Sétra

service d'Études techniques des routes et autoroutes

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Technical guide

The use of standards for hot mixes

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RÉPUBLIQUE FRANÇAISE

MINISTÈRE DE L'ÉCOLOGIE, DU DÉVELOPPEMENT ET DE L'AMÉNAGEMENT DURABLES

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Technical guide

The use of standards for hot mixes

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- issuing approvals for road laboratories;
- carrying out procedures of certification and conformity with standards.

French Road Engineering Committee
Association ruled under the law of 1st july 1901.
Its Head office is located at:
10 rue Washington 75008 Paris
Phone: 33 (0)1 44 13 32 87 – Fax: 33 (0)1 42 25 89 99
mél : cftr@usirf.com
internet : http://www.cftr.asso.fr

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Its content has been validated by a survey conducted among CFTR members.

Drafting Committee:

Georges Aussedat (UNPG)

Thomas Caillot (Sétra)

Samuel Charpentier (CETE Normandie-Centre – LRPC de Blois)

Jean-Luc Delorme (DREIF – LREP)

Bernard Depaux (STAC)

Hervé Guiraud (Sétra)

François Jullemier (ADP)

Jean-François Lafon (CETE Sud-Ouest – LRPC de Toulouse)

Francis Letaudin (SACER)

Benoît Masson (ASFA)

Jean-Paul Michaut (Société Colas)

Samir Soliman (EUROVIA Management)

Patrick Vangrevenynghe (CETE Méditerranée – LRPC d'Aix)

François Verhee (USIRF)

Contents

The French standards which are derived from European standards for mixes specify families of mixes, their compositions and their performance. They cover the contexts where mixes are used in France, for wearing courses, base courses or sub-base and roadbase layers.

This documents sets out to select those European standards which apply in the French context and to supplement them with the characteristics of the aggregate and the features of manufacturing, laying and testing which are specific to France. In addition, it sets out the nomenclature and the composition of the mixes used, the different stages of the mix design which are applied and how these correspond to European standards.

These French standards which are derived from European standardization give no indication about the transport and laying of the mixes nor their use according to traffic, altitude or climate. Consequently, the French standard NF P 98 150-1, which replaces the standard NF P 98-150 of 1992, concerning manufacture, transport and laying is an indispensable supplement to the series of French standards. This standard lays down the requirements concerning deformation of the substrate or existing pavement before the laying of a new layer of mix, the proportions to be used for tack coats, the thicknesses to be laid depending on the type of mix, the tests to be performed and the corresponding specifications for in-situ density for all layers and the macrotexture for wearing courses. This guide does not detail the last items but refers readers to the document in which they are set out.

The NF EN standards currently allow for two different mix design approaches:

- the first, known as the empirical approach, consists of selecting the grading curve, the void contents, the water resistance, the resistance to rutting, the grading envelope and curve and the binder content;
- the second, known as the fundamental approach, applies a number of requirements with regard to water resistance, voids contents and rutting resistance but adds the complex and fatigue moduli. In the second approach, the binder content and the grading curve are not fixed. It is this approach which is the most frequently used in France.

It is obvious that these approaches cannot be combined, so one or other must be selected. Ultimately, in Europe, the empirical approach should be replaced by the fundamental approach.

N.B.: It should be borne in mind that binder content is expressed as a percentage of the total mass of the mix.

Some of the provisions in this document may be used for products, binders or aggregate which are not currently covered by the standards.

1 - References to standards, terminology

1.1 - References to standards

NF EN 12697-1 : Mélanges bitumineux – Méthode d'essai pour mélange hydrocarboné à chaud - Partie 1 : teneur en liant soluble (Bituminous mixtures - Test methods for mix asphalt - Part 1 : soluble binder content)

NE EN 12697-2 : Mélanges bitumineux – Méthode d'essai pour mélange hydrocarboné à chaud - Partie 2 : granulométrie (Bituminous mixtures - Test method for hot mix asphalt - Part 2: Determination of particle size distribution)

NF EN 12697-5 : Mélanges bitumineux – Méthode d'essai pour mélange hydrocarboné à chaud - Partie 5 : masse maximale (masse volumique réelle) des matériaux bitumineux (Bituminous mixtures - Test methods for hot mix asphalt - Part 5: Determination of the maximum density)

NF EN 12697-12 : Mélanges bitumineux – Méthode d'essai pour mélange hydrocarboné à chaud - Partie 12 : détermination de la sensibilité à l'eau des éprouvettes bitumineuses (Bituminous mixtures - Test methods for hot mix asphalt - Part 12 : determination of the water sensitivity of bituminous specimens)

NF EN 12697-19 : Mélanges bitumineux – Méthode d'essai pour mélange hydrocarboné à chaud - Partie 19 : perméabilité des éprouvettes (Bituminous mixtures - Test methods for hot mix asphalt - Part 19 : permeability of specimen)

NF EN 12697-20 : Mélanges bitumineux – Méthode d'essai pour mélange hydrocarboné à chaud - Partie 20 : essai cubes ou éprouvettes Marshall (Bituminous mixtures - Test methods for hot mix asphalt - Part 20 : indentation using cube or Marschall specimens)

NF EN 12697-21 : Mélanges bitumineux – Méthode d'essai pour mélange hydrocarboné à chaud - Partie 21 : essai plaques (Bituminous mixtures - Test methods for hot mix asphalt - Part 21 : indentation using plate specimens)

NF EN 12697-22 : Mélanges bitumineux – Méthode d'essai pour mélange hydrocarboné à chaud - Partie 22 : essai d'orniérage (Bituminous mixtures - Test methods for hot mix asphalt - Part 22 : wheel tracking)

NF EN 12697-24 : Mélanges bitumineux – Méthode d'essai pour mélange hydrocarboné à chaud - Partie 24 : résistance à la fatigue (Bituminous mixtures - Test methods for hot mix asphalt - Part 24 : Resistance to fatigue)

NF EN 12697-26 : Mélanges bitumineux – Méthode d'essai pour mélange hydrocarboné à chaud - Partie 26 : module (Bituminous mixtures - Test methods for hot mix asphalt - Part 26 : stiffness)

NF EN 12697-31 : Mélanges bitumineux – Méthode d'essai pour mélange hydrocarboné à chaud - Partie 31 : confection d'éprouvette à la presse à compactage giratoire (Bituminous mixtures - Test methods for hot mix asphalt - Part 31 : specimen preparation by gyratory compactor)

NF EN 12697-41 : Mélanges bitumineux – Méthode d'essai pour mélange hydrocarboné à chaud - Partie 41 : résistance aux fluides de déverglaçage (Bituminous mixtures - Test methods for hot mix asphalt - Part 41 : resistance to de-icing fluids)

NF EN 12697-43 : Mélanges bitumineux – Méthode d'essai pour mélange hydrocarboné à chaud - Partie 43 : résistance aux carburants (Bituminous mixtures - Test methods for hot mix asphalt - Part 43: Resistance to fuel)

NF EN 13043 : Granulats pour mélanges hydrocarbonés et pour enduits superficiels utilisés dans la construction des chaussées, aérodromes et d'autres zones de circulation (Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas)

XP P 18-545 : Granulats – Éléments de définition, conformité et codification (Aggregates - Defining elements, conformity and coding)

NF EN 13108-1 : Mélanges bitumineux – Spécifications des matériaux - Partie 1 : enrobés bitumineux (Bituminous mixtures - Material specifications - Part 1 : asphalt concrete)

NF EN 13108-2 : Mélanges bitumineux – Spécifications des matériaux - Partie 2 : bétons bitumineux très minces (Bituminous mixtures - Material specifications - Part 2 : asphalt concrete for very thin layers)

NF EN 13108-3 : Mélanges bitumineux – Spécifications des matériaux - Partie 3 : bétons bitumineux souples (Bituminous mixtures - Material specification - Part 3 : soft asphalt)

NF EN 13108-6 : Mélanges bitumineux – Spécifications des matériaux - Partie 6 : asphaltes coulés routiers (Bituminous mixtures - Material specifications - Part 6 : mastic asphalt)

NF EN 13108-7 : Mélanges bitumineux – Spécifications des matériaux - Partie 7 : bétons bitumineux drainants (Bituminous mixtures - Material specifications - Part 7 : porous asphalt)

NF EN 13108-8 : Mélanges bitumineux – Spécifications des matériaux - Partie 8 : agrégats d'enrobés (Bituminous mixtures - Material specifications - Part 8 : reclaimed asphalt)

NF EN 13108-20 : Mélanges bitumineux – Spécifications des matériaux - Partie 20 : épreuve de formulation (Bituminous mixtures - Materials specifications - Part 20 : type testing)

NF EN 13108-21 : Mélanges bitumineux – Spécifications des matériaux - Partie 21 : maîtrise de la production (Bituminous mixtures - Material specifications - Part 21 : factory production control)

NF P 98-149 : Enrobés hydrocarbonés- Terminologie – composants et composition des mélanges – mise en œuvre- produits- techniques et procédés (Asphalt - Terminology - Components and composition of mixtures - Implementation - Products - Techniques and processes)

Terminology

AC: asphalte coulé routier (road mastic asphalt)

AT: asphalte coulé pour trottoir (footpath mastic asphalt)

BBSG: béton bitumineux semi grenu (semi-course asphalt concrete)

BBME: béton bitumineux à module élevé (high modulus asphalt concrete)

BBM: béton bitumineux mince (asphalt concrete for thin layers)

BBTM: béton bitumineux très mince (asphalt concrete for very thin layers)

BBDr: béton bitumineux drainant (porous asphalt)

BBA: béton bitumineux aéronautique (airfield asphalt concrete)

BBCS: béton bitumineux pour couches de surface de chaussées souples à faible trafic (asphalt concrete for low traffic flexible pavements)

EME: enrobé à module élevé (high modulus asphalt concrete)

GB: grave bitume (road base asphalt)

GSP: gyratory shear press (PCG : Presse à Cisaillement Giratoire)

1.2 - Remarks

Each “product” standard includes, before the NF EN standard proper, a national foreword which provides guidance on the characteristics which are suggested should be used in France among the very large number of possibilities provided by the European standard.

Asphalt concrete for low traffic flexible pavements (BBCS) musts not be confused with the standards for soft asphalt (NF EN 13108-3) for which the binders are classified on the basis of the viscosity of the bitumen and not its penetration grade.

Hot Rolled Asphalt (NF EN 13108-4), Stone Mastic Asphalt (NF EN 13108-5) and Soft Asphalt (NF EN 13108-3) are not used in France and there is no French experience on how they behave under heavy 13 tonne axle load traffic. Consequently, these products are not dealt with in this document.

2 - The bituminous materials used in France, use and characteristics

2.1 - Use

The following bituminous materials are used in pavement layers:

- wearing courses:
  BBSG, BBME, BBM, BBTM, BBDR for all types of traffic, BBA for all airfield traffic, BBCS for low traffic flexible pavements and AC;
- base courses:
  BBSG, BBME, BBM for all types of traffic. BBA for all airfield traffic and BBCS for low traffic flexible pavements;
- sub-base and roadbase layers:
  GB, EME for all types of traffic.

2.2 - Classification

Table 1 below uses the terminology used in this document and states the corresponding European standard, the number of the relevant table and the use which is made of the mix. The fourth column states which of the mix design tables in Annex A should be used.

French name	European standard	Use	Mix design	Characteristics of the aggregate	Specification*
BBSG	13108-1	Wearing course	Annex A Table 16	Annex B Table 20	Annex C empirical and fundamental
BBSG	13108-1	Base course	Annex A Table 16	Annex B Table 20	Annex C empirical and fundamental
BBME	13108-1	Wearing course	Annex A Table 16	Annex B Table 20	Annex C fundamental
BBME	13108-1	Base course	Annex A Table 16	Annex B Table 20	Annex C fundamental
BBCS	13108-1	Wearing course	Annex A Table 16	Annex B Table 20	Annex C empirical
BBCS	13108-1	Base course	Annex A Table 16	Annex B Table 20	Annex C empirical
BBA	13108-1	Wearing course	Annex A Table 16	Annex B Table 20	Annex C empirical and fundamental
BBA	13108-1	Base course	Annex A Table 16	Annex B Table 20	Annex C empirical and fundamental
BBM	13108-1	Wearing course	Annex A Table 16	Annex B Table 20	Annex C empirical
BBM	13108-1	Base course	Annex A Table 16	Annex B Table 20	Annex C empirical
BBTM	13108-2	Wearing course	Annex A Table 17	Annex B Table 20	Annex C empirical
BBDr	13108-7	Wearing course	Annex A Table 18	Annex B Table 20	Annex C empirical
GB	13108-1	Road base layer	Annex A Table 16	Annex B Table 20	Annex C empirical and fundamental
GB	13108-1	Sub-base layer	Annex A Table 16	Annex B Table 20	Annex C empirical and fundamental

EME	13108-1	Road base layer	Annex A Table 16	Annex B Table 20	Annex C fundamental
EME	13108-1	Sub-base layer	Annex A Table 16	Annex B Table 20	Annex C fundamental
AC	13108-6	Wearing course	Annex A Table 19	Annex B Table 20	Annex C empirical

** Readers are reminded that in all cases the binder content is expressed as a percentage of the total mass of the mix.*

Table 1: Name and reference

In addition to this classification, a use, a class and a type may be defined as shown in Table 2 below.

French name	European name	Use	Class	Type
BBSG	EB Ø roul liant	Wearing course	1, 2 or3	0/10 or 0/14
BBSG	EB Ø liai liant	Base course	1, 2 or3	0/10 or 0/14
BBME	EB Ø roul liant	Wearing course	1, 2 or3	0/10 or 0/14
BBME	EB Ø liai liant	Base course	1, 2 or3	0/10 or 0/14
BBCS	EB Ø roul liant	Wearing course	No class	0/10 or 0/14
BBCS	EB Ø liai liant	Base course	No class	0/10 or 0/14
BBA	EB Ø roul liant	Wearing course	1, 2 or 3	C or D and 0/10 or 0/14
BBA	EB Ø liai liant	Base course	1, 2 or 3	C or D and 0/10 or 0/14
BBM	EB Ø roul liant	Wearing course	1, 2 or 3	A, B or C and 0/10 or 0/14
BBM	EB Ø liai liant	Base course	1, 2 or 3	A, B or C and 0/10 or 0/14
BBTM	BBTM Ø classe liant	Wearing course	1 or 2	0/6 or 0/10
BBDr	BBDr Ø liant	Wearing course	1 or 2	0/6 or 0/10
GB	EB Ø assise liant	Road base layer	2, 3 or 4	0/14 or 0/20
GB	EB Ø assise liant	Sub-base layer	2, 3 or 4	0/14 or 0/20
EME	EB Ø assise liant	Road base layer	1 or 2	0/10, 0/14 or 0/20
EME	EB Ø assise liant	Sub-base layer	1 or 2	0/10, 0/14 or 0/20

Ø: diameter of largest aggregate particle *Binder:state the penetration grade used*

Table 2: Use, class and type

Examples:

BBSG 1 0/10: class 1 semi-coarse asphalt concrete with 0/10 grading (EB 10 roul 35/50)

BBA D 2 0/14: class 2 gap graded airfield asphalt concrete with a grading of 0/14 (EB 14 roul 35/50)

The tables in Annex A and B show the tests to be performed and the correspondence between the French mixes named above and the characteristics of the aggregate as laid down in European standard NF EN 13043 and the French standard XP P 18-545.

2.3 - Characteristics of mixes and road mastic asphalts

The characteristics of mixes and road mastic asphalts must comply with those stated in the national forewords for the corresponding product standards.

3 - Type test and level of mix design for bituminous coated materials

3.1 - Type test

The type test is performed in a laboratory. It is not compulsory to perform a type test for each construction project as it is possible to use the results of previous tests. The type tests are described in the standard NF P 98-150-1.

The decision to use previous results or to perform a new test should be made with reference to the importance of the project, its size, the date of the previous studies and how representative they are. The study should have been performed less than 5 years ago in standard situations and, for example, less than one year ago in specific situations.

3.2 - Mix design level

5 levels of mix design have been defined in France, denoted by the figures 0 to 4.

Level 0 consists of defining a grading curve and fixing a binder content.

The other levels of mix design are as follows:

- level 1: water resistance test and GSP test;
- level 2: water resistance test, GSP test and wheel tracking test;
- level 3: water resistance test, GSP test, wheel tracking test and stiffness test;
- level 4: water resistance test, GSP test, wheel tracking test, stiffness test and fatigue test.

The level of mix design which is applied to a coated material depends on its position within the pavement (wearing course, base course or sub-base and road base layers), the level of stress to which it is subjected and the level of technical risk associated with it.

The tables contained in the following sections state the specifications and test conditions for the various mixes.

With regard to resistance to rutting, it may be necessary to perform a wheel tracking test in order to ensure the mix performs adequately if the level of stress to which it is subjected is:

- very severe (Mediterranean climate, channelized traffic, slow speeds): the wheel tracking test is compulsory;
- severe (continental climate, channelized traffic, slow speeds): the test may be necessary;
- normal (continental climate, non-channelized traffic, normal speeds): to be decided by the contract manager.

The characteristics which are required for the mixes used in France are set out in Annex C at the end of this document.

For example, for a coated material used in a sub-base layer within a structure, level 1 mix design supplemented by a stiffness test could be demanded.

4 - Characteristics of the aggregate

The characteristics of the aggregate must comply with the standard NF EN 13043 and the additional provisions of the experimental standard XP P 18-545.

Reference to the standard NF EN 13043 should be made either by directly specifying the categories, or by employing summary codes which bring together several characteristics.

If summary codes are used they must be defined in the contracts.

The codes Anc, Bnc, Cnc, Dnc are in conformity with the standard NF EN 13043.

The codes A, B, C, D meet the additional provisions in the standard XP P 18-545.

Articles 7 and 8 of the standard XP P 18-545 supplement the European standard:

- by adding specifications regarding regularity or cleanliness which are considered indispensable for the quality of the French bituminous mixtures;
- by proposing, in the case of applications **where it is justified,** that the Los Angeles (LA) values and Micro-Deval (MDE) values are able to offset one another up to a limit of 5 points;

The justification for applying the offsetting rule between the LA and MDE values must be stated in the contract documents (for example, the economical and rational use of resources or a reduction in transport with reference to sustainable development).

The specifications are set out in Tables 3 to 8 for the mixes mentioned in the Annexes.

Los Angeles NF EN 1097-2	Micro-Deval NF EN 1097-1	Determination of the polished stone value of chippings for wearing courses NF EN 1097-8	NF EN 13043 and Code XP P 18-545
LA_{20}	$M_{DE}15$	PSV 56	Anc
LA_{20}	$M_{DE}15$	PSV 50	Bnc
LA_{25}	$M_{DE}20$	PSV 50	Cnc
LA_{30}	$M_{DE}25$		Dnc

Table 3: Physical characteristics of chippings according to NF EN 13043- coded nc

Los Angeles NF EN 1097-2	Micro-Deval NF EN 1097-1	Determination of the polished stone value of chippings for wearing courses NF EN 1097-8	Code XP 18-545
LA_{20}	$M_{DE}15$	PSV 56	A (1)
LA_{20}	$M_{DE}15$	PSV 50	B (1)
LA_{25}	$M_{DE}20$	PSV 50	C (1)
LA_{30}	$M_{DE}25$		D (1)
(1) Maximum offsetting of 5 points is possible between LA et M_{DE} values in applications where it is justified.			

Table 4: Physical characteristics of chippings according to the additional provisions in XP P 18-545

Grading	to D/1.4 if 2 ≤ D/d < 4	to D/2 if D/d ≥ 4	Property	Flakiness (NF EN 933-3)	Code
$G_C85/20$ $G_C85/15$ if used in a gap-graded mix	$G_{25/15}$ or $G_{20/15}$	$G_{20/17.5}$	$f_{0.5}$ (2)	FI_{20} FI_{25} if D ≤ 6.3 mm	II (1)
$G_C85/20$			f_1 (3)	FI_{25} FI_{30} if D ≤ 6.3 mm	III (1)
(1) Additional criteria for the geometric regularity of aggregate particles are necessary: the maximum tolerated range between d and D is 10%. (2) f_1 if MB_F 10 (3) f_{2if} MB_F10					

Table 5: Manufacturing requirements for chippings

Grading	Assessment of fines < 0.125 mm (NF EN 933-9)	Code
G_F85 $G_{TC}10$ G_A85 for graded aggregate D > 2mm	MB_F10	a (1)
(1) Code a signifies that the 0/2 mm fraction has the properties MB_2. It is accepted that the < 0.125 mm aggregate complies with MB_F10 if the 0/2 mm fraction complies with MB_2		

Table 6: Manufacturing requirements for sands and graded aggregate

Chippings for wearing courses		
Percentage of broken surfaces NF EN 933-5	Correspondence with the results of the flow test EN 933-6 (1)	Code
$C_{100/0}$	None	-
$C_{95/1}$	E_{CG} 110	Ang 1
$C_{90/1}$	E_{CG} 105	Ang 2
$C_{50/10}$	E_{CG} 95	Ang 3
(1) Alternative test conducted on the 4/6.3 – 6.3/10 – 4/10 or 10/14 mm fraction depending on which has the highest presence		

Table 7: Angularity of alluvial chippings from rivers or the sea

Sands for wearing courses	
Flow test NF N 933-6 on the 0/2mm fraction	Code
E_{CS} 38(1)	Ang 1
E_{CS} 35	Ang 2
E_{CS} 30	Ang 3
(1) it is occasionally difficult to achieve this value	

Table 8: Angularity of alluvial sands from rivers or the sea

The codes which correspond to the specifications in the French standards are given for the different mixes in Annex B at the end of this document.

5 - The characteristics of fines

5.1 - The characteristics of fillers

The characteristics of fillers are set out in Table 9.

Parameter		Specification	Maximum range
Grading	2 mm	Vsi 100	-
(% of passing fraction by mass)	0.125 mm	Li 85	10
	0.063 mm	Li 70	10
Blaine test		Stated range	e < 140 m²/kg
True density		Stated value	
Rigden void content		$V_{28/45}$	
Delta ring and ball temperature		Δ_{TBA} 8/16	

Table 9: Physical characteristics and grading

5.2 - Quality of fines and particles < 0.125 mm in sands and graded aggregate

The fines must comply with Table 10.

Test	Value (g/kg)
Methylene blue test (amount of methylene blue absorbed in grams by 1000 g of fines, NF EN 933-9)	MB_{F10}

Table 10: Characterization of fines

6 - Coating binders

The coating binders used must comply with the standards for pure bitumens (NF EN 12591), hard bitumens (NF EN 13924) and modified binders (NF EN 14023). Special binders which are not yet covered by standards can also be used for mixes and mastic asphalts.

7 - Reclaimed asphalt

7.1 - The use of reclaimed asphalt

The standard NF EN 13108-8 makes it possible to classify reclaimed asphalt. Table 11 below supplements this and details the possible uses of reclaimed asphalt in new mixes on the basis of its composition and characterization.

<table>
<tr><th colspan="7">Use of reclaimed asphalt</th></tr>
<tr><td rowspan="3">Pavement layer</td><td colspan="2">Wearing course</td><td>0 %</td><td colspan="2">10 %(1)</td><td>30 %</td><td>10 %</td><td>40%</td></tr>
<tr><td colspan="2">Base course</td><td rowspan="2">10 %</td><td>20 %</td><td>30%</td><td colspan="3" rowspan="2">40 %</td></tr>
<tr><td colspan="2">Sub-base and road base layers</td><td colspan="2"></td></tr>
<tr><td rowspan="4">Components of the reclaimed asphalt</td><td rowspan="2">Bituminous binder</td><td>Content</td><td>TLNS</td><td colspan="2">TL2</td><td colspan="3">TL1</td></tr>
<tr><td>Penetration or TR&B</td><td colspan="2">BNS</td><td>B2</td><td colspan="3">B1</td></tr>
<tr><td rowspan="2">Aggregate</td><td>Grading</td><td colspan="2">GNS</td><td colspan="2">G2</td><td colspan="2">G1</td></tr>
<tr><td>Intrinsic characteristic</td><td colspan="3">RNS</td><td>R1</td><td>RNS</td><td>R1</td></tr>
<tr><td colspan="9">(1) if the average binder content of the reclaimed asphalt exceeds 5%, the mix is considered to be an asphalt concrete whose aggregate has been selected with reference to minimal criteria close to those desired for the recycled material.</td></tr>
</table>

Table 11: Use of reclaimed asphalt

The percentages of reclaimed asphalt given in this Table may be increased on condition that each batch of reclaimed asphalt is characterized or if its origin is known and uniformity and compliance with the specifications is guaranteed. It must be borne in mind that the percentage of reclaimed asphalt that can be added to mixes also depends to a very high degree on the manufacturing equipment.

It is therefore necessary to characterize the reclaimed asphalts which are discussed in the following sections in order to be able to use recycled asphalt in the percentages specified in the Table above. This involves:

- the average binder content (TL) and its range (7.2),
- the minimum penetration or maximum ring and ball temperature (B) of the binder in the reclaimed asphalt and their ranges (7.3),
- the grading uniformity (G) of the reclaimed asphalt (7.4),
- intrinsic characteristics and angularity (R) (7.5).

7.2 - Average binder content and its range

The categories of reclaimed asphalt are defined on the basis of its binder content range, see Table 12.

Binder content range	Category
≤ 1 %	TL 1
≤ 2 %	TL 2
> 2 % or not specified	TL NS

Table 12: Binder content and category of recycled asphalt

7.3 - Minimum penetration or maximum $T_{R\&B}$ of the binder in the reclaimed asphalt and their ranges

As specified in the standard NF EN 13108-8, the categories of reclaimed asphalt in France are to be stated and defined on the basis of the range of penetration or the $T_{R\&B}$ of the binder as shown in Table 13.

Penetration in 1/10 mm	$T_{R\&B}$ in °C	Frequency of test	Category
Minimum = 5 and range ≤ 15	Maximum = 77 and range ≤ 8	1 test for every 1000 tonnes with a minimum of 5 tests	B1
Minimum = 5	Maximum = 77	1 test for every 1000 tonnes with a minimum of 5 tests	B 2
To be stated	To be stated	Not specified	B NS

Table 13: Classification with regard to the binder's range of penetration or $T_{R\&B}$ of the binder

7.4 - The grading uniformity of reclaimed asphalt

The categories of reclaimed asphalt are defined on the basis of the grading uniformity of the aggregate it contains (Table 14).

% passing a sieve of size 1.4 D	% passing sieve of size D	% passing a 2 mm sieve	% passing a 0.063 mm sieve	Category
Vsi 99	Li 85 Ls 99 e 10	e 15	e 4	G1
Vsi 99	Li 80 Ls 99 e 15	e 20	e 6	G2
Not specified	Not specified	Not specified	Not specified	G NS
N.B.: D, Vsi, Li, Ls and e are defined as in the standard XP P 18-545				

Table 14: Classification with reference to the grading uniformity of the aggregate

7.5 - Intrinsic characteristics and angularity

The categories of reclaimed asphalt are defined on the basis of the intrinsic characteristics and angularity of the aggregate it contains (Table 15). The characteristics of the aggregate can be found in the documents used to design the mixes present in the reclaimed asphalt.

Category of aggregate	Frequency of tests	Category
Code A or B and code Ang 1 for chippings and sand	1 per batch	R1
Code C or not characterized	Not specified	R NS

Table 15: Required intrinsic characteristics and angularity for aggregate extracted from reclaimed asphalt

In order for a batch of reclaimed asphalt to be classified in category R1, the following values must be measured for the aggregate after binder stripping or obtained from existing documents:

- The Los Angeles value and the Micro-Deval value according to the standards NF EN 1097-2 and NF EN 1097-1,
- The PSV value (only if the aggregate is to be used in a wearing course) as specified in NF EN 1097-8

The batch is identified using a reclaimed asphalt information sheet (FTAE) of the type shown in Annex D.

8 - Manufacture, laying, tests (reminder)

The French standards that are derived from European standards stop when the mix is loaded onto trucks. Consequently, the standard NF P 98-150-1 is an indispensable supplement to French standards for mixes.

8.1 - Manufacture

The production control of mixes is detailed in the standard NF P 98-150-1.

8.2 - Laying and tests

The tests and the specifications to be complied with are given in the standard NF P 98-150-1 which explains the laying thickness on the basis of the type of mix, the average texture depth to be achieved for wearing courses in the case of the different mixes and the voids content to be obtained at the worksite.

9 - How to use this guide

This document makes it possible to transcribe the information that is required to design and specify the hot mix asphalts which are in common use in France in the language of the NF EN standards. To facilitate the task, this section illustrates the various stages of this transcription with reference to a specific case.

Let us consider the case of a class 1 semi-coarse asphalt concrete with a 0/10 grading (BBSG 1 0/10) which is to be used in a base course

Table 1 in §2.2 makes it possible to find where the necessary information can be found on the basis of the name of the mix. The *Table 2* in §2.2 lists the names and classifications of the bituminous materials used in France.
For this example, for a BBSG used in a base course, it is necessary to refer to the standard NF EN 13 108-1 and the information necessary for mix design in 0 Table 16, the minimum specification for the aggregate in Annex B and the performance in Annex C (it is possible to choose between the empirical characteristic in Table 21 and the fundamental characteristics in Table 29.

1. Once a level of mix design has been selected as described in § 3.2 of this document, the tables in Annex A will provide the characteristics to be achieved and the test methods to be applied.

   Level 2 mix design includes the performance of water sensitivity tests, GSP tests and rutting tests. The reference "test" standards are, for the GSP test, the standard NF EN 12 697-31, for the water sensitivity test the standard NF EN 12 697-12 and for rutting the standard NF EN 12 697-22, using the large device in air at the specified temperature. Instructions are also provided about how to calculate the true density of the mix.

2. The table in Annex B then provides the minimum specifications for the aggregate. These characteristics are given in the form of a code, whose meaning is explained in the tables in § 4.
   In the case of BBSG used in a base course, the minimum specifications are as follows: code D for the physical characteristics of the chippings, code III for the manufacturing requirements for the chippings, code a for the manufacturing requirements for the sands and, if alluvial aggregate is used, code Ang3 for angularity.

3. 0 states the test results which should be obtained. When, if the choice is available, it has been decided to adopt an empirical or fundamental approach, all that is required is to apply the performance to be obtained for a given mix design.

For a BBSG 1 0/10 designed using the empirical approach, the specifications are as follows:

- The type of binder is to be stated;
- The minimum binder content is TLmin5.2;
- The GSP voids content can vary between V_{min5} and V_{max10} (after 60 gyrations);
- The water sensitivity is ITSR70;
- The rutting resistance is characterized by P10 (≤10% at 60°C and 30 000 cycles), Vi=5% and Vs=8%.

This is a simplified example of the use of this guide. It is strongly recommended to read carefully the entire document in order to gain a fuller understanding of the operation of the NF EN standards.

Annex A: Mix design

Property	Test method
True density of mixes	EN 12697-5 method A in water
Voids content of GSP specimens	EN 12697-31
Water sensitivity (1)	EN 12697-12
Resistance to permanent deformation (2)- for mixes designed for axle loads ≥ 13 T	EN 12697-22, large device, in air at the specified temperature
Stiffness modulus	EN 12697-26 – Annex A and E
2 point fatigue test for pavement design	EN 12697-24 – Annex A
Resistance to fuel(3) (airfields)	EN 12697-43
Resistance to de-icing fluids (airfields)	EN 12697-41

(1) *Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures - Part 1: DURIEZ test on hit-mix).*

Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity. (2)*This test is required in France for mixes used on airfields.*

(3) *For bituminous mixes used on airfields only.*

Table 16: Type of test and method for asphalt concrete designed according to the standard EN 13108 1 (BBM, BBSG, BBA, BBCS, BBME, GB, EME)

Property	Test method
True density of coated materials of coated materials	EN 12697-5 method A in water
Voids content of GSP specimens	EN 12697-31
Water sensitivity (1)	EN 12697-12
Mechanical stability	EN 12697-22, large device, in air at the specified temperature

(1) *Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures - Part 1: DURIEZ test on hit-mix).*

Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity..

Table 17: Type of test and method for asphalt concrete for very thin layers designed according to the standard EN 13108 2 (BBTM)

Property	Test method
True density of coated materials of coated materials	EN 12697-5 method A in water
Voids content of GSP specimens	EN 12697-31
Permeability	EN 12697-19
Water sensitivity (1)	EN 12697-12
(1 Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures - Part 1: DURIEZ test on hit-mix). *Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity.*	

Table 18: Type of test and method for BBDr designed according to the standard EN 13108 7

Property	Test method
Permanent deformation for indentation values greater than 2.5 mm	EN 12697-20 for D ≤ 11.2 mm EN 12697-21 for D > 11.2 mm

Table 19: Type of test and method for road mastic asphalt designed according to the standard 13108-6

Annex B: Minimum specifications for aggregate in mixes:

<table>
<tr><th rowspan="2">Use</th><th rowspan="2">French name</th><th rowspan="2">Physical characteristics of chippings</th><th colspan="2">Manufacturing requirements</th><th colspan="2">Angularity of crushed rock aggregate</th></tr>
<tr><th>chippings</th><th>sands</th><th>chippings</th><th>sands</th></tr>
<tr><td rowspan="2">Wearing course</td><td>BBTM
BBDr
BBA (high stress)
AT
AC</td><td>LA_{20} - $M_{DE}15$ (1)
PSV_{50}

Code B</td><td>$G_C85/20$ (2)
$G_{20/15}$ or $G_{25/15}$
e10 to d and D
FI_{20} (3) $f_{0.5}$ (5)

Code II</td><td rowspan="3">G_F85 (7)

$G_{TC}10$

MB_2 (8)

Code a</td><td rowspan="2">$C_{95/1}$
or
$E_{CG}110$

Code Ang1</td><td rowspan="2">$E_{CS}38$ (9)

Code Ang1</td></tr>
<tr><td>BBSG
BBME
BBCS
BBA
BBM</td><td>LA_{25} - $M_{DE}20$ (1)
PSV_{50}

Code C</td><td>$G_C85/20$

$G_{20/15}$ or $G_{25/15}$

e10 to d and D

FI_{25} (4) f_1 (6)

Code III</td></tr>
<tr><td>Thin base course</td><td>BBM</td><td>LA_{25} - $M_{DE}20$ (1)

Code C</td><td rowspan="3">$C_{50/10}$
or
$E_{CG}95$

Code Ang3</td><td rowspan="3">$E_{CS}30$

Code Ang3</td></tr>
<tr><td>Thick base course and road base layer</td><td>BBSG
BBME
BBCS
BBA</td><td rowspan="2">LA_{30} - $M_{DE}25$ (1)

Code D</td></tr>
<tr><td>Sub-base layer</td><td>EME
GB</td></tr>
<tr><td colspan="7">(1) With the possibility of applying a maximum offsetting of 5 points between the LA and M_{DE} values, if the justification is explicitly stated in the contract documents.</td></tr>
<tr><td colspan="7">(2) $G_C85/15$ for gap-graded mixes.</td></tr>
<tr><td colspan="7">(3) FI_{25} if D ≤ 6.3 mm. (4) FI_{30} if D ≤ 6.3 mm.</td></tr>
<tr><td colspan="7">(5) f_1 if MB_F10. (6) f_2 if MB_F10.</td></tr>
<tr><td colspan="7">(7) G_A85 if 2 < D ≤ 6.3 mm.</td></tr>
<tr><td colspan="7">(8) Means the aggregate belongs to MB_F10.</td></tr>
<tr><td colspan="7">(9) $E_{CS}35$ on condition a wheel tracking test is performed for the purpose of verification.</td></tr>
</table>

Table 20: Minimum specifications for aggregate in mixes

EXAMPLE OF THE SPECIFICATION of 4/6.3 mm chippings and 0/2 mm sand for BBTM:

- **4/6.3 mm chippings** – LA_{20} - $M_{DE}15$ with the possibility of applying maximum offsetting of 5 points between the LA and M_{DE} values, if the justification is explicitly stated in the contract documents.

  PSV_{50} - $G_C85/15$ - $G_{20/15}$ or $G_{25/15}$ - e10 for d and D - FI_{25} - $f_{0.5}$ (f_1 if MB_F10) – $C_{95/1}$ or $E_{CG}110$.
- **0/2 mm sand**- G_F85 - $G_{TC}10$ - $MB2$ - $E_{CS}38$ or $E_{CS}35$ if checking performed by a wheel tracking test.

Or : **4/6.3 mm chippings and 0/2 mm sand** for gap graded mixes with codes B - II - a – Ang1.

Annex C: Performance summary tables Empirical approach

Name, class, type	Binder	Binder content	% voids (GSC)	Water sensitivity**	Resistance to rutting
BBSG 1 0/10	Type to be stated	$TL_{min5.2}$	V_{min5} to V_{max10} (60 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%
BBSG 1 0/14	Type to be stated	$TL_{min5.0}$	V_{min4} to V_{max9} (80 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%
BBSG 2 0/10	Type to be stated	$TL_{min5.2}$	V_{min5} to V_{max10} (60 gyrations)	$ITSR_{70}$	• $P_{7.5}$ (≤7.5% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%
BBSG 2 0/14	Type to be stated	$TL_{min5.0}$	V_{min4} to V_{max9} (80 gyrations)	$ITSR_{70}$	• $P_{7.5}$ (≤7.5% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%
BBSG 3 0/10	Type to be stated	$TL_{min5.2}$	V_{min5} to V_{max10} (60 gyrations)	$ITSR_{70}$	• P_{5} (≤5% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%
BBSG 3 0/14	Type to be stated	$TL_{min5.0}$	V_{min4} to V_{max9} (80 gyrations)	$ITSR_{70}$	• P_{5} (≤5% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%

*** Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures - Part 1: DURIEZ test on hit-mix).*

Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity.

Table 21: Performance to be attained, with the empirical approach, for BBSG wearing courses and base courses

Name, class, type	Binder	Binder content	% voids (GSC)	Water sensitivity**	Resistance to rutting
BBCS 1 0/10	Type to be stated	$TL_{min5.2}$	V_{min4} to V_{max9} (40 gyrations)	$ITSR_{80}$	--
BBCS 2 0/10	Type to be stated	$TL_{min5.2}$	V_{min4} to V_{max9} (60 gyrations)	$ITSR_{80}$	--
BBCS 3 0/14	Type to be stated	$TL_{min5.2}$	V_{min4} to V_{max9} (80 gyrations)	$ITSR_{70}$	--
BBCS 4 0/14	Type to be stated	$TL_{min4.8}$	V_{min4} to V_{max9} (100 gyrations)	$ITSR_{70}$	--

*** Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures - Part 1: DURIEZ test on hit-mix).*

Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity.

Table 22: Performance to be attained, with the empirical approach, for BBCS wearing courses and base courses

Name, class, type	Binder	Binder content	% voids (GSC)	Water sensitivity**	Resistance to rutting
BBA C 1 0/10	Type to be stated	$TL_{min5.4}$	Base course: V_{min4} to V_{max8} (60 gyrations)	$ITSR_{70}$	• P_{15} (≤15% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%
			Wearing course: V_{min3} to V_{max7} (60 gyrations)	$ITSR_{80}$	
BBA C 2 0/10	Type to be stated	$TL_{min5.4}$	Base course: V_{min4} to V_{max8} (60 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%
			Wearing course: V_{min3} to V_{max7} (60 gyrations)	$ITSR_{80}$	
BBA C 3 0/10	Type to be stated	$TL_{min5.4}$	Base course: V_{min4} to V_{max8} (60 gyrations)	$ITSR_{70}$	• $P_{7.5}$ (≤7.5% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%
			Wearing course: V_{min3} to V_{max7} (60 gyrations)	$ITSR_{80}$	
BBA C 1 0/14	Type to be stated	$TL_{min5.2}$	Base course: V_{min4} to V_{max8} (80 gyrations)	$ITSR_{70}$	• P_{15} (≤15% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%
			Wearing course: V_{min3} to V_{max7} (80 gyrations)	$ITSR_{80}$	
BBA C 2 0/14	Type to be stated	$TL_{min5.2}$	Base course: V_{min4} to V_{max8} (80 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%
			Wearing course: V_{min3} to V_{max7} (80 gyrations)	$ITSR_{80}$	
BBA C 3 0/14	Type to be stated	$TL_{min5.2}$	Base course: V_{min4} to V_{max8} (80 gyrations)	$ITSR_{70}$	• $P_{7.5}$ (≤7.5% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%
			Wearing course: V_{min3} to V_{max7} (80 gyrations)	$ITSR_{80}$	
BBA D 1 0/10	Type to be stated	$TL_{min5.2}$	V_{min5} to V_{max9} (40 gyrations)	$ITSR_{80}$	• P_{15} (≤15% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%
BBA D 2 0/10	Type to be stated	$TL_{min5.2}$	V_{min5} to V_{max9} (40 gyrations)	$ITSR_{80}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%
BBA D 3 0/10	Type to be stated	$TL_{min5.2}$	V_{min5} to V_{max9} (40 gyrations)	$ITSR_{80}$	• $P_{7.5}$ (≤7.5% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%
BBA D 1 0/14	Type to be stated	$TL_{min5.0}$	V_{min5} to V_{max9} (60 gyrations)	$ITSR_{80}$	• P_{15} (≤15% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%
BBA D 2 0/14	Type to be stated	$TL_{min5.0}$	V_{min5} to V_{max9} (60 gyrations)	$ITSR_{80}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%
BBA D 3 0/14	Type to be stated	$TL_{min5.0}$	V_{min5} to V_{max9} (60 gyrations)	$ITSR_{80}$	• $P_{7.5}$ (≤7.5% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%

*** Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures - Part 1: DURIEZ test on hit-mix).*

Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity.

Table 23: Performance to be attained, with the empirical approach, for BBA wearing courses and base courses

Name, class, type	Binder	Binder content	% voids (GSC)	Water sensitivity**	Resistance to rutting
BBMA 1 0/10	Type to be stated	$TL_{min5.0}$	V_{min6} to V_{max11} (40 gyrations)	$ITSR_{70}$	• P_{15} (≤15% - 60°C and 3,000 cycles) • Vi= 7% – Vs = 10%
BBMA 2 0/10	Type to be stated	$TL_{min5.0}$	V_{min6} to V_{max11} (40 gyrations)	$ITSR_{70}$	• P_{15} (≤15% - 60°C and 10,000 cycles) • Vi= 7% – Vs = 10%
BBMA 3 0/10	Type to be stated	$TL_{min5.0}$	V_{min6} to V_{max11} (40 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 30,000 cycles) • Vi= 7% – Vs = 10%
BBMA 1 0/14	Type to be stated	$TL_{min5.0}$	V_{min6} to V_{max11} (40 gyrations)	$ITSR_{70}$	• P_{15} (≤15% - 60°C and 3,000 cycles) • Vi= 7% – Vs = 10%
BBMA 2 0/14	Type to be stated	$TL_{min5.0}$	V_{min6} to V_{max11} (40 gyrations)	$ITSR_{70}$	• P_{15} (≤15% - 60°C and 10,000 cycles) • Vi= 7% – Vs = 10%
BBMA 3 0/14	Type to be stated	$TL_{min5.0}$	V_{min6} to V_{max11} (40 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 30,000 cycles) • Vi= 7% – Vs = 10%
BBMB 1 0/10	Type to be stated	$TL_{min5.0}$	V_{min7} to V_{max12} (40 gyrations)	$ITSR_{70}$	• P_{15} (≤15% - 60°C and 3,000 cycles) • Vi= 8% – Vs = 11%
BBMB 2 0/10	Type to be stated	$TL_{min5.0}$	V_{min7} to V_{max12} (40 gyrations)	$ITSR_{70}$	• P15 (≤15% - 60°C and 10,000 cycles) • Vi= 8% – Vs = 11%
BBMB 3 0/10	Type to be stated	$TL_{min5.0}$	V_{min7} to V_{max12} (40 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 30,000 cycles) • Vi= 8% – Vs = 11%
BBMB 1 0/14	Type to be stated	$TL_{min5.0}$	V_{min7} to V_{max12} (40 gyrations)	$ITSR_{70}$	• P_{15} (≤15% - 60°C and 3,000 cycles) • Vi= 8% – Vs = 11%
BBMB 2 0/14	Type to be stated	$TL_{min5.0}$	V_{min7} to V_{max12} (40 gyrations)	$ITSR_{70}$	• P_{15} (≤15% - 60°C and 10,000 cycles) • Vi= 8% – Vs = 11%
BBMB 3 0/14	Type to be stated	$TL_{min5.0}$	V_{min7} to V_{max12} (40 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 30,000 cycles) • Vi= 8% – Vs = 11%
BBMC 1 0/10	Type to be stated	$TL_{min5.0}$	V_{min8} to V_{max13} (40 gyrations)	$ITSR_{70}$	• P_{15} (≤15% - 60°C and 3,000 cycles) • Vi= 8% – Vs = 11%
BBMC 2 0/10	Type to be stated	$TL_{min5.0}$	V_{min8} to V_{max13} (40 gyrations)	$ITSR_{70}$	• P_{15} (≤15% - 60°C and 10,000 cycles) • Vi= 8% – Vs = 11%
BBMC 3 0/10	Type to be stated	$TL_{min4.8}$	V_{min8} to V_{max13} (40 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 30,000 cycles) • Vi= 8% – Vs = 11%

Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures - Part 1: DURIEZ test on hit-mix).

Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity.

Table 24: Performance to be attained, with the empirical approach, for BBM wearing courses and base courses

Name, class, type	Binder	Binder content	% voids (GSC)	Water sensitivity**	Mechanical stability
BBTM 1 0/6	Type to be stated	TImin 5.0	V_{min12} to V_{max19} (25 gyrations)	$ITSR_{75}$	• P20 (≤20% - 60°C and 3,000 cycles) • Vi= 16% – Vs = 22%
BBTM 2 0/6	Type to be stated	TImin 5.0	V_{min20} to V_{max25} (25 gyrations)	$ITSR_{75}$	• P20 (≤20% - 60°C and 3,000 cycles) • Vi= 16% – Vs = 22%
BBTM 1 0/10	Type to be stated	TImin 5.0	V_{min10} to V_{max17} (25 gyrations)	$ITSR_{75}$	• P15 (≤15% - 60°C and 3,000 cycles) • Vi= 9% – Vs = 16%
BBTM 2 0/10	Type to be stated	TImin 5.0	V_{min18} to V_{max25} (25 gyrations)	$ITSR_{75}$	• P15 (≤15% - 60°C and 3,000 cycles) • Vi= 9% – Vs = 16%

*** Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures Part 1: DURIEZ test on hit-mix).*

Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity..

Table 25: Performance to be attained, with the empirical approach, for BBTM wearing courses

Name, class, type	Binder	Binder content	% voids (GSC)	Water sensitivity**	Resistance to rutting
BBDr 1 0/6	Type to be stated	TLmin4.0	• V_{min20} (40 gyrations) • V_{max26} (40 gyrations) • V_{min14} (200 gyrations)	$ITSR_{80}$	--
BBDr 2 0/6	Type to be stated	TLmin4.0	• V_{min26} (40 gyrations) • V_{max30} (40 gyrations) • V_{min20} (200 gyrations)	$ITSR_{80}$	--
BBDr 1 0/10	Type to be stated	TLmin4.0	• V_{min20} (40 gyrations) • V_{max26} (40 gyrations) • V_{min14} (200 gyrations)	$ITSR_{80}$	--
BBDr 2 0/10	Type to be stated	TLmin4.0	• V_{min26} (40 gyrations) • V_{max30} (40 gyrations) • V_{min20} (200 gyrations)	$ITSR_{80}$	--

*** Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures - Part 1: DURIEZ test on hit-mix).*

Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity.

Table 26: Performance to be attained, with the empirical approach for BBDr wearing courses

Name, class, type	Binder	Binder content	% voids (GSC)	Water sensitivity**	Resistance to rutting
GB 2 0/14	Type to be stated	$TL_{min3.8}$	V_{max11} (100 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 8% – Vs = 11%
GB 2 0/20	Type to be stated	$TL_{min3.8}$	V_{max11} (120 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 8% – Vs = 11%
GB 3 0/14	Type to be stated	$TL_{min4.2}$	V_{max10} (100 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 7% – Vs = 10%
GB 3 0/20	Type to be stated	$TL_{min4.2}$	V_{max10} (120 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 7% – Vs = 10%
*** Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures - Part 1: DURIEZ test on hit-mix).* *Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity.*					

Table 27: Performance to be attained, with the empirical approach, for mixes for GB sub-base and roadbase layers

French name	Binder content	Indentation
AT 0/4	TLmin 7.5	Imin 2, Imax 8, (1)
AT 0/6	TLmin 7.5,	Imin 2, Imax 8, (1)
AC1 0/6	TLmin 7.0	Imin1, Imax 3, (1)
AC1 0/10	TLmin 7.0	Imin 1, Imax 3, (1)
AC2 0/10	TLmin 6.5	Imin1, Imax 3, (1)
AC2 0/14	TLmin 6.5	Imin1, Imax 3, (1)
(1) *to be specified depending on the selected indentation test*		

Table 28: Performance to be attained, with the empirical approach, for road mastic asphalt

Annex D: Performance summary tables Fundamental approach

Name, class, type	Binder	% voids (GSC)	Water sensitivity**	Resistance to rutting	Modulus	Fatigue
BBSG 1 0/10	Type to be stated	V_{min5} to V_{max10} (60 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%	• $S_{min5\ 500}$ (≥ 5,500 MPa at 15°C, 10Hz or 0.02s) • -Vi= 5% – Vs = 8%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 5% – Vs = 8%
BBSG 1 0/14	Type to be stated	V_{min4} to V_{max9} (80 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%	• $S_{min5\ 500}$ (≥ 5,500 MPa at 15°C, 10Hz or 0.02s) • Vi= 5% – Vs = 8%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 5% – Vs = 8%
BBSG 2 0/10	Type to be stated	V_{min5} to V_{max10} (60 gyrations)	$ITSR_{70}$	• $P_{7.5}$ (≤7.5% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%	• $S_{min7,000}$ (≥ 7,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 5% – Vs = 8%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 5% – Vs = 8%
BBSG 2 0/14	Type to be stated	V_{min4} to V_{max9} (80 gyrations)	$ITSR_{70}$	• $P_{7.5}$ (≤7 5% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%	• $S_{min7,000}$ (≥ 7,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 5% – Vs = 8%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 5% – Vs = 8%
BBSG 3 0/10	Type to be stated	V_{min5} to V_{max10} (60 gyrations)	$ITSR_{70}$	• P_5 (≤5% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%	• $S_{min7,000}$ (≥ 7,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 5% – Vs = 8%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 5% – Vs = 8%
BBSG 3 0/14	Type to be stated	V_{min4} to V_{max9} (80 gyrations)	$ITSR_{70}$	• P_5 (≤5% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%	• $S_{min7,000}$ (≥ 7,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 5% – Vs = 8%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 5% – Vs = 8%

*** Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures - Part 1: DURIEZ test on hit-mix).*

Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity.

Table 29: Performance to be attained, with the fundamental approach, for BBSG wearing courses and base courses

Name, class, type	binder	% voids (GSC)	Water sensitivity**	Resistance to rutting	Modulus	Fatigue
BBME 1 0/10	Type to be stated	V_{min5} to V_{max10} (60 gyrations)	$ITSR_{80}$	• P_{10} (≤10% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%	• $-S_{min9,000}$ (≥ 9,000 MPa at 15°C, 10Hz or 0.02s) • -Vi= 5% – Vs = 8%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 5% – Vs = 8%
BBME 1 0/14	Type to be stated	V_{min4} to V_{max9} (80 gyrations)	$ITSR_{80}$	• P_{10} (≤10% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%	• $S_{min9,000}$ (≥ 9,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 5% – Vs = 8%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 5% – Vs = 8%
BBME 2 0/10	Type to be stated	V_{min5} to V_{max10} (60 gyrations)	$ITSR_{80}$	• $P_{7.5}$ (≤7.5% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%	• $S_{min11,000}$ (≥ 11,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 5% – Vs = 8%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 5% – Vs = 8%
BBME 2 0/14	Type to be stated	V_{min4} to V_{max9} (80 gyrations)	$ITSR_{80}$	• $P_{7.5}$ (≤7.5% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%	• $S_{min11,000}$ (≥ 11,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 5% – Vs = 8%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 5% – Vs = 8%
BBME 3 0/10	Type to be stated	V_{min5} to V_{max10} (60 gyrations)	$ITSR_{80}$	• P_5 (≤5% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%	• $S_{min11,000}$ (≥ 11,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 5% – Vs = 8%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 5% – Vs = 8%
BBME 3 0/14	Type to be stated	V_{min4} to V_{max9} (80 gyrations)	$ITSR_{80}$	• P_5 (≤5% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%	• $S_{min11,000}$ (≥ 11,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 5% – Vs = 8%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 5% – Vs = 8%

** *Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures - Part 1: DURIEZ test on hit-mix).*

Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity.

Table 30: Performance to be attained, with the fundamental approach, for BBME wearing courses and base courses

Name, class, type	binder	% voids (GSC)	Water sensitivity**	Resistance to rutting	Modulus	Fatigue
BBA C 1 0/10	Type to be stated	Base course: V_{min4} at V_{max8} (60 gyrations)	$ITSR_{70}$	• P_{15} (≤15% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%	• $S_{min5\ 500}$ (≥ 5 500 MPa at 15°C, 10Hz or 0.02s) • -Vi= 4% – Vs = 7%	• $\varepsilon_{6\text{-}130}$ (≥130.10^{-6} at 10°C, 25Hz) • Vi= 4% – Vs = 7%
		Wearing course: V_{min3} at V_{max7} (60 gyrations)	$ITSR_{80}$			
BBA C 2 0/10	Type to be stated	Base course: V_{min4} at V_{max8} (60 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%	• $S_{min5\ 500}$ (≥ 5 500 MPa at 15°C, 10Hz or 0.02s) • Vi= 4% – Vs = 7%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 4% – Vs = 7%
		Wearing course: V_{min3} at V_{max7} (60 gyrations)	$ITSR_{80}$			
BBA C 3 0/10	Type to be stated	Base course: V_{min4} at V_{max8} (60 gyrations)	$ITSR_{70}$	• $P_{7.5}$ (≤7.5% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%	• $S_{min7,000}$ (≥ 7,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 4% – Vs = 7%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 4% – Vs = 7%
		Wearing course: V_{min3} at V_{max7} (60 gyrations)	$ITSR_{80}$			
BBA C 1 0/14	Type to be stated	Base course: V_{min4} at V_{max8} (80 gyrations)	$ITSR_{70}$	• P_{15} (≤15% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%	• $S_{min5\ 500}$ (≥ 5 500 MPa at 15°C, 10Hz or 0.02s) • Vi= 4% – Vs = 7%	• $\varepsilon_{6\text{-}130}$ (≥130.10^{-6} at 10°C, 25Hz) • Vi= 4% – Vs = 7%
		Wearing course: $_{min3}$ at V_{max7} (80 gyrations)	$ITSR_{80}$			
BBA C 2 0/14	Type to be stated	Base course: V_{min4} at V_{max8} (80 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%	• $S_{min5\ 500}$ (≥ 5 500 MPa at 15°C, 10Hz or 0.02s) • Vi= 4% – Vs = 7%	• ε6-100 (≥100.10-6 at 50,00°F, 25Hz) • Vi= 4% – Vs = 7%
		Wearing course: V_{min3} at V_{max7} (80 gyrations)	$ITSR_{80}$			
BBA C 3 0/14	Type to be stated	Base course: V_{min4} at V_{max8} (80 gyrations)	$ITSR_{70}$	• $P_{7.5}$ (≤7.5% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%	• $S_{min7,000}$ (≥ 7,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 4% – Vs = 7%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 4% – Vs = 7%
		Wearing course: V_{min3} to V_{max7} (80 gyrations)	$ITSR_{80}$			

** *Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures - Part 1: DURIEZ test on hit-mix).*

Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity.

Table 31: Performance to be attained, with the fundamental approach, for class C BBA wearing courses and base courses

Name, class, type	binder	% voids (GSC)	Water sensitivity**	Resistance to rutting	Modulus	Fatigue
BBA D 1 0/10	Type to be stated	V_{min5} at V_{max9} (40 gyrations)	$ITSR_{80}$	• P_{15} (≤15% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%	• $S_{min5\ 500}$ (≥ 5 500 MPa at 15°C, 10Hz or 0.02s) • Vi= 4% – Vs = 7%	• $\varepsilon_{6\text{-}130}$ (≥130.10^{-6} at 10°C, 25Hz) • Vi= 4% – Vs = 7%
BBA D 2 0/10	Type to be stated	V_{min5} at V_{max9} (40 gyrations)	$ITSR_{80}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%	• $S_{min5\ 500}$ (≥ 5 500 MPa at 15°C, 10Hz or 0.02s) • Vi= 4% – Vs = 7%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 4% – Vs = 7%
BBA D 3 0/10	Type to be stated	V_{min5} at V_{max9} (40 gyrations)	$ITSR_{80}$	• $P_{7.5}$ (≤7.5% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%	• $S_{min7,000}$ (≥ 7,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 4% – Vs = 7%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 4% – Vs = 7%
BBA D 1 0/14	Type to be stated	V_{min5} at V_{max9} (60 gyrations)	$ITSR_{80}$	• P_{15} (≤15% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%	• $S_{min5\ 500}$ (≥ 5 500 MPa at 15°C, 10Hz or 0.02s) • Vi= 4% – Vs = 7%	• $\varepsilon_{6\text{-}130}$ (≥130.10^{-6} at 10°C, 25Hz) • Vi= 4% – Vs = 7%
BBA D 2 0/14	Type to be stated	V_{min5} at V_{max9} (60 gyrations)	$ITSR_{80}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%	• $S_{min5\ 500}$ (≥ 5 500 MPa at 15°C, 10Hz or 0.02s) • Vi= 4% – Vs = 7%	• $\varepsilon_{6\text{-}100}$(≥100.10^{-6} at 10°C, 25Hz) • Vi= 4% – Vs = 7%
BBA D 3 0/14	Type to be stated	V_{min5} at V_{max9} (60 gyrations)	$ITSR_{80}$	• $P_{7.5}$ (≤7.5% - 60°C and 10,000 cycles) • Vi= 4% – Vs = 7%	• $S_{min7,000}$ (≥ 7,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 4% – Vs = 7%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 4% – Vs = 7%

** *Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures - Part 1: DURIEZ test on hit-mix).*

Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity.

Table 32: Performance to be attained, with the fundamental approach, for class D BBA wearing courses

Name, class, type	binder	% voids (GSC)	Water sensitivity **	Resistance to rutting	Modulus	Fatigue
GB 2 0/14	Type to be stated	V_{max11} (100 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 8% – Vs = 11%	• $S_{min9,000}$ (≥ 9,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 7% – Vs = 10%	• $\varepsilon_{6\text{-}80}$ (≥ 80.10^{-6} at 10°C, 25Hz) • Vi= 7% – Vs =10%
GB 2 0/20	Type to be stated	V_{max11} (120 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 8% – Vs = 11%	• $S_{min9,000}$ (≥ 9,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 7% – Vs = 10%	• $\varepsilon_{6\text{-}80}$ (≥ 80.10^{-6} at 10°C, 25Hz) • Vi= 7% – Vs =10%
GB 3 0/14	Type to be stated	V_{max10} (100 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 7% – Vs = 10%	• $S_{min9,000}$ (≥ 9,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 7% – Vs = 10%	• $\varepsilon_{6\text{-}90}$ (≥ 90.10^{-6} at 10°C, 25Hz) • Vi= 7% – Vs =10%
GB 3 0/20	Type to be stated	V_{max10} (120 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 10,000 cycles) • Vi= 7% – Vs = 10%	• $S_{min9,000}$ (≥ 9,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 7% – Vs = 10%	• $\varepsilon_{6\text{-}90}$ (≥ 90.10^{-6} at 10°C, 25Hz) • Vi= 7% – Vs =10%
GB 4 0/14	Type to be stated	V_{max9} (100 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%	• $S_{min\ 11,000}$ (≥ 11,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 5% – Vs = 8%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 5% – Vs = 8%
GB 4 0/20	Type to be stated	V_{max9} (120 gyrations)	$ITSR_{70}$	• P_{10} (≤10% - 60°C and 30,000 cycles) • Vi= 5% – Vs = 8%	• $S_{min11,000}$ (≥ 11,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 5% – Vs = 8%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 5% – Vs = 8%

** *Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures - Part 1: DURIEZ test on hit-mix).*

Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity..

Table 33: Performance to be attained, with the fundamental approach, for road base asphalt for sub-base and roadbase layers

Name, class, type	binder	% voids (GSC)	Water resistance**	Rutting resistance	Modulus	Fatigue
EME 1 0/10	Type to be stated	V_{max10} (80 gyrations)	$ITSR_{70}$	• $P_{7.5}$ (≤7.5% - 60°C and 30,000 cycles) • Vi= 7% and Vs = 10%	• $S_{min14,000}$ (≥ 14,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 7% and Vs = 10%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} to 10°C, 25Hz) • Vi= 7% and Vs =10%
EME 1 0/14	Type to be stated	V_{max10} (100 gyrations)	$ITSR_{70}$	• $P_{7.5}$ (≤7.5% - 60°C and 30,000 cycles) • Vi= 7% and Vs = 10%	• $S_{min14,000}$ (≥ 14,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 7% and Vs = 10%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 7% – Vs =10%
EME 1 0/20	Type to be stated	V_{max10} (120 gyrations)	$ITSR_{70}$	• $P_{7.5}$ (≤7.5% - 60°C and 30,000 cycles) • Vi= 7% and Vs = 10%	• $S_{min14,000}$ (≥ 14,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 7% and Vs = 10%	• $\varepsilon_{6\text{-}100}$ (≥100.10^{-6} at 10°C, 25Hz) • Vi= 7% and Vs =10%
EME 2 0/10	Type to be stated	V_{max6} (80 gyrations)	$ITSR_{70}$	• $P_{7.5}$ (≤7.5% - 60°C and 30,000 cycles) • Vi= 3% and Vs = 6%	• $S_{min14,000}$ (≥ 14,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 3% and Vs = 6%	• $\varepsilon_{6\text{-}130}$ (≥130.10^{-6} at 10°C, 25Hz) • Vi= 3% and Vs = 6%
EME 2 0/14	Type to be stated	V_{max6} (100 gyrations)	$ITSR_{70}$	• $P_{7.5}$ (≤7.5% - 60°C and 30,000 cycles) • Vi= 3% – Vs = 6%	• $S_{min14,000}$ (≥ 14,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 3% and Vs = 6%	• $\varepsilon_{6\text{-}130}$ (≥130.10^{-6} at 10°C, 25Hz) • Vi= 3% and Vs = 6%
EME 2 0/20	Type to be stated	V_{max6} (120 gyrations)	$ITSR_{70}$	• $P_{7.5}$ (≤7.5% - 60°C and 30,000 cycles) • Vi= 3% – Vs = 6%	• $S_{min14,000}$ (≥ 14,000 MPa at 15°C, 10Hz or 0.02s) • Vi= 3% and Vs = 6%	• $\varepsilon_{6\text{-}130}$ (≥130.10^{-6} at 10°C, 25Hz) • Vi= 3% and Vs = 6%

** *Water sensitivity NF EN 12697-12 . Bituminous mixtures - Test methods for hot mix asphalt - Part 12: Determination of the water sensitivity of bituminous specimens. The European version of November 2003 contains some inaccuracies that may affect the results and is currently being revised so that it includes a compression method derived from the standard NF P 98-251-1 (September 2002) Essais relatifs aux chaussées - Essais statiques sur mélanges hydrocarbonés - Partie 1 : Essai DURIEZ sur mélanges hydrocarbonés à chaud (Test relating to pavements - Static test on bituminous mixtures - Part 1: DURIEZ test on hit-mix).*

Until the revised version is published it is strongly recommended to use the second of these standards in order to characterize water sensitivity.

Table 34: Performance to be attained, with the fundamental approach, for mixes for EME sub-base and roadbase layers

Annex E: Reclaimed asphalt information sheet

Place of storage / Coating plant:		Company:
Diameter of the pieces of recycled asphalt:		
Quantity stored:		Date of test report:
Mean binder content:	Category: TL_{NS} ☐	TL_2 ☐ $T L_1$ ☐
	Mean $T_{R\&B}$ of binder:	
Or mean penetration of binder :	Category: B_{NS} ☐	B_2 ☐ B_1 ☐
D of the stripped aggregate:	Category: G_{NS} ☐	G_2 ☐ G_1 ☐
Intrinsic characteristics - Category R_{NS} ☐	R_1 base or sub-base and road-base ☐	R_1 wearing ☐

Binder content	Number of measurements or Doc (1) ☐			
	Max.			
	Min.:			
	Difference:			
	Category of binder content (2)	TL_{NS}	TL_2 < 2 %	TL_1 < 1%

$T_{R\&B}$ or Penetration of binder	Number of measurements				Number of measurements			
	Max $T_{R\&B}$: (≤ 7)				Max. Pen: (≥ 5)			
	Min. $T_{R\&B}$:				Min pen.:			
	Difference:				Difference:			
	Binder category (2)	B_{NS}	B_2	B_1< 8	Binder category(2)	B_{NS}	B_2	B_1<15 1515

Particle size analysis of aggregate after binder stripping	Passing 1.58 Den e:	Number of measurements :					
	screen	Min.:			NS	> 99	
	D	Max.:			NS	< 99	
		Min.:			NS	≥ 80	≥ 85
		Difference:			NS	≤ 15	≤ 10
		Max.:	Min.:	Diff.: Différence:			
	2 mm				NS	≤ 20	≤ 15
	0.08 mm				NS	≤ 6	≤ 4
	Grading category (2)				G_{NS}	G_2	G_1

Intrinsic characteristics of the aggregate		class d/D tested:	Doc(1)		
	LA		☐		
	MDE		☐		
	PSV or RAP		☐		
	Friability of sand	D:	☐		
	Category of intrinsic characteristics(2)			R_{NS}	R_1

(1) Tick if documentary proof exists of the original binder content or the intrinsic characteristics.

(2) Put a ring round the appropriate category.

Annex F: List of tables

service d'Études techniques des routes et autoroutes

Sétra

46 avenue
Aristide Briand
BP 100
92225 Bagneux Cedex
France
téléphone :
33 (0)1 46 11 31 31
télécopie :
33 (0)1 46 11 31 69
internet : www.setra.
equipement.gouv.fr

On 1 March 2008, the product standards in the NF P series will be definitively withdrawn and replaced by the new NF EN French standards derived from European standardization.

This document explains the nomenclature and formulation of the mixes generally used in France and how they correspond to European standards. It also sets out the stages of the French mix design process.

The series of European standards covers French mixes and others besides, for wearing courses, base courses and sub-base and road base layers. It is therefore necessary to present the information in the European standards to make it suitable for application in the French context

This technical guide makes it possible to perform this transcription. It is divided into a number of sections which explain the references to standards, the bituminous materials used in France, the type tests for mixes, the characteristics of the aggregates, the fines, the coating binder and the use of reclaimed asphalt. The guide does not deal with recommendations for laying, but explains where this information can be found.

The guide ends with a series of Annexes containing tables that summarize the mix formulations, the minimum characteristics of the aggregates, the performance that is expected of the various types of mix, ending with a reclaimed asphalt information sheet.

The Sétra belongs to the scientific and technical network of the French Public Work Ministry (RST)

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