

BS 812-124:2009



BSI Standards Publication

Testing aggregates

Part 124: Method for determination
of frost heave

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 32, an inside back cover and a back cover.

Foreword

Publishing information

This part of BS 812 is published by BSI and came into effect on 30 April 2009. It was prepared by Subcommittee B/502/6, *Test methods*, under the authority of Technical Committee B/502, *Aggregates*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 812 supersedes BS 812-124:1989, which is withdrawn.

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.

Contractual and legal considerations

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

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

1 Scope

This British Standard describes a test procedure for the determination of the frost resistance of unbound aggregate mixtures that have been compacted to form a cylindrical specimen with a predetermined water content and density.

It is applicable to unbound aggregate mixtures used in the construction of roads and other paved areas at a depth that might experience frost penetration.

NOTE This method can be used to assess hydraulically bound aggregate mixtures. However, acceptable values of frost heave might differ from those used to assess unbound mixtures.

This British Standard includes an option for the use of comparator specimens to confirm that the test chamber is working correctly. The method for the use of comparator specimens is given in Annex B.

2 Normative references

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

BS EN 932-1, *Tests for general properties of aggregates – Part 1: Methods for sampling*

BS EN 932-2, *Tests for general properties of aggregates – Part 2: Methods for reducing laboratory samples*

BS EN 932-5, *Tests for general properties of aggregates – Part 5: Measurement and calibration systems*

BS EN 933-1, *Tests for geometrical properties of aggregates – Part 1: Determination of particle size distribution – Sieving method*

BS EN 933-2, *Tests for geometrical properties of aggregates – Part 2: Determination of particle size distribution – Test sieves, nominal size of apertures*

BS EN 1097-5, *Tests for mechanical and physical properties of aggregates – Part 5: Determination of the water content by drying in a ventilated oven*

BS EN 13286-4, *Unbound and hydraulically bound mixtures – Test methods for laboratory dry density and water content – Part 4: Vibrating hammer*

BS EN 60584-2, *Thermocouples – Part 2: Tolerances*

3 Terms and definitions

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

3.1 constant mass

mass achieved by successive weighings after drying at least 1 hour apart not differing by more than 0.1 %

NOTE In many cases constant mass can be achieved after a test portion has been dried for a predetermined period in a specified oven (see 6.3.13) at (110 ± 5) °C. Test laboratories may determine the time required to achieve constant mass for specific types and sizes of sample, dependent upon the drying capacity of the oven used.

3.2 frost heave

maximum increase in the height of a test specimen during the freezing period

3.3 laboratory sample

reduced sample derived from a bulk sample for laboratory testing

3.4 test specimen

sample used in a single determination when a test method requires more than one determination of a property

4 Principle

Cylindrical specimens of unbound aggregate mixtures, compacted at a predetermined water content and density, are placed in a self-refrigerated unit (SRU).

The SRU subjects the upper surface of each test specimen to freezing air at $-17\text{ }^{\circ}\text{C}$ whilst their lower ends have access to water maintained at $+4\text{ }^{\circ}\text{C}$. Comparator specimens can be used to confirm that the SRU is operating correctly.

The temperature gradient in the SRU causes water to be drawn into the freezing zone and might lead to the formation of ice lenses that increase the height of the specimens. The change in height is measured at intervals over a period of 96 h. The maximum increase is recorded and is used to calculate the frost heave of the mixture.

5 Sampling and sample reduction

Take the laboratory sample of unbound aggregate mixture to be sent to the laboratory in accordance with BS EN 932-1.

The mass of the laboratory sample shall be at least twice the quantity estimated as being necessary for the tests to be carried out. The minimum amount required for each test shall conform to Table 1.

When required, divide and reduce the size of the laboratory sample in accordance with BS EN 932-2.

NOTE The values in Table 1 are calculated using a loose bulk density of 2.0 Mg/m^3 .

Table 1 **Minimum mass of test portion**

Test method		Minimum mass of test portion
		kg
BS EN 933-1	Particle size distribution (0/32 mm size mixture)	10
BS EN 13286-4	Dry density and water content by vibrating hammer	40
BS 812-124	Determination of frost heave	36

6 Apparatus

6.1 Particle size apparatus

The apparatus for the determination of the particle size distribution shall be as specified in BS EN 933-1.

6.2 Dry density and water content relation apparatus

The apparatus for determining the relationship between the dry density and water content of the unbound aggregate mixture shall be as specified in BS EN 13286-4.

6.3 Frost test apparatus

6.3.1 The apparatus for determining the frost resistance of the material shall be as specified in **6.3.2** to **6.3.15**. Unless otherwise stated, all apparatus shall conform to BS EN 932-5.

6.3.2 *Self-refrigerated unit (SRU)*, as described in Annex A.

6.3.3 *Balance(s)*, of suitable capacity, readable to 0.1% of the mass of the test portion.

6.3.4 *Container*, of suitable capacity, for the controlled addition of water to the test specimens.

6.3.5 *Mixing bowl and suitable spatula or trowel*.

NOTE Alternative methods of mixing may be used providing they are effective in distributing the added water evenly through the specimen.

6.3.6 *Containers*, at least nine, that can each hold 15 kg of mixture and are closeable.

6.3.7 *Low carbon steel mould and end plugs*, for specimen preparation, as shown in Figure 1.

6.3.8 *Hand-held steel tamper*, weighing 1 100 g to 1 200 g.

NOTE A suitable design is shown in Figure 2.

6.3.9 *Electrically powered vibrating hammer*, as described in BS EN 13286-4.

6.3.10 *Steel tamper*, with a circular foot of 100 mm diameter, to fit the vibrating hammer.

NOTE A suitable design is shown in Figure 3. The shank is a force-fit into the disc.

6.3.11 *Depth gauge*, capable of reading depths up to 250 mm and readable to 1 mm.

6.3.12 *Jacking device*, for ejecting the compacted specimen from the mould.

NOTE 1 A compression testing machine with suitable extension extruders has been found suitable.

NOTE 2 The apparatus used at the extrusion stage is illustrated in Figure 4, Figure 5 and Figure 6.

6.3.13 *Ventilated oven*, thermostatically controlled to maintain a temperature of $(110 \pm 5) ^\circ\text{C}$.

6.3.14 *Test sieve*, 40 mm size, as specified in BS EN 933-2.

6.3.15 *A supply of distilled or demineralized water*.

Figure 1 Mould and end plugs for the preparation of frost-heave test specimens

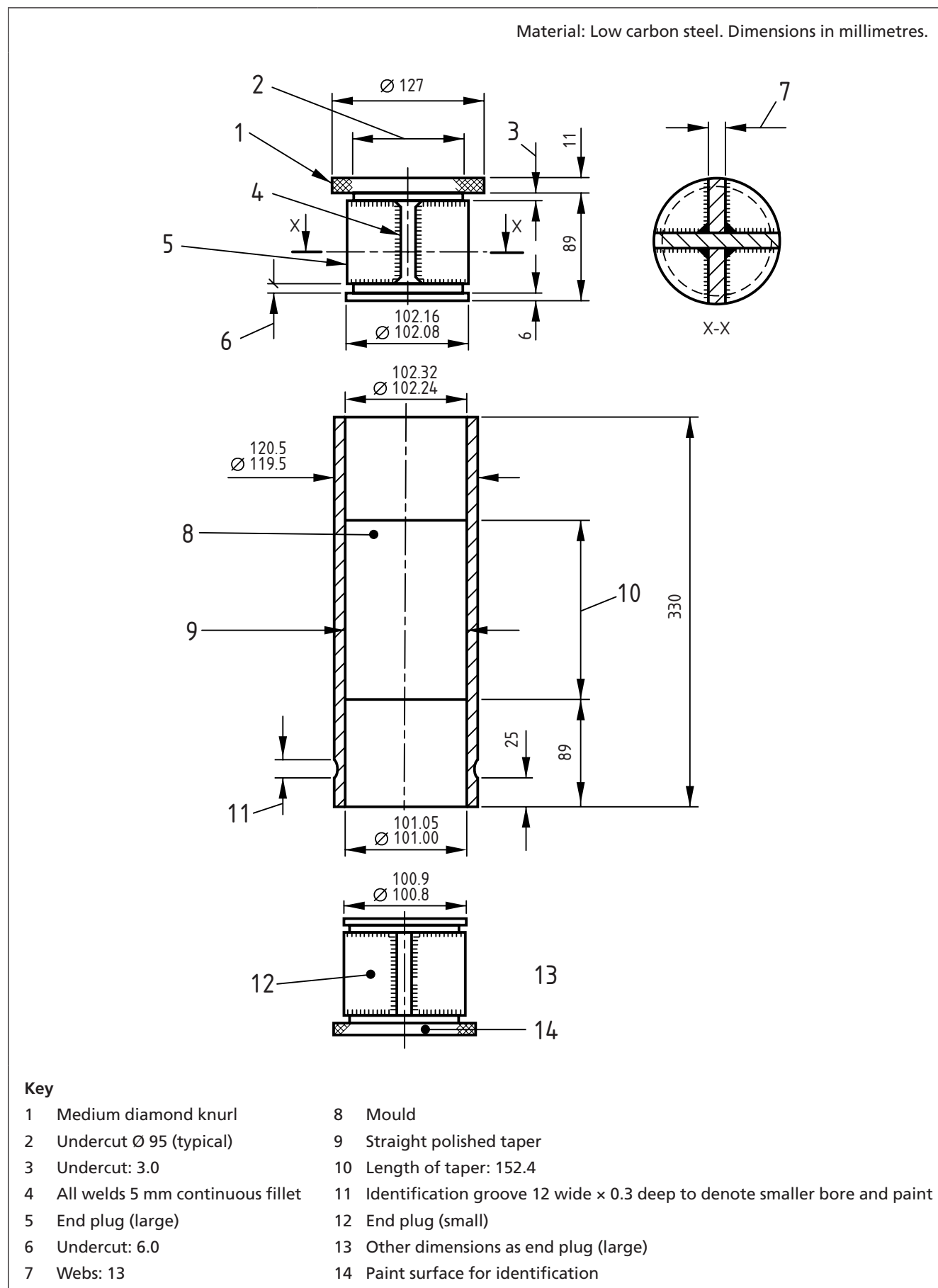


Figure 2 Hand-held tamper

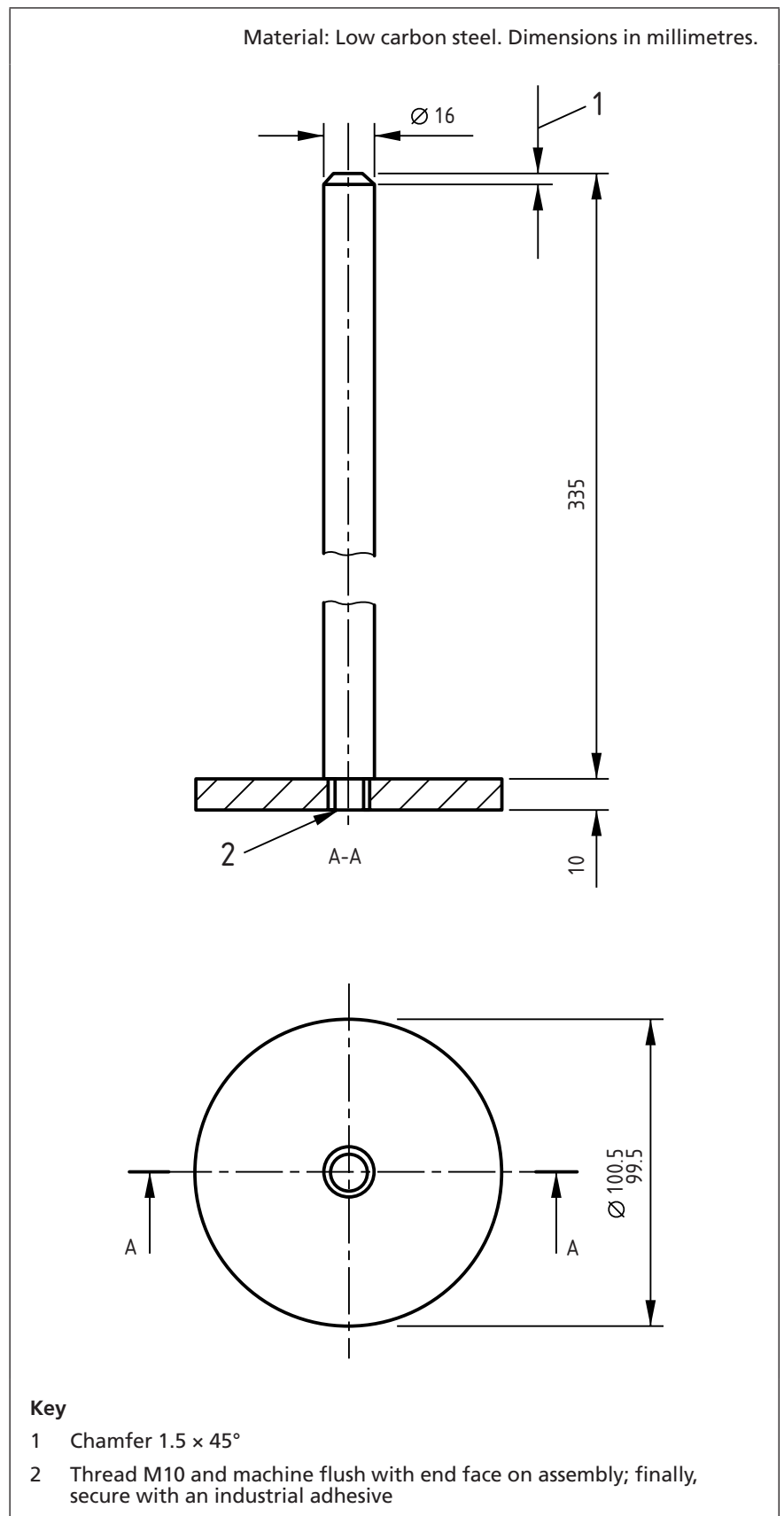


Figure 3 100 mm tamping foot for vibrating hammer

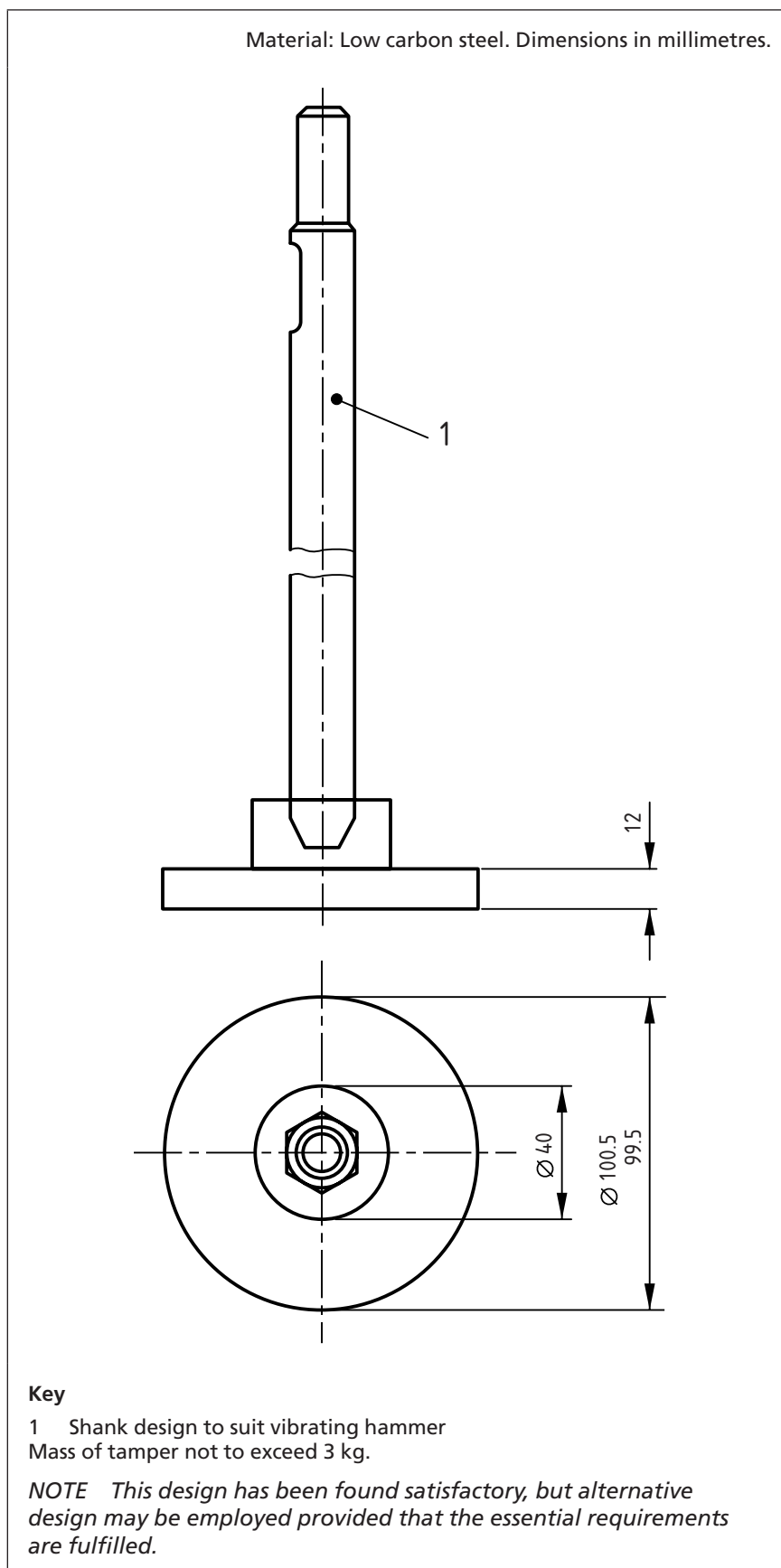


Figure 4 Specimen extruder

