

The harmonised European standard test methods for asphalt mixtures

Prepared for Highways Agency, Quarry Products Association and Refined Bitumen Association

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Executive Summary

The national standard specifications and test methods across Europe are being harmonised by the Comité Européen de Normalisation (CEN). This harmonisation is adopting an inclusive approach that will increase the number of potential test methods for any member country. The current intention is that the package of CEN specifications and test methods for asphalt will be adopted in December 2003, when equivalent national standards will have to be withdrawn. Therefore, all sides of industry need to familiarise themselves with the new standards that they will have to use and to plan their future strategy accordingly.

The proposals for the extended list of European tests have been reviewed with an emphasis on comparison with current British tests and on their suitability for use with performance-related specifications. The test methods are described, with more emphasis being placed on those that may be useful but which are not currently used in the United Kingdom. Any significant differences between the draft European methods and their BS equivalents are also pointed out. The review shows that the change to the harmonised European test methods is unlikely to be detrimental to the move towards performance-related specifications. This comprehensive review will help to prepare the UK asphalt industry for harmonisation and enable it to assess how the CEN Standards may impinge on work practices prior to implementation. However, it should be borne in mind that changes may be made subsequently in the test procedures as the drafts pass through the various approval stages.

1 Introduction

1.1 CEN Standards for asphalt

The European Committee for Normalisation, or Comité Européen de Normalisation (CEN), have programmes to produce harmonised Standards across Europe for many product areas, which include asphalt surfacing mixtures and their component materials. This harmonisation is important because, when completed, the standard specifications and associated test methods being developed by the various committees will be adopted by each of the States that subscribe to CEN. CEN itself will not publish the finished Standards; the documents will be published by each national standardisation committee as their national Standards and they will be introduced in packages of specification(s) with associated test methods. The asphalt package, together with the aggregate package, is currently scheduled to be implemented in December 2003.

The relevant CEN Working Group for asphalt is TC 227/WG 1. This Working Group is producing harmonised specifications and test methods for asphalt mixtures, but with a longer-term intention of achieving performance-related specifications and the necessary test methods to support them. The harmonised specifications being produced initially are for:

- prEN 13108-1, Asphalt concrete (including both designed 'Marshall' asphalt and 'recipe' macadams);
- prEN 13108-2, Very thin surfacings;
- prEN 13108-3, Soft asphalt;
- prEN 13108-4, Hot rolled asphalt;
- prEN 13108-5, Stone mastic asphalt;
- prEN 13108-6, Mastic asphalt and Gussasphalt; and
- prEN 13108-7, Porous asphalt (including airfield friction course).

The test methods being developed to support these specifications for mixed materials are given in Table 1. This list is more extensive than currently required by any individual national specification and it is not intended that all the properties will be mandatory; some will optional whilst others will be for information only.

Although a great deal of work has been carried out by the Task Groups in TC 227/WG 1, it takes a considerable time to reach agreement across Europe. Therefore, as yet, no specifications or test methods have been published, but there are many whose technical content is essentially finalised. Therefore, it is an opportune time to review their contents and assess the implications of their adoption before they have to be voted on and, if accepted, replace existing British Standards.

1.2 Stages in the drafting of CEN standards

The formal stages in the preparation of a European Standard are given in Appendix A. In the case of TC 227/WG 1/Task Group 2 (TG 2) dealing with test methods, each asphalt test method is allocated to one member of the Task Group to draft in consultation with other members, as required. After the first draft has been prepared, there are a series of increasingly wide consultations; initially the Task Group, then the Working Group, etc. After each consultation, the comments are tabulated, together with the consequential actions, and a revised draft is produced. In the process, there is a general understanding that comments should be accommodated as far as possible in order to facilitate the approval of the draft.

There are about forty different test methods for asphalt materials (see Table 1) currently being prepared by CEN TC 227/WG 1/TG 2. If these drafts are finally approved, they will supersede all the equivalent British Standard test methods. The stage that each test method has reached is summarised in Appendix B.

Ideally, each draft CEN Standard test method should include aspects of each of the test methods currently used in the various Member States. However, not every nation has a test procedure for all the properties and some of the methods for measuring the same nominal property use a completely different approach. Therefore, in some drafts the 'best' or most widely used alternative has been selected whilst, in others, more than one option has been included. However, the options selected are often influenced by the experience of the member of TG 2 who drafts the harmonised Standard.

1.3 Contents of review

This report is intended for readers currently working with British Standards, although readers who use other sets of standards may still find it of use. The review is only current at the time of writing (May 2000) because some of the draft standards may well have significant changes, either technical or organisational, during the remaining drafting and comment stages.

The report on each draft CEN Standards in the following sections gives details of:

- the member of TG 2 responsible for drafting it;
- the status of the test method within the CEN approval procedure;
- the date of the draft being assessed;
- the scope of the Standard as set out in the current draft¹; and
- the equivalent BSI Standard, if there is one, or a related specification.

The drafts themselves are not put into the public domain other than at public enquiry stages and, as such, not all those reviewed are available to other than members of the relevant CEN Committee, Working Party or Task Group.

If the draft method is similar to a BSI method, then the principal differences are identified and the implications discussed. If the test is new to the United Kingdom, then the principle of the method is discussed together with an assessment of whether it will be of use in the United Kingdom (some tests will not be applicable, such as the test for abrasion by studded tyres).

¹ Suggested clarifications to the English, where given, are shown in square brackets.

The assessments have been made after allocating each test to one of the following four categories:

- A Tests that need a full explanation of their applicability and their implications for the United Kingdom.
- B Tests that need a brief explanation of their applicability and their implications for the United Kingdom.
- C Tests that are already well established in the United Kingdom and only require a brief indication of any differences between the current United Kingdom and proposed CEN methods and the likely effects (if any) of those differences.
- D Tests that are unlikely to be used in the United Kingdom and, for these, only a brief description is given.

Table 1 CEN test methods for bituminous materials

The order in which the test methods are listed in the following assessments is according to the following categories:

- Sampling and sample preparation.
- Analysis.
- Density and compaction.
- Mixture design.
- Performance-related.
- Fundamental.
- Oddments.

The tests for surface characteristics, such as texture depth, skid resistance and evenness, are not included because they are being drafted by the Task Groups in a different Working Group of the Technical Committee, CEN TC 227/WG 5/TG 1 and TG 2.

Number	Title
prEN 12697-1	Soluble binder content
prEN 12697-2	Particle size distribution
prEN 12697-3	Binder recovery, rotary evaporator
prEN 12697-4	Binder recovery, fractionating column
prEN 12697-5	Maximum density
prEN 12697-6	Bulk density by hydro-static method or by dimensions
prEN 12697-7	Bulk density by gamma rays
prEN 12697-8	Air voids content
prEN 12697-9	Reference density
prEN 12697-10	Compactibility
prEN 12697-11	Compatibility between aggregates and binder
prEN 12697-12	Water sensitivity
prEN 12697-13	Temperature measurement
prEN 12697-14	Water content
prEN 12697-15	Segregation sensitivity
prEN 12697-16	Abrasion by studded tyres
prEN 12697-17	Particle loss from porous asphalt
prEN 12697-18	Binder drainage
prEN 12697-19	Permeability of porous asphalt specimen
prEN 12697-20	Indentation using cube or Marshall specimen
prEN 12697-21	Indentation using plate specimen
prEN 12697-22	Wheel-tracking
prEN 12697-23	Indirect tensile strength
prEN 12697-24	Resistance to fatigue
prEN 12697-25	Cyclic compression
prEN 12697-26	Stiffness
prEN 12697-27	Sampling
prEN 12697-28	Prep. of samples for determining binder content, water content and grading
prEN 12697-29	Dimensions of a bituminous specimen
prEN 12697-30	Specimen preparation by impact compactor
prEN 12697-31	Specimen preparation by gyratory compactor
prEN 12697-32	Specimen preparation by vibratory compactor
prEN 12697-33	Specimen preparation by slab compactor
prEN 12697-34	Marshall test
prEN 12697-35	Laboratory mixing
prEN 12697-36	Thickness of a bituminous pavement
prEN 12697-37	Adhesivity of binder on precoated chippings for hot rolled asphalt
prEN 12697-38	Test equipment and calibration
Not allocated	Soluble binder content of polymer-modified mixtures
Not allocated	Binder content by ignition
Not allocated	Hydraulic conductivity of mix in the layer

2 Sampling and sample preparation procedures

2.1 Sampling		
Reference Number:		prEN 12697-27
Assessment category:		C
TG 2 drafter:		John Richardson and Cliff Nicholls, United Kingdom
Latest draft:	Date: Status:	December 1999 Formal Vote (Stage 51)
Scope:		The Standard 'describes test methods for sampling bituminous mixtures for roads and other paved areas to determine their physical properties and composition.'
Summary of method:		The method specifies the equipment to be used and the procedure to be followed when sampling asphalt materials in the following situations:
		 mastic asphalt from a mixer transporter.
		 mixed material from around the augers of a paver.
		• mixed material from a heap,
		• from laid but not rolled material using a sampling tray,
		• from laid but rolled material using a trench,
		• from laid and compacted material by coring,
		• from laid and compacted material by manually breaking out or sawing,
		• from the slat conveyor of a continuous process plant, and
		• from stockpiles of pre-coated chippings.
		The advantages and disadvantages of each method are given.
Equivalent BS: Principal differences:		BS 598: Part 100: 1987 (incorporating Amendments 1 and 2) The advice on the minimum mass of bulk samples is not given because it was considered to depend on the test to be carried out. All the processes in the British Standard are included with very similar text except that sampling during discharge from a mixing plant has been made specific for mastic asphalt from a 'mixer transporter'. Methods for sampling from laid but rolled material using a trench and from laid and compacted material by sawing or manually breaking out have been added. One change is that the nominal size of increments for material with aggregate sizes less than or equal to 16 mm is reduced from 7 kg to 3 kg.
Implications for	or UK:	The use of this draft CEN Standard should not have any adverse implications for current UK practice because it is closely aligned to the present British Standard except that sampling from the mixing plant is not included.

2.2 Preparation of samples for determining binder content, water content and grading

Reference Numb	ber:	prEN 12697-28
Assessment category:		C
TG 2 drafter:		John Richardson and Cliff Nicholls, United Kingdom
Latest draft:	Date: Status:	December 1999 Formal Vote (Stage 51)
Scope:		The Standard 'describes test methods for preparing test portions for the determination of the binder, water content and grading of samples of bituminous mixtures, when the sample submitted to the laboratory has a mass greater than or equal to four times the test portion.'
Summary of met	thod:	The Standard sets out how to inspect and store laboratory samples on arrival from site, together with preliminary treatments for:
		• situations where binder drainage or the presence of uncoated aggregate may occur with samples taken before compaction; and
		• the presence of pre-coated chippings, surface dressings, bond coats, fractured aggregate, multiple courses or free water with samples of compacted material.
		The samples are then heated, if they cannot be remixed at room temperature, and reduced to the required mass by either quartering from heaps or by the use of a sample splitter.
Equivalent BS: Principal differences:		BS 598: Part 101: 1987 (incorporating Amendment 1) The wordings of both Standards are very similar. The main differences are that, in the draft CEN Standard:
		• a warm laboratory is quantified at (21 ± 3) °C;
		• the maximum temperature for reheating are marginally reduced for mixtures with binders having penetrations less than 55 dmm but increased significantly for those with penetrations greater than 200 dmm at 25 °C;
		• no reheating temperatures are given for tar-bound mixtures because tar-bound materials are not included in the CEN asphalt standards;
		• the maximum mass of mixture required (for which the nominal aggregate sizes are changed to the CEN sizes) is only informative and not normative; and
		• there is not a separate table of mass.
Implications for	UK:	The use of this draft CEN Standard should not have any adverse implications for current UK practice because it is so closely aligned to the present British Standard.

2.3 Laboratory	mixing	
Reference Number:		prEN 12697-35
Assessment categ	gory:	C
TG 2 drafter:		Oskar Neubauer, Switzerland
Latest draft:	Date: Status:	August 1999 Final WG1 draft for internal voting
Scope:		The Standard 'describes the manually [manual] or mechanically [mechanical] mixing of bituminous materials in the laboratory for preparation of specimens to be used for testing.'
Summary of method:		The bitumen and aggregates are pre-heated to nominal temperatures depending on the binder grade and whether the material is mastic asphalt or not. The aggregate is then weighed into a bowl and any admixtures added and mixed. The prescribed mass of binder is added and the material mechanically mixed for up to 3 min or manually mixed for up to 5 min. The quantity is limited to that sufficient for one sample if it is mixed manually.
Equivalent BS:		None directly, but BS 598: Part 107: 1990, Clause 6 does include a specific procedure for mechanically mixing hot rolled asphalt for the manufacture of 'Marshall' specimens.
Implications for UK:		The draft CEN Standard is an additional procedure that will be a requirement for testing laboratories. However, it is assumed that most already have in-house procedures to cover this activity. The proposal should not run counter to present practice, and will help to standardise procedures.

2.4 Specimen preparation by impact compactor

Reference Number:		prEN 12697-30
Assessment category:		В
TG 2 drafter:		Peter Gauer, Germany
Latest draft:	Date: Status:	January 2000 (BSI DPC No. 00/101937DC) CEN enquiry (Stage 41)
Scope:		The Standard 'describes methods of moulding specimens from bituminous mixtures by impact compaction. Such specimens are primarily used to determine volumetric density and other technological characteristics. The laboratory preparation of mixtures of mineral aggregates and binders (e.g. for suitability tests) is described in EN 12697-35. The sampling and handling of plant mix asphalt is described in EN 12697-27. The sampling and handling of cores is described in EN 12697-27.'
Summary of method:		The required quantity of asphalt is mixed and kept for not more than three hours at up to 130 °C. It is brought up to the compaction temperature (135 °C for unmodified, 155 °C for mixtures with modified binders) and poured loose into a pre-warmed steel mould of 101.6 mm diameter by 63.5 mm high (or 150 mm diameter by a height still to be decided) and covered with a paper disc. The asphalt is compacted by 50 blows of a sliding mass of 4.55 kg falling 460 mm. The mould is then reversed and compacted by a further 50 blows. If the specimen is being compacted to refusal density, the process is repeated with a further 50 blows on each face. There are maximum time constraints on each operation. The specimens are then cooled to 40 °C before being demoulded, water-cooling being permitted when quick results are needed.
		The compaction takes place with the specimen on an anvil. The anvil can be of steel or of wood, but steel is defined as the preferred option. However, the draft does state that 'compatible [comparable] results are expected by use of the alternative apparatus if the wooden block is in compliance with the specified requirements'.
Equivalent BS:		BS 598: Part 107: 1990 (incorporating Amendments 1 and 2), Clause 7
Principal differer	nces:	The filling of the mould is given in less detail in the draft CEN Standard and does not positively require cooling in water. The British Standard gives the compaction temperature as 92 °C above the softening point of the binder rather than a fixed value for modified and unmodified mixtures.
Implications for	UK:	The preference for the steel anvil may require some testing laboratories to re-equip for reference purposes, but the assumed equality will allow the majority of work to be undertaken with existing equipment.

2.5 Specimen preparation by gyratory compactor

Reference Num	ber:	prEN 12697-31	
Assessment cate	egory:	А	
TG 2 drafter:		Jean-Luc Delorme, France	
Latest draft:	Date: Status:	January 2000 (BSI DPC No. 00/10 CEN enquiry (Stage 41)	1936DC)
Scope:		The Standard 'specifies the method mixtures using a gyratory compact shearing action and an axial resulta used for:	I for compaction of cylindrical specimens of bituminous or. Such compaction is achieved by combining a rotary ant force applied by a mechanical head. The method can be
		• the preparation of specimens of testing of their mechanical prop	given height at a predetermined density, for subsequent erties.
		• the derivation of a curve density determination of reference dens of the compactibility, according	versus number of gyrations. This curve can be used for the ities according to prEN 12697-9, and for the characterisation to prEN 12697-10.
		This Draft European Standard is an [the] laboratory and those resulting not larger than 31,5 mm.'	pplicable to bituminous mixtures (both those made up in from work site sampling), with a maximum aggregate size
Summary of me	ethod:	The mixture is prepared in accorda sufficiently to be able to break it up Cylindrical moulds and inserts in t at least two hours. The mould is fil retained within an insert. The filled two hours.	nce with the relevant Standard and, if a core, heated o in order to sample the required mass of material. he gyratory compactor are heated to the test temperature for led with the required mass of the bituminous mixture and I mould is kept at the test temperature for between half and
		Compaction is achieved by the sim shearing action resulting from the of revolution, while the ends of the surface at all times (Figure 1). The throughout the test. During the test constant but its height, which is co	ultaneous action of a low static compressive force and the notion of the centre-line, which generates a conical surface test piece remain perpendicular to the axis of the conical angle is kept constant, within a prescribed tolerance, , the cross-section and the mass of the specimen remain ntinuously monitored, reduces.
		The angle through which the samp compaction machine using three re revolutions per minute and the test temperature is specified in prEN 12697-35.	le is turned is calibrated for a particular gyratory ference mixtures. The speed of rotation is between 6 and 32
		The density of the material is derived from the height of the specimen. If the method is used to prepare specimens at a predetermined density, the compaction process is ended when the height attained corresponds to the required density.	F
Equivalent BS:		None.	× @
Implications for	UK:	With the introduction of gyratory compaction machines becoming more common in UK laboratories, there is a need for a standard method for their use and this draft CEN Standard will satisfy that need. The important issue is the use of this draft CEN	Figure 1 Test piece motion diagram

Standard in specifications and in other test methods in relation to the equivalence of the various methods of compaction (impact, gyratory, vibratory and slab), which will also become more commonplace.

Other comments: An inter-laboratory pre-normative trial has been carried out to show that the different types of gyratory compactor currently available produce the same result but require slightly different nominal angles through which to rotate the specimen.

2.6 Specimen preparation by vibratory compactor

Reference Number:		prEN 12697-32
Assessment category:		В
TG 2 drafter:		John Richardson, United Kingdom
Latest draft:	Date: Status:	December 1999 Awaiting Formal Vote (Stage 50)
Scope:		The Standard 'describes a compaction method for the preparation of bituminous test specimens using a vibratory compaction technique. The method is applicable for both loose mixtures and cores and can be used to establish the reference density for a mixture, in accordance with the procedures described in prEN 12697-9 or the ease of compaction, as described in prEN 12697-10.'
Summary of method:		Core specimens are heated until the centre of the sample is at the test temperature. The core or a loose mixture (either plant-mixed or laboratory-prepared) is placed in a 152 mm diameter mould, covered with a paper disc and compacted with a vibratory compactor of which the 102 mm diameter tamping foot has been preheated to above 60 °C. The vibrator is moved in a set pattern around the mould until the total time of compaction is 120 seconds. The specimen is then levelled with a 146 mm diameter tamping foot.
		A spare base plate is clamped to the top of the mould, the specimen inverted and the original base plate removed. The sample is pushed firmly to the bottom of the mould with the 146 mm diameter tamping foot before being compacted for a further 120 seconds with the 102 mm diameter tamping foot. When completed, the sample is allowed to cool in air for at least 2 hours before being removed from the mould.
Equivalent BS:		BS 598: Part 104: 1989 (incorporating Amendments 1 and 2), Clause 3
Principal differen	nces:	The draft CEN Standard includes only the compaction, the calculation of PRD is in a separate part of prEN 12697 (Section 4.5).
Implications for UK:		The draft CEN Standard is based on the British Standard and, therefore, its adoption should not present any problems in the United Kingdom.

2.7 Specimen preparation by slab compactor

Reference Number:		prEN 12697-33
Assessment category:		Α
TG 2 drafter:		Jean-Luc Delorme, France
Latest draft:	Date: Status:	August 1999 (BSI DPC No. 99/106558DC) Results received from CEN enquiry (Stage 46)
Scope:		The Standard 'specifies the methods for compacting parallelepipedic specimens (slabs) of bituminous mixtures, to be used directly for subsequent testing, or from which test specimens are cut. For a given mass of bituminous mixture, the specimen can be prepared either under controlled compaction energy, or until a specified volume and therefore bulk density are obtained. This standard describes three methods, which differ by the compaction process:
		• method using one or two wheels fitted with pneumatic tyres;
		• method using a smooth steel roller;
		• method using a kneading action by metal sliding plates.
		This standard is applicable to bituminous mixtures manufactured in the laboratory or in a mixing plant.'
Summary of method:		The appropriate mass of asphalt is mixed and placed in the mould. The required mass of the mixture is selected to allow for a reduction in volume with compaction. The specimens are then compacted by one of the three pieces of apparatus, although the dimensions of each are only defined in terms of 'usual dimensions'. After completion, the specimens are allowed to cool to room temperature before being removed from the mould.
		In the method using one or two wheels fitted with pneumatic tyres, the number of passes, the tyre pressure and the lateral displacement between passes are defined for 'light compaction' and 'heavy compaction' with either 1 or 2 tyres. Advice on when to use light or heavy compaction is not given. Compaction can be until a specified energy has been applied or until a specified air voids content has been reached.
		In the method using a smooth steel roller, the roller is lubricated by a mild soapy solution or the material being compacted is separated from the roller by a thin malleable sheet (or film). Again, compaction can be until a specified energy has been applied or until a specified air voids content has been reached. A vibrating roller can be used, although this option is not mentioned in the scope.
		In the method using a kneading action by metal sliding plates (where the sliding plates are mounted vertically and press down on the specimen when a roller passes over them), compaction is until a specified air voids content has been reached.
Equivalent BS:		None.
Implications for	UK:	The availability of a standard method for compaction of slabs will allow the wheel-tracking test to be used as a compliance test as well as a design test. However, the availability of slab compactors in UK laboratories is relatively limited. Therefore, it is important (at least in the short to medium term) that none of these methods becomes the only method that can be used with a test procedure (such as wheel-tracking) in the United Kingdom. This concern would be exacerbated if the pneumatic tyre or sliding plate compactors (as currently used in France and Germany, respectively) were to become the reference method.

Analysis methods

3.1 Soluble bin	der conter	ıt
Reference Number:		prEN 12697-1
Assessment category: TG 2 drafter:		C
		John Richardson and Cliff Nicholls, United Kingdom
Latest draft:	Date: Status:	May 2000 Formal Vote (Stage 51)
Scope:		The Standard 'describes test methods for the determination of the soluble binder content of samples of bituminous mixtures. The test methods described are suitable for quality control purposes during the production of plant mix and for checking compliance with a product specification. Test methods for the analysis of mixtures containing modified binders are outside the scope of this European Standard.'
Summary of method:		The Standard provides a unified approach to the examination of asphalt mixtures that allows some divergence in the detail of procedures followed by individual laboratories. The determination of binder content comprises:
		• binder extraction by dissolving the sample in a hot or cold solvent;
		• separation of the mineral matter from the binder solution;
		• determination of the binder content by difference or by binder recovery;
		• calculation of the soluble binder content; and
		• if required, correction for any insoluble portion of the binder.
		The Standard includes a definition of binder content that does allow for there being an insoluble portion.
		The basic operations for both binder extraction and separation of the mineral matter are given, together with guidance on the choice of the alternative items of equipment in an informative annex. The test methods with the different equipment (hot extractor with paper filter, hot extractor with mesh filter, Soxhlet extractor, bottle rotation machine, centrifuge extractor and agitation for binder extraction; continuous flow centrifuge, pressure filter and bucket type centrifuge for separation of mineral matter) are given in another, normative, annex with a separate informative annex for a method of determining the residual mineral matter in the binder by extract by incineration.
		The hot extractor (paper filter) is the same as the BS hot extractor method, except that there is a modified condenser to allow for solvents with a density less than unity.
		The hot extractor (mesh filter) is a glass or metal extractor, fitted with a condenser and suitable extraction cup. The test portion is weighed into dried extraction thimbles made of fibrous material in the extraction cup. The extraction cup is placed in the extraction apparatus and the binder extracted by boiling the solvent until the condensed solvent becomes colourless. After extraction, the mineral aggregate with its container is removed and dried to constant mass. The solution is filtered through filter paper, or centrifuged, to remove any fine material and the mass of insoluble matter determined.
		The Soxhlet extractor is a glass extractor, consisting of a flask, an extraction case with tap and vapour tube, and a condenser (Figure 2). The flask and dry extraction case are weighed before the test portion is added and the extraction case reweighed. The case with the test portion is placed on a gauze in the extractor, which has been filled with solvent. The extractor tap is then opened a heater switched on. The extraction is stopped when the solvent collected in the extractor becomes colourless. The mineral aggregate with its container is then removed and dried to constant mass. The solution is filtered through filter paper, or centrifuged, to remove any fine material and the mass of insoluble matter determined.
		The bottle rotation machine is the same as the BS extraction bottle method, with procedures for both binder determination by difference (procedure 1) and binder portion recovered (procedure 2).



Figure 2 Soxhlet equipment for binder content

The centrifuge extractor consists of a bowl (Figure 3), an apparatus in which the bowl may be revolved, a container for collecting the solvent thrown from the bowl and a drain for removing the solvent. A weighted test portion is placed into the bowl and covered with solvent for sufficient time for the solvent to disintegrate the test portion before being placed in the extraction apparatus. The filter discs are dried to constant mass and allowed to cool in a desiccator before being weighed. The mass of a filter ring is determined and it is fitted around the edge of the bowl. The cover is clamped on the bowl



Figure 3 Centrifuge extractor bowl for binder content

tightly and a beaker is placed under the drain to collect the extract. The centrifuge is operated until solvent ceases to flow from the drain, further solvent is added and the procedure repeated until the extract is colourless. The extract and washings are collected in a suitable container. The filter ring is removed from the bowl and dried. The contents of the bowl are removed into a metal tray and dried to constant mass. The mass of the extracted aggregate is calculated from the mass of the aggregate in the tray plus the increase in mass of the filter rings.

For the cold mix with dissolution by the agitation method, a weighed mass of asphalt is placed in a container at a temperature of less than 90 °C to which solvent is added. The mass of the solvent is:

- 1,6 times the mass of the sample if it contains more than 5 % of binder;
- 0,8 times the mass of the sample if it contains 5 % or less;
- 3 to 5 times the mass of the sample if it is mastic asphalt.

The sample is shaken for at least 30 min and then left to settle.

The continuous flow centrifuge is a high-speed continuous flow centrifuge set up as illustrated in Figure 4.

Two clean and dry centrifuge cups are weighed separately and one is placed in the centrifuge whilst the other is retained. The sieve that is fitted to the feed funnel is also weighed. The feed funnel is fitted centrally above the centrifuge funnel and the binder solution obtained from the binder extraction process is fed into the feed funnel. The feed funnel tap is adjusted to give the required flow rate into the running continuous centrifuge. The filler collected in the centrifuge cup is re-washed using as small a quantity of solvent



- 1 2 mm sieve (optional)
- 2 63 µm sieve
- Feed tunnel 3
- 4 Flow-regulating tap
- 5 Funnel introducing the liquid
- into the centrifuge cap 6 Cap catching the solution and conveying it to 7
- 8 Removable aluminium cup
- 9 Rotating cup holder
- 10 Electric motor
- 11 Support pin
- 12 Liquor receiver

Figure 4 Schematic diagram of a continuous flow centrifuge

	as possible until the decanted solvent becomes colourless. The centrifuged effluent is collected and the cup containing the extracted filler removed and placed in an oven for drying. The procedure is then repeated with the second cup except at a different flow rate. After the centrifuging is completed, the cup and feed funnel sieve are placed with the first cup in the oven for drying. The filler collected is calculated from the difference in weights of the two cups and the mineral matter retained is determined from the weigh the sieve.
	The pressure filter has a dry, pre-weighed filter paper fitted into it. A nest of test sieves is supported above a funnel mounted above the pressure filter. The binder solution obtained from the binder extraction process is decanted through the test sieves into the pressure filter, being forced through the filter paper using air pressure. The receptacle containing the washed aggregate is rinsed to remove as much of the mineral matter as possible; the washings are passed through the sieves and the pressure filter until the solvent is clear. The clean aggregate is transferred from sieves to a tray and the solvent evaporated from the aggregate, the sieves and the receptacle. Any mineral matter in the receptacle is transferred to the tray with the remainder of the aggregate. The mass of the aggregate in the tray is weighed and the filter paper, complete with any mineral matter, is removed from the pressure filter and dried to constant mass. A filtering aid is permitted.
	The bucket centrifuge type 1 (for use with samples from the bottle rotation machine) is as described in Annex E of the British Standard for the extraction bottle method: binder directly determined. Part of that method is separated off into Section B.3, Soluble binder content.
	The bucket centrifuge type 2 (for use with agitated samples) uses higher speeds of not less than $40\ 000\ \text{m/s}^2$ for at least 30 min for mastic asphalt and for at least 15 min for other types of mixture.
	The sets of different equipment are deemed to be equally suitable for carrying out particular parts of the test. Other methods and equipment, including automated equipment, can be used provided that it can be demonstrated that they provide the same results as one of the given methods within the limits of the precision given in the Standard.
Equivalent BS:	BS 598: Part 102: 1996
Principal differences:	All the methods in BS 598: Part 102 are included, with the extraction bottle method (5.1 & 5.2) being combined into the bottle rotation machine (B.1.4), and the hot extractor method (5.3) becoming the hot extractor (paper filter) (B.1.1). No adjustment factors for the binder or filler contents are applied in the draft CEN Standard for the proportion of fine aggregate found relative to the design quantity. No solvents are named in the CEN draft because of conflicting views about the least dangerous.
Implications for UK:	The loss of the adjustment factors on the binder and filler contents for the deviation from the design quantity of fine aggregate will either produce tighter tolerances on gradings for recipe aspects of any specification or will require revision of the tolerances applied. Nevertheless, the draft CEN Standard does permit the procedures currently being used whilst allowing additional ones which have been proven elsewhere. Therefore, the implementation should allow greater flexibility without having any detrimental effects on the current or developing UK approaches to asphalt specification, providing due allowance is made for the loss of the correction factors.

3.2 Soluble binder content of mixtures containing modified binders

Reference Number:		Not yet allocated (new Work Item).
Assessment category:		Α
TG 2 drafter:		Ann Vanelstraete, Belgium
Latest draft:	Date: Status:	March 2000 First Working Group Draft
Scope:		The Standard 'describes the procedures to be followed for the determination of the soluble binder content of samples of bituminous mixtures containing modified binders. The test methods described are suitable for quality control purposes during the production of plant mix and for checking compliance with a product specification. This Standard makes use by reference of prEN 12697-1, Test methods for hot mix asphalt – soluble binder content.'
Summary of met	hod:	The draft CEN Standard gives advice on modifications to the procedures set out in prEN 12697-1 that need to be carried out when a mixture contains polymer-modified binder.
		With the hot extractor (paper filter and wire mesh filter) and Soxhlet extractor methods, extraction is not stopped when the solvent collected becomes colourless but is continued for a period of approximately 10 % of the time taken for the solvent to become colourless. It is recommended that the hot extractor should have a transparent inspection window in order to determine the completion of extraction. For the bottle rotation machine method, the minimum rolling times are increased. It is recommended that the rotation speed of the bottles does not exceed 20 rev/min, because of risks of crushing. For the centrifuge extractor method, extraction should be continued for an extra 200 ml addition of solvent after the extract has become colourless. For cold mix dissolution of modified binder by agitation, the container should be shaken for at least 45 min instead of 30 min. However, this method cannot be applied if the solubility of the modified binder is insufficient.
		For the separation of mineral matter by the continuous flow centrifuge, re-washing of the filler collected in the centrifuge cup should be repeated once more, after the decanted solvent has become colourless. The use of the pressure filter is not recommended for polymer modified binder because of risks of clogging. There are no changes to the methods for bucket centrifuges type 1 and type 2.
Equivalent BS:		None.
Implications for UK:		With the increasing use of polymer-modified binders, there is a need to have defined procedures for assessing the binder contents of such mixtures. However, there may be a need for the draft CEN Standard to go into more detail and give recommendations as to suitable solvents and/or additional procedures for each type of polymer currently used.

3.3 Binder content by ignition

Reference Number:	Not yet allocated (New Work Item)
Assessment category:	C
TG 2 drafter:	Cliff Nicholls, United Kingdom
Latest draft: Date: Status:	March 2000 First Working Group Draft
Scope:	The Standard 'describes the procedures to be followed for the determination of the binder content of samples of bituminous mixtures by ignition. As such, it is an alternative to the more traditional method of extracting the binder through the use of hazardous and/or environmental damaging solvents. The method can be used for evaluation of mixture composition because the remaining aggregate can be used for determining aggregate gradation and density provided excessive breakdown of the aggregate particles does not occur at the temperature reached. However, the need for calibration of a mixture before an analysis is carried out makes it inappropriate for routine compliance checking in many instances but it can be used for process control with regularly used mixtures, particularly when mixture compliance is checked against performance criteria rather than composition. The test method is equally suitable for the analysis of mixtures containing unmodified or modified binders because the method has to be calibrated for each mixture being checked.'
Summary of method:	The test method determines the binder content of bituminous mixtures by ignition in a furnace at a specified test temperature, usually 540 °C. The binder content is obtained by calculation that includes a calibration factor. Calibration factors are determined for particular mixtures or aggregates, where applicable. Two test methods are described; Method A utilises a furnace with an internal balance; Method B permits the use of a furnace and an external balance.
Equivalent BS:	BS DD 250: 2000
Principal differences:	The draft CEN Standard is based on the British Standard.
Implications for UK:	The test is environmentally more acceptable than traditional solvent methods, and its inclusion in the set of CEN standards will permit and encourage its future usage.
Other comments:	There are serious concerns about:
	 the applicability of the method because of the need to calibrate each mixture; and the universality of the method because of the potential for damage of aggregate particles from certain sources.

Hence, the scope includes warnings that the method is not suitable for routine compliance of mixtures and the lack of any significant breakdown of aggregate particles at the test temperature needs to be checked if the particle size distribution is to be evaluated.

3.4 Particle size distribution

Reference Number:		prEN 12697-2
Assessment category:		C
TG 2 drafter:		Joss van der Heide, Netherlands
Latest draft:	Date: Status:	November 1998 (BSI DPC No. 98/109469DC) Results received from CEN enquiry (Stage 46)
Scope:		The Standard 'describes a procedure for the determination of the particle size distribution of the aggregate of bituminous mixtures by sieving. This test can be carried out on the aggregate that is recovered after the binder extracting procedure according to prEN 12697-1. Note that fibres or solid (non-soluble during extraction) additives do influence the test result.'
Summary of method:		The Standard calls up prEN 933-1 for extracting the binder by solvent to obtain the aggregate with a rider that, if there is insufficient material available, all the material shall be used. The particle size distribution is then obtained by sieving. If the material has been thoroughly washed during extraction so that it has a limited fines content, dry sieving can be used but it has to be verified against wet sieving for each specific mixture.
Equivalent BS:		BS 598: Part 102: 1996, sub-clauses 5.1.5, 5.2.6 & 5.3.6
Principal differences:		Both standards refer to the aggregate analysis Standard. The BS methods require sieving of all the coarse aggregate but only a sample of the fine aggregate, whereas the draft CEN Standard leaves that aspect to the aggregate Standard.
Implications for UK:		There are no significant implications for the United Kingdom in having this aspect in a separate Standard.

3.5 Binder recovery, rotary evaporator

Reference Number:		prEN 12697-3
Assessment category:		C
TG 2 drafter:		John Richardson and Cliff Nicholls, United Kingdom
Latest draft:	Date: Status:	May 2000 Formal Vote (Stage 51)
Scope:		The Standard 'describes a procedure for the recovery of soluble bitumen from bituminous mixtures from pavements in a form suitable for further testing. This procedure is only suitable for the recovery of penetration grade bitumens.'
Summary of method:		The bitumen is separated from the sample by dissolving in dichloromethane. After removal of undissolved solids from the bitumen solution, the bitumen is recovered from it by vacuum distillation using a rotary evaporator. The bitumen is in solution for less than 24 h.
Equivalent BS:		BS 2000: Part 397: 1995
Principal differences:		The draft CEN Standard is based on the British Standard and, therefore, there are no significant differences. The main difference is that the sample is agitated and left to stand prior to centrifuging/filtering out the insoluble matter rather than being rotated gently.
Implications for UK:		None.

3.6 Binder recovery, fractionating column

Reference Number:		prEN 12697-4
Assessment category:		C
TG 2 drafter:		John Richardson and Cliff Nicholls, United Kingdom
Latest draft:	Date: Status:	May 2000 Formal Vote (Stage 51)
Scope:		The Standard 'describes a procedure for the recovery of soluble binder from bituminous mixtures from pavements in a form suitable for further testing. This procedure is suitable for the recovery of penetration grade bitumen and is also suitable for mixtures containing volatile matter such as cut-back bitumen but the results may be less precise. Note: There is limited experience of recovery when polymer-modified binders are used.'
Summary of method:		The binder is separated from the sample by dissolving in dichloromethane. After removal of undissolved solids, the binder solution is concentrated by atmospheric distillation in a fractionating column. The last traces of solvent are removed from the concentrate by distillation at an elevated temperature and reduced pressure with a stream of carbon dioxide gas. When cutback bitumens containing very volatile fluxes are being recovered, the carbon dioxide gas is omitted.
Equivalent BS:		BS 2000: Part 105: 1991 (withdrawn)
Principal differences:		The draft CEN Standard is based on the withdrawn British Standard and, therefore, there are no significant differences. The only omission is the advice on preparation of the binder solution, but this was only advice in the British Standard.
Implications for UK:		The inclusion of this test method in the CEN suite of tests will reinstate the situation in the United Kingdom because the fractionating column method was withdrawn when the rotary evaporator method became a full British Standard.

3.7 Water cont	tent	
Reference Number:		prEN 12697-14
Assessment category:		С
TG 2 drafter:		John Richardson and Cliff Nicholls, United Kingdom
Latest draft:	Date: Status:	May 2000 Formal Vote (Stage 51)
Scope:		The Standard 'describes a test method for the determination of the water content of samples of bituminous mixtures. The test method is suitable for checking compliance to a product specification, where required.'
Summary of method:		The laboratory sample is divided into two portions by quartering and one portion retained in a closed container. The other portion is weighed and placed in a well-ventilated oven at 110 °C for 1 hour before being re-weighed. If the loss in mass is less than 0,1 per cent, no further action is required. Otherwise, the retained portion is transferred to a dry hot extractor pot, possibly in a cylindrical container. Sufficient solvent is added in order to permit refluxing to take place and the apparatus assembled with an adequate flow of cold water and heat to give a steady reflux action. The heating continues until the volume of water in the receiver remains constant for at least 5 minutes. The volume of water is then measured. The water content is then calculated as a proportion either of the original sample or of the dried portions.
Equivalent BS:		BS 598: Part 102: 1996, Clause 6.
Principal differences:		The solvent to be used is not limited to trichloroethylene as in the British Standard.
Implications for UK:		The draft CEN Standard is based on the British Standard with a few minor changes and there are no adverse implications associated with its adoption.

4 Density and compaction methods

4.1 Maximum	density		
Reference Number:		prEN 12697-5	
Assessment category: TG 2 drafter:		C	
		Joss van der Heide, Netherlands	
Latest draft:	Date: Status:	December 1997 Awaiting Formal Vote (Stage 50)	
Scope:		The Standard 'describes three procedures for determining the maximum density of a bituminous material (voidless mass): a volumetric procedure, a hydrostatic one and a mathematical one. The test method described is intended for use with loose bituminous materials containing paving grade bitumens, modified binders or bituminous oils. The test is suitable for both fresh and aged bituminous materials. Samples may be supplied as loose material or as compacted material; the latter has to be separated first. General guidelines on selection of a test procedure to determine the maximum density of a bituminous mixture is given in [an] Annex'.	
Summary of method:		In the volumetric method (which is the reference method), the sample is broken up into coarse aggregate and agglomerations of not more than 6 mm diameter in order to expose any occluded voids. The volume of the material is measured as the de-aired water displaced in a pycnometer, after evacuating any air by the application of a partial vacuum. Boiled water or a suitable organic solvent can be used instead of de-aired water. The maximum density is then calculated from that volume and the dry mass of the sample.	
		In the hydrostatic method, the sample is broken up into coarse aggregate and agglomerations of not more than 6 mm diameter in order to expose any occluded voids. The material is then weighed in air and water. If required, a partial vacuum can be applied or the water used can have been boiled. The maximum density is calculated from the dry and wet masses.	
		In the mathematical method, the maximum density is calculated from the densities of the constituent components and their relative proportions in the mixture.	
Equivalent BS:		DD 228: 1996 (incorporating Amendment 1) and BS 598: Part 104: 1989 (incorporating Amendments 1 & 2), Appendix E	
Principal differences:		In the British Standards, the mathematical method is included in part of the Appendix to BS 598: Part 104 rather than DD 228. The draft CEN Standard:	
		• does not limit the maximum size of sample;	
		• allows heating to only 110 °C rather than 120 °C in order to break up samples;	
		• allows the test to be carried out at any temperature, with correction by using the density of water at that temperature, rather than standardising on 25 °C;	
		• calibration of the pycnometer is not required for the hydrostatic test; and	
		• in the hydrostatic test, the application of a vacuum is not mandatory.	
Implications for	r UK:	The differences are not significant in terms of the overall applicability of the test other than, possibly, the dropping of the vacuum conditions for the hydrostatic test. Therefore, there should not be any adverse implications in adopting the draft CEN Standard.	
Other comments:		The French have carried out some comparison tests with several laboratories using each of the different procedures in the draft CEN Standard. Their conclusions were that the hydrostatic method should be dropped on the basis of the wider spread of results (possibly due to there not being a mandatory requirement to use a vacuum) so that the method with the solvent was the most reliable. However, the methods with water did not produce totally unacceptable results.	

4.2 Bulk density by hydro-static method or by dimensions

Reference Number:		prEN 12697-6
Assessment category:		C
TG 2 drafter:		Joss van der Heide, Netherlands
Latest draft:	Date: Status:	December 1997 Awaiting Formal Vote (Stage 50)
Scope:		The Standard 'describes four procedures for determining the bulk density of a compacted specimen. By the described method, the bulk density can be determined from specimens which are laboratory compacted or from cores cut from the pavement after placement and compacting. Four procedures are described; the choice of the procedure to be followed depends on the estimated content and accessibility of voids in the specimen.
		'The bulk density of a bituminous specimen is its mass per volume where the volume includes the voids in the material. The performance of bituminous materials is generally ruled [controlled] by its volumetric composition, viz by the volumes of the constituent materials. However, the composition is expressed in percentages by mass. The bulk density provides information on the relation[ship] between both composition[al] characteristics. The bulk density of bituminous materials, together with the maximum density, is used to calculate the air voids content and other volumetric-related properties of an intact specimen.'
Summary of met	thod:	The thickness of specimens has to be not less than both 20 mm and twice the nominal aggregate size. General guidance on which of the four methods to select is given in an Annex.
		The 'dry' procedure is for specimens with a very dense surface. The specimen is weighed in air when dry (either at the start of the test or after drying at the end) and in water. The density is calculated from the two masses together with the density of the water at the test temperature.
		The 'saturated surface-dry' ('SSD') procedure is for specimens with a dense surface. The specimen is weighed in air when dry (either at the start of the test or after drying at the end), in water after being allowed to soak until at constant weight and after removal from the water and being wiped so as to be surface dry. The density is calculated from the three masses together with the density of the water at the test temperature.
		The 'sealed specimen' procedure is for specimens with an open or coarse surface. The specimen is weighed in air when dry, sealed with paraffin wax, shrinkage foil or latex emulsion (taking care not to enclose any air bubbles between the specimen and the seal folds) before being re-weighed dry and then in water. No distinction is made between sealing materials that fill at least the larger of the surface voids, such as paraffin wax, and those that span across those voids, such as shrinkage foil. The density is calculated from the three masses together with the density of the water at the test temperature.
		The 'by dimensions' procedure is for specimens with regular geometric shapes (cuboids or cylinders). The specimen is weighed in air when dry and its dimension measured. The density is calculated from the mass and the dimensions.
Equivalent BS:		BS 598: Part 104: 1989 (incorporating Amendments 1 & 2), Clause 4; BS 598: Part 107: 1990 (incorporating Amendments 1 & 2), Clause 8
Principal differences:		The Part 104 method contains both the 'dry' and 'sealed specimen' methods for cores while the Part 107 method is the 'dry' procedure for laboratory compacted specimens. The requirement to remove pre-coated chippings before testing from Part 104 is not in the draft CEN Standard.
Implications for UK:		The test procedures in the draft CEN Standard are more comprehensive than those in the British Standard and will allow the various densities to be measured in a standardised form. However, the loss of the requirement to remove pre-coated chippings before testing will need to be allowed for in future specifications (and as already included in clause 943 in the <i>Specification for Highway Works</i> (MCHW 1)).
Other comments:		The French have carried out some comparison tests with several laboratories using each of the different procedures in the draft CEN Standard. Their conclusions were that the three methods are equivalent, based on the inter-laboratory spread. For low voids contents, they gave the same results whilst for 'intermediate' voids contents (6 to 12 per cent), the method using paraffin wax gave result midway between those with the other two methods. The maximum divergences were of the order of 0.03 Mg/m ³ , which equates to approximately 1 per cent of air voids.

4.3 Bulk density by gamma rays

Reference Number:		prEN 12697-7
Assessment category:		C
TG 2 drafter:		Jean-Luc Delorme, France
Latest draft:	Date: Status:	June 1998 Awaiting Formal Vote (Stage 50)
Scope:		The Standard 'defines a method for measuring the bulk density of pavement materials using a transmission-type gamma radiation test bench. The safety regulations applicable to the use of gamma rays shall be applied. This standard applies to cylindrical specimens or blocks, prepared in a laboratory or cut from a pavement, the thickness of which is known as well as the mass absorption coefficient that is a function of the chemical composition. The thickness of the specimen body traversed by the radiation shall be between 30 and 300 mm. The method cannot be applied to materials containing slags, with [the] variable metal content[s] affecting the absorption of gamma rays.'
Summary of method:		If the water content of a specimen is not know, it is dried to constant mass. In all cases, any foreign matter is removed and the dimensions of the specimen are measured. The specimen is placed in the apparatus between collimators in front of the emitter-source unit and remote receiving unit. The apparatus has to be calibrated periodically against a specimen of known density. The test specimen can be either moved in a direction perpendicular to the direction of measurement for continuous measurements or held still for localised measurements. For localised measurements on cylinders, the specimen has to rotate during measurement. The density at each level is then calculated on the basis that the absorption of the gamma rays by bituminous materials follows an exponential law dependent on the density.
Equivalent BS:		None.
Implications for UK:		The method is an automated method that gives the density profile of a specimen. However, the method is currently a research tool for measuring the variation in density with depth and is not considered appropriate for specification purposes, unless close uniformity of density in all directions was found to correlate strongly with a required performance characteristic. The technology has been used in research at TRL for some years and it has provided much useful information, particularly on the variation in density with depth. Therefore, whilst there are advantages to having a standardised method, it should not be called up in the material specifications at this time.

4.4 Air voids co	ntent	
Reference Number:		prEN 12697-8
Assessment category:		C
TG 2 drafter:		Joss van der Heide, Netherlands
Latest draft:	Date: Status:	December 1997 Awaiting Final Vote (Stage 50)
Scope:		The Standard 'describes a procedure for calculating the percentage of air voids in a compacted bituminous specimen. By the described method, the air voids content can be determined from specimens that are laboratory compacted or from cores cut from the pavement after placement and compacting. The air voids content can be used as a mix design criterion or as a parameter for evaluating the mixture after placing and compaction in the road.'
Summary of method:		The procedure is simply a calculation of the air voids content from the difference between the maximum density and bulk density measurements, as a proportion of the maximum density.
Equivalent BS:		None, but the calculation procedure is given in a sub-clause of Clause 943 in the <i>Specification for Highway Works</i> (MCHW 1).
Principal differences:		None.
Implications for UK:		The method is needed because more specifications are incorporating limits for air voids contents but it probably does not warrant being a separate Part of the draft CEN Standard (it could be combined with, say, maximum density).

4.5 Reference	density	
Reference Number:		prEN 12697-9
Assessment category:		А
TG 2 drafter:		Jean-Luc Delorme, France and John Richardson, United Kingdom
Latest draft:	Date: Status:	September 1999 Awaiting Formal Vote (Stage 50)
Scope:		The Standard defines 'a method for the determination of reference densities of bituminous mixtures. These densities are obtained on specimens compacted by three alternative compactors at specified compaction energies. The compaction methods are described in EN 12697-30, EN 12697-31 and EN 12697-32 for the impact, gyratory and vibratory compactors, respectively. The method is applicable to bituminous mixtures, both [those] made up in the laboratory and those resulting from work site operations, with D (maximum particle size) dependent upon the compaction method and not $> 31,5$ mm.'
Summary of me	ethod:	The method covers the determinations of reference density and compaction degree and of refusal density and PRD.
		For reference density, a laboratory or plant mixture is compacted either by an impact compactor for a fixed number of blows per face or by a gyratory compactor for a fixed number of gyrations (the number of blows or gyrations being defined in the material specification). The compaction may also be carried out by vibratory compactor, but this is not the usual procedure. The density of the compacted specimen is then measured as the reference density.
		For refusal density, a sample, which may be a reheated core, is compacted either by a gyratory compactor for 200 gyrations or by a vibratory compactor to refusal. The density of the compacted specimen is then measured as the refusal density.
		For compaction degree and PRD, the initial bulk density of a specimen is measured. The compaction degree is the ratio of the initial bulk density to the reference density for that material and the PRD is the ratio of the initial bulk density to the refusal density; both are measured in per cent.
Equivalent BS:		BS 598: Part 104: 1989 (incorporating Amendments 1 & 2), Clause 3 for refusal density and PRD only.
Principal differences:		The details of each method are in the draft CEN Standards for the respective item of compaction apparatus (see Sections 2.4, 2.5 and 2.6) so that there are no details in this draft CEN Standard.
Implications for UK:		The inclusion of the PRD is important for the UK whereas the concept of a reference density is not currently used in the United Kingdom. Reference densities are associated with mixture design and job mixture approvals, as in France, rather than checking the compliance of performance properties in the field, as is developing in the United Kingdom with the move towards performance-related specifications.

4.6 Compactibil	ity	
Reference Number:		prEN 12697-10
Assessment category:		Α
TG 2 drafter:		Jean-Luc Delorme, France
Latest draft:	Date: Status:	December 1999 Formal Vote (Stage 51)
Scope:		The Standard 'describes three test methods for characterising the compactibility of a bituminous mix, by the relation between its density or voids content and the compaction energy applied to it, using an impact (Marshall) compactor, a gyratory compactor or a vibratory compactor. This European Standard applies to hot mix asphalt (both those prepared in laboratory and those sampled from plant produced mixtures), with D [*] not larger than 31,5 mm in accordance with EN 13043 for the impact and gyratory compactors, and 40 mm for the vibratory compactor. The results of the test serve to supplement the results of mixture design.'
Summary of method:		An asphalt mixture is compacted by either impact, gyratory or vibratory compactor at the prescribed temperature in the compaction method Standard. The density is measured after various compaction energies (using the analogues of number of blows for impact compactor, number of gyrations for gyratory compactor and time for vibratory compactor). The specimen height is measured either on the same sample after different compaction energies or on different specimen, each compacted by different compaction energies (the gyratory compactor is only used with the same sample for all levels of compaction energy).
		The sample heights are used to calculate the bulk density (impact compactor) or voids content (gyratory compactor and vibratory compactor). Linear regression analysis is carried out on the data pairs of the analogue for compactive energy and the associated density or voids content in order to obtain the constants in the relevant equation for the type of compactor used.
Equivalent BS:		None.
Implications for UK:		The test procedure is intended as an aid at the supplier/laying contractor interface but not as a specification requirement, as indicated by the last sentence in the Scope. Providing this intention is followed through, then it may be of benefit to contractors if it proves to be meaningful but will be of no disbenefit to the United Kingdom if it does not.

^{*} Maximum norminal size of aggregate

5 Mixture design methods

Reference Number:		prEN 12697-11
Assessment category:		В
TG 2 drafter:		Ole Andersson, Denmark
Latest draft:	Date: Status:	November 1999 (BSI DPC No. 99/108550DC) CEN Enquiry (Stage 41)
Scope:		The Standard 'describes a procedure for determination of the compatibility between aggregate and bitumen, expressed by visual registration of the loss of adhesion in uncompacted bitumen- coated aggregate mixtures under mechanical stirring in presence of water. This method can be used to evaluate the effect of moisture with or without adhesion agents including liquids, such as amines, and fillers, such as hydrated lime or cement.'
Summary of method:		The aggregate is sieved and the 8/11 mm fraction (or the 5,6/8 mm fraction if the former is not available) is separated. This fraction is washed, dried and mixed with bitumen to obtain a uniform coverage over the whole of the surface area of the aggregate. The bitumen-coated aggregate is placed loosely so as to be distributed across a metal plate or sheet of silicone pape and then stored at ambient temperature (not defined) overnight.
		The sample is divided into three and each part is transferred to a bottle filled with water in which there is a glass rod with rubber tube attached (Figure 5). The bottles are sealed and placed on a rolling-bottle device. The bottles are rolled for 6 hours, the water removed and, if necessary, with the aid of a magnifying glass, the proportion of bitumen coverage estimated by two technicians, independently.
		The aggregate is replaced into the bottles, which are then refilled with the same water. The bottles are again rolled, with the binder coverage being re-measured after a total of 24, 48 and 72 hours.
Equivalent BS:		None for hot mixtures, although there is the immersion tray test for determining the concentration of adhesion agent required for binders in Road Note 39 for surface dressings.
Implications for UK:		There is a need for a compatibility test, but no proposal has managed to be fully quantitative. The reliance on the ability of two technicians to estimate the proportion of binder coverage is the weak link in this test, as it is in the immersion tray test for surface dressings. Therefore, the use of the test in material specifications should not be encouraged. Based on limited trials in the United Kingdom, the test as drafted is not suitable for mixtures with high polished-stone value aggregates because the aggregate particles abrade, removing the binder film with the abraded aggregate and leaving aggregate exposed. As a result, specimens appear to 'fail' when there is no evidence of binder stripping.

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5.1 Compatibility between aggregates and binder

Figure 5 Test bottle for compatibility test

70 mm

5.2 Water sensit	ivity	
Reference Number:		prEN 12697-12
Assessment category:		Α
TG 2 drafter:		Ole Andersson, Denmark
Latest draft:	Date: Status:	February 2000 (BSI DPC No. 00/101934DC) CEN Enquiry (Stage 41)
Scope:		The Standard 'describes a procedure for determination of the effect of saturation and accelerated water conditioning on the indirect tensile strength of cylindrical specimens of bituminous mixtures. The method can be used to evaluate the effect of moisture with or without anti-stripping additives including liquids, such as amines, and fillers, such as hydrated lime or cement.'
Summary of method:		Not less than six cylindrical test specimens are measured, weighed and their volumes and bulk densities calculated. The set is then divided into two subsets with the subsets having approximately the same average length and the same average density. The 'dry' subset is stored at 20 °C whilst the 'wet' subset is placed in a desiccator filled with distilled water at 20 °C in a vacuum for half an hour and then at atmospheric pressure for a further half hour. The volumes of the wet specimens are recalculated and any whose volume has increased by more than one per cent rejected. The wet samples are then stored in a water bath at 40 °C for a further 68 hours (nearly three days).
		All samples are conditioned to 25 °C in either a water bath or thermostatically controlled air chamber for not less than two hours. Using a water bath, the dry specimens are sealed in a soft plastic bag or other watertight protection while, using an air chamber, the wet specimens are in leak-proof, soft plastic bags filled with water. The indirect tensile strength of each specimen is then measured in accordance with the relevant Standard (see Section 6.8). The indirect tensile strength of wet subset to that of the dry subset, in per cent.
Equivalent BS:		None, although there is a protocol developed under the Department of Transport LINK programme on Transport Infrastructure and Operations led by the University of Nottingham, and subsequently modified by Specialist Group 3 of the British Board of Agrément-Highway Authorities Product Approval Scheme for use with thin surfacing systems.
Principal differences:		In the protocol, the test is the non-destructive indirect tensile stiffness modulus test to BS DD 213: 1993 carried out on a single specimen with the indirect tensile stiffness modulus being measured initially and after each conditioning cycle. In the draft CEN Standard, the test is the destructive indirect tensile test and separate samples are used, only one conditioning cycle is used and averages of at least three specimens are determined. The conditioning in the protocol starts similarly with 30 minutes in a vacuum, but thereafter it is more extreme but for a shorter period.
Implications for UK:		The need for a test on water sensitivity has not been a high priority in the United Kingdom because of the adequate supply of sources of aggregates that are not sensitive to moisture with the bitumens marketed here. Nevertheless, the standardisation of a suitable test would be beneficial. The test evolving in the United Kingdom is not dissimilar, but the method in the draft CEN Standard is unlikely to be acceptable because there are doubts as to whether a single conditioning cycle is sufficient to distinguish mixtures that are sensitive to moisture.

5.3 Segregation sensitivity

Reference Number:		prEN 12697-15
Assessment category:		Α
TG 2 drafter:		Joss van der Heide, Netherlands
Latest draft:	Date: Status:	December 1997 (BSI DPC NO. Document 97/109348 DC) Results received from CEN enquiry (Stage 49)
Scope:		The Standard 'covers the determination of the tendency of segregation of hot mixtures. The tendency of segregation of bituminous mixtures is influenced by the composition of the mixtures in terms of types and amounts of aggregates and bituminous materials. Segregation is [of] a bituminous mixture is caused by e.g. improper loading of the hopper, lorry, or finisher. (This method should only be adopted for mixtures having a flow time from the conical bin of less than 15 s. Gummy mixtures containing additives like polymers, fibres, etc. may produce confusing results.)'
Summary of method:		A hot sample of asphalt is placed in a heated conical hopper (Figure 6). The plate at the bottom of the cone is slid away and the mixture falls onto a platform underneath to form a pile. A trap-door in the platform under the centre of the pile is opened and the central, finer portion of the pile flows through the opening. The opening is then expanded further and an intermediate portion of the pile flows through the expanded opening. The binder content and grading of the finer, central portion and of the remaining, coarser portion of the asphalt are determined. The segregation value is the difference between the binder content of the two portions.
Equivalent BS:		None
Implications for UK:		The test is intended to be used by the material supplier and/or laying contractor and not to have contractual implications. Providing that this intention is followed through, there should be no problems. However, if it becomes part of the material specifications, experience with the test procedure will be needed.



Figure 6 Apparatus for segregation sensitivity test

5.4 Binder drain	nage	
Reference Number:		prEN 12697-18
Assessment category:		C
TG 2 drafter:		Aurelio Ruiz Rubio, Spain
Latest draft:	Date: Status:	June 1999 CEN Enquiry (Stage 41)
Scope:		Part A of the Standard (Basket method) 'gives a method to determine the binder drainage of a porous asphalt' whilst Part B (Schellenberg method) 'specifies a method to determine the binder drainage of a bituminous mixture.' For both parts, 'the method is stated for design purposes. It can be used either determining the binder drainage for different binder contents, or with a single binder content, eliminating the successive repetitions. It can also be used for factory production control. It also enables the effects of varying fine aggregate types and the effect of any anti-draining additive to be quantified. Although a single temperature is included in the test method, it could be carried out at more than one temperature.'
Summary of method:		In Part A (Basket method), the quantity of binder lost by drainage, after three hours at the maximum mixing temperature expected at the mixing plant, is measured for duplicate samples of the mixture with the same aggregate grading but with different binder contents. The test results are the data pairs of binder content and mean binder drained.
		In Part B (Schellenberg method), three batches of 1 kg of aggregate are prepared to the specified grading and placed in separate tins. Three beakers are weighed and heated to the test temperature, which is the maximum mixing temperature for that mixture or 15 °C above the mixing temperature in the laboratory-mixing Standard. Each batch of aggregate is mixed with the required amount of binder and any additives, put in a beaker and returned to the oven for 1 hour. At the end of that time, the temperature of the mixture in one beaker is measured; this beaker is not used again in the test. The other two beakers are removed from the oven and upturned for 10 seconds. After cooling, the beakers are reweighed with the remaining (drained) material. If the remaining material is more than 0.5 per cent of the original mass, it is washed with solvent over a 1 mm sieve. The mean drained material is calculated. The procedure is repeated at three binder contents at 0.3 per cent intervals.
Equivalent BS:		BS DD 232: 1996
Principal differences:		Part A of the draft CEN Standard is similar to the British Standard whilst Part B is totally different, being simpler and probably less precise. The test temperature in Part A of the draft CEN Standard is the maximum expected temperature at the plant rather than being related back to an equi-viscous temperature with values provided for unmodified bitumen, as in the British Standard. In the draft CEN Standard, the test is carried out at the minimum permitted binder content and at two increments of 0.5 per cent above that whereas, in the British Standard, the test is carried out at five binder contents around the expected maximum binder content. The draft CEN Standard does not define the maximum binder content or any other single value, leaving that to the material specifier.
Implications for UK:		There is nothing in Part A of the draft CEN Standard to conflict with current UK practice except the definition of the test temperature, but it would allow less rigorous analysis with the reduction from a minimum of five to three pairs of measurements. The implementation of this Standard would require more explanation of how to make use of the results whenever it is called up in a specification.
		The use of a separate test for mixtures other than porous asphalt, in particular stone mastic asphalt, seems unnecessary unless it is assumed that the requirements are less severe and only need a simpler test. The introduction of this test in the United Kingdom may benefit suppliers by marginally reducing their testing costs, but whether the results are equally valid is, as yet, unproven.

5.5 Marshall tes	st	
Reference Number:		prEN 12697-34
Assessment category:		C
TG 2 drafter:		Geraldine Walsh, Ireland
Latest draft:	Date: Status:	November 1999 (BSI DPC No. 99/108554DC) CEN Enquiry (Stage 41)
Scope:		The 'test procedure is used to determine the stability, the flow and the Marshall Quotient values of specimens of bituminous mixtures mixed according to prEN 12697-35 and prepared using the impact compactor method of test prEN 12697-30.'
Summary of method:		The compacted specimens are demoulded and left for at least 4 hours but testing is completed within 24 hours. The density and height of each specimen is measured and then they are immersed in a water bath at 60 °C for between 40 and 60 minutes. Each specimen, in turn, is placed on its side between the upper and lower segments of a breaking head on the testing machine and a load is applied at constant strain of 50 mm/min until the load applied has reached a maximum. The mean stability from four specimens is calculated from the maximum load applied and the mean flow from the deformation at maximum load.
Equivalent BS:		BS 598: Part 107: 1990 (incorporating Amendments 1, 2 & 3), clauses 9 and 10
Principal differences:		The principal differences are:
		• the time of testing is changed from within 8 hours in the British Standard to 4 – 24 hours in the draft CEN Standard;
		• the tolerance on the temperature is doubled and that on the rate of strain reduced by a third; and
		• no advice is given on the calculation of the design binder content in the draft CEN Standard.
Implications for	UK:	There are no particular problems with the general content of this draft CEN Standard except that the UK design procedure will need to be defined somewhere.

6 Performance-related tests

6.1 Abrasion by studded tyres

Reference Number:		prEN 12697-16
Assessment category:		D
TG 2 drafter:		Ole Andersson, Denmark
Latest draft:	Date: Status:	February 2000 (BSI DPC No. 00/101938DC) CEN Enquiry (Stage 41)
Scope:		The Standard 'describes two alternative procedures (Method A and Method B) for preparing and determination of abrasion caused by studded tyres, tested on cylindrical specimens of bituminous mixtures. Note: Both methods (A and B) may be used where relevant for determination of abrasion by studded tyres.'
Summary of method:		For Method A, a cylindrical specimen at a temperature of 5 °C is agitated in an abrasion apparatus with 40 steel balls for 15 minutes. The abrasion value is determined as the loss of volume of the specimen.
		For Method B, a cylindrical specimen at a temperature of 5 °C is agitated by an abrasion apparatus with a rotation unit with three studded rubber tyres for two hours. The abrasion value is determined as the loss of volume of the specimen.
Equivalent BS:		None.
Implications for UK:		Studded tyres are not permitted in the United Kingdom, so this Standard will not be used here.

6.2 Particle loss of specimen (abrasion of porous asphalt)

er:	prEN 12697-17
gory:	Α
	Aurelio Ruiz Rubio, Spain
Date: Status:	June 1999 Translation following Working Group 1 internal voting (Stage 31)
	The Standard 'provides a method for determining the particle loss (or abrasion) from porous asphalt mixes caused by traffic. The test method can be used within a type testing procedure. Abrasion is assessed by the loss of weight of porous asphalt samples after turns in the Los Angeles machine. The test can be applied to porous asphalt mixes whose maximum particle size do not exceed 25 mm. The test does not reflect the abrasion action by studded tyres.'
hod:	At least five 100 mm diameter cylinders of porous asphalt are prepared and their masses, bulk densities and air voids contents determined. Each specimen in turn is placed in a Los Angeles machine without any steel balls at the test temperature, usually between 15 °C and 25 °C. The specimens are rotated at between 30 and 33 rpm for 300 turns and re-weighed. The particle loss is then calculated from the average difference between the initial and final masses as a proportion of the initial masses.
	None.
UK:	The test will be called up in the material specification for porous asphalt, prEN 13108-7 (at CEN Enquiry stage, BSI DPC No. 00/102575DC) and so will become part of the design procedure for the material. If the use of porous asphalt were to increase significantly in the United Kingdom, then the availability of the test procedure and the performance of any mixture in this test will be important.
	er: gory: Date: Status: hod:

6.3 Permeability of porous asphalt specimen

Reference Number:		prEN 12697-19
Assessment category:		A
TG 2 drafter:		Geraldine Walsh, Ireland
Latest draft:	Date: Status:	March 2000 (BSI DPC No. 00/101939DC) CEN Enquiry (Stage 41)
Scope:		The Standard 'describes a method for determining the permeability of a cylindrical specimen of porous asphalt. The specimen can be cored out of the road or from laboratory made slabs or may be prepared with a compaction device. The permeability can be determined in both the horizontal and in the vertical direction.'
Summary of method:		The Standard includes separate methods for determining vertical and horizontal permeability of a specimen.
		With the apparatus set up for vertical permeability, a specimen is placed in a rubber cuff that is inflated and pressed firmly around the wall of the specimen to form a seal. The bottom of the specimen is left clear and the specimen rests on a platform in a water-bath above a collecting reservoir so that the top of the specimen is level with the rim of the water bath (Figure 7).
		With the apparatus set up for horizontal permeability, a plastic tube is glued to the upper face of the specimen and the tube is placed in a rubber cuff which is inflated and pressed firmly around it to form a seal. The bottom of the specimen is sealed to the bottom of a platform in a water-bath above a collecting reservoir so that the bottom of the tube is level with the rim of the water bath (Figure 8).
		In both tests, a column of water with a constant height is applied to the specimen and the water is allowed to permeate through the specimen for a controlled time. The permeability value, k , is then calculated from the flow rate of the water in accordance with Darcy's law for vertical permeability, k_v , and a modified Darcy's law for horizontal permeability, k_h . The tests are carried out at ambient temperature with no correction in the calculation for any change in viscosity of water.
Equivalent BS:		None.
Implications for	UK:	The introduction of this test will allow porous asphalt mixtures to be designed for permeability. Experience with the test on cores taken from material of known hydraulic conductivity and on laboratory made samples will be needed for it to be a useful test. With that experience, the permeability of site-compacted material will be able to be estimated from laboratory-prepared samples and the potential relative hydraulic conductivity of a mixture will be able to be estimated from its vertical and/or horizontal permeability and its nominal thickness.



Figure 7 Apparatus for vertical permeability test of specimens



Figure 8 Apparatus for horizontal permeability test of specimens

6.4 In-situ drainability of porous asphalt

Reference Number:		Not yet allocated (new Work Item).
Assessment category:		C
TG 2 drafter:		Cliff Nicholls, United Kingdom
Latest draft:	Date: Status:	January 1993 None
Scope:		The Standard 'specifies a method to determine the in-situ relative hydraulic conductivity, at specific locations, of a permeable road surfacing. An estimate of the average value for the surfacing is obtained from the mean value of a number of determinations on each section of road. The test area shall be clean and free from detritus. Measurements can be made when the road is wet, but not if in a frozen state.'
Summary of method:		A falling-head radial-flow permeameter is used to determine the time taken for 2 litres of water under a known head condition to dissipate through an annular area of the surfacing. The reciprocal of the outflow time is used to calculate the relative hydraulic conductivity of the surfacing.
Equivalent BS:		BS DD 229: 1996
Principal differences:		The draft CEN Standard is based on the British Standard. However, the equipment is held down with a specified load $(1 - 2 \text{ kN})$ rather than 'an operative on each side' and there is no correction for temperature, which affects the viscosity of the water.
Implications for UK:		The draft CEN Standard, as currently written but with the insertion of a temperature correction value, would have no noticeable affect on current procedures in the United Kingdom. The next draft will contain more changes (see below) and will require testing consultants to re-equip for this test.
Other comments:		The method has had a low priority because it measures an in-situ property and not a property of the material in the delivery wagon, towards which the main effort has been direct. The early drafts were prepared under the same Work Item as those for the permeability of porous asphalt specimen test (see Section 6.3), but work was dropped until early 2000, when a separate Work Item was raised for it and a new drafter appointed.
		Since the last draft, a comparative trial has taken place between the UK and French permeameters. The main differences of the French equipment from the United Kingdom equipment are:
		• it has a wider cylinder (so that the change in head is less);
		• the annular area is also larger;
		• the equipment is held down hydraulically from the back of a vehicle rather than relying on the weight of two operatives; and
		• the timing is performed automatically.
		The results showed that a combined design with the larger diameter cylinder and the smaller annular area would be technically superior. The larger diameter cylinder allows more water to flow through the equipment before measurement has to start, saturating the system. The smaller annular area results in the flow close to the apparatus being predominantly downwards

smaller annular area results in the flow close to the apparatus being predominantly downward rather than outwards, and hence the associated impedance being less dependant on the thickness of the porous asphalt layer. The next draft will incorporate the composite design, together with the use of automatic timing and controlled loading of the equipment.

6.5 Indentation using cube or marshall specimen

Reference Number:		prEN 12697-20
Assessment category:		В
TG 2 drafter:		Rolf Leutner, Germany
Latest draft:	Date: Status:	November 1999 (BSI DPC No. 99/108551DC) CEN Enquiry (Stage 41)
Scope:		The Standard describes an indentation test which 'serves to determine the depth of indentation, and thus to test the behaviour of mastic asphalt, rolled and other asphalts, when force is applied to them via a cylindrical indentor pin with a circular flat-ended base. Mastic asphalt as described in prEN 13108-6 for road construction, in prEN for floor screeds and in prEN for waterproofing in building and engineering constructions can be tested following the test method prescribed hereafter. The maximum nominal size of the aggregate in the mix is up to and including 16 mm.'
Summary of method:		Specimens are produced either as Marshall specimens or as moulded test cubes. The specimens are placed in an indentation test apparatus within a water bath (Figure 9). The test apparatus is pre-calibrated using a rubber calibration block.
		Two specimens are pre-conditioned at the test temperature of either 40 °C or 22 °C (40 °C for road pavements) for at least one hour and then indicator pins are pushed into them with a force of 25 N for 10 minutes before the initial reading are taken. The indicator pins are then pushed into the specimen at the test load of 525 N for a set period, the application period depending on the use of the asphalt. The result is the mean indentation from the two specimens.
Equivalent BS:		BS 5284: 1976, Clause 6
Principal differences:		The two standards are essentially different tests, although measuring the same property. The British Standard applies a different load (311 N) five times on the same specimen rather than once each on two specimen. The draft CEN Standard defines the test temperature whilst, for the British Standard, the test temperature is specified in the material standard.
Implications for UK:		The test method in the draft CEN Standard does not appear to be any better or worse than that in the British Standard. However, its adoption will require a review of the appropriate equivalent values for use in specifications and the purchase of replacement equipment by testing laboratories.
Other comments:		The need for the test is uncertain given the overlap with the next test, indentation using plate specimen (see Section 6.6). It is understood that the duplication arose from a political wish to keep both tests, and the current intention is that this test is used for type approval whilst the indentation using plate specimen is used as a guide for conformity. However, a uniformity of test methods would have advantages.



Figure 9 Typical indentation test apparatus for two specimens

6.6 Indentation using plate specimen

Reference Number:		prEN 12697-21
Assessment category:		В
TG 2 drafter:		Rolf Leutner, Germany
Latest draft:	Date: Status:	November 1999 (BSI DPC No. 99/108552DC) CEN Enquiry (Stage 41)
Scope:		The Standard 'determines the consistency of mastic asphalt by the hardness number test under the defined operating conditions. Mastic asphalt as described in prEN 13108-6 for road construction, in prEN for floor screeds and in prEN for waterproofing in building and engineering constructions can be tested following the test method prescribed hereafter. The result of the indentation test should be considered as indicative only.
		'This test consists in measuring – at a given temperature and load – the penetration of a standardised section-pin into a sample of the mastic asphalt. The penetration, expressed in units of 1/10 mm, depends on:
		• dimensions of the pin;
		• temperature at which the test is executed;
		• load applied; and
		• duration of the test.
		The values of these four parameters are fixed in relation to the nature of the mastic asphalt (and the application for which it is intended).'
Summary of method:		Material can be sampled on discharge from a mobile mixer, from site remelting equipment or from laid material. The sampled material is remelted and moulded into slabs (plates). Two specimens are pre-conditioned at the test temperature for at least half an hour and then an indentor-pin is pushed into them with a set force for a set period, with readings made of the penetration after two set periods. The procedure is repeated either three or five times on each of the specimens. The test temperature, test load, area of the surface of the indentor-pin, the number of determinations on a sample and the period to initial and final readings of indentation are set for different uses of mastic asphalt. However, how to select the appropriate set of test conditions from the four listed for particular circumstances is not clearly identified. The result is the mean indentation from the initial to the final reading for the average indentation on the two specimens.
Equivalent BS:		BS 5284: 1976, Clause 6
Principal differen	nces:	The British Standard is effectively equivalent to one of the test conditions, condition W, but with a load of 317 N instead of 311 N (presumably a typographical change during drafting).
Implications for UK:		The selection of Test condition W (from those offered in the draft CEN Standard) will mean effectively no change in the test procedure in the United Kingdom. However, if type testing is carried out using the other indentation test, then UK suppliers will also need to gain experience with that test (see Section 6.5).

6.7 Wheel-track	king	
Reference Number:		prEN 12697-22
Assessment category:		C
TG 2 drafter:		Jean-Luc Delorme, France
Latest draft:	Date: Status:	August 1999 (BSI DPC No. 99/106559DC) Results received of CEN Enquiry (Stage 46)
Scope:		The Standard 'describes the procedures to be followed for determining the susceptibility of bituminous materials to deform under load. The test is applicable to mixtures with nominal aggregate sizes not larger than 32 mm. The procedures can be carried out on specimens that have either been manufactured in a laboratory or cut from a pavement; test specimens are held in a mould with their surface flush with the upper edge of the mould. The susceptibility of bituminous materials to deform is assessed by the rut formed by repeated passes of a loaded wheel at constant temperature. Two alternative types of devices can be used according to this Standard: large-size devices and small-size devices. With large-size devices, the specimens are to be conditioned in air during testing. With small-size devices, they can be conditioned either in air or in water. Note: Large-size devices are not suitable for use with cylindrical cores.'
Summary of me	thod:	There are effectively three methods:
		• large-scale devices with samples conditioned in air;
		• small-scale devices with samples conditioned in air; and
		• small-scale devices with samples conditioned in water.
		For the large-scale device with samples conditioned in air, two samples are conditioned by loading with a pneumatic tyre at 600 kPa for 1000 cycles at a temperature of (20 ± 5) °C. The samples are then raised to the test temperature (which is not defined in the draft CEN Standard but left to the product Standard) for between 12 and 16 hours before the device is run. The deformation is measured at various times including after 1000, 3000 and 10 000 cycles at 15 locations and the proportional deformation recorded as the ratio of the mean value from the 15 locations divided by the specimen thickness. Linear regression analysis of the results from both specimens is used to define the relationship between the number of load cycles and the proportional deformation, from which the proportional deformation after a specified number of passes can be calculated.
		For the small-scale device with samples conditioned in air, six specimens are conditioned at the test temperature for between 4 hours (6 hours for thicknesses over 60 mm) and 24 hours before being tracked for 45 minutes under a solid rubber tyre 50 mm wide with a 700 N load. The first five cycles are used for conditioning. The wheel-tracking rate is calculated from the average rate of deformation in mm/h over the last third of the test and the proportional deformation is calculated from the average total deformation as a proportion of sample thickness.
		For the small-scale devices with samples conditioned in water, two specimens are conditioned at the test temperature for not less than an hour before being tracked for 10 000 cycles under a solid rubber tyre 50 mm wide with a 700 N load. The first five cycles are used for conditioning. The deformation is measured 6 or 7 times in the first hour and every 500 load cycles thereafter. The wheel-tracking rate is calculated as the mean value in mm/10 ³ cycles between 5 000 and 10 000 load cycles and the proportional rut depth as for the large-scale device.
Equivalent BS:		BS 598: Part 110: 1998 (incorporating Amendment 1)
Principal differe	ences:	The method for the small-scale device with samples conditioned in air is based on the British Standard method. The load in the draft CEN Standard is 700 N compared to 520 N in the British Standard. The permitted range of frequencies for the apparatus has been widened from (21 ± 0.2) cycles per minute to (21 ± 1) cycles per minute which may impair the precision. Five conditioning passes have been included in the method. The results for the draft CEN Standard include the proportional deformation rather than the rut depth, as required in the British Standard.

Implications for UK:The adoption of the draft CEN Standard should not impose any significant problems for the
United Kingdom provided that all methods can be used and the large-scale device is not made
the reference method. The inclusion of five conditioning passes should not make any
significant difference to the method whereas values used in specifications will need to be
revised to take account of the change in applied load.Other comments:A pre-normative research programme developed approximate equivalencies between the

Other comments: A pre-normative research programme developed approximate equivalencies between the results from the three methods. The Germans are carrying out a research programme to justify the inclusion of the small-scale test with conditioning in water being carried out with steel wheels.

6.8 Indirect tensile strength

Reference Number:		prEN 12697-23
Assessment category:		A
TG 2 drafter:		Ole Andersson, Denmark
Latest draft:	Date: Status:	November 1999 (BSI DPD No. 99/108553DC) CEN Enquiry (Stage 41)
Scope:		The Standard 'describes a procedure for determination of the (splitting) indirect tensile strength of cylindrical specimens of bituminous materials. The test method also forms a part of the determination of water sensitivity of bituminous specimens according to prEN 12697-12.'
Summary of method:		Specimens can be cores or laboratory prepared cylinders with 100 mm, 150 mm or 160 mm diameters. A test specimen is conditioned at 5 °C for at least 4 hours before being placed in compression testing machine between loading strips. The specimen is then loaded at a constant strain of 50 mm/min until it breaks. The indirect tensile strength is calculated for each specimen from the peak load and the dimensions of the cylinder; the test result is the mean indirect tensile strength from at least three specimens.
Equivalent BS:		None.
Implications for UK:		The test method is relatively simple and can use the same compression equipment as the Marshall test, although 'an ordinary 28 kN Marshall compression testing machine may not be able to produce sufficient load when 150 mm or 160 mm specimens (and for high stability mixes even 100 mm specimens) are tested. In such cases, high-load 40 kN Marshall compression testing machines or other, more powerful types, should be preferred'. Therefore, the inclusion of this test into the repertoire of most testing laboratories should not cause any problem. However, it has to be decided whether there is a need to measure the indirect tensile strength rather than, say, the indirect tensile stiffness modulus.

7 Fundamental tests

7.1 Resistance to	fatigue	
Reference Number:		prEN 12697-24
Assessment category:		Α
TG 2 drafter:		Enrico Eustacchio, Austria
Latest draft:	Date: Status:	August 1999 (BSI DPC 99/106701DC) Results received from CEN Enquiry (Stage 46)
Scope: The Standard 'describes a method to char fatigue loading with controlled displacem specimens. The method can be used for b 20 mm on specimens prepared in a labora at least 40 mm'.		The Standard 'describes a method to characterise the behaviour of bituminous mixtures under fatigue loading with controlled displacement by two-point bending using trapezoidal specimens. The method can be used for bituminous mixtures with maximum aggregate size of 20 mm on specimens prepared in a laboratory or obtained from road layers with a thickness of at least 40 mm'.
Summary of method:		Specimens are either manufactured in the laboratory as slabs (termed 'plates') or cut from the road and then kept for at least 12 weeks before being sawn into the required trapezoidal shape. The required thickness and other dimensions of the specimens are dependent on the maximum nominal size of aggregate in the mixture and have tolerances of ± 1 mm. The samples are tested between 2 and 4 weeks after cutting.
		The longer parallel side of a sample is glued to a grooved metal plate whilst held in a rig to accurately position it and a cap is glued to the other parallel side. The thermostatic chamber and loading equipment are brought to test temperature and the desired head displacement adjusted with a dummy elastic specimen before the test specimen is installed. The test specimen is conditioned for at least 4 hours before the test starts.
		The cap on the shorter parallel side of the specimen is then moved sinusoidally at a constant displacement amplitude. The test continues until the force required drops to below 40 per cent of that initially required, where the initial force is defined as the mean of that required between 100 and 500 cycles. The test is repeated on at least 6 specimens at each of three levels of strain, a minimum of 18 specimens. The fatigue line is then found by linear regression of the natural logarithm of the fatigue life in cycles (presumably, but not explicitly stated, being the number until the force has reached 40 per cent of the initial value) and the strain level. The calculated fatigue life is the number of cycles at a strain of 10^6 .
Equivalent BS:		None, although work has started on a BS Draft for Development.
Principal differences: Implications for UK:		The two methods are totally different, with the draft BS DD being based on the Nottingham Asphalt Tester (or equivalent).
		The preparation of at least 18 trapezoidal specimens to a dimensional tolerance of ± 1 mm will be exacting and, with the time required to carry out the test, will mean that the test can only be used for type testing. However, agreement has been reached at CEN to include three other methods (3-point bending, 4-point bending and indirect tensile) as separate parts to the Standard, providing suitable drafts are prepared by interested parties. These will be incorporated as comments at the CEN Enquiry Stage and so the combined draft will not have to go out to public comment until the final vote.
Other comments:		The draft method is a constant displacement (strain) test. There is some dispute as to what thicknesses (or strengths) of pavement require the use of constant strain and what thicknesses require constant force (stress), and how to analyse pavements using these two categories, given the different ranking orders that can result from them. Therefore, there may be a need for methods for both constraints.

7.2 Cyclic comp	ression		
Reference Number:		prEN 12697-25	
Assessment category:		A	
TG 2 drafter:		Ann Vanelstraete, Belgium, and Nils Ulmgren, Sweden	
Latest draft:	Date: Status:	January 2000 (Triaxial) and October 1998 (uniaxial) Third Working Group 1 draft	
Scope:		The (part of the) Standard for triaxial cyclic compression 'describes the creep characteristics of bituminous mixtures by means of the triaxial cyclic compression test. The purpose of this test is to determine the resistance to permanent deformation of a bituminous mixture. The test is most often used for the purpose of evaluation and development. The test is suitable for ranking various bituminous mixtures or to check on the acceptability of a given mix. It is not intended for production control. In this test, a cylindrical specimen is subject to a static confining stress and a dynamic axial stress. Specimens prepared in the laboratory or cored from the road can be used. The maximum size of aggregates is 32 mm.'	
		The (part of the) Standard for uniaxial cyclic compression 'describes the method for determining the creep characteristics of bituminous mixtures by means of the uniaxial cyclic compression test. The purpose of the test is to determine the resistance to permanent deformation. This standard is applicable to determination of the resistance to rutting of asphalt pavements subjected to heavy traffic loads.'	
Summary of method: (triaxial cyclic compression)		The test is carried out on at least two specimens that are not tested until at least 14 days after they have been compacted, either in the laboratory or in the road. After sampling and prior to testing, samples are kept within the temperature range 0 °C and 10 °C. The specimens are dried in air to constant mass and the end faces prepared so that a smooth and plain surface is left. The specimens are then conditioned to the test temperature.	
		A cylindrical test specimen, at the test temperature, is placed between two parallel loading platens. The specimen is subjected to a static confining pressure on which a dynamic axial pressure is superimposed. The static confining pressure can be applied by:	
		• placing the whole specimen, including the upper and lower platens, in a rubber socket (or foil) which is sealed around the platens by O-rings and the confining pressure is applied by pressurising the cell by water, oil or water;	
		• mounting an inner tube of an appropriate sized tyre around the specimen and inflating the tyre; or	
		• sealing the specimen within a rubber membrane, sealed at each end by O-rings, and forming a partial vacuum by extracting the air through holes in the top face of the lower platen.	
		The dynamic axial pressure can be a haversinusoidal or block pulse.	
		The specimens are pre-loaded in order to adjust the self-aligning pressure plates for up to 2 min on the self-aligning platen. The static pre-load is applied again gradually and smoothly for 2 min, after which time the confining pressure is applied. Within 10 seconds of the confining stress being applied, a cyclic axial load is applied. The specimen is held at a constant temperature whilst being subjected to the static confining pressure and sinusoidal axial stress.	
		During the test, the height of the specimen is measured at specific time intervals and the deformation from the original height plotted against the number of axial load cycles. The test is ended either when the axial strain is 6 per cent or after 10,000 loading cycles (unless the test needs to be extended in order to be able to determine the creep parameters). The resistance to deformation is computed as the slope during the period when it is constant or at the point of inflection if it never stabilises.	
Summary of method: (uniaxial cyclic compression)		The test is carried out on at least five specimens that are not tested until at least a week after they have been compacted. After sampling and prior to testing, the samples are dried in air to constant mass at a temperature of up to 25 °C. The specimens are then conditioned to the test temperature of 40 °C for between 4 and 6 hours and the ends coated with grease.	
		A cylindrical specimen with a diameter of 150 mm is placed between two horizontal pressure platens, of which the lower one is fixed. The upper platen has a diameter of 100 mm, chamfered to 96 mm at the interface with the specimen. A pre-load of 10 kPa is applied for	

	10 min before the cyclic block-pulse axial load of 100 kPa at a frequency of 0.5 Hz is applied. During the test, which ends after 3,600 pulses, there is no confining pressure applied. The axial deformation of the specimen is measured and plotted against the number of load applications, from which the creep at 3,600 pulses and the dynamic creep modulus are computed.
Equivalent BS:	BS DD 226: 1996
Principal differences:	The draft CEN Standard requires a confining stress (either directly or by self-confinement using a sample larger than the platen) whereas the British Standard is an unconfined test and the stresses and temperature are not given in the draft CEN Standard whereas they are defined in the British Standard. However, a planned revision of the British Standard will require vacuum confinement, one of the options in the triaxial creep test.
Implications for UK:	In the United Kingdom, the test is considered not relevant for stiff pavements (major roads) and too expensive to be widely used for thin pavements. Furthermore, the scope of the draft CEN Standard emphasises the limitations of the test itself. Nevertheless, with the option of the vacuum confinement, the test would be acceptable to the United Kingdom.
Other comments:	Currently, the triaxial and uniaxial cyclic compression tests are in separate drafts. However, they are to be combined in the next draft and so have been discussed here as a single draft CEN Standard. The triaxial method is based on French Standard NF P 98253-2.

7.3 Stiffness			
Reference Number:		prEN 12697-26	
Assessment category:		Α	
TG 2 drafter:		Enrico Eustacchio, Austria	
Latest draft:	Date: Status:	November 1997 Awaiting CEN Enquiry	
Scope:		The Standard 'describes the method how to evaluate tests which have the aim to characterise the stiffness properties of bituminous mixtures. Such tests are executed on compacted bituminous material under a sinusoidal loading or other controlled loading, using different types of specimens and supportings [supports]. The applicable test methods are set up in paragraph 5.	
		'The procedure can be used to rank bituminous mixtures on the basis of stiffness, as a guide to relative performance in the pavement, to obtain data for estimating potential deformation behaviour in the road and to judge test data according to specifications for bituminous mixtures. If, in the specifications for a certain bituminous mixture, the test conditions are set to fixed values, the stiffness modulus can be determined directly at the given combination of temperature and frequency.'	
Summary of method:		The Standard defines the outputs of complex modulus and secant modulus and how to derive them and produce isotherms, a master curve and a Black diagram. General guidance is given on the test conditions, including loading patterns, strain amplitudes, loading frequencies and temperatures but specific advice is dependent on the procedure selected. The accepted test procedures, with methods given for some (but not all) of them in appendices, are:	
		• Two-point bending on trapezoidal specimens (Appendix A);	
		• Two-point bending on prismatic specimens;	
		• Three-point bending on prismatic specimens;	
		• Four-point bending on prismatic specimens (Appendix B);	
		• Indirect tensile resilient modulus on cylindrical specimens (Appendix C);	
		• Uniaxial tension-compression on cylindrical specimens (Appendix D.1); and	
		• Uniaxial tension on cylindrical specimens (Appendix D.2).	
		For two-point bending of trapezoidal specimens, the specimens are sawn between 2 weeks and 2 months prior to testing. A specimen is glued by its base to a rigid chassis, conditioned at the test temperature for at least 4 hours and then a sinusoidal deflection is applied to the head of the specimen for between 30 seconds and 2 minutes. The deflection is selected to give a strain in the most heavily stressed part of the specimen of less than 50 x 10 ⁻⁶ , taken to be within the linear range of bituminous materials. On the basis of the applied load, the deflection and the phase lag (measured during the last 10 seconds of the test), the complex modulus is calculated at not less than 4 temperatures (separated by not more than 10 °C), starting at the lowest temperature, and at not less than 3 frequencies at each temperature.	
		For four-point bending on prismatic specimens, six specimens are sawn from each of three slabs, which must be at least two weeks old, taken from the road or manufactured in a laboratory. Four of the specimens from each slab are dried to constant mass and their dimensions measured. Each of these 12 specimens is subjected to four-point periodic bending with free rotation and translation at each loading and reaction points. The bending is applied in the vertical direction, perpendicular to the axis of the specimen, at the two central supports while the end supports remain fixed. The applied load is sinusoidal at 8 Hz and symmetrical with the displacement amplitude of 150 μ m/m throughout the test; the test temperature is 10 °C. During the test, the force needed to deform a specimen is measured as a function of time and the complex stiffness modulus calculated between the 45 th and 75 th load application; the test result is the mean value for the twelve specimen.	
		For the indirect tensile resilient modulus on cylindrical specimens, a core is trimmed to remove any projections and then cut to form specimen(s) of the appropriate thickness. The dimensions of a specimen are measured and two mutually-perpendicular diameters drawn on one face. The specimen, together with a dummy specimen used to monitor the temperature, is conditioned to the test temperature, usually 20 °C. The specimen is mounted in the test jig on its side with	

	loading platens at the top and bottom of one of the marked diagonals. Five conditioning pulses are applied to allow the equipment to adjust the load magnitude and duration to give a horizontal diametral deformation and rise time to achieve a load area factor of 0.6. A further five pulses are applied, the results of which are used to calculate the stiffness modulus. The core is rotated through 90 ° and the measurement repeated. The test result is the mean of the two measurements provided they do not differ more than a specific amount.
	For the uniaxial tension-compression on cylindrical specimens, a core or a laboratory-prepared cylindrical specimen is stored for between 2 weeks and 2 months. Steel plates are glued to both ends of the specimen; the plates are attached via ball joints and a load cell to a tensile test machine. The specimen is conditioned to the test temperature for at least 4 hours before being subjected to a sinusoidal strain with an amplitude of not more than 25×10^{-6} and the complex modulus calculated. Measurements are made at not less than four temperatures (usually 10 °C , 20 °C , 30 °C and 40 °C) and at not less than six frequencies (usually 0.1 Hz , 0.3 Hz , 1.0 Hz , 3.0 Hz , 10 Hz and 20 Hz) at each of the temperatures.
	For the uniaxial tension on cylindrical specimens, a core or laboratory-prepared cylindrical or prismatic specimen is conditioned at the test temperature for at least 4 hours (diameter up to 100 mm) or 8 hours (diameter over 100 mm). Plates are glued to both ends of the specimen (although this step is not actually given in the Appendix) and the plates attached via ball joints to a tensile test machine. The specimen remains with zero stress for not less than 30 minutes, during which time the change in strain is not to be greater than 4 microstrain. A tensile load is then applied and plotted against the resulting strain. The procedure is repeated on four specimens as one test. [Note: This Appendix is the least clear of the test procedures currently being reviewed.]
Equivalent BS:	BS DD 213: 1993
Principal differences:	The indirect tensile resilient modulus on cylindrical specimens method in Appendix C of the draft CEN Standard is based on the British Standard. However, the concept of load area factor is introduced in the draft CEN Standard. Also, the draft CEN Standard assumes a Poisson's ratio of 0.35 whereas the British Standard assumes that it varies with temperature (although it is 0.35 for the standard test temperature of 20 °C). The changes to bring the British Standard into line with the draft CEN Standard have already been proposed for future editions of the British Standard.
Implications for UK:	The draft CEN Standard should be acceptable for use in the United Kingdom because it allows the use of the current method, although there could be problems if one of the other methods were selected as the reference method.
Other comments:	The specimen preparation, number of replicates and general approach in the test methods given in the different Appendices are, presumably, still to be harmonised.

8 Oddments

8.1 Temperatur	e measure	ement
Reference Number:		prEN 12697-13
Assessment cate	gory:	C
TG 2 drafter:		John Richardson and Cliff Nicholls, United Kingdom
Latest draft:	Date: Status:	May 2000 Formal Vote (Stage 51)
Scope:		The Standard 'describes a test method for measuring the temperature of hot bituminous mixtures after mixing and during storage, transportation and laying. This Standard does not include the use of non-contact temperature-measuring devices.'
Summary of method:		There are separate methods for measuring the temperature of asphalt in a lorry, after being laid and in a heap with a common section on conditioning the probe. Each method requires at least four measurements to be made with the result being their mean. The measurements in a lorry are at a depth of at least 250 mm spaced evenly along each side but not less than 500 mm from any edge. The measurements of laid material is as close as possible to mid-layer depth. The measurements in a heap are at a depth of at least 250 mm spaced evenly around the accessible perimeter and not less than 300 mm from the base.
Equivalent BS:		BS 598: Part 109: 1990, Clause 4
Principal differences:		Measurement of the temperature of material in a heap is not in the British Standard. The minimum number of measurements for laid material has been increased in the draft CEN Standard from three to four, as for material in a lorry. The recommendation in the British Standard for the result to be preferably the mean of six (from a lorry) or five (of laid material) measurements has been removed.
Implications for UK:		The draft CEN Standard is based on the British Standard and no adverse implications for the United Kingdom are foreseen with its implementation.

8.2 Dimensions of a bituminous specimen

Reference Number:	prEN 12697-29
Assessment category:	C
TG 2 drafter:	Martin Jacobs, Netherlands
Latest draft:	Date: 1999 Status: Awaiting Formal Vote (Stage 50)
Scope:	The Standard 'specifies a method for determining the dimensions of cylindrical, rectangular or non-rectangular bituminous test specimens by measurement. This test shall be used on cores out of the road or on specimens that are made in the laboratory. Both types of specimens should have been trimmed by sawing.'
Summary of method:	For cylindrical specimens, the height is mean of four measurements made using a calliper gauge (or 'approved jig or other device') evenly spaced around the perimeter and 10 mm in from the edge. The diameter is the mean of three pairs of measurements (top, bottom and middle), the pairs being across mutually perpendicular diameters.
	For (non-)rectangular specimens, the height, width and depth are each the mean of four measurements evenly spaced around the perimeter. When the dimensions in one or more directions change substantially, the number of readings is increased to allow the volume to be calculated (although no advice is given on determining how many may be appropriate).
Equivalent BS:	None.
Implications for UK:	The procedures standardise common sense, and so should not present any problems.

8.3 Thickness of a bituminous pavement

Reference Number:		prEN 12697-36
Assessment category:		В
TG 2 drafter:		Martin Jacobs, Netherlands
Latest draft:	Date: Status:	1999 Awaiting Formal Vote (Stage 50)
Scope:		The Standard 'specifies two methods for determining the thickness of a bituminous pavement. In the first method, measurements are carried out on one or more cores which have been drilled from the full depth of the slab or road structure (destructive method). In the second method, electro-magnetic (non-destructive) measurements are used. Both methods can be used for the determination of the thickness of a bituminous paving construction. When compliance is to be established, the method to be used and – if relevant – the position of the cores in the slab should be agreed in advance by the relevant parties or should be defined in contracts.'
Summary of method:		For the destructive method, 100 mm or 150 mm diameter full-depth cores are cut from the pavement. Four measurement lines are marked on the side of the core parallel with the axis and evenly spaced around the circumference. Each change in layer is also marked. The depth of each boundary is measured from the surface along each measurement line. The thickness of each layer is the average difference between the depth of the bottom of the layer and that of the top. When the core has been drilled at an angle of more than 5 $^{\circ}$ with the vertical, the measurements is corrected for the slope.
		For the non-destructive method, an antipole consisting of aluminium foil is fixed, prior to laying, at the bottom of the layer to be measured. After it has been overlaid, the thickness of the layer (or layers) is measured by electromagnetic apparatus using the eddy current principle. No metal object must be within one metre of the antipole. The thickness of several layers can be measured with a single antipole if measurements are made after each layer is applied.
Equivalent BS:		None.
Implications for UK:		The coring procedure standardises common sense, and so should not present any problems. The non-destructive test method should prove useful if the precision is acceptable, but will require forethought until the placing of antipoles becomes routine.

8.4 Adhesivity of binder on precoated chippings for hot rolled asphalt

Reference Number:		prEN 12697-37
Assessment category:		C
TG 2 drafter:		Cliff Nicholls, United Kingdom
Latest draft:	Date: Status:	April 2000 Results received from CEN Enquiry (Stage 46)
Scope:		The Standard 'describes a hot sand test method for determining the condition of the binder on coated chippings for use with hot rolled asphalt wearing course.'
Summary of method:		Pre-coated chippings are dried before being placed on trays with 25 mm depth of silica sand at a temperature of 125 °C to 130 °C and then further sand at the same temperature poured over. The chippings and sand are maintained at that temperature for at least 10 min before the tray is removed from the oven, the chippings are sieved out and left to cool. The cool chippings are next placed in a tin with silica grit and shaken, The chippings are re-sieved and weighed to assess the mass of sand, as a proportion of the mass of chippings, adhere to the chippings. The chippings are also assessed for those being less than half covered in sand.
Equivalent BS:		BS 598: Part 108: 1990
Principal differences:		The draft CEN Standard having been based on the British Standard, there is only one significant technical difference between them. This difference is that the requirement for the sand and grit to have 'rounded particle shape' in the British Standard is quantified in the draft CEN Standard as a flow coefficient of not less than 27 s.
Implications for UK:		There are no adverse implications anticipated adopting the draft CEN Standard.

8.5 Test equipment and calibration

Reference Number:		prEN 12697-38	
Assessment category:		В	
TG 2 drafter:		Cliff Nicholls, United Kingdom	
Latest draft:	Date: Status:	April 2000 Final WG1 draft for internal voting	
Scope:		The Standard 'specifies common test equipment and calibration procedures for the EN series of tests for properties of bituminous mixtures. It also specifies general requirements for apparatus and methods of calibration to be used when testing bituminous mixtures for compliance purposes. Hence, this standard specifies the minimum level of calibration checks considered necessary to establish conformance of common equipment and apparatus. This standard makes use by reference of the requirements for common equipment and calibration prepared for aggregates. Note: Accreditation agencies may need to consider alternative requirements and/or calibration frequencies in order to cover the possibilities of National Health & Safety, regulatory and legislative requirements.'	
Summary of method:		The Standard gives guidance on the requirements for equipment, including tolerances, and their calibration, including frequency of calibration. Those items covered in prEN 932-5, Tests for general properties of aggregates – Part 5: Common equipment and calibration, are covered by cross-reference rather than directly. There are informative annexes on recommendations for laboratory management, accuracy of measurement and rounding of values for reported results.	
Equivalent BS:		None.	
Implications for UK:		The Standard is not a test method but advice on tolerances, calibration and related matters. The introduction of such a Standard could have significant implications for the management of testing, depending on the force that is put behind the advice and on the required frequency of reference checks and calibrations. If the levels are set appropriately, the document should help to ensure a consistent amount of traceability from all testing laboratories.	
Other comments:		The original draft was based on the equivalent document for aggregates, to which the current draft refers. It is intended that liaison with TC 154 will allow a common aggregates and asphalt Standard to be produced, which could then be extended to include concrete, bitumen and cement. This common approach would be beneficial for most testing laboratories that carry out testing in more than one of these inter-related fields.	

9 Conclusions

The conclusions of this review are that, overall, the implementation of the harmonised European testing Standards should not have a detrimental effect to the UK industry. Most draft CEN Standards that replace existing British Standards have only minor changes from those they replace whilst there are several additional test procedures, some of which may be beneficial to the UK industry. The area of greatest concern is the tests to determine fundamental properties, but these are the least developed at this time.

However, consideration should now be given to selecting those Standards that are going to be used in specifying materials in the United Kingdom and to gaining some experience of the CEN procedures, including an indication of the precision of the tests. For those tests that are similar, but not identical, to existing UK tests, an indication of whether the changes will affect the numerical result of the test, and if so by how much, will also be required.

10 Acknowledgements

The work described in this paper was carried out in the Infrastructure Division of the Transport Research Laboratory with Mr M E Nunn as Project Manager and Dr J Rolt as Quality Audit and Review Officer. The Highways Agency is supporting the involvement of the author in the development of these CEN Standards.

11 References

Manual of Contract Documents for Highway Works. Stationery Office, London.

Volume 1: Specification for Highway Works (MCHW 1).

British Board of Agrément (1998). Guidelines Document for the Assessment and Certification of Thin Surfacing Systems for Highways: Appendix A.2, Sensitivity to Water. Draft document SG3/98/145. British Board of Agrément, Watford.

British Standards Institution, London

- BS 598 Sampling and examination of bituminous mixtures for roads and other paved areas.
 - Part 100: 1987 Methods for sampling for analysis
 - Part 101: 1987 Methods for preparatory treatment of samples for analysis.
 - Part 102: 1996 Analytical test methods.
 - Part 104: 1989 Methods of test for the determination of density and compaction.
 - Part 107: 1990 Method of test for the determination of the composition of design wearing course asphalt.
 - Part 108: 1990 Methods for determination of the condition of the binder on coated chippings and for measurement of the rate of spread of coated chippings.

Part 109: 1990	Method for the assessment of the compaction performance of a roller and recommended procedures for the measurement of the temperature of bituminous mixtures.
Part 110: 1996	Method for determination of wheel tracking rate of cores of bituminous wearing course.
Part 111: 1995	Method for determination of resistance to permanent deformation of bituminous mixtures subject to unconfined uniaxial loading.
BS 5284: 1976	Sampling and testing mastic asphalt and pitchmastic used in building
BS DD 213: 1993	Method for determination of the indirect tensile stiffness modulus of bituminous mixtures
BS DD 226: 1996	Methods for determination of resistance to permanent deformation of bituminous mixtures subject to unconfined dynamic loading
BS DD 228: 1996	Methods for determination of maximum density of bituminous mixtures
BS DD 229: 1996	Method for determination of the relative hydraulic conductivity of permeable surfacings
BS DD 232: 1996	Method for determination of the maximum binder content of bituminous mixtures without excessive binder drainage

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Development of a typical EN in CEN



Stage codes and usage codes

Level	Code	Stage	Explanation					
0.	Work	08	Work item registered (title).	Definition stage of work items.				
	definition	09	Work item described (title and scope).	Definition stage of work items.				
1.	Initiation	10	Proposal for new work to be approved.	Proposal presented to BT, TC, WG, and not yet includ in the appropriate programme of work.				
		11	Work allocated to a Technical Body*.	Work item allocated to a TC, WG, SR, by an authorised body (AG, BT,).				
		12	Work already in Technical Body* scope.	Work item included in a TC, WG, programme as evidently within its scope (e.g. revisions, amendments).				
		13	RD submitted to BT.	Questionnaire Procedure step.				
		14	PQ decided by BT.	Questionnaire Procedure step.				
		15	UQ to be launched.	Questionnaire Procedure step. A UQ may be decided by BT or launched automatically by the CS.				
		16	RD to be submitted to Formal Vote (HD, EN, ENV [‡] ,).	 Submission of ENV-clause 7.3 to vote by CEN/CENELEC members. 				
				 Direct submission of RD to Formal Voting, as decided by BT, TC, 				
2.	Questionnaire	20	Document available for PQ/UQ.					
	procedure	21	PQ/UQ circulated, standstill started.	Questionnaire Procedure step.				
		22	Submission of PQ/UQ results to BT.	Questionnaire Procedure step.				
		23	PQ/UQ results in Formal Vote (EN, ENV).	Questionnaire Procedure step.				
		24	PQ/UQ results in Format Vote, HD.	Questionnaire Procedure step.				
		25	Task referred to Technical Body*.	Questionnaire Procedure step. Work referred to a Technical Body, after evaluation of the Questionnaire results.				
		27	Work stopped, standstill maintained.	Questionnaire Procedure step.				
		28	Work stopped, standstill released.	Questionnaire Procedure step.				
3.	Technical Body* stage	31	Working document expected from Technical Body.	Working document (1st, 2nd, 3rd,) expected from a Technical Body.				
		32	Working document circulated.	Working document (1st, 2nd, 3rd,) expected from a Technical Body circulated for comments to members of this body.				
		33	CEN/CENELEC enquiry decided.	Decision to launch a CEN/CENELEC enquiry on basis of a draft from a Technical Body.				
		34	Formal Vote decided (EN, ENV, HD,).	Decision to launch directly a Formal Vote on basis of a draft produced by a Technical Body.				
		37	Work stopped, standstill maintained.					
		38	Work stopped, standstill released.					
		39	Situation Report submitted to BT.	Work not completed by a Technical Body within target.				
4.	CEN/ CENELEC enquiry	40	Document available for CEN/CLC enquiry.	CEN/CENELEC enquiry, including CDL check 1.				
		41	CEN/CENELEC enquiry and CDL1 [†] started.	CEN/CENELEC enquiry, including CDL check 1.				
		42	Second CEN/CENELEC enquiry decided.	CEN/CENELEC enquiry, including CDL check 1.				
		43	Second CEN/CENELEC enquiry started.	CEN/CENELEC enquiry, including CDL check 1.				
		44	Vote decided, and CDL2 ⁺ , no deviation.	Decision to launch a Formal Vote on basis of CEN/CENELEC enquiry results, including CDL check 2.				
		45	Vote decided, and CDL2 [†] with deviations.	Decision to launch a Formal Vote on basis of CEN/CENELEC enquiry results, including CDL check 2.				
		46	Results of CEN/CLC enquiry established.	CEN/CENELEC enquiry, including CDL check 1.				
		47	Work stopped, standstill maintained.					
		48	Work stopped, standstill released.					

Continued

Level	Code	Stage	Explanation					
5.	Formal Voting	49	Document available for formal vote.	Formal Vote step (EN, HD, ENV clause 7.2).				
		50	Preparatory Vote.	Preparatory vote, e.g. vote in an ASB or similar (COCOR,).				
		51	Formal Vote launched (EN, ENV [‡] , HD).	Formal Vote step (EN, HD, ENV clause 7.2).				
		52	Voting Report established.	 Formal Vote step (EN, HD, ENV clause 7.2). Formal Vote evaluation may lead to: ratification; publication of a report; complementary vote (e.g.: CECC); activity stopped (standstill released or maintained); activity referred to a Technical Body. 				
		53	Ratified. Publication decided.	Formal Vote step (EN, HD, ENV clause 7.2).				
		54	Complementary Formal Vote launched.	Complementary vote launched on a draft, which takes into account the results of the Formal Vote under 51 (CECC).				
		55	Task referred to Technical Body*.					
		57	Work stopped, standstill maintained.					
		58	Work stopped, standstill released.					
		59	Results reported to AG/CA.	Report to AG or CA.				
6.	Finalisation and printing	61	HD being finalised.	Finalisation and printing step.				
		62	HD available.	Finalisation and printing step.				
		63	EN, ENV, Report being finalised.	Finalisation and printing step.				
		64	EN available.	Finalisation and printing step.				
		65	Report available.	Finalisation and printing step.				
		66	ENV available.	Finalisation and printing step.				
7.	National	71	HD implemented (all countries).	Implementation of HD and EN at national level.				
	implementation	72	ENV implemented (all countries).	Implementation of ENV at national level.				
		73	EN implemented (all countries).	Implementation of HD and EN at national level.				
		74	Proposal referred to ISO/IEC.	Proposal to be referred to ISO/IEC by a CEN/CENELEC member.				

Stage codes and usage codes (continued)

*

Technical Body = TC, WG, SR, ..., occasionally BT, CS CDL1 and CDL2 are CDL first and second checks respectively See usage notes for stages 16 and 51

† ‡

Appendix B: Status of draft test method standards

CEN Stage					32	40	41	46	_	49	51
Description	Final TG2 draft	First WG1 draft	Second WG1 draft	Final WG1 draft	TC 227 draft	Trans -lation	CEN Enquiry	Results	Comments Res'tion	Final draft	Voting
prEN 12697-1											
prEN 12697-2											
prEN 12697-3											
prEN 12697-4											
prEN 12697-5											
prEN 12697-6											
prEN 12697-7											
prEN 12697-8											
prEN 12697-9											
prEN 12697-10											
prEN 12697-11											
prEN 12697-12											
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prEN 12697-15											
prEN 12697-16											
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prEN 12697-31											
prEN 12697-32											
prEN 12697-33											
prEN 12697-34											
prEN 12697-35											
prEN 12697-36											
prEN 12697-37											
prEN 12697-38											
Mod binder anal											
Ignition method											
Hydraulic c'ty											

*Suggested clarifications to the English, where given, are shown in square brackets. *Maximum nominal size of aggregate

Abstract

There is a move from recipe-based to performance-related specifications for asphalt mixtures. This change produces a need for tests that can be used under contractual conditions to measure the performance-related properties of mixtures. At the same time, the national standard specifications and test methods are being harmonised by the Comité Européen de Normalisation across Europe. Such harmonisation will increase the number of potential test methods that are available in any State because of the inclusiveness of the approach. The proposals for European tests are reviewed with an emphasis on comparison with current British tests and on their suitability for use with performance-related specifications. Tests that could be useful, but which are not currently used in the United Kingdom, are described and also attention is drawn to significant differences between the draft European methods and their BS equivalents. There may be subsequent changes to the draft test methods because they are still evolving, so the information will be accurate for only a limited time scale. The review shows that the change to the harmonised European test methods is unlikely to be detrimental to the move towards performance-related specifications.

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