BRITISH STANDARD

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Incorporating Amendments Nos. 1 and 2

Methods of test for

Soils for civil engineering purposes —

Part 4: Compaction-related tests

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Committees responsible for this British Standard

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British Civil Engineering Test Equipment Manufacturers' Association
County Surveyors' Society
Department of the Environment (Property Services Agency)
Department of the Environment (Building Research Establishment)
Department of Transport
Department of Transport (Transport and Road Research Laboratory)
Co-opted members

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Contents

Foreword

This Part of BS 1377 has been prepared under the direction of the Road Engineering Standards Policy Committee. It is a revision of Clause **4** of BS 1377:1975 which is superseded by amendment. BS 1377 was first published in 1948 and first appeared in metric form in 1975. BS 1377:1975 which has now been withdrawn is replaced by the following Parts of BS 1377:1990:

— *Part 1: General requirements and sample preparation;*

— *Part 2: Classification tests;*

— *Part 3: Chemical and electro-chemical tests;*

— *Part 4: Compaction-related tests;*

— *Part 5: Compressibility, permeability and durability tests;*

— *Part 6: Consolidation and permeability tests in hydraulic cells and with pore pressure measurement;*

— *Part 7: Shear strength tests (total stress);*

— *Part 8: Shear strength tests (effective stress);*

— *Part 9: In-situ tests.*

Reference should be made to Part 1 of BS 1377 for further information about each of the Parts.

The following methods of test, additional to those described in the 1975 standard, have been introduced.

Determination of the maximum and minimum densities of granular soils.

Determination of the moisture condition value.

Determination of the chalk crushing value.

In the dry density/moisture relationship tests, and the California Bearing Ratio (CBR) test, sample preparation procedures have been set out in more detail than before, with explanatory flow diagrams.

It has been assumed in the drafting of this British Standard that the execution of its provisions is entrusted to appropriately qualified and experienced personnel, for whose guidance it has been prepared.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 63 and a back cover.

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1 Scope

This Part of BS 1377 describes methods of test for determining characteristics related to the compaction of soils, which can be used as a basis for specifying requirements for soils compacted in the field.

This Part also includes a method for assessing an empirical strength criterion (the CBR value) of a compacted or undisturbed soil used as a sub-grade material for pavement construction.

Reference is made to some of the classification tests described in BS 1377-2.

Reference is made to BS 1377-1 for general requirements that are relevant to all Parts of this standard, and for methods of preliminary preparation of soil for testing.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Terms and definitions

For the purposes of this Part of BS 1377, the definitions given in BS 1377-1 apply.

3 Determination of dry density/moisture content relationship

3.1 General

3.1.1 *Principle.* Compaction of soil is the process by which the solid particles are packed more closely together, usually by mechanical means, thereby increasing the dry density of the soil. The dry density which can be achieved depends on the degree of compaction applied and on the amount of water present in the soil. (The terms used in compaction tests are illustrated in Figure 6.) For a given degree of compaction of a given cohesive soil there is an optimum moisture content at which the dry density obtained reaches a maximum value. For cohesionless soils an optimum moisture content might be difficult to define.

NOTE For some highly permeable soils such as clean gravels, uniformly graded and coarse clean sands, the results of the laboratory compaction test may provide only a poor guide for specifications on field compaction. The laboratory test might indicate meaningless values of moisture content in these free-draining materials and the maximum dry density is often lower than the state of compaction which can be readily obtained in the field. For these soils one of the maximum dry density tests described in Clause **4** would be more appropriate.

The objective of the tests described in this clause is to obtain relationships between compacted dry density and soil moisture content, using two magnitudes of manual compactive effort, or compaction by vibration.

3.1.2 *Types of test.* Three types of compaction test are described, each with procedural variations related to the nature of the soil. The first is the light manual compaction test in which a 2.5 kg rammer is used. The second is the heavy manual compaction test which is similar but gives a much greater degree of compaction by using a 4.5 kg rammer with a greater drop on thinner layers of soil.

For both these tests a compaction mould of 1 L internal volume is used for soil in which all particles pass a 20 mm test sieve. If there is a limited amount of particles up to 37.5 mm size, equivalent tests are carried out in the larger California Bearing Ratio (CBR) mould.

NOTE 1 Specifications for compaction by rammer in the CBR mould are based on the same compactive effort per unit volume of soil as in the 1 L compaction mould. The variable effects of side wall friction might result in differences between the densities achieved in the two moulds. For a series of tests on a particular soil, one size of mould should be used consistently.

NOTE 2 If more than 30 % of material is retained on a 20 mm test sieve the material is too coarse to be tested.

The third type of test makes use of a vibrating hammer, and is intended mainly for granular soils passing a 37.5 mm test sieve, with no more than 30 % retained on a 20 mm test sieve. The soil is compacted into a CBR mould.
For each type of test, alternative procedures depend on whether or not the soil contains particles susceptible to crushing during compaction. Methods of sample preparation covering most possible requirements are described in **3.2**. Test procedures are described separately in **3.3**, **3.4**, **3.5**, **3.6** and **3.7**.

The compaction procedures are summarized in Table 1.