
**Geotechnical investigation and
testing — Laboratory testing of soil —
Part 4:
Determination of particle size
distribution**

iTeh STANDARD PREVIEW
*Reconnaissance et essais géotechniques — Essais de laboratoire sur
les sols —
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*Partie 4: Détermination de la distribution granulométrie des
particules*

ISO 17892-4:2016

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

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

ISO 17892-4 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 341, *Geotechnical investigation and testing*, in collaboration with ISO Technical Committee TC 182, *Geotechnics*, in accordance with the agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition cancels and replaces the first edition (ISO/TS 17892-4:2004), which has been technically revised.

It also incorporates the Technical Corrigendum ISO/TS 17892-4:2004/Cor 1:2006.

A full list of parts in the ISO 17892 series, published under the general title *Geotechnical investigation and testing — Laboratory testing of soil*, can be found on the ISO website.

Introduction

This part of ISO 17892 covers areas in the international field of geotechnical engineering never previously standardized. It is intended that this part of ISO 17892 presents broad good practice throughout the world and significant differences with national documents is not anticipated. It is based on international practice (see Reference [2]).

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Geotechnical investigation and testing — Laboratory testing of soil —

Part 4: Determination of particle size distribution

1 Scope

This part of ISO 17892 specifies a method of determining the particle size distribution of soils.

This part of ISO 17892 is applicable to the laboratory determination of the particle size distribution of a soil test specimen by sieving, or sedimentation, or a combination of both within the scope of geotechnical investigations.

The particle size distribution is one of the most important physical characteristics of soil. Classification of soils is mainly based on the particle size distribution. Many geotechnical and geohydrological properties of soil are related to the particle size distribution.

The particle size distribution provides a description of soil based on a subdivision in discrete classes of particle sizes. The size of each class can be determined by sieving and/or sedimentation. Coarse soils are usually tested by sieving, but fine and mixed soils are usually tested by a combination of sieving and sedimentation, depending on the composition of the soil.

The sieving method described is applicable to all non-cemented soils with particle sizes less than 125 mm. Two sedimentation methods are described: the hydrometer method and the pipette method.

NOTE This part of ISO 17892 fulfils the requirements of the particle size distribution testing in accordance with EN 1997-2.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3310-1, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth*

ISO 3310-2, *Test sieves — Technical requirements and testing — Part 2: Test sieves of perforated metal plate*

ISO 4788, *Laboratory glassware — Graduated measuring cylinders*

ISO 14688-1, *Geotechnical investigation and testing — Identification and classification of soil — Part 1: Identification and description*

ISO 17892-1, *Geotechnical investigation and testing — Laboratory testing of soil — Part 1: Determination of water content*

ISO 17892-3, *Geotechnical investigation and testing — Laboratory testing of soil — Part 3: Determination of particle density*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

**3.1
sieving**

process of separating soil particles into size classes by the use of test sieves consisting of a wire mesh or slotted metal plate that permits particles smaller than the mesh size to pass through

**3.2
sedimentation**

process of separating soil particles into size classes by the gravitational settling of soil particles in a liquid, where different size classes settle at different rates

**3.3
particle size distribution**

proportions by mass of the various particle size classes present in a soil

**3.4
dispersion**

mechanical or chemical treatment of the soil to separate any aggregations into single particles

**3.5
coagulation**

process of aggregation of soil particles in suspension

**3.6
equivalent particle diameter**

particle diameter calculated from *sedimentation* (3.2) data using Stokes' law, assuming spherical particles

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Note 1 to entry: Stokes' law establishes the relationship between the terminal velocity of a sphere falling through a column of fluid, the sphere's diameter, the density and dynamic viscosity of the fluid and the density of the sphere.

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4 Apparatus

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4.1 General

See [Annex A](#) for calibration, maintenance and checks on the following apparatus.

4.1.1 Balances

The balance for sieve test and hydrometer test shall have an accuracy of 0,01 g or 0,1 % of the weighed mass, whichever value is greater. The balance for pipette test shall have an accuracy of 0,001 g or 0,1 % of the weighed mass, whichever is greater.

4.1.2 Drying ovens

The drying oven should be of the forced-draught type and shall be capable of maintaining a uniform temperature throughout the drying chamber. Any air circulation shall not be so strong that any transport of particles can take place.

4.1.3 Timing devices

The watch or clock shall be readable to 1 s.

4.1.4 Temperature measuring devices

Temperature measuring devices, such as thermometers and thermocouples, shall cover the temperature range of that part of the test and be readable to 0,1 °C.

4.1.5 Desiccator

A desiccator, if used, shall be of suitable size and contain dry, self-indicating desiccant such as silica gel. It is not required if test specimen containers with close-fitting lids are used.

4.1.6 Test specimen containers

Test specimen containers shall be made of a material that does not change mass as a result of repeated drying cycles. Glass, porcelain and corrosion-resistant metals have been found to be suitable.

Containers shall have a capacity large enough to hold the mass of sample to be dried without spillage, but should not be so large that the mass of the empty container is significantly in excess of that of the specimen.

4.1.7 Sample separation following pre-treatment

If pre-treatment is required, a centrifuge or vacuum filter and ancillaries or other apparatus used shall be suitable for separating out the soil particles from the reagent without altering the particle size distribution.

4.2 Sieving method

4.2.1 Test sieves

Test sieves conforming to ISO 3310-1 and ISO 3310-2, together with appropriate receivers, shall be used.

The number of sieves used and their aperture sizes shall be sufficient to ensure that any discontinuities in the grading curve are detected.

The inclusion of sieves 63 mm, 20 mm, 6,3 mm, 2,0 mm, 0,63 mm, 0,20 mm and 0,063 mm is recommended as these represent the boundary sizes for coarse materials as defined in ISO 14688-1. These facilitate sample description and classification.

4.2.2 Mechanical sieve shaker (optional)

A mechanical sieve shaker, if used, shall hold a nest of sieves with their lid and receiver securely. The design of the shaker shall ensure that the test material on any given sieve progresses over the surface of the sieve when it is agitated.

4.2.3 Ancillary apparatus

The ancillary apparatus shall consist of the following:

- corrosion resistant trays;
- large corrosion resistant or plastic tray or bucket;
- scoop;
- sieve brushes;
- rubber tubing;
- laboratory glassware (e.g. beakers and flasks);
- riffle box (optional).

4.3 Hydrometer method

4.3.1 Hydrometer

The hydrometer shall be torpedo-shaped, made of glass, as free as possible from visible defects and preferably manufactured to a national standard. The hydrometer stem and bulb shall be circular in cross section and symmetrical around the main axis, without abrupt change in cross section.

The scale and inscription shall be marked clearly and permanently, showing no apparent irregularities in spacing as shown in [Figure A.1](#). The range of the hydrometer shall be at least between 0,995 0 g/ml and 1,030 0 g/ml with graduation lines at intervals of 0,000 5 g/ml or less. The markings may be directly in g/ml or may be the difference from 1,000 0 g/ml, expressed in mg/ml. The hydrometer shall be indelibly marked with a unique identification number.

NOTE Some hydrometers measure the specific gravity of the solution (i.e. the density of the solution relative to that of pure water) rather than the absolute density of the solution. Use of a hydrometer measuring specific gravity will introduce a small error in the measurements.

4.3.2 Sedimentation cylinders

Sedimentation cylinders marked at 1 000 ml shall have constant cross-sectional area throughout their length and be transparent to facilitate reading. The diameter shall be at least twice that of the hydrometer bulb and the length shall be sufficient to ensure that the hydrometer can float freely in 1 000 ml of pure water. Larger cylinders of the same specification may be used provided the quantities of the contents are scaled up equally to ensure that the concentration of the suspension is maintained.

4.3.3 Water bath (optional)

The temperature in the cylinders shall not vary by more than 3 °C during the test. Unless this is achieved within a temperature controlled room, a water bath fitted with a temperature controller shall be used. If using a water bath, the water level in the bath shall be maintained at least as high as the suspension in the sedimentation cylinder throughout the test.

NOTE Temperature control minimizes the formation of convection currents within the suspension which may affect the results.

4.3.4 Mechanical shaker or mixer

The mechanical shaker or mixer shall be capable of keeping the appropriate quantities of soil and water in continuous suspension, but not so vigorously that soil particles are fractured or lost.

4.4 Pipette method

4.4.1 Pipette

The pipette shall have a nominal volume of 2 % of the volume of the soil suspension and shall be mounted in a pipette configuration ([Figure 1](#)).

4.4.2 Sedimentation cylinders

Sedimentation cylinders (marked at specified volume) shall be of constant cross-sectional area throughout their length and transparent to facilitate reading. Cylinders should have a minimum volume of 500 ml.

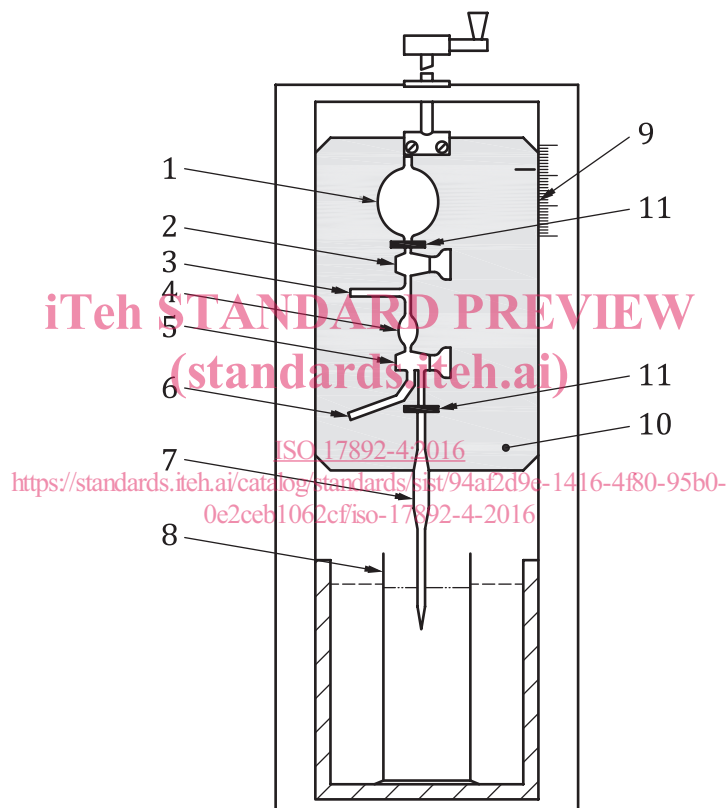
4.4.3 Pipette specimen containers

Containers, e.g. glass bottles with ground glass stoppers or evaporating dishes, shall be suitable for the drying of aliquots removed from the sedimentation suspension by the pipette. Glass bottles about 25 mm in diameter and about 50 mm tall have been found to be suitable for a 10 ml sampling pipette.

4.4.4 Water bath (optional)

The temperature in the cylinders shall not vary by more than 3 °C during the test. Unless this is achieved within a temperature controlled room, a water bath fitted with a temperature controller shall be used. If using a water bath, the water level in the bath shall be maintained at least as high as the suspension in the sedimentation cylinder throughout the test.

NOTE Temperature control minimizes the formation of convection currents within the suspension which may affect the results.



Key

- | | | | |
|---|---------------------------|----|------------------------|
| 1 | rubber suction bulb | 7 | sampling pipette |
| 2 | tap | 8 | sedimentation cylinder |
| 3 | safety bulb suction inlet | 9 | graduated scale |
| 4 | safety bulb | 10 | sliding panel |
| 5 | three-way tap | 11 | clamps |
| 6 | outlet tube | | |

Figure 1 — Example of pipette configuration

4.4.5 Mechanical shaker or mixer

The mechanical shaker or mixer shall be capable of keeping the appropriate quantities of soil and water in continuous suspension, but not so vigorously that soil particles are fractured or lost.

4.4.6 Centrifuge (optional)

The centrifuge or vacuum filter and ancillaries or any other apparatus shall be suitable for separating out the soil particles following pre-treatment for the removal of salts, organic and/or calcareous matter.

4.5 Reagents

4.5.1 General

Other than water, the following reagents shall be of recognized analytical reagent quality.

4.5.2 Water

The water shall be distilled, de-ionized or demineralized. Where distilled is referred to in this part of ISO 17892, the terms are interchangeable.

4.5.3 Dispersing agent

Where a dispersing agent is required by the test procedure, options include but are not limited to the following:

- sieving: hexa-sodium hexametaphosphate or tetra-sodium diphosphate, approximately 2 g/l dissolved in water;
- sedimentation: hexa-sodium hexametaphosphate, approximately 40 g/l, or tetra-sodium diphosphate, approximately 20 g/l, dissolved in water.

Dispersing agent solutions shall not be used more than 1 month after their preparation.

NOTE Different dispersing agents, and different concentrations of the agents, can cause differences in the effectiveness of dispersion, as can differences in the pH of the solution. There is no single universally agreed optimal dispersing agent for all soils.

4.5.4 Hydrogen peroxide (optional)

Hydrogen peroxide (20 % V/V) may be used to remove organic material. See [Annex B](#).

4.5.5 Hydrochloric acid (optional)

Hydrochloric acid (0,2 M ± 0,02 M) may be used to remove carbonate. See [Annex B](#).

5 Test procedure

5.1 Selection of test method

The test method or combination of methods should be specified prior to testing or be selected on the following basis.

- If a sample has less than about 10 % of particles smaller than 0,063 mm, sedimentation test is not normally required.
- If all of the sample is smaller than 2 mm and has less than about 10 % of particles larger than 0,063 mm, a full sieve test is not normally required.
- For all other samples, a combination of sieve test and sedimentation should be performed in order to determine the full particle size distribution.