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Specification

Dense tar surfacing for roads and other paved areas

UDC 625.859

Co-operating organizations

The Road Engineering Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Asphalt and Coated Macadam Association*
Association of Consulting Engineers
British Quarrying and Slag Federation*
British Tar Industry Association*
Cement and Concrete Association
Concrete Society
Contractors' Plant Association
County Surveyors' Society*
Department of the Environment*
Department of the Environment (Transport and Road Research Laboratory)*
Federation of Civil Engineering Contractors
Federation of Manufacturers of Construction Equipment and Cranes
Greater London Council*
Institute of Petroleum*
Institute of Quarrying
Institution of Civil Engineers*
Institution of Highway Engineers*
Institution of Municipal Engineers*
Institution of Structural Engineers
Ministry of Defence
Refined Bitumen Association
Road Emulsion Association
Road Surface Dressing Association
Sand and Gravel Association Limited*
Society of Chemical Industry*
Individual experts

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

Standardization of Tar Products Test Committee
Individual expert

This British Standard, having been approved by the Road Engineering Industry Standards Committee, was published under the authority of the Executive Board on 28 November 1975

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Foreword

The British Road Tar Association[1)] publication "Dense Tar Surfacing", originally published in 1954, was last fully revised in 1966; it was reprinted in 1968 with minor amendments, and an amendment sheet was issued in 1972 in which there were alterations to the fine aggregate grading in Table 2 for DTS wearing course (crushed rock or slag fine aggregate).

This British Standard, prepared under the authority of the Road Engineering Industry Standards Committee, is a fully metricated version of the BRTA specification published in 1966, including the subsequent amendments and with certain deletions. The specification for fine-textured wearing-course material is now included in BS 4987 "Coated macadam for roads and other paved areas" and is called "6 mm nominal size fine-textured tarmacadam". BS 4987 also includes 40 mm, 28 mm and 20 mm nominal size dense tarmacadam basecourse materials. Reference should be made to that British Standard for those materials.

NOTE This standard has been prepared using metric units as part of the national policy to change to the metric system. As a consequence there will be a transitional period during which material will still be supplied that has been produced using equipment based on imperial sizes, and the original BRTA specification with 1972 amendments will also continue to apply during this period. It is important, therefore, that the supplier should state, on his advice note to the purchaser, the specification to which he has supplied the material.

Although the specification requires that the mixed material shall, on analysis, comply with the requirements of the respective tables, it should be realized that when any sampling procedure is used complete compliance with specification may not always be achieved with every sample tested, even when the material is satisfactory. This should be borne in mind when deciding whether or not the material is acceptable.

It has not been found possible at this stage to introduce into the standard a system of compliance based on statistical methods.

The term "mass" has been used in place of the term "weight" in this standard. There is no explicit SI unit of weight, and when "weight" is used in the sense of "mass" the unit is the kilogram. The metric tonne (1 000 kg) is also used.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity for illegal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 10, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

[1)] Now the British Tar Industry Association

Section 1. General requirements

1 Scope

This British Standard specifies the composition, manufacture, testing and transport of dense tar surfacing (DTS), defined in BS 892 as

> a hot process wearing course material consisting of aggregate, filler and road tar, in such gradings and proportions that when spread and compacted it provides a close textured impervious mixture.

Notes on the use of DTS are given in Appendix A. Recommendations for laying the materials and for measuring their temperatures are included in Appendix B and Appendix C.

The mixtures specified are as follows:

DTS (crushed rock or slag fine aggregate)

35 % coarse aggregate content 14 mm and 10 mm nominal size

50 % coarse aggregate content 14 mm and 10 mm nominal size

DTS (sand fine aggregate)

35 % coarse aggregate content 14 mm and 10 mm nominal size

50 % coarse aggregate content 14 mm and 10 mm nominal size

2 References

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

3 Sampling and testing

The importance of obtaining representative samples cannot be over emphasized. Sampling and testing shall be carried out in accordance with the appropriate clauses of the following British Standards:

Binders:BS 76 and BS 3690-1 and BS 3690-3

Aggregates:BS 812 and BS 1047

Dense tar surfacing:BS 598

The analysis methods given in BS 598 are based on wet sieving. The passing 75 μm values specified in Table 2 and Table 5 of this standard have been adjusted to allow for this and therefore no wet/dry sieving correction shall be employed.

4 Constituent materials

4.1 Binder. The tar shall conform to the requirements of BS 76. The viscosity of the tar shall be selected according to the traffic volume and the climatic conditions. The following figures are given as a guide:

Category	Grade
A 300 c.v.d. or more	C54
B 50 c.v.d. to 300 c.v.d.	C50 or C54
C less than 50 c.v.d.	C46 or C50

NOTE Traffic volume in commercial vehicles per day (c.v.d.) is the number of such vehicles, being defined as goods or public service vehicles of unladen mass exceeding 1 500 kg, counted normally *in one direction* over 16 h. The levels given above refer to the existing traffic levels, not the projected levels.

The supplier shall state the proportion of tar which is insoluble in the toluene or other solvent used for the determination of binder content together with the density of the tar at 20 °C.

4.2 Aggregate

4.2.1 *Coarse aggregate.* The coarse aggregate shall be crushed rock, slag or gravel as approved by the purchaser and shall be substantially free from material passing a 3.35 mm BS sieve[2)].

When gravel is used the clay and silt content shall not exceed 1 % by mass of the coarse aggregate when determined in accordance with the sedimentation or decantation methods given in BS 812-1. In the event of a dispute the sedimentation method shall be used.

4.2.2 *Fine aggregate.* For the purposes of this standard, fine aggregate is material substantially passing a 3.35 mm BS test sieve.

The fine aggregate shall consist of crushed rock, slag or sand or mixtures thereof and the type shall be subject to approval by the purchaser. When sand is used the clay and silt content shall not exceed 3 % by mass of the fine aggregate when determined in accordance with the sedimentation or decantation methods given in BS 812-1. In the event of a dispute the sedimentation method shall be used.

4.2.3 *Crushed rock.* Crushed rock shall be hard, clean, durable material of one or more of the types listed below. The supplier shall, if required by the purchaser, inform him of the group, or groups, to which the aggregate belongs.

a) Granite group

b) Basalt group

c) Gabbro group

d) Porphyry group

e) Quartzite group

[2)] BS 410.

f) Hornfels group

g) Gritstone group

h) Limestone group

It is recognized that certain aggregates may not belong to any of the groups given above. If it is proposed to use an aggregate of another type, the attention of the purchaser shall be called to the fact and his approval of the proposed composition obtained.

4.2.4 *Slag*. Blast-furnace slag shall comply with the following requirements:

a) *Stability*. The slag shall comply with the stability requirements of Appendix A of BS 1047:1983.

slag shall not exceed 2.75 %, determined in accordance with the method given in Appendix **B.2** of BS 1047:1983.

c)*Bulk density or unit mass.* The bulk density or unit mass shall be the "rodded" or compacted mass determined in accordance with the method described in BS 812, and shall be no lower than 1 100 kg/m^3. The samples of slag to be used in this test shall all pass the 14 mm BS test sieve and be retained on the 10 mm BS test sieve, and shall be tested in the oven-dried condition. The supplier shall state the bulk density of the slag used if required by the purchaser.

Steel slag, whether electric-arc furnace or basic oxygen slag, shall be weathered until it is no longer susceptible to falling. The compacted density (see c) above) shall be between 1 700 kg/m^3 and 1 900 kg/m^3.

NOTE Other slags may be suitable aggregates for dense tar surfacing but are outside the scope of this standard.

4.2.5 *Gravel.* The gravel shall be from one or more of the groups given in **4.2.3** or shall be flint. It may be crushed or uncrushed, or a mixture of both.

4.3 Filler. The added filler shall consist of fine mineral dust prepared from limestone, other crushed rock or slag. The approval of the purchaser shall be obtained if it is the intention to use any other material. The added filler shall have the following properties:

Passing 300 μm BS sieve	100 %
Passing 75 μm BS sieve	75 % to 100 %

Bulk density within the range 0.5 g/ml to 0.8 g/ml when tested in accordance with the method given in BS 812-2.

Void content of the dry compacted materials within the range 0.3 to 0.4 when tested in accordance with the method given in BS 812-2.

4.4 Chippings for application to surface of wearing course

4.4.1 *General.* The chippings to be rolled into the surface of DTS wearing courses and their manner of coating shall comply with the requirements given below. (For the application of the chippings see **B.7**.)

4.4.2 *Chippings.* The chippings shall comply with the requirements of BS 63, shall be of either 20 mm or 14 mm nominal size and shall have a size and shape index of 60 or less.

NOTE Size and shape index = Percentage of undersize[3] + Flakiness index[4].

4.4.3 *Coating.* The binder used for coating the chippings prior to application shall conform to the requirements of Table 1. The chippings shall be completely coated with the specified binder at a rate, found on analysis, of 1.5 ± 0.3 % by mass. The analysis shall be carried out on chippings taken from the stockpile when their temperature is below 130 °C.

The chippings shall be dried and fed into the mixer at a temperature of 130 °C to 185 °C. The binder shall be added at a temperature not exceeding 175 °C and the coated chippings on discharge from the mixer shall be in the range 130 °C to 185 °C.

In order to minimize the formation of insoluble material in the binder the coated chippings shall, on discharge from the mixer, be cooled quickly to ambient temperature by the application of clean water or by spreading out in a layer not exceeding 1.0 m in thickness. Chippings shall be cooled to and maintained below 160 °C.

5 Composition of mixtures

The composition of freshly mixed DTS shall comply on analysis with the appropriate requirements in section 2. Where the characteristics of the aggregate are such that it requires, a binder content other than that given in section 2, a new target binder content shall be agreed between the manufacturer and the purchaser, and the same tolerances shall be applied. In the case of blast-furnace slag aggregate the supplier shall declare its bulk density.

6 Manufacture

The aggregate and the binder shall not be heated above the appropriate maximum temperatures specified in Table 4 and Table 7. Before coating, the aggregate shall be adequately dried.

[3] Percentage of undersize is the percentage less than the specified size as given in BS 63.

[4] Flakiness index as determined in accordance with BS 812.

Table 1 — Properties of binders for coated chippings

Property		Bitumen	Lake asphalt-bitumen	Pitch-bitumen
Penetration at 25 °C		50 ± 10	50 ± 10	50 ± 10
Softening point	°C min.	47	47	47
(ring and ball)	°C max.	56	56	56
Loss on heating for 5 hours at 163 °C				
a) Loss by mass	% max.	0.2	0.5	1.0
b) Drop in penetration	% max.	20	20	30
Solubility in carbon	% min.	99.5	75	95
disulphide or trichloroethylene	% max.	100	79	100
Ash content	% min.	nil	16	nil
	% max.	0.5	19	1.0

Table 2 — Aggregate grading

Type of mix	35 % coarse aggregate content		50 % coarse aggregate content	
Nominal size	14 mm	10 mm	14 mm	10 mm
BS sieve	Aggregate grading			
mm	Percentage by mass of total aggregate[a] passing			
20	100	—	100	—
14	95 – 100	100	90 – 100	100
10	75 – 90	95 – 100	65 – 85	90 – 100
6.3	—	70 – 80	—	60 – 75
3.35	60 – 70	60 – 70	45 – 55	45 – 55
1.18	30 – 60	30 – 60	25 – 45	25 – 45
µm				
300	15 – 35	15 – 35	10 – 28	10 – 28
75	9 – 14	9 – 14	6 – 11	6 – 11

[a] Percentage of the total aggregate (i.e. coarse aggregate, fine aggregate and filler) in the mix excluding binder.

The materials, including filler, shall be weighed or measured into a mechanical mixer and mixed in such a manner that the DTS on discharge from the mixer is uniform in composition and all particles of the aggregate are completely coated.

NOTE Attention to temperature is essential. It is particularly important to avoid excessive heating of the tar binder, both during storage and by excessively hot aggregate at the time of mixing, so as not to adversely affect the quality of the DTS.

7 Transport

The DTS shall be transported from the manufacturing plant to the site of the work in clean vehicles and shall be properly sheeted to prevent heat loss and as a protection against adverse weather. The use of dust, coated dust, oil or water on the interior of vehicles to facilitate discharge of the DTS is permissible, but the amount shall be kept to a minimum, and any excess removed by brushing or tipping.

NOTE Insulated or heated vehicle bodies are particularly suitable for DTS.

Section 2. Specific requirements

8 DTS wearing course (crushed rock or slag fine aggregate)

The aggregate grading, binder content and temperature of mixing shall be in accordance with Table 2 to Table 4.

Table 3 — Binder content

Type of mix	35 % coarse aggregate content	50 % coarse aggregate content
Fine aggregate	Tar content[a]	
	Percentage by mass of total mixture	
Crushed-rock steel or electric furnace slag	7.7 ± 0.5	7.0 ± 0.5
Blast furnace slag		
Bulk density kg/m^3		
1 440	8.0 ± 0.5	7.3 ± 0.5
1 360	8.5 ± 0.5	7.7 ± 0.5
1 280	9.0 ± 0.5	8.1 ± 0.5
1 200	9.6 ± 0.5	8.6 ± 0.5
1 120	10.1 ± 0.5	9.2 ± 0.5

[a] The contents are based on a density of tar of 1.16 g/ml to 1.22 g/ml at 20 °C. Where the density of the tar at 20 °C is below 1.16 g/ml the target tar content shall be decreased by 0.3 % of the total mixture and where the density of the tar is above 1.22 g/ml the target tar content shall be increased by 0.3 % of the total mixture. Where the density of the tar is below 1.12 g/ml (the general case with low temperature tars permitted in BS 76) the target tar content shall be decreased by a further 0.3 % of the total mixture, for crushed rock fine aggregate only.

Table 4 — Mixing temperatures

Type and grade of tar	Temperature of aggregate		Temperature of tar in heater		Temperature of mixed material on dicharge from mixer	
	min.	max.	min.	max.	min.	max.
	°C	°C	°C	°C	°C	°C
C 50 or C 54	95	110	95	105	90	105
C 46	80	100	85	100	75	95

Table 5 — Aggregate grading

Type of mix	35 % coarse aggregate content		50 % coarse aggregate content	
Nominal size	14 mm	10 mm	14 mm	10 mm
BS sieve	Aggregate grading			
mm	Percentage by mass of total aggregate[a] passing			
20	100	—	100	—
14	95 – 100	100	90 – 100	100
10	75 – 90	95 – 100	65 – 85	90 – 100
6.3	—	70 – 80	—	60 – 75
3.35	60 – 70	60 – 70	45 – 55	45 – 55
1.18	45 – 70	45 – 70	35 – 55	35 – 55
µm				
300	25 – 55	25 – 55	20 – 45	20 – 45
75	9 – 14	9 – 14	7 – 12	7 – 12

[a] Percentage of the total aggregate (i.e. coarse aggregate, fine aggregate and filler) in the mix excluding binder.

Table 6 — Binder content

Type of mix	35 % coarse aggregate content	50 % coarse aggregate content
Fine aggregate	Tar content[a]	
	Percentage by mass of total mixture	
Sand	7.0 ± 0.5	6.5 ± 0.5

[a] The tar contents are based on a density of tar of 1.16 g/ml to 1.22 g/ml at 20 °C. Where the density of the tar at 20 °C is below 1.16 g/ml the target tar content shall be decreased by 0.3 % of the total mix and where the density of the tar at 20 °C is above 1.22 g/ml the target tar content shall be increased by 0.3 % of the total mix. Where the density of the tar is below 1.12 g/ml (the general case with low temperature tars permitted in BS 76) the target tar content shall be decreased by a further 0.3 % of the total mixture.
Where the coarse aggregate is blast-furnace slag the tar contents given in the table are suitable for slag having a bulk density of 1 440 kg/m^3. For slag of bulk density 1 120 kg/m^3 the tar content shall be increased by 0.5 % of the total mix. Intermediate bulk densities require proportionate intermediate increases expressed to the nearest 0.1 % of the total mix.

Table 7 — Mixing temperatures

Type and grade of tar	Temperature of aggregate		Temperature of tar in heater		Temperature of mixed material on discharge from mixer	
	min.	max.	min.	max.	min.	max.
	°C	°C	°C	°C	°C	°C
C 50 or C 54	95	110	95	105	90	105
C 46	80	100	85	100	75	95

9 DTS wearing course (sand fine aggregate)

The aggregate grading, binder content and temperature of mixing shall be in accordance with Table 5 to Table 7.

Appendix A Notes on the use of DTS

A.1 It is recognized that materials need to be selected from a range of compositions which are varied according to traffic load and other conditions of service. The purchaser will have taken into account design and other requirements, for example Road Note 29[5)] procedure in the case of new construction, and his final selection of a particular composition will thus depend on engineering and cost considerations.

A.2 In view of the quick setting time of DTS compared with warm-laid tarmacadam, winter working should be avoided, unless haulage distances are short and conditions favourable for laying. It is important that laying should not be attempted if the atmospheric temperature is so low that rolling cannot be completed before the material has cooled below the recommended minimum rolling temperatures or when weather conditions are otherwise unsuitable.

A.3 The following maximum intervals between mixing and laying are given as a guide in order to ensure that attempts are not made to lay DTS at a temperature below that specified in Appendix B:

summer conditions	3 h
winter conditions	2 h

These journey times may be extended when specially insulated or heated lorries are used.

A.4 On a sound substrate of good profile, one course of DTS is normally adequate for resurfacing work. On a base that requires strengthening or is excessively irregular, two-course construction should be used. The basecourse should be dense-coated macadam with high viscosity binder or rolled asphalt. DTS should not be laid on fresh warm-laid coated macadam basecourses because the temperature of laying can cause softening of the basecourse binder and consequent movement under rolling.

A.5 The recommended average course thicknesses for DTS are as given in Table 8.

Table 8 — Recommended average course thicknesses

Average compacted thickness of course	40 mm	30 mm
Nominal size of coarse aggregate (retained 3.35 mm. sieve)	14 mm or 10 mm	10 mm

The minimum compacted thickness at any point should be 25 mm for courses of 40 mm nominal thickness and 20 mm for courses of 30 mm nominal thickness.

A.6 In order to obtain a dense and impervious wearing course, the DTS should be rolled within the specified temperature range to the compacted thickness as specified in the above table for the nominal size which is used.

A.7 50 % coarse aggregate content DTS with crushed rock or slag fine aggregate and 54 °C evt tar (C 54) is the preferred mixture for the heaviest duty use, e.g. motorway service areas.

A.8 If the 35 % coarse aggregate content material is laid on roads where skid resistance is important, coated chippings of suitable PSV should be rolled into the surface.

A.9 The following information should be given to the manufacturer with any enquiry or order or invitation to tender.

a) Purpose for which material is to be used (e.g. class of road, car park etc.)

b) Site of work

c) Whether single-course or two-course construction

d) Finished thickness of course(s)

e) Type of aggregate

f) Nominal size and coarse aggregate content of wearing course material

g) Type and grade of binder

h) Whether coated chippings are to be applied and rate of spread

i) Method of laying (by hand or by machine)

j) Whether a tack coat is to be used before surfacing and rate of spread

k) Times and rate of delivery required

Appendix B Recommendations for the laying of DTS

B.1 General. Adequate compaction at the proper temperature is essential for successful results and it is recommended that the temperatures of laying and rolling should be within the ranges given in Table 9. Not only is it important to comply with all details of the specified compositions but in particular the recommended temperatures should be observed as the product can be seriously damaged if these limits are not kept.

[5)] Obtainable from HMSO.

Table 9 — Temperature of laying and rolling

Type and grade of tar	Temperature for laying by machine	Temperature for laying by hand	Temperature for rolling[a]
	°C	°C	°C
C 50 or C 54	80 – 100	85 – 100	60 – 80
C 46	65 – 90	70 – 90	50 – 70

[a] Compaction should be completed within the temperature range given.

B.2 Preparatory work. In all cases the surface on which the material is to be laid should be free from standing water and thoroughly cleaned of loose material, leaves, or other foreign matter by brushing and/or scraping before applying the material.

When an existing road is to be surfaced, all weak places should be strengthened, major inequalities of profile remedied and depressions filled with suitable material thoroughly compacted prior to the laying of the dense tar surfacing. Any excess of tar or bitumen on the old surface should be removed. The minimum compacted thickness of the new surface at any point should never be less than the recommendations given in **A.5**.

If hot-laid shaping material is not available and low temperature coated macadam has to be used for shaping, it is particularly important that this should be left for at least six months to harden by exposure, otherwise it will soften unduly and move under the roller when the hot DTS is superimposed.

Where such shaping is not required, any small local depressions or potholes may be filled in just ahead of the machine by shovelfuls of material taken from the hopper of the spreading machine and consolidated by hand.

The accuracy of the prepared surface on which the DTS is to be laid should be determined in the longitudinal direction by placing a 3 m straightedge at any position on the road parallel to the centre line of the carriageway. The gap at any place between the points at which the straightedge is in contact with the road, unless otherwise specified by the purchaser, shall not exceed 25 mm for the laying of two-course work or 13 mm for the laying of single-course DTS. The transverse profile should conform to a similar standard of accuracy, using a correctly shaped camber board instead of the straightedge.

When DTS is to be laid on gradients and/or hard, smooth surfaces under conditions of heavy or fast traffic, a light tack coat of hot tar or cold emulsion should be applied. The coverage of the tack coat should be from 0.3 $1/m^2$ to 0.5 $1/m^2$. The application should be by means of spraying and not by brushing, and every care should be taken to ensure uniform coverage within the above limits.

B.3 Laying by machine. The DTS should be supplied continuously to the machine, which should be of the self-propelled type and capable of laying coated materials continuously so as to produce an even and compact surface to the required widths, thicknesses and cross-falls. The material should be laid at temperatures within the range given in Table 9. Material should not be left in the hopper of the spreading machine awaiting the arrival of the next load; if this has not arrived in time, the machine should proceed until empty. It should then move on to enable a joint to be cut to the full depth of the course before resuming work. This is essential to obtain adequate compaction.

If the laying machine is being operated efficiently, the filling in of low or open-textured places should be unnecessary. If, however, this is unavoidable, it should be done *before* the roller passes over the surface. Unnecessary "scattering back" is strongly deprecated.

Narrow strips remaining in machine work should be hand-laid and rolled at the same time as the machine-laid work, and allowance should be made for extra compaction of hand-laid work.

B.4 Laying by hand. The material should be laid at a temperature within the range given in Table 9. The material should not be tipped from the lorry until required and should then be protected by a double tarpaulin sheet. Loads should be tipped in one heap.

Every care should be taken to spread the material to correct levels before rolling, as no further material can be successfully applied to the surface once the roller has been over it. On completion of rolling, the levels and shape of the finished surface should conform to the standards specified by the purchaser.

Hand laying, other than that covered in the last paragraph of **B.3**, should not be carried out when the air temperature is below 5 °C.

B.5 Compaction and jointing

B.5.1 The DTS should be compacted immediately with a roller of not less than six tonnes. Early compaction is important and it may be necessary to use a number of rollers. A lighter roller immediately behind the laying machine, with a 6/10 tonne roller following has been found to assist in early compaction.

B.5.2 The temperature of the laid material should be checked to ensure that compaction is carried out within the range given in Table 9.
See also Appendix C.

B.5.3 Roller wheels should be kept clean and damp.

B.5.4 When rolling any hot-laid materials alongside an already consolidated strip, the first run should be made with one wheel of the roller over the joint so as to obtain the best possible fusion while the material is hot. Rolling should then be continued in the normal way, i.e. longitudinally from sides to centre. The rollers should not be allowed to stand on newly laid DTS.

B.5.5 In two-course construction, the wearing-course material should be spread on the basecourse as soon as practicable after the latter has been properly compacted. The basecourse at the end (and side when the work is carried out in part widths) of each section of work should be left uncovered for a sufficient length or width to break joint with the wearing course. Care should be taken to avoid contamination of the surface of the basecourse, so that the adhesion between the two courses is as complete as possible.

B.5.6 Both longitudinal and transverse joints should be cut back to a vertical face of the full depth of the course and be painted with hot tar before laying fresh material up to them. Vertical faces of manhole covers, metal boxes, gully covers, etc. should be similarly painted.

B.5.7 To obtain a fully compacted joint with no difference in level between the adjoining strips, due allowance should be made for the compaction of the newly laid material during rolling.

B.5.8 The DTS should be properly compacted around stop cocks, hydrant boxes, manhole covers, etc. and adequate hand ramming should be carried out while the material is still workable. This applies whether covers are adjusted before or after the surfacing.

B.6 Accuracy of finished DTS. The surface of the DTS should be such that the gap under a 3 m straightedge, placed longitudinally, does not exceed 10 mm for handlaid work or 6 mm for machine-laid work, allowance being made for the projections of coated chippings if used. The transverse profile should be finished to a similar standard of accuracy, checked under a template.

NOTE On new construction and large surfacing contracts more stringent requirements may be specified.

B.7 Coated chippings. When coated chippings are specified for 35 % coarse aggregate content DTS, they should be applied to the surface of the wearing course immediately after the laying machine and rolled at once while the material is still in a warm and plastic condition. Coated chippings cannot be used with 50 % coarse aggregate content DTS.

The coated chippings should be evenly distributed at the rate of 5 kg/m^2 to 6 kg/m^2 for 14 mm size chippings and 6 kg/m^2 to 9 kg/m^2 for 20 mm size chippings.

When spreading the chippings the channels should be covered by boards not less than 150 mm wide to prevent interference with the flow of surface water to the gulleys.

B.8 Opening to traffic. Traffic may be allowed on the newly laid DTS as soon as it has been compacted and has cooled to atmospheric temperature.

Appendix C Recommendations for the measurement of the temperature of DTS

C.1 General. The temperatures of the raw materials fed into the mixer are specified in the relevant clauses of this standard and the following recommendations are for guidance on the instruments and the methods to be used in measuring the temperature of the materials. Temperatures of the raw materials can normally be determined from the instruments provided with the plant being used. Periodic checks should be made with alternative calibrated thermometers to ensure that the built-in instruments have maintained their accuracy. Further details cannot be given because of the variety of plants used.

C.2 Type of thermometer

C.2.1 Where the material is in bulk, i.e. in the lorry, in the hopper of the paver or in a heap after discharge from the lorry, the instrument should be 225 mm long and the stem should be fully inserted into the material.

C.2.2 When measuring the temperature of the material, after it has been laid and during rolling, the instrument should have a temperature-sensitive element small enough to be completely surrounded by the "thin" layer of material to be rolled, and the temperature-sensitive element should be at the mid-point of the thickness of the layer.

C.2.3 The range of the temperature scale should be chosen to suit the temperature to be measured and the scale should be graduated at every 5 °C. The accuracy should be ± 2 °C.

C.2.4 The thermal capacity of the thermometer should be as small as possible consistent with adequate robustness, to minimize the time required to obtain a reliable reading.

C.3 Checks on thermometer. The thermometer should be checked before use against a thermometer that complies with the requirements of BS 1704 over the range of temperature for which the thermometer is to be used. Additionally, the thermometer should be checked at frequent intervals or when the accuracy is in doubt. If the thermometer is in constant use, a daily check by immersing the temperature-sensitive element in boiling water should be sufficient.

C.4 Method of measurement. There are two main principles which should be taken into account in measuring temperature. First, because of the low thermal capacity and conductivity of DTS, the insertion of a cold thermometer of relatively high thermal capacity will remove sufficient heat from the material to give a low temperature reading. Second, the temperature can be expected to vary from point to point throughout the heap or thickness of course. It is, therefore, recommended that the following procedure be followed.

a) The thermometer should be allowed to heat up to approximately the true temperature of the DTS in one position, and then be moved quickly to an adjacent position to obtain a measurement.

b) Measurements of delivery temperatures in the lorry should be made as soon as practicable after its arrival on site. In cases of dispute two measurements at least 1 m apart and 500 mm from the edge should be taken on each side and averaged.

c) In the case of laid material at least three and preferably five measurements should be taken and averaged. To avoid delays in rolling it is preferable with DTS to use an electronic type of instrument in order to obtain readings more quickly than they would be obtained with a bimetallic probe.

d) It is important with laid material that each measurement is carefully taken at the mid-point of the course.

NOTE The above requirements may be satisfied by several types of temperature measuring devices, e.g. electronic thermometers using thermocouples or thermistors, or bimetallic rotary thermometers. The latter type although cheapest, is possibly least satisfactory owing to its comparative flimsiness and slow response time and it requires frequent recalibration. More robust models are available, but robustness is associated with lengthened response time.
With the electronic type, the heat-sensing element is very small and is normally mounted in the tip of the probe; thus one probe can be used for measuring temperatures of bulk or laid material. Thermocouple probes available cover a wide temperature range (e.g. 400 °C) while those using thermistors are sufficiently accurate over a more limited range (e.g. 150 °C).

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Publications referred to

This standard makes reference to the following British Standards:
BS 63, *Single-sized roadstone and chippings.*
BS 76, *Tars for road purposes.*
BS 410, *Test sieves.*
BS 598, *Sampling and examination of bituminous mixtures for roads and other paved areas.*
BS 812, *Methods for sampling and testing of mineral aggregates, sands and fillers.*
BS 812-1, *Sampling, size, shape and classification.*
BS 812-2, *Physical properties.*
BS 892, *Glossary of highway engineering terms.*
BS 1047, *Air-cooled blast furnace slag coarse aggregate for concrete.*
BS 1704, *General purpose thermometers.*
BS 3690, *Bitumens for building and civil engineering.*
BS 3690-1, *Specification for bitumens for road purposes.*
BS 3690-3, *Specification for bitumen mixtures.*
BS 4987, *Coated macadam for roads and other paved areas.*

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