium chloride solution (4.2) into a 1 000 ml volumetric flask and dilute to volume with water at 20 °C. The specific electrical conductivity of this solution is 277 mS/m at 25 °C.

4.4 Potassium chloride solution, c(KCl) = 0,010 0 mol/l.

Pour 100,0 ml of the potassium chloride solution (4.2) into a 1 000 ml volumetric flask and dilute to volume with water at 20 °C. The specific electrical conductivity of this solution is 141 mS/m at 25 °C.

All the potassium chloride solutions (4.2, 4.3 and above) used for calibration shall be stored in tightly sealed bottles which do not release sufficient alkali or alkali-earth cations to affect the electrical conductivity of the solutions.

NOTES

2 Plastics bottles may be suitable.

3 For bottles containing potassium chloride solutions, plastics seals are recommended as glass will weld to the bottle.

4 The use of commercially available conductivity standards is permitted.

5 Apparatus and glassware

5.1 Conductivity meter, fitted with a conductivity cell, equipped with an adjustable measuring range setting and (automatic) temperature correction and having an accuracy of 1 mS/m at 20 °C. Preferably, the conductivity meter should also be equipped with a cell-constant control.

5.2 Analytical balance, with an accuracy of at least 0,01 g.

5.3 Thermometer, capable of measuring to the nearest 0,1 °C.

5.4 Shaking machine, with a horizontal movement sufficiently vigorous to produce and maintain a 1:5 soil:water suspension, placed in a environment where the temperature adjusted is maintained at 20 °C ± 1 °C.

NOTE 5 Machines with a speed of about 180 cycles per minute and a stroke of about 5 cm have been found suitable.

5.5 Filter paper, with low ash and high retentive properties.

5.6 Shaking bottle, of capacity 250 ml, made of borosilicate glass or polyethylene.

5.7 Usual laboratory glassware.

6 Laboratory sample

Use the fraction of particles smaller than 2 mm of air-dried soil samples pretreated according to ISO 11464.

7 Procedure

7.1 Extraction

Weigh 20,00 g of the laboratory sample and transfer to a shaking bottle (5.6). Add 100 ml of water (4.1) at a temperature of 20 °C ± 1 °C. Close the bottle and place it in a horizontal position in the shaking machine (5.4). Shake for 30 min. Filter directly through a filter paper (5.5). Carry out a blank determination in the same way. The value of the blank shall not exceed 1 mS/m. If the value of the blank exceeds this, repeat the extraction.

NOTES

6 The volume of filtrate should be just sufficient to perform the measurements.

7 An extraction ratio of 1:5 (m/V) is chosen to ensure that an extract is obtainable from all soils including those with high organic matter contents. Using a smaller ratio, it is hardly possible to obtain an extract for some soils.

8 The extraction should be performed at the chosen temperature of 20 °C ± 1°C, because the solubility of the salts present depends on the temperature. After the filtration, the temperature of the extract is allowed to change. The measurement is performed with the temperature adjusted to 25 °C.

Measurement of the blank is carried out to determine how much the water, glassware and filter paper used contribute to the electrical conductivity of the extracts.

9 The shaking action should be just sufficient to produce and maintain a suspension. More vigorous shaking may lead to excessive dispersion of clay, difficulty in filtration and consequent adverse effects on conductivity.

7.2 Checking of the cell constant

7.2.1 Measure the conductivity (x_m) of the potassium chloride solutions (4.2 to 4.4) according to the instruction manual of the instrument.

7.2.2 Calculate, for each potassium chloride solution, a cell constant according to

$$K = \frac{x_s}{x}$$

where

K is the cell constant, in reciprocal metres;

x_s is the specific electrical conductivity of one of the potassium chloride solutions, in millisiemens per metre;

x_m is the measured electrical conductivity of the same potassium chloride solution, in millisiemens per metre.

Use the average of the calculated values as the cell constant of the instrument.

The calculated cell constant shall not differ by more than 5 % from the value given by the manufacturer.

7.2.3 Adjust the cell constant on the conductivity meter.

7.3 Measurement of the electrical conductivity of the filtrates

Measure the electrical conductivity of the filtrates (x_m) according to the instructions provided by the manufacturer of the conductivity meter (5.1). Carry out the measurements with the temperature corrected to 25 °C. Note the results to one decimal place, expressed in millisiemens per metre.

8 Interferences

8.1 The measured values of the electrical conductivity can be influenced by contamination of the electrodes.

This type of interference is very difficult to recognize. Pollution of the electrodes may change the cell constant, and this can be perceived by measuring the conductivity of the potassium chloride solutions.

8.2 Air bubbles on the electrodes, for example formed during warming of the extracts, perturb the measurements.

8.3 Measurements of electrical conductivities less than 1 mS/m are influenced by carbon dioxide and ammonia from the atmosphere. In these cases, measurements shall be carried out in an adapted measuring cell. Such measurements are outside the scope of this International Standard.

9 Repeatability

The repeatability of the electrical conductivity measurements in two separately prepared filtrates shall satisfy the requirements of table 1.

Table 1 — Repeatability

Electrical conductivity mS/m at 25 °C	**Accepted variation**
0 to 50	5 mS/m
> 50 to 200	20 mS/m
> 200	10 %

10 Test report

The test report shall contain the following information:

a) a reference to this International Standard;

b) all information necessary for complete identification of the sample;

c) the results of the determination in whole numbers, expressed in millisiemens per metre;

d) details of any operations not specified in this International Standard or regarded as optional, and any other factors which may have affected the results.

Annex A
(informative)

Results of an interlaboratory trial for the determination of the specific electrical conductivity of soils

In 1991, an interlaboratory trial was organized by the Wageningen Agricultural University to test the procedure specified in this International Standard.

For this interlaboratory trial, the determination of the specific electrical conductivity of five soils was carried out by 26 laboratories.

The summary of the results of the interlaboratory trials is presented in table A.1.

Samples 1 and 4 mentioned in table A.1 were collected in salt-affected areas in Hungary. The fifth sample originates from the Netherlands.

The repeatability, r, and the reproducibility, R, given in this table were calculated according to ISO 5725:1986, *Precision of test methods — Determination of repeatability and reproducibility for a standard test method by inter-laboratory tests.*

Table A.1 — Results of an interlaboratory trial for the determination of the specific electrical conductivity

Sample No.	1	2	3	4	5
Number of laboratories retained after eliminating outliers	26	26	26	25	26
Number of outliers (laboratories)	—	—	—	1	—
Number of accepted results	52	52	52	50	52
Mean value (mS/m)	34,931	117,075	142,673	655,506	31,077
Repeatability standard deviation (s_r)	0,874	3,012	1,717	11,153	1,063
Repeatability relative standard deviation (%)	2,501	2,573	1,203	1,701	3,420
Repeatability limit ($r = 2{,}8 \times s_r$)	2,446	8,434	4,806	31,229	2,976
Reproducibility standard deviation (s_R)	7,889	9,021	13,340	62,439	4,116
Reproducibility relative standard deviation (%)	22,583	7,705	9,350	9,525	13,244
Reproducibility limit ($R = 2{,}8 \times s_R$)	22,088	25,259	37,352	174,828	11,524