BS 1377-2:2022



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# BS 1377-2 — Methods of test for soils for civil engineering purposes

Part 2: Classification tests and determination of geotechnical properties



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# Foreword

# **Publishing information**

This part of BS 1377 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 March 2022. It was prepared by Subcommittee B/526/3, *Ground investigation and ground testing*, under the authority of Technical Committee B/526, *Geotechnics*. A list of organizations represented on these committees can be obtained on request to their committee manager.

# Supersession

This part of BS 1377 supersedes <u>BS 1377-2:1990</u>, <u>BS 1377-4:1990</u>, <u>BS 1377-5:1990</u>, <u>BS 1377-6:1990</u> and <u>BS 1377-7:1990</u>, which are withdrawn.

# **Relationship with other publications**

BS 1377 is published in the following parts:

- Part 1: General requirements and sample preparation
- Part 2: Classification tests and determination of geotechnical properties (this document)
- Part 3: Chemical and electrochemical tests
- Part 9: In-situ tests

<u>BS 1377-1</u> provides general information relating to the tests, common calibration and specification requirements and general requirements for testing laboratories and fieldwork. This information is required for tests for which no BS EN ISO standard is available. <u>BS EN ISO 17892</u> standards include specific requirements for sample preparation, equipment maintenance and calibration for each test which take precedence.

<u>BS 1377-3</u> describes test methods for determining the amount of chemical substances in soil and groundwater.

This part of BS 1377 includes reference to BS EN ISO 17892 (all parts) for the relevant test and provides non-contradictory complementary information on the test methods.

# Information about this document

This publication can be withdrawn, revised, partially superseded or superseded. Information regarding the status of this publication can be found in the Standards Catalogue on the BSI website at <u>bsigroup.com/standards</u>, or by contacting the Customer Services team.

Where websites and webpages have been cited, they are provided for ease of reference and are correct at the time of publication. The location of a webpage or website, or its contents, cannot be guaranteed.

This part of BS 1377 consolidates the tests included in <u>BS 1377-2:1990</u>, <u>BS 1377-4:1990</u>, <u>BS 1377-5:1990</u>, <u>BS 1377-6:1990</u> and <u>BS 1377-7:1990</u> into one document as follows:

- <u>BS 1377-2:1990</u>, Part 2: Classification tests
- <u>BS 1377-4:1990</u>, Part 4: Compaction-related tests
- <u>BS 1377-5:1990</u>, Part 5: Compressibility, permeability and durability tests
- <u>BS 1377-6:1990</u>, Part 6: Consolidation and permeability tests in hydraulic cells and with pore pressure measurement

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- <u>BS 1377-7:1990</u>, Part 7: Shear strength tests (total stress)
- <u>BS 1377-8:1990</u>, Part 8: Shear strength tests (effective stress)

The following tests that were included in BS 1377:1990 have been withdrawn:

BS 1377-2:1990, Clause 6.3 Volumetric shrinkage test (definitive method)

BS 1377-2:1990, Clause 6.4 Volumetric shrinkage test (subsidiary method)

BS 1377-7:1990, Clause 9 Multistage unconsolidated undrained triaxial test

#### **Presentational conventions**

The provisions of this standard are presented in roman (i.e. upright) type. Its methods are expressed as a set of instructions, a description, or in sentences in which the principal auxiliary verb is "shall".

*Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.* 

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

# **Contractual and legal considerations**

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Compliance with a British Standard cannot confer immunity from legal obligations.

# 1 Scope

This part of BS 1377 specifies methods of test for the classification of soil and for the determination of geotechnical properties of soils in the laboratory.

Most of these tests are required for the determination of geotechnical behaviour of soils in accordance with BS EN 1997 (all parts) and <u>BS 5930</u>.

This part of BS 1377 includes:

- a) common laboratory tests required for the classification of soils;
- b) determination of compaction characteristics of soils for earthworks, permeability, compressibility and erodibility; and
- c) determination of shear strength of soils in terms of both total and effective stresses.

*NOTE* Where EN ISO test methods are available, these are normatively referenced and commentary provided to assist in their application.

<u>BS 1377-1</u> specifies requirements that include details of sample preparation and equipment calibration that are relevant to tests described in this part of BS 1377, unless otherwise detailed in the referenced <u>BS EN ISO 17892</u> standard.

# 2 Normative references

<u>BS 1377-1:2016</u>, Methods of test for soils for civil engineering purposes – Part 1: General requirements and sample preparation

BS 812-124:2009, Testing aggregates – Part 124: Method for determination of frost heave

BS EN ISO 17892-1:2014, Geotechnical investigation and testing – Laboratory testing of soil – Part 1: Determination of water content

BS EN ISO 17892-2:2014, Geotechnical investigation and testing – Laboratory testing of soil – Part 2: Determination of bulk density

BS EN ISO 17892-3, Geotechnical investigation and testing – Laboratory testing of soil – Part 3: Determination of particle density

<u>BS EN ISO 17892-4:2016</u>, Geotechnical investigation and testing – Laboratory testing of soil – Part 4: Determination of particle size distribution

<u>BS EN ISO 17892-5:2017</u>, Geotechnical investigation and testing – Laboratory testing of soil – Part 5: Incremental loading oedometer test

<u>BS EN ISO 17892-7:2018</u>, Geotechnical investigation and testing – Laboratory testing of soil – Part 7: Unconfined compression test

<u>BS EN ISO 17892-8:2018</u>, Geotechnical investigation and testing – Laboratory testing of soil – Part 8: Unconsolidated undrained triaxial test

BS EN ISO 17892-9:2018, Geotechnical investigation and testing – Laboratory testing of soil – Part 9: Consolidated triaxial compression tests on water saturated soils

<u>BS EN ISO 17892-10:2018</u>, Geotechnical investigation and testing – Laboratory testing of soil – Part 10: Direct shear tests

<u>BS EN ISO 17892-11</u>, Geotechnical investigation and testing – Laboratory testing of soil – Part 11: Permeability tests BS EN ISO 17892-12:2018+A1:2021, Geotechnical investigation and testing – Laboratory testing of soil – Part 12: Determination of liquid and plastic limits

# 3 Terms and definitions

For the purposes of this part of BS 1377, the terms and definitions given in BS 1377-1 apply.

# 4 Determination of water content

#### COMMENTARY ON CLAUSE 4

Water is present in most naturally occurring soils. The amount of water, expressed as a proportion by mass of the dry solid particles, previously known as the moisture content, has a profound effect on soil behaviour. In this context, a soil is "dry" when no further water can be removed at a temperature not exceeding 110 °C.

Water content is required as a guide to classification of natural soils and as a control criterion in recompacted soils and is measured on samples used for most field and laboratory tests. The oven-drying method is the definitive procedure used in standard laboratory practice.

In some situations, e.g. in the field control of earthworks, a rapid method of measurement of water content might be required and a number of rapid methods are available, such as the sand bath method, the microwave oven-drying method and the calcium carbide method. These methods are not necessarily appropriate for all soil types and when used on a particular soil, the oven-drying method could also be used as a check.

A procedure for determining the water content at full saturation of chalk is described in <u>4.2</u>.

# 4.1 Oven-drying method

Water content shall be determined in accordance with BS EN ISO 17892-1.

*NOTE 1* This method covers the determination of the water content of a specimen of soil as a percentage of its dry mass.

NOTE 2 A microwave oven should not be used for the determination of water content by the definitive method for soils containing clay or organic matter or some other minerals due to the difficulty maintaining the temperature of the soil below 110 °C before all the water is removed. Higher temperatures than this can alter the chemical composition of some minerals, including some clay.

NOTE 3 Certain soils contain gypsum, which on heating, loses its water of crystallization. The water content determined by this method is affected by approximately 0.2% for each 1% of gypsum. If it is suspected that gypsum is present in the soil the water content samples should be dried at no more than 50 °C and possibly for a longer time. The presence of gypsum might be in the field description or visible in the sample and can be identified by heating a small quantity of soil on a metal plate. Grains of gypsum turn white within a few minutes, whereas most other mineral grains remain unaltered.

NOTE 4 If the water content is to be related to the Atterberg limits, e.g. for determining the liquidity or consistency index, and the soil contains material retained on a 425  $\mu$ m sieve, the measured water content, w (%), can be corrected to give the equivalent water content, w < 0.425 (%), of the fraction passing the 425  $\mu$ m sieve, as described in BS EN ISO 17892-12:2018+A1:2021, Annex B.

NOTE 5 For further information on testing saline samples refer to BS EN ISO 17892-1:2014, Annex C.