

Sampling and examination of bituminous mixtures for roads and other paved areas —

**Part 107: Method of test for the
determination of the composition of
design surface course rolled asphalt**

ICS 93.080.20

Committees responsible for this British Standard

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- British Civil Engineering Manufacturers' Association
- County Surveyors' Society
- Department for Transport — Highways Agency
- Highways Agency — Safety Standards and Research
- Institute of Asphalt Technology
- Institution of Civil Engineers
- Institution of Highways and Transportation
- Mastic Asphalt Council Ltd.
- MoD — UK Defence Standardization
- Quarry Products Association
- Refined Bitumen Association
- Scottish Office — Roads Directorate
- Society of Chemical Industry
- TRL — Transport Research Laboratory
- United Kingdom Accreditation Service
- Co-opted members

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Foreword

This part of BS 598 has been prepared by Subcommittee B/510/1. It supersedes BS 598-107:1990 which is withdrawn.

The start and finish of text introduced or altered by amendment No.1 is indicated by tags **Δ**. Minor editorial changes are not tagged.

This new edition of BS 598-107 incorporates technical changes only. It does not reflect a full review or revision of the standard, which will be undertaken in due course.

This edition introduces a number of changes associated with the introduction of the European standards for aggregates and the associated test method standards. These changes include the use of new sieve sizes which are used both for the definition of the actual mixtures and their size designations. This edition of BS 598 has therefore been amended to align with BS EN 13043, which was implemented in the UK on 01/01/2004. Detailed guidance and advice on the changes may be found in PD 6682-2 and PD 6682-9.

Due to the different factors to be considered when sampling and testing mastics for roads and other paved areas it has been decided to continue publishing the requirements for mastics as a separate British Standard, i.e. BS 5284.

It has been assumed in the drafting of this part of BS 598 that the execution of its provisions is entrusted to appropriately qualified and experienced people.

It is recognized that safety during sampling is of great importance. It should be noted that the work of sampling may be subject to the provisions of the Health and Safety at Work etc. Act 1974 [1], the Factories Act 1961 [2] (as amended by the Health and Safety at Work etc. Act 1974) and in particular the Construction Regulations 1961 [3].

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 does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 23 and a back cover.

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1 Scope

This part of BS 598 describes a method for the determination of the composition of design surface course rolled asphalt.

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

2 Definitions

For the purposes of this part of BS 598 the definitions given in BS 6100 apply together with the following.

NOTE These definitions apply specifically to the design method.

2.1

stability

maximum resistance to deformation in newtons of a moulded asphalt specimen

2.2

flow

deformation of the moulded specimen in millimetres at the point of maximum resistance

2.3

mix density

mass of asphalt mixture per unit volume of the compacted specimen

2.4

design binder content

binder content of an asphalt mixture

A1 2.5

constant mass

successive weighings after drying at least 1 h apart not differing by more than 0.1 % **A1**

3 General

Aggregate compositions suitable for surface course rolled asphalt that is to be specified by the design method are given in Table 3 and Table 4 of BS 594-1:2005. This part of BS 598 describes the procedure to be followed when deciding a suitable binder content for a chosen aggregate composition. The appropriate binder content will differ, for any particular grading of aggregate, according to the nature and source of the aggregate, hence the need for a design procedure, particularly if an unfamiliar aggregate source is to be used.

It has to be emphasized that the design procedure is not simple and takes time. At least three consecutive working days are needed to carry out the procedure properly, and great care and attention to detail are essential if a reliable result is to be obtained. Precise conformity to all the requirements for apparatus and procedure will give a binder content that can be used with confidence in specification; other equipment and the use of short cuts and variation in procedure will almost certainly give misleading results.

The procedure gives a binder content, called the design binder content, which is a compromise between the conflicting needs of stability, durability and workability.

The method involves the determination of a binder content of the complete mix using Marshall test equipment. Specimens for test are made with the aggregate required for use in the plant mix and with a range of binder contents using the grade of binder proposed for the actual job. Marshall stability, flow and densities are determined by defined procedures which also permit the calculation of other properties.

Annex B of BS 594-1:2005 gives advice on the application of test data obtained from the design procedure for deciding the best composition of surface course asphalt for a given site. Suggestions are also given in the same annex on the verification procedure to be adopted.

4 Apparatus

NOTE All dimensions are nominal unless tolerances are given.

4.1 Balance, of not less than 2 kg capacity, accurate to 0.1 g.

NOTE A second balance, accurate to 0.5 g, is convenient for proportioning aggregates, filler and binder.

4.2 Oven, conforming to Annex A with fan assisted air circulation, fitted with thermostatic control to maintain temperature in the range 80 °C to 200 °C.

NOTE Two ovens may be found to be convenient. Aggregates, moulds and steel blocks may be heated in one oven and binder in a smaller oven with a time switch controller.

4.3 Mechanical mixing unit, of not more than 8 L capacity, capable of combining 1 500 g of aggregate, filler and binder speedily and thoroughly without loss.

NOTE A mechanical mixer with detachable mixing bowl and accurately controlled heating element capable of maintaining the bowl at the required temperature is suitable. A wire whisk of adequate strength is normally found most suitable and the design illustrated has been found to be satisfactory for planetary mixers.

4.4 Whisk, of a suitable design such as that shown in Figure 1.

NOTE 1 Alternative designs of the whisk head to that shown in Figure 1 are suitable providing the wire scrapes the bowl sides.

NOTE 2 Since the wire blades wear out quickly, an economical method of obtaining a whisk is to purchase a boss and bayonet fitting as shown and to produce and fit the wires separately.

4.5 Steel mould cylinders, with a 101.6 ± 0.1 mm internal diameter, complete with mould bases and extension collars as shown in Figure 2 sufficient in number to enable the work to continue as required.

4.6 Steel compaction hammer, of total mass $7\,850 \pm 50$ g including a sliding weight of $4\,535 \pm 25$ g with a free fall of 457 ± 5 mm that acts upon the foot assembly as shown in Figure 3. The apparatus shown in Figure 2 is suitable for hand compaction. The foot assembly shall comprise a spring housing and a helical compression spring of hardened and tempered steel with a load rate of 10 N/mm to 18 N/mm and designed to exert a preload of 80 N to 150 N when confined within the foot assembly leaving a minimum movement of 20 mm. The foot of the hammer shall be machined flat and smooth and be securely fixed to the foot assembly.

4.7 Automatic compactor, the mass, free fall and design of the complete hammer foot assembly being as specified in 4.6. The operating mechanism shall not be supported by the laminated hardwood block of the compaction pedestal. The free fall height shall be measured when the machine is in operation and be capable of being maintained within the specified tolerances throughout the compaction procedure. The automatic mechanism shall be capable of applying 50 blows at the rate of 60 ± 5 blows per minute.

NOTE The use of an automatic compactor is recommended particularly in cases of dispute.

4.8 Steel block, of 100 mm diameter by not less than 50 mm high, used for the initial heating of the compaction hammer.

NOTE The use of more than one block may be advantageous.

4.9 Compaction pedestal, as shown in Figure 4 and consisting of the following.

- a) *Vibrated concrete base*, of minimum density $2\,200 \text{ kg/m}^3$ and minimum dimensions $450 \text{ mm} \times 450 \text{ mm} \times 200 \text{ mm}$ with a shoulder to receive a laminated hardwood block.
- b) *Laminated hardwood block*, $200 \pm 4 \text{ mm} \times 200 \pm 4 \text{ mm}$ in cross-section and $450 \pm 4 \text{ mm}$ in height, made from straight-grained, seasoned timber (such as sapele) free from shakes, splits and knots with a density of 560 kg/m^3 to 720 kg/m^3 at a moisture content of 8 % to 10 %. The block shall be built up of between six and ten approximately equal laminations of quarter sawn board bonded with waterproof resin glue. The ends shall be smooth and normal to the vertical axis and the block shall be treated with a water-resistant impregnant and varnished to minimize changes of moisture content.
- c) *Mild steel plate*, $300 \pm 5 \text{ mm} \times 300 \pm 5 \text{ mm} \times 25 \pm 1 \text{ mm}$ fitted with a positive location to receive the hardwood block and with a mould assembly holder to secure the mould assembly centrally on the pedestal during compaction and a guide to ensure that the hammer is maintained in a truly vertical position throughout compaction. The mild steel plate with assembly holder and guide shall be secured to the base with four tie rods each tensioned to the equivalent of a torque of $10 \pm 1 \text{ N}\cdot\text{m}$ on an M10 thread.

NOTE The compaction pedestal plays an important part in the compaction of specimens and it is essential that it conforms to the detailed description.

4.10 *Extractor*, of suitable design to eject the specimens from the moulds without distortion or shock to the specimens.

4.11 *Water bath*, fitted with thermostatic control to maintain the temperature at 60 ± 0.5 °C, with a tray or trays and deep enough to allow at least 25 mm depth of water above and below the specimens. It shall be made so that the specimens can be placed flat face down and not in contact with one another. The bath shall be fitted with one or more pumps, impellers or stirring devices to ensure a continuous circulation of water around the specimens.

NOTE It is recommended that the water bath be large enough to hold a minimum of 15 specimens.

4.12 *Steel or cast iron testing head*, as shown in Figure 5, having segments machined to an inner radius of 50.8 ± 0.05 mm.

4.13 *Compression testing machine*, having a minimum capacity of 22 kN and capable of applying a constant rate of strain to the specimens of 50 ± 3 mm/min under all loading conditions. The load measurement device shall be calibrated in accordance with BS 1377-1 or BS EN ISO 7500-1.

Means of measuring flows of up to 10 mm with an accuracy of ± 0.1 mm and of indicating the maximum load and flow achieved during the test shall be provided.

NOTE Methods by which the test data can be retained as a printed or graphical display are preferred. Any such device should be capable of recording load to an accuracy in accordance with BS EN ISO 7500-1 and flow to an accuracy of ± 0.1 mm.

4.14 *Riffle box*, of sufficient size to blend samples of aggregates prior to weighing out to ensure representative sampling (see Clause 6).

4.15 *Cans, containers and trays*, comprising binder cans fitted with lids, aggregate containers and trays of adequate capacity.

4.16 *Silicone grease*. A grease to Ministry of Defence Standard 50-10¹⁾ is suitable.

4.17 *Spatulas*, as follows:

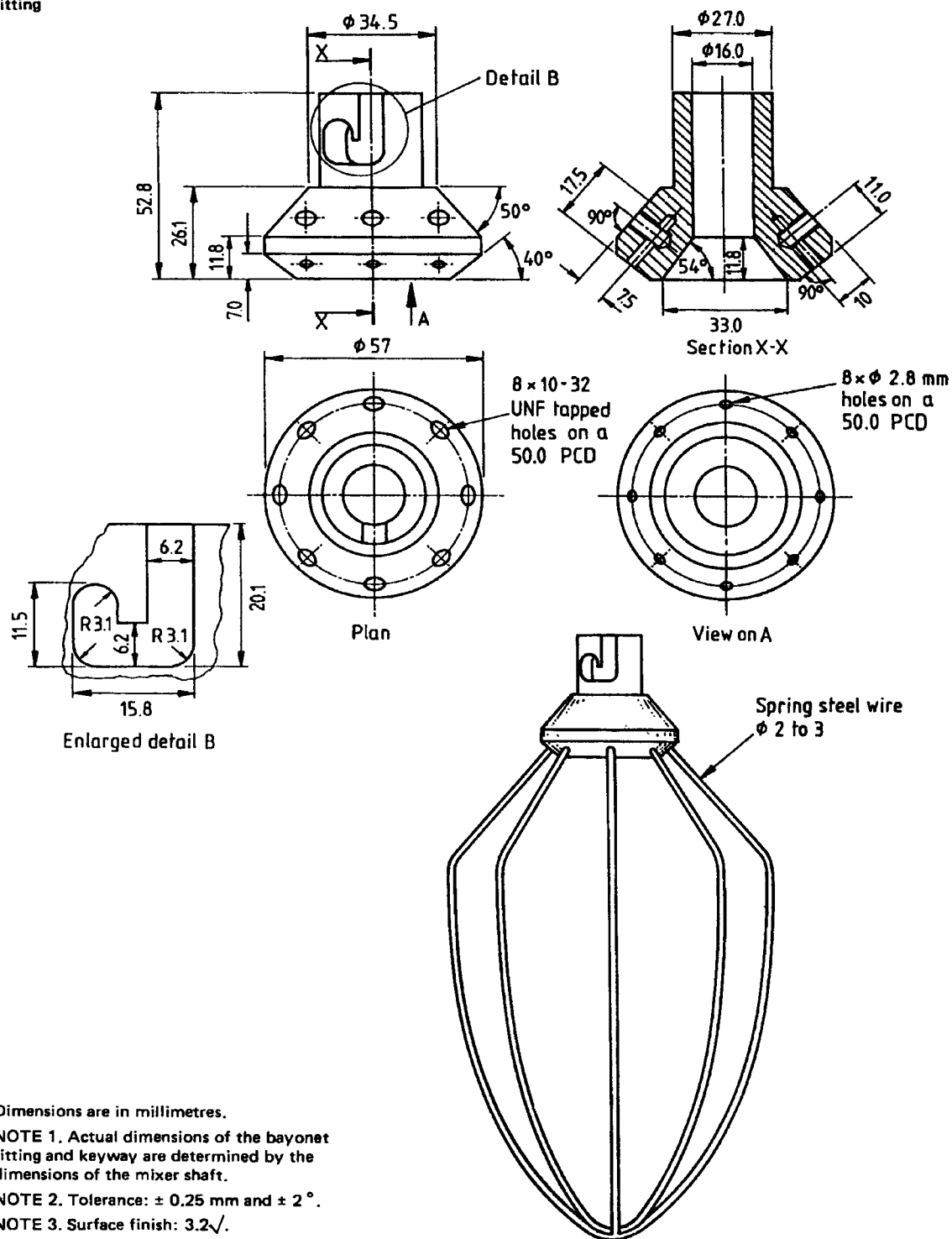
- size 1: with blade approximately 150 mm long $\times$ 25 mm wide
- size 2: with blade approximately 200 mm long $\times$ 32 mm wide.

4.18 *Sieves*, having apertures of 2 mm and 0.063 mm and conforming to BS 410.

4.19 *Heat-resistant gloves*.

¹⁾ MOD standard 59-10 "Insulating and filling compounds (insulating compound, electric/silicon grease type)" published by Directorate of Standardization, Ministry of Defence, London.

Boss and bayonet fitting



Dimensions are in millimetres.

NOTE 1. Actual dimensions of the bayonet fitting and keyway are determined by the dimensions of the mixer shaft.

NOTE 2. Tolerance: ± 0.25 mm and $\pm 2^\circ$.

NOTE 3. Surface finish: 3.2 $\sqrt{}$.

NOTE 4. Complete assembly to consist of the details shown plus 8 No 10 - 32 UNF x 12.7 mm long fully threaded socket cap screws.

Figure 1 — Suitable design of whisk for a planetary mixing unit

