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British Standard

Coated macadam for roads and other paved areas

Part 1. Specification for constituent materials and for mixtures

Macadam pour routes et autres surfaces pavées
Partie 1. Matériaux constitutifs et mélanges — Spécifications

Mischmakadam für Straßen und andere Verkehrsflächen
Teil 1. Bestandteile und Gemische

Foreword

This Part of BS 4987 has been prepared under the direction of the Road Engineering Standards Committee. Together with BS 4987 : Part 2 it is a complete revision of BS 4987 : 1973 which is withdrawn. Several major changes have been introduced.

The standard now comprises two Parts:

Part 1 Specification for constituent materials and for mixtures

Part 2 Specification for transport, laying and compaction

In the 1973 edition, the opportunity was taken for some rationalization of nomenclature by including in parentheses the correct designation of some traditional mixtures such as 'fine cold asphalt'. In the present revision, this rationalization has been extended and the correct designation is now used, with the traditional name in parentheses.

A general change in nomenclature has been adopted.

Where a mixture is expected to be relatively impervious, the word 'dense' has been retained. Those mixtures formerly classified as 'dense' (e.g. dense wearing course) are now referred to as 'close graded'. The word 'texture' has been replaced by 'graded' in all contexts. A new dense roadbase mixture has been introduced of smaller (28 mm) size. A specification for a 6 mm size dense macadam has also been added in view of its increasing popularity.

The 40 mm size open textured basecourse macadam in BS 4987 : 1973 has been deleted, as has coarse cold asphalt (10 mm size fine graded wearing course), as they are both now seldom used.

The previous differential between 100 and 200 penetration bitumen in dense basecourse macadam mixtures has been removed.

A completely new range of mixtures has been included for the first time. These are the pervious wearing course mixtures, intended to provide a drainage layer to remove water from the road surface as rapidly as possible to the side of the carriageway.

Tests for certain aggregate properties are still under development and will be included in this standard when they are fully developed and proven.

It is recognized that different properties can be imparted to coated macadam mixtures by the use of modified binders instead of bitumen or tar. Such modified materials are usually proprietary and several are already in limited use. Officially supervised road trials are in progress to determine the advantages, if any, of such binders in different circumstances, and when the results of these trials are available, steps will be taken to include the binders in this standard, where appropriate.

The requirements for transporting coated macadam mixtures and for site work, included in BS 4987 : 1973, have been updated and are included in BS 4987 : Part 2.

The requirements for the composition of all mixtures are based on the testing of the constituents and of the mixture by methods described in BS 598. For the first time provision is made to measure the compaction of macadam on the road in terms of the percentage refusal density (PRD) as described in BS 598 : Part 104*.

It has been assumed in the drafting of this Part of BS 4987 that the execution of its provisions is entrusted to appropriately qualified and experienced people.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

* In preparation.

Contents

	Page		Page
Foreword		Inside front cover	
Committees responsible		Back cover	
Specification			
Section one. General			
1 Scope	3	7 Grade of binder for 20 mm size open graded basecourse	7
2 Definitions	3	8 Aggregate grading for 40 mm size single course	8
3 Sampling and testing	3	9 Binder content for 40 mm size single course	8
4 Constituent materials	3	10 Grade of binder for 40 mm size single course	8
		11 Aggregate grading for 40 mm size dense basecourse	9
Section two. Requirements for coated macadams		12 Binder content and grade for 40 mm size dense basecourse	9
5 Group one: roadbase mixtures	5	13 Aggregate grading for 28 mm size dense basecourse	10
5.1 40 mm size dense roadbase	5	14 Binder content and grade for 28 mm size dense basecourse	10
5.2 28 mm size dense roadbase	6	15 Aggregate grading for 20 mm size dense basecourse	11
6 Group two: basecourse mixtures	7	16 Binder content and grade for 20 mm size dense basecourse	11
6.1 20 mm size open graded basecourse	7	17 Aggregate grading for 14 mm size open graded wearing course	12
6.2 40 mm size single course	8	18 Binder content for 14 mm size open graded wearing course	12
6.3 40 mm size dense basecourse	9	19 Grade of binder for 14 mm size open graded wearing course	12
6.4 28 mm size dense basecourse	10	20 Aggregate grading for 10 mm size open graded wearing course	13
6.5 20 mm size dense basecourse	11	21 Binder content for 10 mm size open graded wearing course	13
7 Group three: wearing course mixtures	12	22 Grade of binder for 10 mm size open graded wearing course	13
7.1 14 mm size open graded wearing course	12	23 Aggregate grading for 14 mm size close graded wearing course	14
7.2 10 mm size open graded wearing course	13	24 Binder content for 14 mm size close graded wearing course	14
7.3 14 mm size close graded wearing course	14	25 Grade of binder for 14 mm size close graded wearing course	14
7.4 10 mm size close graded wearing course	15	26 Aggregate grading for 10 mm size close graded wearing course	15
7.5 6 mm size dense wearing course	16	27 Binder content for 10 mm size close graded wearing course	15
7.6 6 mm size medium graded wearing course	17	28 Grade of binder for 10 mm size close graded wearing course	15
7.7 3 mm size fine graded wearing course	18	29 Aggregate grading for 6 mm size dense wearing course	16
7.8 Coated chippings for fine graded wearing course	18	30 Binder content for 6 mm size dense wearing course	16
7.9 Coated grit	18	31 Grade of binder for 6 mm size dense wearing course	16
8 Group four: pervious wearing course mixtures	19	32 Aggregate grading for 6 mm size medium graded wearing course	17
8.1 20 mm size pervious wearing course	19	33 Binder content and grade for 6 mm size medium graded wearing course	17
8.2 10 mm size pervious wearing course	20	34 Aggregate grading for 3 mm size fine graded wearing course	18
		35 Binder content for 3 mm size fine graded wearing course	18
Section three. Preparation of mixtures		36 Grade of binder for 3 mm size fine graded wearing course	18
9 Mixing	21	37 Aggregate grading for 20 mm size pervious wearing course	18
Appendices			
A Recommended storage temperatures for binders	22		
B Guidance on the selection of materials and mixtures	22		
C Information to be supplied by the purchaser	24		
Tables			
1 Aggregate grading for 40 mm size dense roadbase	5		
2 Binder content and grade for 40 mm size dense roadbase	5		
3 Aggregate grading for 28 mm size dense roadbase	6		
4 Binder content and grade for 28 mm size dense roadbase	6		
5 Aggregate grading for 20 mm size open graded basecourse	7		
6 Binder content for 20 mm size open graded basecourse	7		

	Page
38 Binder content and grade for 20 mm pervious wearing course	19
39 Aggregate grading for 10 mm size pervious wearing course	20
40 Binder content and grade for 10 mm size pervious wearing course	20
41 Maximum temperatures of mixed macadam	21
42 Recommended storage temperatures for binders	22

Section one. General

1 Scope

This Part of BS 4987 specifies the requirements for all types of coated macadam to be laid as roadbase (group one), basecourse (group two), wearing course (group three) or pervious wearing course (group four) for roads and other paved areas excluding heavy duty airfield pavements. The standard does not include requirements for macadams incorporating bitumen emulsions as binders; for these see BS 434.

NOTE. The titles of the publications referred to in this Part of BS 4987 are listed on page 25.

2 Definitions

For the purposes of this Part of BS 4987 the definitions given in BS 6100 apply, together with the following.

2.1 test sieve. A sieve complying with BS 410.

2.2 traffic category. The volume of commercial vehicles travelling in one direction counted over a 16 h period and expressed in commercial vehicles per day (c.v.d.).

The categories are:

(a) category A: more than 250 c.v.d.;

(b) category B: up to 250 c.v.d.

NOTE. These categories refer to existing traffic levels, not projected levels.

2.3 commercial vehicle. A vehicle with an unladen mass exceeding 1500 kg.

3 Sampling and testing

NOTE. The tolerances and ranges specified in this Part of BS 4987 are intended to provide for errors in sampling and testing when carried out by a skilled operator as well as for variations in the macadam due to plant inconsistencies and fluctuations in the grading of the aggregates. Attention is drawn to the difficulties inherent in obtaining representative samples of coated macadam for analysis and to the further (usually smaller) errors in the reduction of the sample and its analysis in the laboratory. It should be realized that when any sampling and testing procedure is used complete compliance with the specification may not always be achieved with every sample tested even when the material is satisfactory (see BS 598 : Part 102*).

3.1 Binder

3.1.1 Bitumens and tar bitumen mixtures shall be sampled and tested in accordance with BS 3690 : Part 1 and Part 3, respectively.

3.1.2 Tars shall be sampled and tested in accordance with BS 76.

3.2 Aggregates and fillers

Coarse and fine aggregates and fillers shall be sampled and tested in accordance with BS 812.

3.3 Coated macadam

Coated macadams shall be sampled and tested in accordance with the relevant methods given in BS 598. The grading of the mineral aggregate fraction of the mixture shall be determined by means of 'wet' sieving and therefore no wet/dry sieving correction shall be employed.

3.4 Coated chippings

Coated chippings shall be sampled from the stockpile when their temperature is below 130 °C and tested in accordance with the methods given in BS 598.

4 Constituent materials

4.1 Binder

4.1.1 The binder shall be one of the following types:

(a) petroleum bitumen complying with BS 3690 : Part 1, excluding 450 penetration grade;

(b) cut back bitumen complying with BS 3690 : Part 1;

(c) road tar complying with BS 76;

NOTE. The terms 'high temperature tar' and 'low temperature tar' relate to the relative temperatures of carbonization of the coal during production of the tar. Both types are permitted by BS 76 but the different density of each dictates that different binder contents for the mixes be used as specified in section two of this standard.

(d) mixture of tar and bitumen complying with BS 3690 : Part 3, and which shall thereafter be treated as though it were bitumen.

The type and grade of binder shall be as given in the tables in section two for the individual mixtures.

NOTE 1. The recommended storage temperatures for binders are given in appendix A.

NOTE 2. The grades of binders specified in the tables are suitable for machine laid macadam. See B.5.7 for guidance on grades of binders for hand laid mixtures.

4.1.2 When the addition of tar or adhesion agents is made to bitumen, the mixtures shall have the relevant penetration or viscosity required for bitumen given by the individual tables in section two.

NOTE. The addition of not more than 10 % by mass of tar to bitumen can reduce the risk of water stripping the binder from some aggregates. This may also be achieved by the addition of adhesion agents to the bitumen or at the mixing stage (see also B.2).

4.2 Coarse aggregate

4.2.1 Type of coarse aggregate. The coarse aggregate shall be material substantially retained on a 3.35 mm test sieve and shall consist of one of the following.

(a) Crushed rock of one or more of the following groups: basalt, gabbro, granite, gritstone, hornfels, limestone, porphyry or quartzite (see note 1).

(b) Gravel of one or more of the groups in (a) or flint, crushed or uncrushed, or combinations of both types.

*In preparation.

BS 4987 : Part 1 : 1988

Section one

When gravel other than limestone gravel is used, 2 % by mass of the total aggregate of either hydrated lime or Portland cement shall be used as a filler.

(c) Blastfurnace slag complying with BS 1047.

(d) Steel slag, either electric arc furnace slag or basic oxygen slag, which shall be weathered until it is no longer susceptible to falling and the compacted bulk density of which shall be between 1700 kg/m³ and 1900 kg/m³ when tested as for blastfurnace slag.

NOTE 1. It is recognized that certain aggregates may not belong to any of these groups. If it is proposed to use such an aggregate the approval of the purchaser should be obtained.

NOTE 2. The use of 2 % by mass of the total aggregate of hydrated lime or Portland cement filler reduces the risk of water stripping the binder from some aggregates. This may also be achieved by the addition of adhesion agents to the bitumen or at the mixing stage.

NOTE 3. Slags other than those referred to in (c) and (d) above may be suitable aggregates for coated macadams but are outside the scope of this standard.

4.2.2 Particle shape. With the exception of the pervious macadams specified in clause 8, for which lower values are specified, the overall flakiness index of the coarse aggregate shall not exceed 45 % for crushed rock and crushed gravels and 50 % for uncrushed gravels, when tested in accordance with the method described in BS 812.

4.2.3 Fraction passing 75 µm sieve. When gravel is used, the material passing the 75 µm sieve shall not exceed 1 % by mass of the coarse aggregate when determined in accordance with either the sedimentation method or the decantation method given in BS 812. In the event of a dispute the sedimentation method shall be used.

NOTE 1. There is no acceptable method for determining clay content of materials, but some indication can be obtained from the sedimentation test described in BS 812.

NOTE 2. This standard does not include requirements for all the properties of aggregates such as the polished stone value or the aggregate abrasion value that may be required to control skidding resistance or the 10 % fines value which indicates aggregate strength (see B.5.2).

4.3 Fine aggregate

4.3.1 Type of fine aggregate. The fine aggregate shall substantially pass a 3.35 mm test sieve and be of the following types:

(a) fines produced by crushing material from one of the groups specified in 4.2.1; or

(b) sand; or

(c) a mixture of (a) and (b).

4.3.2 Fraction passing 75 µm sieve. When sand is used, the material finer than 75 µm shall not exceed 8 % by mass of the fine aggregate when determined in accordance with either the sedimentation method or the decantation method given in BS 812. In the event of a dispute the sedimentation method shall be used.

NOTE. There is no acceptable method for determining clay content of fine aggregate but some indication can be obtained from the sedimentation test described in BS 812.

4.4 Added filler

If added filler is used in the macadam it shall consist of crushed rock, crushed slag, hydrated lime, Portland cement or other material approved by the purchaser, and at least 75 % of it shall pass a 75 µm test sieve (but see note 2 in 4.2.1).

4.5 Composition of mixture

4.5.1 The binder content and aggregate grading of the freshly-mixed coated material when sampled and tested in accordance with BS 598 shall comply with the relevant requirements for groups one, two, three and four as specified in clauses 5, 6, 7 and 8 respectively of this standard.

NOTE 1. Advice on the selection of materials and mixtures, including hand-laid work, is given in appendix B.

NOTE 2. The binder contents given in the relevant tables are appropriate for most aggregates but it is not possible to cover the requirements of all aggregates in this way. Where the characteristics of the aggregates require a binder content other than those given in the tables a new target binder content should be agreed between the manufacturer and the purchaser based on trials and/or evidence of satisfactory performance. The tolerances as specified in the relevant table should apply.

NOTE 3. The binder content of dense basecourse may be reduced by up to 0.5 % if the compaction is controlled by the percentage refusal density test as described in BS 598 : Part 104* if agreed between manufacturer and purchaser; this would apply normally to roads carrying category A traffic.

NOTE 4. Where a roadbase is to be open to traffic before the base-course is laid the upper layer of roadbase should conform to the dense basecourse specification.

4.5.2 Where the bulk density of the blastfurnace slag used is between those densities specified for the groups, a proportional change shall be made to the binder content.

* In preparation. Until such time as BS 598 : Part 104 is published the test method as described in Specification for Highway Works, 6th edition published by the Department of Transport applies.

Section two. Requirements for coated macadams

5 Group one: roadbase mixtures

5.1 40 mm size dense roadbase

The aggregate grading, binder content and grade of binder shall be in accordance with tables 1 and 2.

Table 1. Aggregate grading for 40 mm size dense roadbase	
Test sieve aperture size	Aggregate: crushed rock, slag or gravel
	% by mass passing
50 mm	100
37.5 mm	95 to 100
28 mm	70 to 94
14 mm	56 to 76
6.3 mm	44 to 60
3.35 mm	32 to 46
300 µm	7 to 21
75 µm	2 to 9

Table 2. Binder content and grade for 40 mm size dense roadbase			
Aggregate	Bitumen grade	High temperature tar grade	Low temperature tar grade
	200 pen or 100 pen	C50 or C54*	C50 or C54*
	% by mass of total mixture ($\pm 0.6\%$)		
Crushed rock (including limestone)	3.5	4.3	3.9
Blastfurnace slag of bulk density kg/m ³			
1440	4.0	5.0	5.0
1360	4.2	5.3	5.3
1280	4.8	5.6	5.6
1200	5.4	6.0	6.0
1120	5.8	6.5	6.5
Steel slag	3.5	4.3	3.9
Gravel*	4.5	5.0	4.6
*C58 tar shall be used with flint gravel or gravels containing flint on roads carrying category A traffic.			

BS 4987 : Part 1 : 1988
Section two

5.2 28 mm size dense roadbase

The aggregate grading, binder content and grade of binder shall be in accordance with tables 3 and 4.

Table 3. Aggregate grading for 28 mm size dense roadbase	
Test sieve aperture size	Aggregate: crushed rock, slag and gravel
	% by mass passing
37.5 mm	100
28 mm	90 to 100
20 mm	71 to 95
14 mm	58 to 82
6.3 mm	44 to 60
3.35 mm	32 to 46
300 µm	7 to 21
75 µm	2 to 9

Table 4. Binder content and grade for 28 mm size dense roadbase			
Aggregate	Bitumen grade	High temperature tar grade	Low temperature tar grade
	200 pen or 100 pen	C50 or C54*	C50 or C54*
Crushed rock (including limestone)	% by mass of total mixture (± 0.6 %)		
	4.0	4.7	4.3
Blastfurnace slag of bulk density kg/m ³			
1440	4.5	5.3	5.3
1360	4.8	5.6	5.6
1280	5.2	6.0	6.0
1200	5.8	6.4	6.4
1120	6.2	6.8	6.8
Steel slag	4.0	4.7	4.3
Gravel*	4.5	5.0	4.6
* C58 tar shall be used with flint gravel or gravels containing flint on roads carrying category A traffic.			

6 Group two: basecourse mixtures

6.1 20 mm size open graded basecourse

The aggregate grading, binder content and grade of binder shall be in accordance with tables 5, 6 and 7.

NOTE. This type is unsuitable for category A traffic.

Table 5. Aggregate grading for 20 mm size open graded basecourse

Test sieve aperture size	Aggregate	
	Crushed rock and slag	Gravel
	% by mass passing	
28 mm	100	100
20 mm	95 to 100	95 to 100
14 mm	50 to 80	55 to 85
6.3 mm	15 to 35	25 to 40
3.35 mm	10 to 25	10 to 20
75 µm	0 to 9	0 to 6

Table 7. Grade of binder for 20 mm size open graded basecourse

Type of binder	Period	Grade of binder for category B traffic
Bitumen*	Winter	100 s to 200 pen
	Summer	200 s to 200 pen
Tar	Winter	C.34 or C.38
	Summer	C.38 or C.42

*With gravel aggregate, the bitumen shall be either 300 pen or 200 pen grade.

Table 6. Binder content for 20 mm size open graded basecourse

Aggregate	Bitumen	High temperature tar	Low temperature tar
	% by mass of total mixture (± 0.6 %)		
Crushed rock (excluding limestone)	4.0	4.4	4.0
Limestone	3.8	4.2	3.8
Blastfurnace slag of bulk density kg/m ³			
1440	4.5	5.2	5.2
1360	4.8	5.5	5.5
1280	5.1	5.8	5.8
1200	5.4	6.1	6.1
1120	6.0	6.4	6.4
Steel slag	3.6	4.4	4.0
Gravel	5.0	5.4	4.9