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GUIDELINES DOCUMENT

FOR THE ASSESSMENT AND CERTIFICATION OF

THIN SURFACING SYSTEMS

FOR HIGHWAYS

May 2008

Note: This document may be revised from time to time to take account of improvements and amendments to test and assessment methods and material innovations. Readers are advised to contact the British Board of Agrément hotline to check the latest edition.

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HAPAS GUIDELINES

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1 SCOPE

1.1 The assessment is directed towards the issue of a BBA HAPAS Roads and Bridges Agrément Certificate confirming a thin surfacing system's compliance with the requirements as defined by Specialist Group 3, Thin Surface Course Systems, and agreed by HiTAC.

1.2 The test methods and protocols contained in this document are for certification purposes only and are not intended for use on a contractual basis as a specification.

1.3 For the purpose of this scheme a thin surfacing system is defined as a proprietary bituminous product with suitable properties to provide a surface course that is laid at a nominal depth of less than 50mm.

1.4 Systems receiving a Certificate shall be recognised under the Highway Authorities Product Approval Scheme (HAPAS).

1.5 A condition of Certification shall be that systems are only installed by contractors approved by the Certificate holder and who operate a quality system which satisfactorily addresses the appropriate details listed in clause 3.1.1. The Certificate holder shall periodically audit the contractor and make the details of the audits available to the BBA when requested.

1.6 A system shall be classified in accordance with Table 1, Classification. If required the suitability of a system for use on any particular site, with respect to stress and traffic levels, shall be determined using the procedure detailed in Appendix C.

1.7 A system's performance shall, (where relevant), be measured against the parameters defined in Table 2, Mandatory tests and, at the request of the applicant, against one or more of those defined in Table 3, Optional tests.

2 INTRODUCTION

2.1 The assessment and certification procedure shall be undertaken in six stages, as follows:

Stage 1 - Assessment of applicant's data
Stage 2 - Assessment of production control
Stage 3 - Laboratory testing
Stage 4 - System installation trial
Stage 5 - System performance trial (if required)
Stage 6 - Certification

2.2 Generally each stage shall be successfully completed and, where appropriate, a report issued prior to the commencement of the next stage. However, stages 1 to 5 may at the request of the applicant be undertaken concurrently. The applicant shall have the option of withdrawing from the programme at any stage should the system submitted fail to comply with the requirements.

2.3 All systems shall be able to demonstrate satisfactory performance on at least 3 sites of appropriate nominal installation depth classification over a period of at least two years. One of the sites shall have been monitored during the two-year period by the BBA or their agent. Existing data obtained during the road trial for departmental type approval will normally be acceptable to the BBA.

2.4 Where systems already have type approval, or part approval, from an overseeing organisation (as defined in the Design Manual for Roads and Bridges) then existing test data, if suitable, may be used for assessment purposes under stages 3 to 5. The suitability of existing test data will be assessed by the BBA.

2.5 In the event of an applicant offering a system including a number of options with regard to system components and/or alternative application procedures the BBA shall define the number of Certificates required and the range of tests to be performed to allow the acceptance of the alternative materials and/or procedures.

2.6 The BBA in consultation with Specialist Group 3 reserves the right to amend or supplement the tests required for BBA assessment and certification at any time if required. The cost of all further tests shall be borne by the applicant.

2.7 A Certificate shall only be awarded on the system's successful completion of the appropriate stages 1 to 6.

3 ASSESSMENT AND CERTIFICATION PROCEDURE

3.1 Stage 1: Assessment of Applicant's Data

3.1.1 Applicants shall submit at least the details listed below for examination by the BBA. If they are found to be acceptable they shall form the basis of the subsequent assessment:

- Application for BBA assessment, including:	- applicant details and historical data for the system.
- Quality Plan, including:	- details of the system to be assessed, production procedures (including controls and tolerances), location of all production plants. For example: -binder (type, source, characteristics etc). -aggregate(s) (type, source, characteristics etc). -ancillary products (type, source, characteristics etc). -Mix design parameters -final product (nominal thickness as laid and claimed regulation, composition, storage, delivery to and storage on site etc) -quality system information
- Installation method statement including:	- limitations in respect to weather and substrate conditions. - substrate preparation. - pre-installation survey details. - installation procedures. -details for maintenance and repair (including any special repair materials) - on-site storage and handling of materials - on site quality control / assurance procedures and associated documentation. - audit checks on the installer(s)
- CE Mark product information (if applicable)	- Information confirming compliance to BS EN 13108 - Data relating to type testing and factory production control in accordance with BS EN 13108 – 20 and 21 - Type test reports indicating mixture constituents, composition and claimed properties - FPC certificate from a Notified Body

3.1.2 Should there be, during the assessment, the need to modify the system defined by the applicant (for example as a result of failure of the system to meet the requirements) the content of the assessment and additional work required shall be reconsidered by the BBA.

3.1.3 If the system includes hazardous substances, i.e. that require special precautions to be taken under the COSHH Regulations, the applicant shall supply all the relevant data. No formal assessment of the suitability of this data, in terms of the COSHH regulations, shall be undertaken by the BBA. However, this data shall always be required by the BBA and its subcontractors to ensure the safe use and testing of the system in their laboratories. The applicant's instructions for use shall include all necessary data to allow the safe use of the products.

3.2 Stage 2: Assessment of factory production control

3.2.1 The BBA shall assess the applicant's production processes, material controls, records etc to ensure that a consistent product is offered for sale. This shall[(2)] include audit visits to one or more of the manufacturing locations to confirm the Quality Plan and Quality System for the system. The assessment of factory production control shall[(2)] form the basis for subsequent surveillance visits.

3.2.2 Where a quality system is ISO 9000 series accredited, this shall be acceptable to the BBA. Other quality assurance schemes[(1)] recognised by the highway authorities may also be acceptable to the BBA.

Note 1 Details of these schemes shall be assessed by the BBA prior to acceptance.
Note 2 Where evidence of a CE Marked product is provided by the applicant, this shall be acceptable to the BBA provided the information given in Stage 1 satisfies the requirements of FPC for EN 13108-21. No further information is required for stage 2 of this assessment.

3.3 Stage 3: Laboratory testing

3.3.1 Identification / Characterisation

3.3.1.1 The applicant shall provide the results of tests, which show that the components of the system offered for assessment fall within the agreed specification for the system. For products that are CE Marked to BS EN 13108 information as outlined in PD 6691 will be sufficient

3.3.1.2 These checks also serve to ensure that the system offered for assessment is typical and to enable confirmation, at a later date, that other samples also fall within the agreed specification.

3.3.2 Performance testing

3.3.2.1 All samples submitted for testing shall be prepared by the applicant or his representative. Preparation of the samples may be witnessed by the BBA, or their agent. The applicant shall provide evidence that the system submitted for this stage is within the declared manufacturing tolerances, e.g. certificate of conformity, including quality control data etc.

Note 1: Where a product is CE Marked to BS EN 13108 the applicant shall identify performance properties from PD 6691 and provide test data to support any performance claims made. This should be compared to the mandatory and optional tests detailed below and any additional tests completed.

3.3.2.2 Testing shall be undertaken, on behalf of the BBA by a laboratory approved by the BBA, in accordance with the test methods defined in appendix A. The tests shall include:

Mandatory tests

a) Laboratory tests

- PSV and AAV (both measurements to be made on aggregate sampled at the same time)
- Wheel tracking at 45°C and/or 60°C (wheel tracking rate / depth of rutting)
- Sensitivity to water
- Torque bond test (may also be carried out as a road test)

b) Road tests

- Visual condition, (initial and after 2 years trial period)
- Texture depth, (Initial texture depth and retained texture depth including rate of decline)

Optional tests at the applicant's request

- SCRIM
- Noise, (statistical pass-by method)
- Hydraulic conductivity
- Stiffness (indirect tensile stiffness modulus)
- Sensitivity to diesel (or other fluid)
- Improvement in surface regularity
- Ageing (ITFT)
- Immersed wheel tracking

3.3.3 On the completion of stage 3 the results of the assessment will be reported to the applicant.

Table 1: Classification

Parameter		Type A	Type B	Type C
Installation Depth	Nominal installation depth (mm)	<18	18-25	>25 - ≤50

Table 2: Mandatory tests

Test		Parameter	Performance Levels[1]	Applicability of test
Laboratory tests:	PSV	Polished Stone Value of the aggregate.	HD36/99[2]	Data always required for aggregates used for installation / performance trial
	AAV	Aggregate Abrasion Value	HD36/99[2]	
	Wheel tracking[3] (45°C and/or 60°C)	Wheel tracking rate (mm/hr) Depth of rutting (mm)	0 - 3	Required when the nominal laid thickness + claimed regulating depth ≥20 mm
	Torque bond test[4]	Shear stress (kPa) Installation depth (mm)	Record[6] Record	Always required Always required
	Sensitivity to water	Retained stiffness after water immersion (ITSM Ratio)	Record	Always required
Road tests:	Visual observations Visual assessment by inspection panel	Initial After 2 years trial period	- 0 - 6	Always required Required for performance trials only
	Texture depth[5]	Initial texture depth (mm) Retained texture depth (mm) Determine rate of decline	0 - 3 0 - 3 Record	Always required Required for performance trials only

Notes:

1 Performance levels are defined in Appendix B

2 Guidance on the specification of PSV should be sought by reference to the Design Manual for Roads and Bridges, Volume 7 Pavement Design and Maintenance, Section 5 Surfacing and Surfacing Materials, HD36/06 Surfacing Materials for new and maintenance construction.

3 Test carried out on samples ≥20mm thick.

4 The bond test may also be carried out as a road test.

5 On surfacing that has undergone trafficking the texture depth measurements shall be made in the nearside wheel tracks.

6 The BBA will record the shear stress and the mode of failure for this test. Available evidence suggests that a system should perform satisfactorily, in terms of bond strength , if it achieves a shear strength >400 kPa, with the main mode of failure occurring at the interface between the system and the substrate. This figure is quoted as a guideline only.

Table 3: Optional tests

Test		Parameter	Performance Levels[(1)]	Applicability of test
Laboratory Tests:	ITSM	Stiffness	Record	Where performance is claimed under the parameter.
	Sensitivity to diesel (or other fluids)	Retained stiffness after diesel or (other fluid) immersion	Record	As above
	ITFT	Ageing characteristics	Record	As above
	Immersed wheel tracking test	Resistance to stripping	Record	As above
Road tests:	Statistical Pass-by	Noise	Record	As above
	Improvement in surface regularity	Change in longitudinal regularity (Profile improvement value) Change in transverse regularity (Rut improvement value)	Record Record	As above
	Hydraulic conductivity	Relative hydraulic conductivity	0 - 3	as above
	SCRIM	SCRIM survey within 12 weeks of system installation MSSC during 2nd summer of trial period	Record Record	Always required when the applicant claims enhanced skid resistance properties from those that would be expected from the PSV of the aggregate and site conditions.

Note: 1 Performance levels are defined in Appendix B

3.4 Stage 4: System installation trial

3.4.1 The applicant shall arrange for the system installation trial, during daylight hours, to demonstrate the installation and quality control to enable verification of his installation procedures.

3.4.2 The trial shall be witnessed and assessed by the BBA to cover the applicant's installation procedures as defined in the Installation Method Statement. If the installation trial is to be used as a performance trial then the inspection panel, if required, shall also be invited to witness the installation.

3.4.3 The Installation Method Statement shall be practicable and sufficiently detailed to cover all foreseen eventualities. It shall include the application rates of the bond coat, binder, aggregate and/or mixed material, methods of verification to be used on site, maintenance and repair techniques, aftercare, and frequency of testing and acceptable variations within the specified limits. Current state of the art techniques are documented in BS 594987 and SHW Clause 903.

3.4.4 The BBA shall inspect the site to assess the visual condition of the system and may witness the site performance tests detailed in 3.3.2.

3.4.5 Alternatively, where a system already has type approval, or part approval, from an overseeing organisation then existing data relating to the road trial carried out as part of the approval, if suitable, may be used for assessment purposes under this stage. The suitability of the data will be assessed by the BBA.

3.5 Stage 5: System performance trial

3.5.1 A system performance trial shall be required to assess the performance of the installed product and to monitor the systems performance over a two-year period.

3.5.2 The applicant shall arrange for a laboratory approved by the BBA to take core samples for mandatory and optional laboratory testing from the installation. Details of the performance (mandatory and optional) tests are given in Tables 2 and 3 respectively.

Note 1: For CE marked products, existing type test data relating to the mandatory and optional laboratory tests, where acceptable to the BBA, may be used for assessment purposes under this stage.

3.5.3 The installation of the system shall be carried out and assessed as detailed in section 3.4.

3.5.4 In addition the applicant shall arrange for monitoring the site and make available the test results from a laboratory approved by the BBA at six monthly intervals over a two-year period. The report shall be made available to the BBA within one month of the due date. The inspection panel may be required to inspect the site, during the trial period, if the results of the monitoring suggest the need for such an inspection.

3.5.6 The following performance tests shall be carried out to monitor the performance of the system over the two-year trial period:

a) Visual observation
b) Texture depth
c) Optional road tests where performance is claimed against a parameter

3.5.7 Test methods and procedures are detailed in appendix A and the performance levels, where applicable, are defined in appendix B.

3.5.8 The inspection panel, at the end of the two-year trial period will conduct a visual assessment of the system in accordance with appendix A.10

3.5.9 Alternatively, where a system already has type approval, or part approval, from an overseeing organisation then existing data relating to the road trial carried out as part of the approval, if suitable, may be used for assessment purposes under this stage. The suitability of the data will be assessed by the BBA.

3.6 Stage 6: Certification

3.6.1 Any Certificate issued shall be in the BBA HAPAS Roads and Bridges series and shall verify the systems compliance with the requirements given in this document. The Certificate shall also define the system assessed, the conditions of use and the likely performance related to the severity of the conditions of use. It shall also include the results of tests.

3.6.2 The assessment and any Certificate issued shall be subject to the terms and conditions of the relevant BBA contract, which shall include the following:

a) Any Certificate issued shall have an unlimited validity provided that:

i) The specification of the system is unchanged by the manufacturer.

ii) The manufacturer continues to have the system checked by the BBA, which shall include ongoing surveillance of the production.

iii) The validity is confirmed by a Review carried out every five years by the BBA.

The validity of a Certificate can be checked by referring to the BBA's website (www.bbacerts.co.uk) or by contacting the BBA direct (Telephone Hotline on 01923 665400).

iv) The requirements of the Guidelines Document remain unchanged.

b) In the event of the Certificate holder going into liquidation the Certificate shall be suspended and may be withdrawn.

c) Reinstatement of a suspended or expired Certificate shall be the subject of a review by the BBA. Certificates which have been suspended or expired for longer than 2 years shall no longer be valid for reinstatement.

3.6.3 During the validity of any Certificate the Certificate holder shall be responsible for the quality assurance/control of the production at the manufacturing locations declared to the BBA.

3.6.4 The BBA or its agents shall carry out one or more audit visits each year to production location(s), and/or the Certificate holders offices (where appropriate), to check the Certificate holders records and to ensure that the procedures and controls defined at the outset continue to apply. The number and frequency of the visits shall be agreed between the BBA and the applicant.

3.6.5 The Certificate holder shall inform the BBA of the locations of any additional manufacturing plants before they become operational.

3.7 Audit Checks on Installers

3.7.1 The applicant shall conduct audit checks on the installer(s) approved by the applicant in accordance with the product Quality Plan and installation method statement.

3.7.2 In addition to the audit checks carried out by the Certificate holder detailed under 3.7.1, the BBA will carry out one or more audit visits each year to installation locations(s), to ensure the installation procedures and controls defined at the outset continue to apply.

4 ACCEPTANCE OF DATA SUPPLIED BY THE APPLICANT

4.1 The BBA shall accept test data from laboratories with UKAS accreditation for the specific tests referred to in appendix A which are performed on samples approved by the BBA. The BBA would require the test laboratory to submit a copy of their "UKAS schedule".

4.2 In the absence of a laboratory meeting the conditions of Section 4.1, the BBA may accept test data from other UKAS accredited testing laboratories, or laboratories approved by the BBA, that have demonstrated their competence and ability to perform the relevant tests to the satisfaction of the BBA Quality Manager.

4.3 Test data from overseas, external, independent testing laboratories that have the equivalent national accreditation for the specific tests may be accepted if there is a reciprocal agreement between UKAS and the national accreditation authority of the country in question, and the test methods used have been demonstrated as being equivalent to the satisfaction of the BBA.

4.4 Other data supplied in support of the assessment (e.g. background information, test data relating to generic materials etc), where the above conditions are not met, shall only be accepted after having been individually assessed and approved as being suitable by the BBA.

4.5 The procedure for the assessment of the suitability of existing data is given in appendix D.

APPENDIX A TEST METHODS AND PROCEDURES

Important note – Please read prior to considering test methods below

Table 4 provides an overview of the interim procedure and test methods for assessment following feedback from representatives on SG3 on how BS and EN standards compare. This will be subject to change as British Standards are withdrawn. For up to date information on this, the optional tests, and any queries regarding Table 4 please contact the BBA.

Table 4 – Mandatory tests

Property	**Test method and interim procedure for acceptance**	**Comment**
Aggregate properties	EN 1097-8: 2000	No change
Wheel tracking (45°C and/or 60°C)	Appendix A.1 with comparative testing to BS EN 12697-22.	Comparative testing with existing BS 598-110 as per the note in Table D.2 of PD 6691, and 9.5.3.5 in BS594987. Current UK Guidance from PD 6691, Table D.2, is that the small device **procedure B,** along with the procedure BS594987 G.3.2., and G.3.2.3. a) is adopted.
Sensitivity to water	See Appendix A.2 with comparative testing to BS EN 12697-12	For new assessments we will accept testing to EN only. For existing Certificates where supporting test reports are provided for alternative raw materials comparative work will be needed.
Torque bond test	Appendix A.3	No change
Texture depth	BS EN 13036-1 : 2002	BS 598-105 can be used but in case of dispute BS EN 13036-1 will be used.
Hydraulic conductivity	BS DD 229: 1996 with comparative testing to BS EN 12697-40	Currently there is no performance criteria for BS EN 12697-40 therefore BS DD 229 will remain within the document alongside comparative testing

Section 1:	**Standard test methods**
Aggregate properties	See Table 4
Texture depth	See Table 4
Hydraulic conductivity	See Table 4
ITSM	BS EN 12697-26, Annex C
Section 2:	**Non-standard test methods and standard test methods with modifications to the method of sample preparation**
Appendix A.1	Wheel tracking rate (see notes in table 4)
Appendix A.2	Sensitivity to water (see notes in table 4)
Appendix A.3	Torque bond strength (see notes in table 4)
Appendix A.4	Ageing Characteristics
Appendix A.5	Sensitivity to diesel (or other fluid)
Appendix A.6	Changes in longitudinal irregularities
Appendix A.7	Initial changes in maximum transverse irregularities
Appendix A.8	Noise
Appendix A.9	Skid resistance
Appendix A.10	Visual assessment
Appendix A.11	Laboratory preparation of samples
Appendix A.12	Accelerated ageing
Appendix A.13	Fatigue characteristics of bituminous mixtures using indirect tensile fatigue

Appendix A.1

Wheel tracking rate

1 Scope

This protocol describes the method for determining the susceptibility of thin surfacing systems to deformation.

The test is carried out on specimens cored from a completed installation ≥ 20mm thick.

The protocol describes a test procedure that has been developed specifically for the assessment of thin surfacing systems under HAPAS Certification procedures. The method has yet to be proven and shown to be valid. The method is therefore unsuitable for use in specifications and should not be used for this purpose.

2 References

2.1 Normative references

This protocol incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed in **10**. Subsequent amendments to, or revisions of, any of these publications apply to this protocol only when incorporated in it by updating or revision.

2.2 Informative references

This protocol refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed in **10**, but reference should be made to the latest edition.

3 Definitions

Test surface of a specimen: The surface of a cored specimen on which the road traffic would run.

In addition, the definitions given in BS EN 12697-27: 2001 and BS 598 - 110: 1998 shall also apply.

4 Apparatus

For the purpose of this protocol the apparatus described in BS EN 12697-27: 2001 and BS 598 - 110: 1998 shall be used.

5 Sampling and test specimens [(1)]

5.1 The samples to be tested shall be cores of (200 ± 5) mm diameter taken in accordance with BS EN 12697-27: 2001.

5.2 A minimum of six cores shall be taken from a 100m length of the installation at nominally even spacing along a diagonal line across the lane width. The cores shall be taken and tested within six weeks of the installation date.

5.3 The cores shall be maintained at (15 ± 10)°C during transportation to the test laboratory and for up to 96 hours once delivered. If wheel tracking testing has not commenced within 96 hours of coring, the specimens shall be placed in storage and maintained at (5 ± 2)°C until commencement of the testing procedure.

5.4 All underlying layers shall be trimmed off and the sample made up to the correct thickness for testing by mounting on a suitable non-compressable material, e.g. marine ply, in accordance with BS 598 - 110: 1998

Notes

1 Laboratory prepared samples prepared in accordance with Appendix A.11 may also be used. However it should be noted that the mechanical properties of bituminous materials are significantly influenced by the method of specimen preparation, even when the volumetric proportions are similar. Therefore laboratory prepared samples can only be accepted for comparative studies.

6 Test procedure

For the purpose of this protocol the test procedure described in BS 598 - 110: 1998 shall be used.

7 Calculation and expression of results

The wheel tracking rate shall be calculated and reported in accordance with BS 598 - 110: 1998.

8 Test report

Report the results of the wheel tracking test in accordance with BS 598 - 110: 1998.

9 Precision

For the purpose of this protocol the precision data given in BS 598 - 110: 1998 apply.

10 List of references

BS EN 12697-27, Bituminous mixtures – Test methods for hot mix asphalt – Part 27: Sampling

BRITISH STANDARDS INSTITUTION. **Sampling and examination of bituminous mixtures for roads and other paved areas**, **Methods of test for the determination of wheel-tracking rate. BSI, London 1998, BS 598-110.**

Appendix A.2

Sensitivity to water

1 Scope

This protocol describes a method for the determination of the water sensitivity of thin surfacing systems by measuring the retained stiffness after water conditioning. This method is applicable to laboratory-moulded specimens and core specimens obtained from existing roads.

The protocol describes a test procedure that has been developed specifically for the assessment of thin surfacing systems under HAPAS Certification procedures. The method has yet to be proven and shown to be valid. The method is therefore unsuitable for use in specifications and should not be used for this purpose.

2 Normative References

This protocol incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed in **10**. Subsequent amendments to, or revisions of, any of these publications apply to this protocol only when incorporated in it by updating or revision.

3 Definitions

Water sensitivity - the quality or state of a thin surfacing system, prepared so as to be suitable for trafficking if it were part of a road pavement, following conditioning in water.

Unconditioned stiffness - the stiffness modulus of the mixture as determined in accordance with BS EN 12697-26: 2004 ANNEX C prior to water and thermal conditioning.

Conditioned stiffness - the stiffness modulus of the mixture as determined in accordance with BS EN 12697-26: 2004 ANNEX C after the compacted mixture has been subjected to one or more cycles of water and thermal conditioning.

Stiffness ratio - the ratio of the conditioned stiffness to unconditioned stiffness.

The definitions given in BS EN 12697-26: 2004 shall also apply.

4 Apparatus

Vacuum desiccator - capable of accommodating the samples to be tested and capable of withstanding a vacuum of 760 mm Hg (1 atmosphere) at sea level.

Vacuum pump - capable of evacuating air from the vacuum desiccator to a partial vacuum of at least 510 mm Hg at sea level.

Water baths - of suitable size to accommodate at least one specimen and thermostatically controlled such that temperatures of (5±1) °C, (20± 0.5)°C and (60±1)°C can be maintained.

Indirect tensile stiffness modulus equipment - as described in BS EN 12697-26: 2004 ANNEX C.

Wire mesh basket - of sufficient rigidity to support the side and bottom of the compacted specimens, without bending or flexing appreciably and having an open area to total area ratio of at least 75 per cent.

Note: Stainless steel Expamet has been found to be suitable for this purpose.

5 Test specimens

The specimens for test shall be laboratory moulded specimens or cylindrical cores. The use of laboratory moulded specimens is strongly preferred and ensures that the more porous cut faces, with exposed aggregate, are not subjected to water conditioning.

5.1 Laboratory moulded specimens

5.1.1 Laboratory moulded specimens shall be compacted using a suitable device in accordance with the method described in Appendix A.11.

5.1.2 The test specimens shall be between 30mm and 75mm thick and have a diameter of (100 ± 5)mm.

5.1.3 Specimens awaiting testing shall be maintained at (15 ± 10)°C for a maximum period of 96 hours from the time of manufacture.

5.1.4 If water sensitivity testing has not commenced within 96 hours of manufacture of the specimens, they shall be placed in storage and maintained at (5 ± 2)°C until commencement of the testing procedure.

5.2 Cored specimens

5.2.1 Core specimens shall be obtained in accordance with BS EN 12697-27: 2001 except that the cores shall have a diameter of (100 ± 5) mm.

5.2.2 All cores shall be of taken at locations evenly distributed across the laid area, but not within 500mm of any edge where possible, but in any case within a laid area of 60 m^2.

5.2.3 Cored specimens must be received at the testing laboratory within 24 hours of coring.

5.2.4 The storage of specimens awaiting testing or preparation for testing shall be maintained at (15 ± 10)°C for a maximum period of 48 hours from receipt at the laboratory.

5.2.5 Cored specimens shall be trimmed by wet sawing in preparation for testing and shall be allowed to dry in air at (15±10)°C for a minimum period of 16 hours prior to commencing the testing procedure.

5.2.6 If water sensitivity testing has not commenced within 96 hours of coring, the cores shall be placed in storage and maintained at (5 ± 2)°C until commencement of the testing procedure.

Six specimens shall be tested and specimens shall not be stacked at any stage.

6 Test procedure

6.1 Determine the unconditioned stiffness in accordance with BS EN 12697-26: 2004 ANNEX C. Designate this as $ITSM_U$.

6.2 Place the specimen in the vacuum desiccator, cover it with distilled water at (20 ± 1)°C, seal the apparatus, and apply a partial vacuum of (510 ± 25) mm Hg for (30 ± 1) minutes.

6.3 Remove the specimen from the vacuum desiccator.

6.4 Place it in a hot water bath at (60 ± 1)°C for (6 ± 1) hours. The sample may be supported in a wire mesh basket if necessary to minimise distortion.

6.5 Remove the specimen from the hot water bath and immediately place it in a cold water bath at (5±1)°C for (16 ± 1) hours.

Note: It is acknowledged that the water temperature will rise when the cores at 60 ˚C are placed in the water bath.

6.6 Remove the specimen from the cold water bath and immediately place it in a water bath at (20±0.5)°C for at least 2 hours.

6.7 Remove the specimen from the water bath, surface dry and determine the conditioned stiffness at a test temperature of (20±0.5)°C for the first conditioning cycle. Designate this as $ITSM_{c1}$.

Note: Ensure that the temperature of the test specimen is equal to (20 ± 0.5)°C prior to performing the stiffness test.

6.8 Repeat steps 6.4 to 6.6. Determine the conditioned stiffness of the specimen for the second and third conditioning cycles. Designate these as $ITSM_{c2}$ and $ITSM_{c3}$ respectively.

7.0 Calculation and expression of results

Calculate the stiffness ratio ($ITSM_{Ratio,ci}$) for the specimens for each conditioning cycle as follows:

$ITSM_{Ratio,ci} = ITSM_{Ci}/ITSM_{U}$

where:
ci = Conditioning cycle i=1, 2, 3
$ITSM_{Ci}$ = Conditioned stiffness after conditioning cycle ci, and
$ITSM_{U}$ = Unconditioned stiffness.

8.0 Test report

Report the conditioned stiffness and the calculated stiffness ratio for each specimen at each conditioning cycle.

In addition the following shall be reported:

The unconditioned stiffness for each specimen
Identification of the specimens
Details of the preparation of the specimens
The test temperature
Any deviations from the test method
Identifying characteristics of sample.

Where core specimens are tested, the location from which the cores were taken, the date they were taken and details of who cut the cores should also be reported.

9 Precision

The precision for this test method has not been established.

10 List of References

BS EN 12697-26:2004 Bituminous mixtures. Test methods for hot mix asphalt. Stiffness

BS EN 12697-27, Bituminous mixtures – Test methods for hot mix asphalt – Part 27: Sampling

Note: The mechanical properties of bituminous materials are significantly influenced by the method of specimen preparation, even when the volumetric proportions are similar. It cannot be inferred that the stiffness or retained stiffness of a laboratory moulded specimen can be replicated in a field core specimen. If cores are tested to this procedure, cut faces with exposed aggregate will be exposed to water conditioning, which may be unrepresentative of field conditions. In this case, testing of cores can be considered as a worst case scenario.

Acknowledgement

This protocol was developed by a team working under the DOT LINK programme on Transport Infrastructure and Operations led by the University of Nottingham.

The protocol has been modified by Specialist Group 3 for use during the HAPAS Assessment and Certification of Thin Surfacing Systems for Highways.

Appendix A.3

TORQUE BOND TEST

1 Scope

The following protocol describes methods for determining the Bond Strength between a thin surfacing system and its substrate, which may be bituminous or cementitious, by measuring the peak shearing torque, at a known temperature.

Two methods of test are described for tests carried out on site and on cores taken from site and tested in the laboratory.

The test shall only be carried out on thin surfacing systems which have been installed for a period of between 28 and 56 days(1).

The protocol describes a test procedure that has been developed specifically for the assessment of thin surfacing systems under HAPAS Certification procedures. The method should not be used for specifying purposes.

2 Definitions

τ : inter-layer bond strength in kiloPascals (kPa),
M : peak value of applied shearing torque in Newton metres (N m),
D : diameter of core in millimetres (mm)

3 Apparatus

3.1 Equipment

3.1.1 *Core cutting apparatus*: suitable for cutting 100mm(1) diameter cores in bituminous and cementitious materials;

3.1.2 *Torque meter*: fitted with a fiducial reading gauge. The device shall be calibrated over a range of 0-350 N m with a scale readable to at least 10 N m. The device shall be fitted with a socket-fitting allowing steel plates to be fitted and removed.

3.1.3 *Metal Plate*: of mild steel having a diameter of (95±5), and a thickness of (14±2) mm. The plate shall incorporate a fitting enabling it to be coupled to the torque meter.(2)

3.1.4 *Thermometer*: readable to 0.1°C and accurate to 0.5°C.

3.1.5 *Steel Rule*

3.1.6 *Callipers:* for measurement of core diameters;

3.1.7 Mould or other means of confining laboratory test samples for testing.

3.1.8 *Watch or Timer*: readable and accurate to 1 second.

3.1.9 *Mould*: for confining laboratory test specimens, (e.g. 150 mm concrete cube mould).

3.1.10 *Spirit Level*: for checking laboratory test specimens;

3.1.11 *Oven or refrigerated incubator (optional)*

Note:
1 **Cores may be cut prior to the 28 days post-installation period and stored at 5 ± 2°C prior to testing.**
2 **Fittings of 12.7 mm and 19.05 mm have been found to be suitable.**

3.2 Materials

3.2.1 *Adhesive*: (a stiff adhesive, such as rapid setting epoxy resin, with sufficient strength to avoid failure within the adhesive or at the adhesive/thin surfacing interface).

3.2.2 *Mounting material (for laboratory tests)*: e.g. rapid hardening mortar, concrete or grout.

4 Test methods

4.1 Site test method

4.1.1 Core the location to be tested using a 100 mm (±5mm) diameter core barrel to a depth of 20 mm below the thin surfacing layer to be tested. The method for sampling shall be to cut six cores at nominally even spacing along a diagonal line across the lane width. Cores shall be taken from a 100m length of the installation or the total installation where this is less than 100m.

4.1.2 Ensure that all debris is removed from the rebate formed by the core barrel. Clean and dry the surface to be tested.

4.1.3 Use the bonding agent to secure the metal plate to the surface of the core, taking care to ensure that the plate is parallel to the surface.

4.1.4 When the bonding agent has developed sufficient strength, (i.e. failure should not occur within the adhesive), fit the torque meter to the metal plate, using adapters and extension rods as appropriate.

4.1.5 Apply torque to the core at a steady rate so that the torque wrench sweeps an angle of 90° within (30±15) s. Care must be taken to ensure that the torque is applied parallel to the core surface (within ± 10°). Torque is applied to the plate until failure of the bond occurs or a torque of 300 N m is exceeded.

4.1.6 Record the value of torque at failure, M, in Newton metres. Measure and record the bond interface temperature immediately after failure.

4.1.7 Examine the core and substrate and record the condition of the bond interface (e.g. smooth, planer, rough or irregular). Record the substrate type (e.g. bituminous or cementitious surface). Where known record details of the substrate condition prior to surfacing, (i.e. planed, untreated or regulated).

4.1.8 Measure and record the core diameter at two locations approximately 90° apart using callipers and record the mean value, D, to an accuracy of 1 mm.

4.1.9 Measure and record the depth of the surfacing to the substrate interface to an accuracy of 1mm.

4.1.10 Calculate the bond strength in accordance with section 5.

4.2 Laboratory test method

4.2.1 Cut a 100mm (or 150mm) diameter core to a minimum depth of 80mm below the bottom of the surface layer. Extract the core taking care not to damage the surface layer of the core or the bond interface with the substrate. Six such cores shall be taken along a 100m length of the installation at nominally even spacing along a diagonal line across the lane width.

4.2.2 Trim the core to a length suitable for mounting if appropriate.

4.2.3 Place the core in the mould, using mortar or grout as a bedding layer if appropriate, so that the upper layer and the bond interface to be tested is (20±10) mm above the rim of the mould. Fill the mould with the mortar/grout and trim flush with the mould rim, ensuring that the core is perpendicular to, and the upper surface parallel with, the mould surface. Check using the spirit level.

4.2.4 Fix the metal plate to the core using the adhesive and allow to set.

4.2.5 Unless otherwise specified[(1)], condition the mounted cores by storing at a temperature of (20±2)°C for a minimum of 4 hours and for not more than 16 hours before testing. Record the times and temperatures employed.

4.2.6 Unless otherwise specified, test the core at a temperature of (20±2)°C: where other temperatures are used the test shall be completed within 5 minutes of removal from the conditioning environment.

4.2.7 Fix or clamp the mould containing the mounted core to a suitably rigid surface. Carry out the test as described in 4.1.5.

4.2.8 Examine the core and record all the relevant information as described in 4.1.6 to 4.1.9.

5 Calculation of Bond Strength and expression of results

Calculate the bond strength for each specimen using the following formula:

$$\tau = \frac{12M \times 10^6}{\pi D^3}$$

Calculate the arithmetic mean of the inter-layer bond strength, τ, for the six specimens

6 Test report

6.1 The test report shall include the following information:

i) Name of organisation carrying out the test
ii) Method of test used
iii) Description of materials (system and substrate)
iv) Date of test
v) Peak torque at failure (N m)
vi) Inter-layer bond strength (kPa), (individual and mean values)
vii) Time to failure (seconds)
viii) Diameter of core (mm)
ix) Depth of Bond interface (mm)
x) Temperature of the Bond interface at test (^{o}C)
xi) Conditioning details (duration and temperature)
xii) Site or Laboratory test
xiii) Identification of Site or Scheme
xiv) Core location
xv) Age of the installation / specimen at the time of test
xvi) Nature of the Bond interface
xvii) Mode of Failure

7 Precision

The precision for this test method has not been determined.

Note:

1 Temperatures outside this range may be specified, e.g. in order to compare data obtained from site tests carried out at temperatures other than (20±2)^{o}C. In this case additional laboratory apparatus (i.e. ovens or refrigerated incubators) may be required. Conditioning of specimens in a soaked condition may also be undertaken. Details of the conditioning used prior to testing shall be recorded.

Appendix A.4

Ageing characteristics

1 Scope

This protocol describes a method for measuring the ageing characteristics of thin surfacing systems by determining fatigue characteristics (using Indirect Tensile Fatigue) before and after long term oven ageing.

The protocol describes a test procedure that has been developed specifically for the assessment of thin surfacing systems under HAPAS Certification procedures. The method has yet to be proven and shown to be valid. The method is therefore unsuitable for use in specifications and should not be used for this purpose.

2 References

Normative references
This protocol incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed in **10**. Subsequent amendments to, or revisions of, any of these publications apply to this protocol only when incorporated in it by updating or revision.

3 Definitions

For the purpose of this protocol, the definitions given in Appendix A.12, Appendix A,13 and BS EN 12697-26 Annex C..

4 Test Specimens

The specimens for test shall be cylindrical cores. The preferred option is core samples removed from the road, but cores removed from trial strips are also acceptable.

The method is applicable to test specimens having a thickness of (40 ± 10)mm and diameter of (100 ± 3) mm.

5 Specimen Preparation

The maximum ambient air temperature during transit to the testing laboratory shall be recorded. Upon receipt at the laboratory they should initially be stored at (15 ± 10)°C.

Storage of specimens awaiting testing or preparation for testing shall be maintained at (15 ± 10)°C up to a maximum period of 72 hours from the time of coring.

Cored specimens that have been trimmed by wet sawing in preparation for testing shall be allowed to dry in air at (15 ± 10)°C for a minimum of 16 hours prior to the determination of bulk density.

If long term oven ageing or fatigue testing has not commenced within 72 hours of coring, the specimens shall be placed in storage and maintained at (5 ± 2)°C until commencement of the testing procedure.

Specimens shall not be stacked at any stage.

6 Replication

A minimum of ten core pairs (20 specimens) shall be taken from the road or trial strip. Each core constituting a pair shall be taken within 100 mm of each other and each core pair shall be clearly identified.

All ten core pairs shall be taken randomly within a load where possible, but in any case within a laid area of 60 m^2.

The diameter of the specimens quoted assumes a nominal maximum aggregate size of not greater than 20mm.

7 Procedure

Separate the 10 core pairs into two sets of 10, nominate one set of 10 samples as the "Unaged Set" and determine the fatigue characteristics of this set of samples according to Appendix A.13. Nominate the other set of 10 samples as the "Aged Set" and age them for 120 hours at 85°C in accordance with the method described in Appendix A12. At the end of the Long Term Oven Ageing Procedure, allow the specimens to cool for at least 24 hours, then determine the fatigue characteristics of this set of samples according to Appendix A.13.

8 Reporting

8.1 Ageing characteristics

Report the results of the stiffness and ageing tests separately for each set of ten samples, as described in Appendix A.13. In addition, report the difference between the "Unaged Set" and "Aged Set" of data in terms of the number of cycles to failure (N_f) at a maximum tensile horizontal strain at the centre of a specimen of 100 microstrain, calculated from the linear regression analysis equation described in Appendix A.13.

8.2 Stiffness

Report the results of the stiffness tests in accordance with BS EN 12697-26 if required.

9 Precision

The precision for this test method has not been established.

10 List of references

BRITISH STANDARDS INSTITUTION. Bituminous mixtures. Test Methods for hot mix asphalt. Stiffness, BS EN 12697-26 : 2004

Appendix A.5

Sensitivity to diesel (or other fluid)

1 Scope

This protocol describes a method for measuring the change in stiffness of thin surfacing systems after immersion in diesel (or other specified fluid).

The protocol describes a test procedure that has been developed specifically for the assessment of thin surfacing systems under HAPAS Certification procedures. The method has yet to be proven and shown to be valid. The method is therefore unsuitable for use in specifications and should not be used for this purpose.

2 Normative References

This protocol incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed in **11**. Subsequent amendments to, or revisions of, any of these publications apply to this protocol only when incorporated in it by updating or revision.

3 Definitions

Conditioned stiffness - the stiffness modulus of the mixture as determined in accordance with BS EN 12697-26: 2004 ANNEX C after the compacted mixture has been subjected to one or more cycles of water and thermal conditioning.

The definitions given in Appendix A.2 and BS EN 12697-26: 2004 ANNEX C shall also apply.

4 Apparatus

For the purpose of this protocol the apparatus described in Appendix A.2 shall be used.

5 Test specimens

The specimens for test shall be laboratory moulded specimens or cylindrical cores. The use of laboratory moulded specimens is strongly preferred and ensures that the more porous cut faces with exposed aggregate, are not subjected to fluid conditioning.

5.1 Laboratory moulded specimens

5.1.1 Laboratory moulded samples shall be compacted using a suitable device in accordance with the method described in Appendix A.11.

5.1.2 The test specimens shall be between 30mm and 75mm thick and have a nominal diameter of 100mm.

5.1.3 Specimens awaiting testing shall be maintained at (15±10)°C for a maximum period of 96 hours from the time of manufacture.

5.1.4 If testing has not commenced within 96 hours of manufacture of the specimens, they shall be placed in storage and maintained at (5 ± 2)°C until commencement of the testing procedure.

5.2 Cored specimens

5.2.1 Core specimens shall be obtained in accordance with BS EN 12697-27: 2001 except that the cores shall have a nominal diameter of 100 mm.

5.2.2 All cores shall be taken at locations evenly distributed across the laid area, but not within 500mm of any edge where possible, but in any case within a laid area of 60 m^2.

5.2.3 Cored samples must be received at the testing laboratory within 24 hours of coring.

5.2.4 The storage of specimens awaiting testing or preparation for testing shall be maintained at (15±10)°C for a maximum period of 48 hours from receipt at the laboratory.

5.2.5 Cored specimens shall be trimmed by wet sawing in preparation for testing and shall be allowed to dry in air at (15±10)°C for a minimum period of 16 hours prior to commencing the testing procedure.

5.2.6 If testing has not commenced within 96 hours of coring, the cores shall be placed in storage and maintained at (5 ± 2)°C until commencement of the testing procedure.

Six specimens shall be tested and specimens shall not be stacked at any stage.

6 Preparation

For the purpose of this protocol sample preparation shall be in accordance with the methods described in Appendix A.2.

7 Test procedure

Separate the 6 specimens into 2 sets of 3 and nominate one set of 3 samples as the "control set". Determine the water sensitivity of this set of specimens in accordance with Appendix A.2.

Nominate the remaining 3 specimens as the "test set" and determine the change in stiffness of this set of specimens after diesel (or other specified fluid) immersion in accordance with the method described in Appendix A.2, but modified by the substitution of diesel (or other specified fluid) to cover the specimen in the vacuum desiccator during the 30 minute vacuum saturation procedure, in lieu of the distilled water specified in clause 7.2 of the protocol.

Note: Ensure that the container used to contain the fluid during the immersion period has adequate resistance to chemical attack by the fluid being considered and that the fluid is safe to handle in accordance with this method.

8 Calculation and expression of results

Calculate and express the results in accordance with Appendix A.2.

9 Test report

Report the results in accordance with the method described in Appendix A.2 for the individual and mean sets of data separately for both the control set and test set of specimens.

In addition, report the ratio of the mean cycle 3 stiffness ratio for the test set as a proportion of the control set.

10 Precision

The precision for this test method has not been established.

11 List of References

BS EN 12697-26:2004 Bituminous mixtures. Test methods for hot mix asphalt. Stiffness

BS EN 12697-27, Bituminous mixtures – Test methods for hot mix asphalt – Part 27: Sampling

Appendix A.6

Changes in longitudinal irregularities

1 Scope

This protocol describes the procedure to be followed for determining the reduction in the number and size of surface irregularities in the direction that traffic will travel following the application of a thin surfacing system by comparison of surveys made with a rolling straight edge carried out before and after the surfacing was laid.

The protocol describes a test procedure that has been developed specifically for the assessment of thin surfacing systems under HAPAS Certification procedures. The method has yet to be proven and shown to be valid. The method is therefore unsuitable for use in specifications and should not be used for this purpose.

2 References

2.1 Normative references

This protocol incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed in **10**. Subsequent amendments to, or revisions of, any of these publications apply to this protocol only when incorporated in it by updating or revision.

2.2 Informative references

This protocol refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are in 10, but reference should be made to the latest editions.

3 Definitions

For the purposes of this protocol, the definitions given in BS EN 12697-27: 2001 apply together with the following:

Initial irregularity is the average number of recorded irregularities weighted by their minimum values in a 1 m length of carriageway prior to resurfacing.

Final irregularity is the average number of recorded irregularities weighted by their minimum values in a 1 m length of carriageway after resurfacing but before trafficking.

Profile improvement value is the reduction in the number and size of longitudinal irregularities due to resurfacing as measured by the proportional change from initial to final irregularity values.

4 Apparatus

Rolling straight edge, as described in TRL Report SR 290.

Note:
Suitable equipment is available from C N S Farnell.

5 Sampling

The testing shall be carried out along strips of the nearside wheel-track of each lane to be overlaid with a combined length of not less than 200 m.

6 Test procedure

6.1 Test strip

Measure the length of test strip in each lane to be tested to ± 1 m.

6.2 Initial measurement

Prior to the surfacing being applied, push the rolling straight edge along each section of the test strip in accordance to TRL Report SR 290. Record the number of irregularities of ≥3 mm to <7 mm, ≥7 mm to <10 mm and ≥10 mm.

6.3 Final measurement

After the surfacing has been applied but before it is opened to traffic, push the rolling straight edge along each section of the test strip in accordance to TRL Report SR 290. Record the number of irregularities of ≥3 mm to <7 mm, ≥7 mm to <10 mm and ≥10 mm.

7 Calculation and expression of results

7.1 Initial irregularity

The initial irregularity value (P_i) is calculated from:

$$P_i = \frac{(3N_a + 7N_b + 10N_c)}{L}$$

where N_a = number of initial irregularities of ≥ 3 mm to < 7 mm;
N_b = number of initial irregularities of ≥ 7 mm to < 10 mm;
N_c = number of initial irregularities of ≥ 10 mm; and
L = length of test strip (m).

The initial irregularity value, in mm/m, shall be recorded to ± 0.01 mm/m.

The initial irregularity value shall be ≥ 1.0 mm/m for the test to be valid.

7.2 Final irregularity

The final irregularity value (P_f) is calculated from:

$$P_f = \frac{(3N_d + 7N_e + 10N_f)}{L}$$

where N_d = number of final irregularities of ≥ 3 mm to < 7 mm;
N_e = number of final irregularities of ≥ 7 mm to < 10 mm;
N_f = number of final irregularities of ≥ 10 mm; and
L = length of test strip (m).

The final irregularity value, in mm/m, shall be recorded to ± 0.01 mm/m.

7.3 Profile improvement value

The profile improvement value ($P_{\%}$) is calculated from:

$$P_{\%} = \frac{100(P_i - P_f)}{P_i}$$

The profile improvement factor, in per cent, shall be recorded to nearest 5 per cent.

8 Test report

The test report shall include the following information:

i) date, time and place of sampling and sample identity number;
ii) date, time and place of test;
iii) the total length of the test strip;
iv) the number of irregularities of 3 mm up to 7 mm, 7 mm up to 10 mm and greater than 10 mm both before and after the surfacing was laid;
v) the initial irregularity, the final irregularity and the profile improvement value;
vi) any test conditions and operational details not provided in this protocol, and anomalies, if any, likely to have affected the results;
vii) name of person taking technical responsibility for the test;
viii) the number and date of this protocol

NOTE. The test report may include the following optional information:

a) name of project;
b) name of supplier and source of material;
c) date of production of material;
d) specification of material.

9 Precision

The precision for this test method has not been determined.

10 List of references

BS EN 12697-27, Bituminous mixtures – Test methods for hot mix asphalt – Part 27: Sampling

YOUNG, J C (1977). **Calibration, maintenance and use of rolling straightedge**. *Department of the Environment Department of Transport TRRL Report SR 290*, Transport and Road Research Laboratory, Crowthorne.

Appendix A.7

Initial changes in maximum transverse irregularities

1 Scope

This protocol describes the procedure to be followed for determining the reduction in the size of any surface irregularities across the direction that traffic will travel following the application of a thin surfacing system by comparison of surveys with a beam and wedge carried out before and after the surfacing was laid.

The protocol describes a test procedure that has been developed specifically for the assessment of thin surfacing systems under HAPAS Certification procedures. The method has yet to be proven and shown to be valid. The method is therefore unsuitable for use in specifications and should not be used for this purpose.

2 References

2.1 Normative references

This protocol incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed in **10**. Subsequent amendments to, or revisions of, any of these publications apply to this protocol only when incorporated in it by updating or revision.

2.2 Informative references

This protocol refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are in 100, but reference should be made to the latest editions.

3 Definitions

For the purposes of this protocol, the definitions given in the BS EN 12697-27: 2001 shall apply together with the following:

Initial rut is the average deformation in the nearside wheel-track over 100 m length of carriageway prior to resurfacing.

Residual rut is the average deformation in the nearside wheel-track over 100 m length of carriageway after resurfacing but before trafficking.

Rut improvement value is the reduction in the size of permanent deformations due to resurfacing as measured by the proportional change from initial to residual ruts.

4 Apparatus

A 2m straightedge, as supplied for "Chart surveys" and associated depth measurement probe.

5 Sampling

The testing shall be carried out along a 100m length of the nearside wheel-track selected to have the required initial deformation.

6 Test procedure

6.1 Test locations

Mark ten locations along the kerb or other suitable reference point at 10m spaces in a manner that will remain visible after the surfacing has been laid.

6.2 Initial measurement

Prior to the surfacing being applied, place the straightedge alongside the first location, so that it is nominally perpendicular to the direction of traffic, bridging the nearside wheel-track. Record the distance from the kerb or other reference line and locate and measure the maximum initial rut depth. Repeat the measurements at the remaining 9 locations and calculate the mean initial rut depth (R_i).

The mean initial rut depth shall be at least 6 mm for the test to be valid.

6.3 Final measurement

After the surfacing has been applied but before it is opened to traffic, place the straightedge in the same position as in 6.2 (± 10 mm) and repeat the measurements at each location. Calculate the mean residual rut (R_r).

7 Calculation and expression of results

7.1 Rut improvement value

The rut improvement value ($R_{\%}$) is calculated from:

$$R_{\%} = \frac{100\,(\,R_i - R_r\,)}{R_i}$$

Where,

The initial rut (R_i) is the mean rut depth at each location measured prior to laying the surfacing. The initial rut shall be recorded to ± 1 mm.

The residual rut (R_r) is the mean rut depth at each location measured after laying the surfacing but before trafficking. The residual rut shall be recorded to ± 1 mm.

The rut improvement value ($R_{\%}$), shall be recorded to the nearest 5 percent.

8 Test report

The test report shall include the following information:

i) date, time and place of test;
ii) the total length of the test strip;
iii) the rut depth at each location, both before and after the surfacing was laid;
iv) the mean initial rut, the mean residual rut and the rut improvement value;
v) any test conditions and operational details not provided in this protocol, and anomalies, if any, likely to have affected the results.
vi) name of person taking technical responsibility for the test;
vii) the number and date of this protocol

NOTE. The test report may include the following optional information:

a) name of project;
b) name of supplier and source of material;
c) date of production of material;
d) specification of material.

9 Precision

The precision of this method has not been determined.

10 List of References

BS EN 12697-27, Bituminous mixtures – Test methods for hot mix asphalt – Part 27: Sampling

BRITISH STANDARDS INSTITUTION (1996). **Methods of measuring irregularities on surfaces of roads, footways and other paved areas using straightedges and wedges**. BSI, London 1996. **BS DD 227**.

Appendix A.8

Noise

1 Scope

This protocol describes the procedure to be followed for the determination of the influence of the road surface on traffic noise using the statistical pass-by method.

The protocol describes a test procedure that has been developed specifically for the assessment of thin surfacing systems under HAPAS Certification procedures. The method has yet to be proven and shown to be valid. The method is therefore unsuitable for use in specifications and should not be used for this purpose.

2 References

2.1 Normative references

This protocol incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed in **10**. Subsequent amendments to, or revisions of, any of these publications apply to this protocol only when incorporated in it by updating or revision.

2.2 Informative references

This protocol refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are in **10**, but reference should be made to the latest editions.

3 Definitions

Category L vehicles - light vehicles including passenger cars and car derived vans, excluding vehicles towing trailers.

Category H1 vehicles - commercial trucks with 2 axles and greater than 3.5 tonnes.

Category H2 vehicles - commercial trucks with more than 2 axles and greater than 3.5 tonnes

Texture depth - the quantity of road surface texture determined using a mobile device taking measurements of the Sensor Measured Texture Depth (SMTD), as defined in TRRL LR 639, or the Sand-Patch as defined in BS 598 – 105: 2000, incorporating Clause 4.2.2.

In addition, the other definitions given in ISO 11819-1:1997 shall apply.

4 Apparatus

For the purposes of this protocol, the apparatus described in ISO 11819-1: 1997 Section 5 shall be used. The frequency range of 100 - 5000 Hz (centre frequencies of the one-third octave bands) should be covered.

5 Test location

5.1 The test location road speed category shall be classified as either Medium or High as defined in ISO 11819-1: 1997, clause 3.3.

5.2 Not less than two test locations shall be selected for each road speed category, which may be on the same site provided that they are at least 100 m apart or on different carriageways. Each test location shall be representative in terms of road speed category and traffic level. For evaluation purposes the road surface at the test location shall have been open to traffic for a period of not less than twelve months. Each of the test sites selected shall meet the requirements of ISO 11819-1: 1997 Section 6 and ISO/CD 11819-2:2000. The road shall be essentially straight, although sites located on slight bends may be considered as valid test sites. To minimise excessive side forces, which would exaggerate tyre/road noise, slight bends are defined as bends with a radius of curvature greater than 500 m for medium-speed, and 1000 m for high-speed road categories. The crossfall of the test lane at the test site shall not exceed 4%.

5.3 The texture of the road surface shall be measured either by high-speed texture meter or other method. The measurements will be taken from the nearside wheel-track along the whole length of test material. The texture depth of the nearside wheel-track in front of a test location shall be within 10 per cent of the average texture measured along the site. In the case of the high-speed road category, the texture depth in the wheel-track at the test location shall be greater than 1.0 mm measured by the Sand-patch or Estimated Texture Depth (ETD) methods.

5.5 The microphone location at each measurement site shall be recorded accurately and marked with appropriate methods such that the position can be readily identified for a period of at least two years.

6 Test procedure

6.1 Acoustic measurements shall only be carried out when the road surface is dry and the meteorological condition specified in ISO 11819-1: 1997, Section 11 are met.

6.2 The ambient air and surface temperatures shall be monitored in accordance with the procedure described in ISO 11819-1: 1997, Clause 8.5. The road surface temperature, $T_{surface}$, shall be within the range 5°C to 50°C during acoustic measurements. The ambient air temperature, T_{air}, shall be within the range 5°C to 30°C.

6.3 Acoustic measurements shall be taken according to ISO 11819-1: 1997, Sections 7 and 8.

7 Calculation and expression of results

7.1 When sufficient vehicle pass-bys' have been measured a linear regression analysis shall be performed in accordance with ISO 11819-1: 1997, Clause 9.1. In the case of the high-speed road category, measurements shall not be made of vehicles travelling at speeds of less than 60 km/h in accordance with AFNOR Standard S31-119.

7.2 For each category of vehicle defined in **3**, the Vehicle Sound Level, L_{veh}, shall be calculated as the ordinate sound level of the regression line at the reference speed for the category of road given in Table 1. All levels shall be calculated to two decimal places and rounded to one decimal place.

Table 1 - Reference speeds for different road speed categories

Vehicle category	Road speed category	
	Medium	High
	Reference speed (km/h)	Reference speed (km/h)
L - light vehicles	80	110
H1- trucks with two axles	70	90
H2 - trucks with more than two axles	70	90

7.3 For the regression calculation and subsequent normalisation to the reference speed, the range of speeds covered by the measured vehicles shall be such that the reference speed shall be within the range of plus-or-minus one standard deviation from the actually measured average speed of the vehicles measured.

7.4 The results for light vehicles shall be normalised for temperature according to the following formula.

Corrected $L_{veh,L}$ = Measured $L_{veh,L}$ + 0.03 x [(0.7$T_{surface}$ + T_{air})/2 -20]

(This is a tentative correction based upon the on-going analysis)

7.5 The overall level of the surface influence on traffic noise at each test site shall be calculated for the road speed category assessed. The overall influence is defined as the Road Surface Influence (RSI_x) and is determined from the Vehicle Sound Levels, $L_{veh,}$, and the weighting factors given in Table 1. This shall be reported to one decimal place.

7.6 For the High Speed road category the Road Surface Influence, RSI_H is defined as;

$$RSI_H = 10\log_{10}(7.8\times 10^{\frac{L_{veh,L}}{10}} + 0.578\times 10^{\frac{L_{veh,H1}}{10}} + 10^{\frac{L_{veh,H2}}{10}}) - 95.9$$

7.7 For the Medium Speed road category the Road Surface Influence, RSI_M is defined as;

$$RSI_M = 10\log_{10}(11.8x10^{\frac{L_{veh,L}}{10}} + 0.629x10^{\frac{L_{veh,H1}}{10}} + 0.157x10^{\frac{L_{veh,H2}}{10}}) - 92.3$$

8 Test report

The category of road assessed should be clearly stated together with the RSI.

In addition, report all results in accordance with ISO 11819-1: 1997, Section 13.

Note that road surface temperature (item 21) is not optional in this protocol.

A graph shall be given for each vehicle type, which shall show measured data together with the calculated regression and its 95 % confidence interval.

9 Precision

For the purposes of this protocol, the precision data given in ISO 11819-1: 1997, Section 9.6 Measurement uncertainty shall apply.

10 List of references

INTERNATIONAL ORGANISATION FOR STANDARDIZATION. **Acoustics - Measurement of the influence of road surfaces on traffic Noise - Part 1: Statistical Pass-by method.** *ISO 11819-1: 1997*. International Organisation for Standardization.

INTERNATIONAL ORGANISATION FOR STANDARDIZATION. **Characterisation of pavement texture utilising surface profiles - Part I Determination of mean profile depth.** *ISO 13473-1:1997*

BRITISH STANDARDS INSTITUTION. **Sampling and examination of bituminous mixtures for roads and other paved areas, Methods of test for the determination of texture depth**. BSI, London 1990. **BS 598 - 105: 2000**.

TRANSPORT AND ROAD RESEARCH LABORATORY. **Measurement of road surface texture by a contactless sensor. LR 639.**

Appendix A.9

Skid resistance

1 Scope

This protocol describes the procedure for the determination of the wet skid resistance of a thin surfacing system using the Sideway force Coefficient Routine Investigation Machine, (SCRIM).

The protocol describes a test procedure that has been developed specifically for the assessment of thin surfacing systems under HAPAS Certification procedures. The method has yet to be proven and shown to be valid. The method is therefore unsuitable for use in specifications and should not be used for this purpose.

2 References

Informative references

This protocol refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are in **10**, but reference should be made to the latest editions.

3 Definitions

For the purposes of this protocol, the definitions given in HD 28/94 shall apply.

4 Apparatus

4.1 Sideway force Coefficient Investigation Machine calibrated and operated in accordance with the manufacturers instructions and/or Annex 1 and Annex 2 respectively of HD 28/94.

4.2 If the measurements are to be made on a trial site which is a trunk road, then the SCRIM shall have taken part in an annual group trial organised by the TRL within the previous twelve months.

5 Test site

5.1 Testing shall be confined to the nearside wheel track of the lane being investigated.

5.2 A minimum length of 100 m shall be available for testing.

6 Test procedure

6.1 Measurements shall be taken with the SCRIM at a speed of 50 km h^{-1}.

6.2 An initial survey with the SCRIM shall be carried out within four weeks of the surfacing being laid.

6.3 Not less than three surveys with SCRIM shall be carried out during the second full summer after the surfacing was laid at timely intervals between 1st May and 30th September and the Mean Summer SCRIM Coefficient (MSSC) calculated in accordance with HD28/94.

Note: If required, not less than three surveys with SCRIM can be carried out during the first full summer after the surfacing was laid at timely intervals between 1st May and 30th September and the MSSC calculated in accordance with HD28/9?. If the initial survey was carried out towards the beginning of the period for making surveys with SCRIM, the initial survey can be used as one of the three surveys.

7 Calculations and expression of results

Calculate and express the results in accordance with HD28/94.

8 Test report

The test report for each SCRIM survey shall contain the commercial vehicle flow per lane per day and the category of road at the trial site in accordance with Table 3.1 of HD 28/94. In addition, if the trial site is a multi-lane carriageway, each lane shall be separately identified, monitored and reported over the trial period.

9 Precision

The precision for this test has not been established.

10 List of references

HD28/94 **Design Manual for Roads and Bridges**: Volume 7: Pavement Design and maintenance: Part 1: Skidding Resistance. HMSO 1999

Appendix A.10

Visual Assessment of trial sites

1 Scope

This protocol describes a general procedure for the visual assessment of trial sites by a BBA HAPAS Inspection Panel.

The protocol describes a procedure that has been developed specifically for the assessment of thin surfacing systems under BBA HAPAS Certification procedures. The method has yet to be proven and shown to be valid. The method is therefore unsuitable for use in specifications and should not be used for this purpose.

2 References

2.1 Normative references

This protocol incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed in **12**. Subsequent amendments to, or revisions of, any of these publications apply to this protocol only when incorporated in it by updating or revision.

2.2 Informative references

This protocol refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are in **12**, but reference should be made to the latest editions.

3 Definitions

For the purposes of this Appendix, the definitions given in BS EN 12697-27:2001 apply together with the following:

3.1 A *site* is a length of highway open to regular traffic on which one or more surfacing materials, component materials or construction techniques has been laid in order to assess their (comparative) performance in service.

3.2 A *section* is a distinct length of a site on which one distinct surfacing material, component material or construction technique has been laid or employed.

4 Responsibilities

4.1 The BBA Convenor

4.1.1 The BBA shall be responsible for fixing the date of the inspection by liaison with the other members of the Inspection Panel and the Applicant.

4.1.2 The BBA shall be responsible for briefing the Inspection Panel on the aims of the inspection and provide the following information:

- A copy of this procedure
- Panel member's Report Form (Appendix F)

4.1.3 The BBA shall be responsible for collating and calculating the panel mark using Tables 2 and 3

4.2 The Applicant

4.2.1 The Applicant shall be responsible for arranging access to the site for inspection, road closures and any other precautions necessary to ensure that the inspection can be carried out in a safe manner.

4.2.2 The Applicant shall also be responsible for arranging any site testing required during the inspection by a BBA Approved Laboratory.

4.3 The Panel members

4.3.1 All panel members shall provide and wear the necessary safety clothing and protection during the inspection.

5 Inspection Panel

5.1 The Inspection Panel shall consist of the BBA Convener and two other members who have experience of road surfaces in particular thin surfacings. If due to unforeseen circumstances one member cannot attend on the day, a minimum of two (including the Convenor) will be acceptable.

5.2 The BBA Convener, after fixing the date for an inspection, shall inform other members as soon as possible before the inspection. A copy of this procedure for inspecting road trial sites shall be sent to panel members who have not taken part before so that they can familiarise themselves with it.

6 Initial project briefing

Once the Inspection Panel has assembled, members shall be given an Inspection Panel Member's Report Form. The BBA Convenor shall also have a BBA Convenor's Report Form (Appendix F.1) in addition to his/her Inspection Panel Member's Report Form. The BBA shall brief members on the particular aims of the trial and any implications on the emphasis of that inspection. A copy of the BBA Inspection report for the site installation trial shall be available on the day.

7 Inspection

7.1 The Panel shall agree on the weather conditions prevailing, and record it on their report forms.

7.2 The Panel shall walk each section, studying the condition as closely as practicable. Members shall stop and look back at intervals so as to view the surfacing with the light in a different direction.

7.3 Any portion at one end of a machine-laid section which has a slightly different appearance from the rest of the section shall be ignored by the Panel. Similarly, localised areas that have been subject to untypical mechanical or chemical actions (e.g. damage caused by a vehicle running on its wheel-rim or by a major diesel spillage) shall also be ignored. If variations are on a larger scale, such as between wagon loads when laid, the section shall be assessed in sub-sections.

Note: The BBA Convenor should try to establish the reasons for any large differences by checking the laying records and, where appropriate, the compositional analysis at the appropriate time.

7.4 Members shall record on their Inspection Panel Member's Report Form a mark for each section or sub-section soon after inspecting it. Whilst members can discuss points of interest noted during the inspection, they shall not reveal their marking until all members have recorded their individual mark.

8 Marking

8.1 Each section or sub-section shall be assessed on the basis of its current serviceability irrespective of the elapsed time since it was laid. In considering the serviceability of the surfacing, the aspects in Table 1 for the specific type of surfacing shall be considered, together with any project related aspects given in the initial briefing. If any of the aspects are evident to a significant degree on the section, the relevant suffix from Table 1 shall be applied to the basic marking. Suffix *v* shall not be applied to a section marked as *t*, nor + to one marked -.

Table 1 Fault Suffixes		
Suffix	Description	Notes
v	Variable	Random variations from point to point within the section only, not "traffic-laning" or of obvious variations from load to load.
t	Variability with traffic intensity	Marked transverse differences caused by variations in traffic intensity between lanes and wheel tracks.
+	Fatting up	
-	Loss of chippings Loss of aggregate Loose aggregate	
f	Fretting of mortar	
g	Growth of vegetation	
p	Ponding	
d	De-lamination from substrate	
s	Stripping	
c	Cracking	

8.2 Once any appropriate fault suffixes have been assigned, the basic mark shall be allocated from the 7-point scale in Table 2.

Mark	Description
E	no discernible fault
G	no significant fault
M	Some faults but insufficient for serious problem
A	Several faults but would usually be just acceptable
S	Seriously faulted but still serviceable in the short term
P	Requires remedial treatment
B	Requires immediate remedial treatment

9 Confidentiality

Whilst the Panel marking can be reported, the individual marks allocated by members of the Panel shall be treated in confidence. This is to allow members to make judgments as to the condition of the trial sections without consideration of the commercial interests of their organisation.

10 Reporting of results

The inspection report shall include the following information:

a) Date, time and location of the inspection;
b) Number of people in the Inspection Panel present;
c) Prevailing weather conditions;
d) Sufficient details of each section inspected to allow unique identification;
e) Basic Panel marking with any associated fault suffixes for each section inspected
f) Any comments about the site(s) not otherwise covered.

11References

BS EN 12697-27, Bituminous mixtures – Test methods for hot mix asphalt – Part 27: Sampling

TRANSPORT RESEARCH LABORATORY (1997). **Laboratory tests on high-friction surfaces for highways.** TRL Report 176, J C Nicholls.

Appendix A.11

Laboratory Preparation of Samples

1 Scope

This protocol describes the procedure for preparing specimens of thin surfacing systems such that they are suitable for subsequent testing.

The protocol describes a procedure that has been developed specifically for the assessment of thin surfacing systems under HAPAS Certification procedures. The method has yet to be proven and shown to be valid. The method is therefore unsuitable for use in specifications and should not be used for this purpose.

2 Normative References

This protocol incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed in **6**. Subsequent amendments to, or revisions of, any of these publications apply to this protocol only when incorporated in it by updating or revision.

3 Apparatus

Mixing apparatus - any type of mechanical mixer which can be maintained at the required mixing temperature, provide a well coated homogenous mixture of the required amount of bituminous mixture in the allowable time and allows essentially all of the mixture to be recovered.

Compactor - any type of mechanical compactor which can compact the mixture to the desired density without causing damage to the aggregate. Suitable compactors include the Marshall Hammer, vibrating hammers, kneading compactors, rolling wheel compactors or gyratory compactors.

Forced-draught oven - thermostatically controlled and capable of being set to maintain any desired temperature from room temperature to 260°C to within ±2°C.

Digital thermometer capable of measuring temperatures from room temperature to 260 °C with an accuracy of ± 2 °C.

Metal oven trays of sufficient size to heat the required amount of aggregate for each mixture.

Metal oven trays of sufficient size to receive, as well as to heat the uncompacted bituminous mixture. The size of the tray should have an area and depth such that the mixture can be spread to a constant depth of up to 40 mm.

Metal spatula or spoon of sufficient size to allow rapid and thorough mixing of the uncompacted mixture.

Oven gloves.

4 Thin Surfacing Systems Mixed Off-Site

4.1 For thin surfacing systems that are mixed at separate mixing plants, representative samples of a typical batch of material prepared at a mixing plant shall be sampled from a wagon in accordance with BS EN 12697-27: 2001.

4.2 Ensure the temperature of the mixture is at the specified compaction temperature and compact the mixture to the required voids content specified by the manufacturer.

Note: The minimum time necessary should be used to heat the mixture if heating is required.

4.3 After compaction, allow the compacted mixture specimen to cool to room temperature prior to removal from the compaction mould.

5 Thin Surfacing Systems Mixed In-Situ

5.1 For thin surfacing systems in which the component materials are mixed in-situ, the aggregates shall be sampled in accordance with BS EN 932-1 and the bitumen shall be sampled in accordance with BS 3690: Part 1: 1989.

5.2 The aggregate shall be graded in accordance with the mixture design provided by the manufacturer. The amount of aggregate shall be sufficient to obtain a mixture specimen(s) of the desired size.

5.3 Obtain a sufficient quantity of binder such that the amount of binder required to achieve the specified binder content can be mixed with the aggregate.

5.4 The desired mixing and compaction temperatures, with tolerances, shall be specified by the manufacturer.

5.5 Preheat the aggregate for a minimum of 2 hours at the specified mixing temperature.

5.6 Preheat the bituminous binder to the specified mixing temperature.

Note: Binders held at the mixing temperature for more than two hours should be discarded.

5.7 Preheat the equipment used for mixing the component materials to form the surfacing system to the desired mixing temperature.

5.8 Manufacture the thin surfacing system in the trays from the binder and aggregate in a manner agreed with the Applicant as replicating the manufacture of the system on the road.

5.9 After completion of manufacture, including appropriate compaction, allow the compacted mixture specimen to cool to room temperature prior to removal from the compaction mould.

6 List of References

BS EN 12697-27, Bituminous mixtures – Test methods for hot mix asphalt – Part 27: Sampling

BS EN 932-1:1997 Tests for general properties of aggregates. Methods for sampling

BS 3690-1:1989+A2:2008 Bitumens for building and civil engineering. Specification for bitumens for roads and other paved areas

Appendix A.12

Accelerated ageing

1 Scope

This protocol is used to simulate the ageing of thin surfacing systems. The ageing simulates the hardening of the bitumen in the mixture subsequent to construction. The practice should result in ageing representative of 5 to 10 years in service for dense-graded mixtures.

The protocol describes a procedure that has been developed specifically for the assessment of thin surfacing systems under HAPAS Certification procedures. The method has yet to be proven and shown to be valid. The method is therefore unsuitable for use in specifications and should not be used for this purpose.

2 Normative References

This protocol incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed in **7**. Subsequent amendments to, or revisions of, any of these publications apply to this protocol only when incorporated in it by updating or revision.

3 Apparatus

Forced-draught oven - thermostatically controlled and capable of being set to maintain any desired temperature from room temperature to 100°C to within ±2°C.

Thermometer - capable of measuring temperatures from room temperature to 100°C and having an accuracy of ±2°C or better.

Wire mesh basket - of sufficient rigidity to support the side and bottom of the compacted specimens, without bending or flexing appreciably and having an open area to total area ratio of at least 75 per cent.

Note: Stainless steel Expamet has been found to be suitable for this purpose.

4 Sampling

Core specimens shall be obtained in accordance with BS EN 12697-27: 2001.

5 Preparation

Core specimens shall be prepared and stored in accordance with Appendix A.4.

6 Procedure

6.1 Place the prepared specimen(s), supported in the wire mesh basket(s), in the forced-draft oven for (120±0.25) hours at a temperature of (85±2) °C.

6.2 After (120±0.25) hours, turn off the oven, open the door and allow the specimen to cool to room temperature for at least 24 hours.

Note: Do not disturb the specimen until it has cooled to room temperature.

6.3 After the specimen has cooled down to room temperature, remove it from the oven. The specimen is now ready for testing as required.

7 List of References

BS EN 12697-27, Bituminous mixtures – Test methods for hot mix asphalt – Part 27: Sampling

8 Acknowledgement

This protocol was developed by a team working under the DOT LINK programme on Transport Infrastructure and Operations led by the University of Nottingham.

The protocol has been modified by Specialist Group 3 for use during the HAPAS Assessment and Certification of Thin Surfacing Systems for Highways.

APPENDIX A.13

Fatigue characteristics of bituminous mixtures using indirect tensile fatigue

1 Scope

This test describes a method to estimate the resistance to fatigue failure of bituminous mixtures. The method is applicable to surface courses, binder courses and bases containing penetration grade bitumens or modified binders.

The results should only be considered as indicating the fatigue characteristics of bituminous mixtures. Caution should be exercised when quoting finite values or when comparing results of different materials tested under different conditions or tested by different methods.

2 Definitions

2.1 The definitions given in BS 12697-27:2001 apply together with the following:

2.2 Failure of a test specimen is defined as when there is a minimum 9 mm of vertical deformation of the top loading strip, or in the case of polymer modified bituminous mixtures, when the test specimen is completely split. In either case, the loading strip shall not embed into the specimen by more than 2 mm.

3 Summary of Test Method

3.1 The dimensions of the test specimens shall be measured and recorded. The specimens are then conditioned at the test temperature before being placed in the test frame, centred on and with the flat faces of the specimen perpendicular to the bottom loading strip. The top loading strip is then placed on the frame so that it is located centrally on the specimen. The loading is then applied via the test apparatus. Each specimen is tested at a different target level of the maximum tensile stress at the centre of the specimen.

3.2 For each specimen, the maximum tensile horizontal strain at the centre of the specimen is calculated from Poisson's ratio, the maximum tensile stress at the centre of the specimen and the indirect tensile stiffness modulus at the maximum tensile stress at the centre of the specimen.

3.3 The indirect tensile stiffness modulus is stress related due to the non-linear visco-elastic nature of bitumen. Preferably, this parameter at the indirect tensile fatigue test stress level is obtained using a controlled stress version of the stiffness test. If this test is unavailable, the parameter is obtained from a series of indirect tensile stiffness moduli measurements at different stress levels for each specimen.

4 Apparatus

The apparatus shall consist of:

4.1 Test system capable of imparting 0 to 4 kN 0 to 10 kN or 0 to 14 kN through a spherical seating with a rise-time of between 80 and 160 ms. A schematic diagram of the testing apparatus is shown in Figure 1.

4.2 Fatigue testing frame of a sufficiently rigid nature to ensure that all the applied loads are transmitted to the specimen and with top and bottom loading strips. The frame shall have a safety system which ensure that, upon violent failure of the samples, the top loading strip does not drop and damage the bottom loading strip.

4.3 Top and bottom loading strips made of hardened steel and machined to a width of (12.5 ± 2) per cent over the range.

4.4 Linear Variable Differential Transformers have a gauge length of at least 10 mm and an accuracy of 0.1 per cent over the range.

4.5 Data logging equipment capable of capturing data on the applied force, transient deformation, overall deformation and the pulse number from every load pulse.

5 Sample Preparation

5.1 General

The samples shall be either laboratory prepared or cut from a pavement, but all the samples taken to generate one fatigue relationship shall be from one method or the other.

5.2 Sample Geometry

The samples shall be cylindrical with a thickness of (40 ± 5)mm and a diameter of (100 ± 3) mm. The parallel flat ends shall be trimmed to a tolerance of ± 5mm.

Note. 150 mm diameter samples can be used for the stiffness testing and then 100 mm samples cored out of the centre of them. However, it is preferable to carry out the stiffness test on the actual 100 mm core that is to be used in the indirect tensile fatigue test.

5.3 Measurements of Sample

5.3.1 Take four determinations of the diameter at approximately equal distances around the circumference of each sample (Figure 2). The diameter of the sample, *d* (mm), shall be the mean of these determinations calculated to the nearest whole millimetre.

5.3.2 Take eight measurements of the thickness at the same points as the diametral measurements (Figure 2). The thickness of the sample, *t* (mm), shall be the mean of these determinations to the nearest whole millimetre.

Note. The sample geometry for the stiffness testing shall comply with all requirements of BS EN 12697-26 Annex C current at the time of testing.

6 Procedure for Individual Determinations

6.1 Test Temperatures

The test temperature shall be (20 ± 1) °C. Both the stiffness modulus and fatigue testing shall be carried out at this temperature.

Note. Test temperatures other than 20°C may be used but the chosen temperature must fall in the range 0 to 30°C. Operators should be aware that, if testing at the low temperatures in this range, tests may progress for extended periods. They should also take care when testing above 25°C that the loading strips do not dig into the specimen by more than 2 mm, measured by placing a straight edge over the indentation and measuring the maximum value. If this does occur then the test specimen and result is void.

6.2 Target stress level

6.2.1 If the controlled stress version of the software is available, the target stress level for the indirect tensile fatigue test shall be used for the controlling value of stress during the stiffness test.

6.2.2 If the controlled stress version of the software is not available, the target deformation shall be 5 µm, 9 µm, 13 µm and 17 µm on each of two axes of the sample.

Note. These deformations are intended as general guidance and it may be necessary, due to the type of material being tested, to adjust the actual target deformations in order to achieve a spread of stress levels. It is suggested that this spread be at least 200 kPa where possible. As the deformations are variable and only used to achieve a range of stress levels, no tolerances need be applied.

6.2.3 Tabulate the resulting eight stiffness measurements and their corresponding stress levels and calculate the average stiffness modulus for the sample.

Note. A suitable table is given as Table 1.

Table 1:Standard Result Sheet

Horizontal deformation (μm)	Axis 1		Axis 2	
	Stress (kPa)	Stiffness (MPa)	Stress (kPa)	Stiffness (MPa)
5				
9				
13				
17				

6.3 **Indirect Tensile Fatigue Testing**

6.3.1 Position the specimen on the lower loading strip so that it seats itself properly without excessive movement and so that the two faces of the specimen are perpendicular to the loading strip. Place the upper loading strip on the top of the specimen and seat it such that there is no excessive movement.

6.3.2 Adjust the linear variable differential transformers so that they are at the minimum limit of their linear range, thus allowing them to measure over a range of at least 9 mm.

6.3.3 Apply the loading at a rate of (40 ± 1) pulses per minute at the test stress level.

6.3.4 Record the number of load applications to failure of the test specimen.

7 Procedure for Fatigue Analysis

7.1 **Number of Determinations**

7.1.1 For a full test, carry out determinations on not less than ten specimens for mixtures with a maximum nominal aggregate size of 20 mm and below and on not less than twelve specimens for mixtures with a maximum nominal aggregate size greater than 20 mm.

7.1.2 For a restricted test, carry out determinations on not less than five specimens for mixtures with a maximum nominal aggregate size of 20 mm and below and on not less than ten specimens for mixtures with a maximum nominal aggregate size greater than 20 mm

7.2 **Target Test Stress Level**

7.2.1 The target test stress level for the first specimen to be tested shall be 600 kPa unless this cannot reliably be obtained, when the first target stress level shall be 500 kPa.

7.2.2 The target test stress level for the second, third and fourth specimens are given in Table 2.

N_{600} is the number of load applications applied to the first specimen tested at a stress level of 600 kPa.

Table 2: Target test stress level for second, third and fourth specimens

Test Stress Level	N_{500} ≤200	200< N_{500} ≤500	500< N_{500} ≤1000	1000< N_{500}
2nd Specimen	400	425	450	475
3rd Specimen	300	350	400	450
4th Specimen	200	250	300	400
Test Stress Level	N_{600} ≤200	200< N_{600} ≤500	500< N_{600} ≤1000	1000< N_{600}
2nd Specimen	500	525	550	575
3rd Specimen	400	450	500	550
4th Specimen	300	350	400	500

Where N_{500} is the number of load applications applied to the first specimen tested at a stress level of 500 kPa; and
N_{600} is the number of load applications applied to the first specimen tested at a stress level of 600 kPa

Note. The values given in Table 2 are for guidance only and it is envisaged that, as operators become experienced, they will be better able to choose test stress levels

7.2.3 The target test stress levels for the fifth and subsequent specimens shall be selected to give as wide a range of lives as possible. The minimum spread of lives must be one order of magnitude so that the maximum value of N_{600} or N_{500} is at least ten times greater the minimum value.

8 Calculation

8.1 Maximum Tensile Stress at the Centre of the Specimen

Calculate the maximum tensile stress at the centre of the specimen, $\sigma_{x,max}$ (kPa),

$$\sigma_{x,max} = \frac{2 \times P_L}{\pi \times d \times t}$$

from:

where P_L is the vertically applied line loading (kN);
d is the diameter of the test specimen (m); and
t is the thickness of the test specimen (m).

8.2 Maximum Tensile Horizontal Strain at the Centre of the Specimen

Calculate the maximum tensile strain generated at the centre of each specimen, $\varepsilon_{x,max}$ (microstrain), from:

$$\epsilon_{x,max} = \frac{\sigma_{x,max} \times (1 + 3\nu)}{S_m} \times 1000$$

where $\sigma_{x,max}$ is the maximum tensile stress at the centre of the specimen (kPa);
ν is Poisson's ratio (assumed to be 0.35); and
S_m is the indirect tensile stiffness modulus at $\sigma_{x,max}$ (MPa).

8.3 **Tabulation of Results**

Tabulate the results for each test specimen.

Note. A suitable table is given as Table 3.

Table 3: Typical format for tabulating results

Specimen number	Diameter (mm)	Thickness (mm)	$\sigma_{x,max}$ (kPa)	S_m (MPa)	$\varepsilon_{x,max}$ (microstrain)	Number of cycles to failure (N)
1						
2						
3						
4						
...						
N						

8.4 **Generation of the Fatigue Relationship for the Bituminous Mixture**

8.4.1 Plot the maximum tensile horizontal strain at the centre of the specimen ($\varepsilon_{x,max}$) against the number of cycles to failure (N_f) using logarithmic horizontal and vertical axes.

8.4.2 Apply linear regression analysis using the Least Squares method to the paired data of $\log_{10}(\varepsilon_{x,max})$ and $\log_{10}(N_f)$ in order to obtain the equation of the line.

Note 1. An example of such a fatigue line with the linear regression is shown in Figure 4.

Note 2. It should be noted that specimens of the same material tested at different temperatures should lie on the same line.

8.5 Statistical Significance

8.5.1 Calculate the square of the correlation coefficient (R^2) for the linear regression analysis.

8.5.2 If the value of R^2 is below 0.90, test additional specimens and incorporate the results into the data set until, when repeating the linear regression analysis, the value of R^2 is greater than 0.90.

8.5.3 If, after ten specimens have been added to the data set, the R^2 value is still less than 0.90, the result shall be reported with a statement concerning the statistical significance of the data.

Note. If further specimens are unavailable, then the result shall be reported with a statement concerning the statistical significance of the data.

9 Precision

The precision of the test method has still to be determined.

10 Reporting of Results

10.1 **Information**

The test report shall include the following information for each test specimen:

(e) The name and address of the testing laboratory;
(f) A unique serial number for the test report;
(g) The number of specimens tested
and whether it was a full or a restricted test;
(h) Descriptions and identifications of the specimens, and the date of receipt;
(i) A completed version of Table 3;

(j) A graphical representation of the fatigue line;
(k) The square of the correlation coefficient and the constants of the equation obtained by linear regression analysis for the number of cycles to failure in terms of the maximum tensile horizontal strain at the centre of the specimen;
(l) The number of cycles to failure (N_f) at a maximum tensile horizontal strain at the centre of a specimen of 100 microstrain calculated from the linear regression analysis equation;
(m) The signature of the person accepting technical responsibility for the test report;
(n) The date of issue;
(o) Any test conditions and operational details not provided in this Draft for Development, and anomalies, if any, likely to have affected the results.

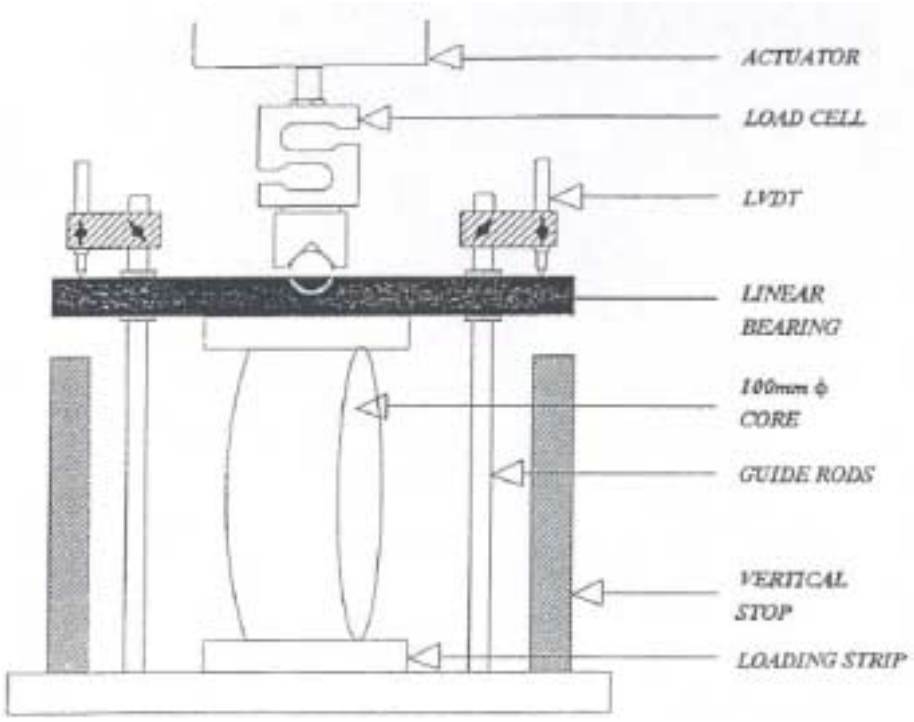

Figure 2: Schematic of one possible apparatus configuration

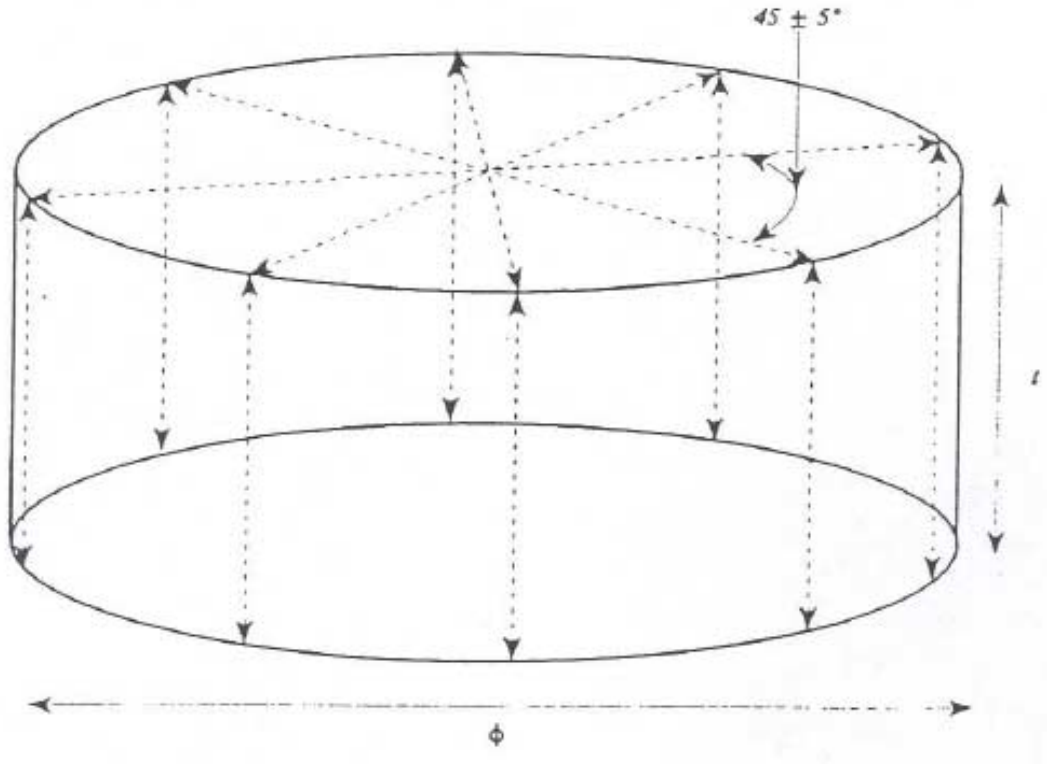

Figure 3: Schematic showing the positions of measurement

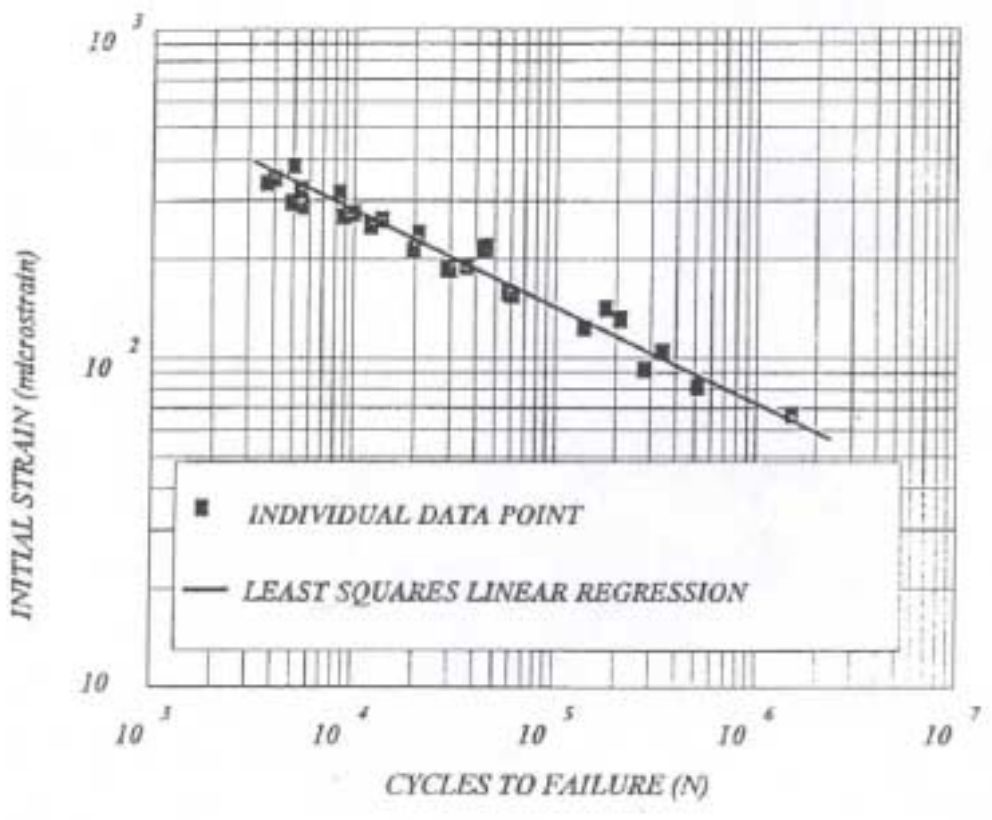

Figure 4: Example of a fatigue graph

APPENDIX B

PERFORMANCE LEVELS

Table B.1 - Wheel tracking levels[1]

Level[2]	Test temperature	Maximum wheel tracking in layers 30mm thick or more		Maximum wheel tracking in layers less than 30mm thick	
	°C	Rate (mm/h) mean/max[3]	Rut depth (mm) mean/max[3]	Rate (mm/h per mm thickness) mean/max[3]	Rut depth (mm of rut/mm thickness) mean/max[3]
3	60	5.0/7.5	7.0/10.5	0.167/0.25	0.233/0.35
2	45	2.0/3.0	4.0/6.0	0.07/0.10	0.133/0.20
1	45	5.0/7.5	7.0/10.5	0.167/0.25	0.233/0.35
0	No requirement				

Notes:

1 These wheel tracking rates were developed for hot rolled asphalt type materials. They may need amending for other types of materials in the light of experience.

2 Level 3 is the same as level 2 in draft clause 943 for hot rolled asphalt and level 2 is the same as level 1 in clause 943. The level 1 in this document is analogous to design asphalt to clause 911 and level 0 has no requirement.

3 "Mean" is the mean result of 6 consecutive results and "max" is the maximum value measured on any single core.

Table B.2 - Texture levels

Level	Minimum texture depth (mm) (Untrafficked)	Minimum texture depth (mm) after 2 years trafficking
3	1.3	1.0
2	1.2	0.8
1	1.0	0.7
0	No requirement	No requirement

Table B.3 - Hydraulic conductivity levels (See Table 4)

Level	Mean of six results (s^{-1})	Individual result (s^{-1})
3	> 0.12	> 0.06
2	> 0.06	> 0.03
1	> 0.03	> 0.02
0	No requirement	No requirement

APPENDIX C

SYSTEM ASSESSMENT FOR TRAFFIC LEVEL RELATIVE TO SITE CLASSIFICATION

Although any trial can only demonstrate definitively that a system is suitable for the actual conditions encountered, it can also provide assurance that the system should be suitable in more severe conditions, the extent of that assurance depending on the ease with which compliance was achieved. Further, a mechanism is needed for allowing a system to progress to usage under increasingly severe conditions. Therefore, the following procedure sets out the method for establishing the extent by which the conditions encountered can be enhanced to give the conditions up to which approval is deemed to be demonstrated by a particular trial.

Under the procedure, a successful trial can be used to demonstrate that a system is appropriate for use on sites with traffic levels up to C_{max} (in commercial vehicles per lane per day, cv/l/d) in accordance with:

$$C_{\max} = f_{site} \times f_{texture} \times f_{depth} \times C_{trial}$$

where: f_{site}, $f_{texture}$ and f_{depth} are factors defined below; and
C_{trial} is the traffic level (cv/l/d) on the trial site.

C_{max} shall be rounded down to the nearest 500 cv/l/d if over 1,000 cv/l/d or the nearest 100 cv/l/d if less than 1,000 cv/l/d. Values of C_{max} (after rounding) in excess of 5,000 cv/l/d for site stress levels 1 and 2 shall be quoted as > 5,000 cv/l/d* and values of C_{max} (after rounding) in excess of 2,500 cv/l/d for site stress levels 3 and 4 shall be quoted as > 2,500 cv/l/d*.

*C_{max} values of >5000 cv/l/d and >2500 cv/l/d imply that the applicability of that system is unrestricted with regard to traffic levels for the combination of site stress level and texture depth.

f_{site} is a factor to take account of any inherently different stresses imposed by the traffic on the trial site from those imposed by the traffic on a potential site on which the system is wanted to be used. Usually, separate values of C_{max} will be calculated for each site stress level for potential sites on which the system may be wanted to be used.

$$f_{site} = \frac{S_{trial}}{S_{design}}$$

where S_{trial} and S_{design} are the site stress levels for the trial site and the potential site on which the system is wanted to be used, respectively, as determined from the site category in accordance with Table C.1.

S_{trial} and S_{design} can have values between 1 and 4, so that f_{site} can have a value between 0.25 and 4.

$f_{texture}$ is a factor to take account of the extent that trafficking reduces the texture depth relative to the required level. Usually, separate values of C_{max} will be calculated for each texture level for which the trial site has met the requirements.

$$f_{texture} = \text{Min}\left(\frac{(7 - 2age)\times t_0 \times T + age \times t_0 \times t_{age} - (7 - age)\times t_{age} \times T}{(7 - age)\times T \times (t_0 - t_{age})}, 2\right)$$

where: t_0 is the initial texture depth (mm) of the trial site before trafficking;
t_{age} is the in-service texture depth (mm) of the trial site at the end of the trial period;
T is the in-service texture depth required after two years (mm) according to Table B.2 for use on sites with that texture level; and
age is the period of the trial (years) before the final texture depth is measured, which is not less than 2 years.

$f_{texture}$ can have values between 1 and 2 for trial sites where the texture depth does not increase with time and which complied with the texture depth requirements in Table B.2 for the required texture level. $f_{texture}$ is designed to be unity if the texture depth only just meets in-service requirement at the end of the trial and to be equal to two if the texture depth would still comply with that requirement after 7 years trafficking assuming that the decrease in texture depth is inversely proportional to the period in-service (see derivation at the end of this appendix).

Examples to show the values that can be produced by the above equation are:

t_0	T_{age}	T	age	$f_{texture}$
1.5	1.0	1.0	2	Min (1.0, 2) = 1.0
1.5	1.2	1.0	2	Min (1.4, 2) = 1.4
2.0	1.2	1.0	2	Min (1.2, 2) = 1.2
2.0	1.5	1.0	2	Min (1.8, 2) = 1.8
2.0	1.5	1.0	3	Min (2.5, 2) = 2.0
2.0	1.6	1.0	2	Min (2.2, 2) = 2.0
1.5	1.5	1.0	2	Min (∞, 2) = 2.0

f_{depth} is a factor to take account of the additional inherent durability that tends to occur with thicker systems. However, it is appreciated that this tendency is not universally true.

$$f_{depth} = Min\left(6, Max\left[3, \frac{d}{10} + 2\right]\right)$$

where d is the nominal thickness of the system (mm).

f_{depth} can have values between 3 and 6.

The following examples illustrate the principles discussed above:

Example 1

A trial of a system with a nominal thickness of 30 mm on a site with 500 cv/l/d, site stress level 1, 1.5 mm initial texture depth and 0.9 mm texture depth after 2 years will provide approval for use of the system on sites with:

	Site Stress Level 1	Site Stress Level 2	Site Stress Level 3	Site Stress Level 4
Texture level 1	3,000 cv/l/d	1,500 cv/l/d	1,000 cv/l/d	800 cv/l/d
Texture level 2	2,500 cv/l/d	1,000 cv/l/d	900 cv/l/d	700 cv/l/d
Texture level 3	n.a.	n.a.	n.a.	n.a.

(NOTE: No values are given for texture level 3 because the texture depth after 2 years is too low)

Example 2

A trial of a system with a nominal thickness of 20 mm on a site with 1,200 cv/l/d, site stress level 1, 2.6 mm initial texture depth and 1.5 mm texture depth after 2 years will provide approval for use of the system on sites with:

	Site Stress Level 1	Site Stress Level 2	Site Stress Level 3	Site Stress Level 4
Texture level 1	>5,000 cv/l/d	4,500 cv/l/d	>2,500 cv/l/d	2,000 cv/l/d
Texture level 2	>5,000 cv/l/d	4,000 cv/l/d	2,500 cv/l/d	2,000 cv/l/d
Texture level 3	>5,000 cv/l/d	3,500 cv/l/d	2,000 cv/l/d	1,500 cv/l/d

Table C.1 - Classification of Sites by Stress Condition

SITE CATEGORY	SITE DEFINITION	STRESS LEVEL
A	Motorway (main line)	1
B	Dual carriageway (all purpose) - non-event sections	1
C	Single carriageway - non-event sections	1
D	Dual carriageway (all purpose) - minor junctions	1
E	Single carriageway - minor junctions	1
F	Approaches to and across major junctions (all limbs)	2
G1	Gradient 5% to 10% longer than 50 m: Dual (downhill only) Single (uphill and downhill)	2
G2	Gradient steeper than 10%, longer than 50 m: Dual (downhill only) Single (uphill and downhill)	2
H1	Bend (not subject to 40 mph or lower speed limit) radius < 250 m	2
H2	Bend (not subject to 40 mph or lower speed limit) radius < 100 m	3
J	Approach to roundabout	4
K	Approach to traffic signals, pedestrian crossings, railway level crossings and similar	4
L	Roundabout	3

Derivation of the factor $f_{texture}$

The derivation below is based on the assumption that texture depth declines at a rate such that its inverse is proportional to the time in service, (see Fig C.1 below).

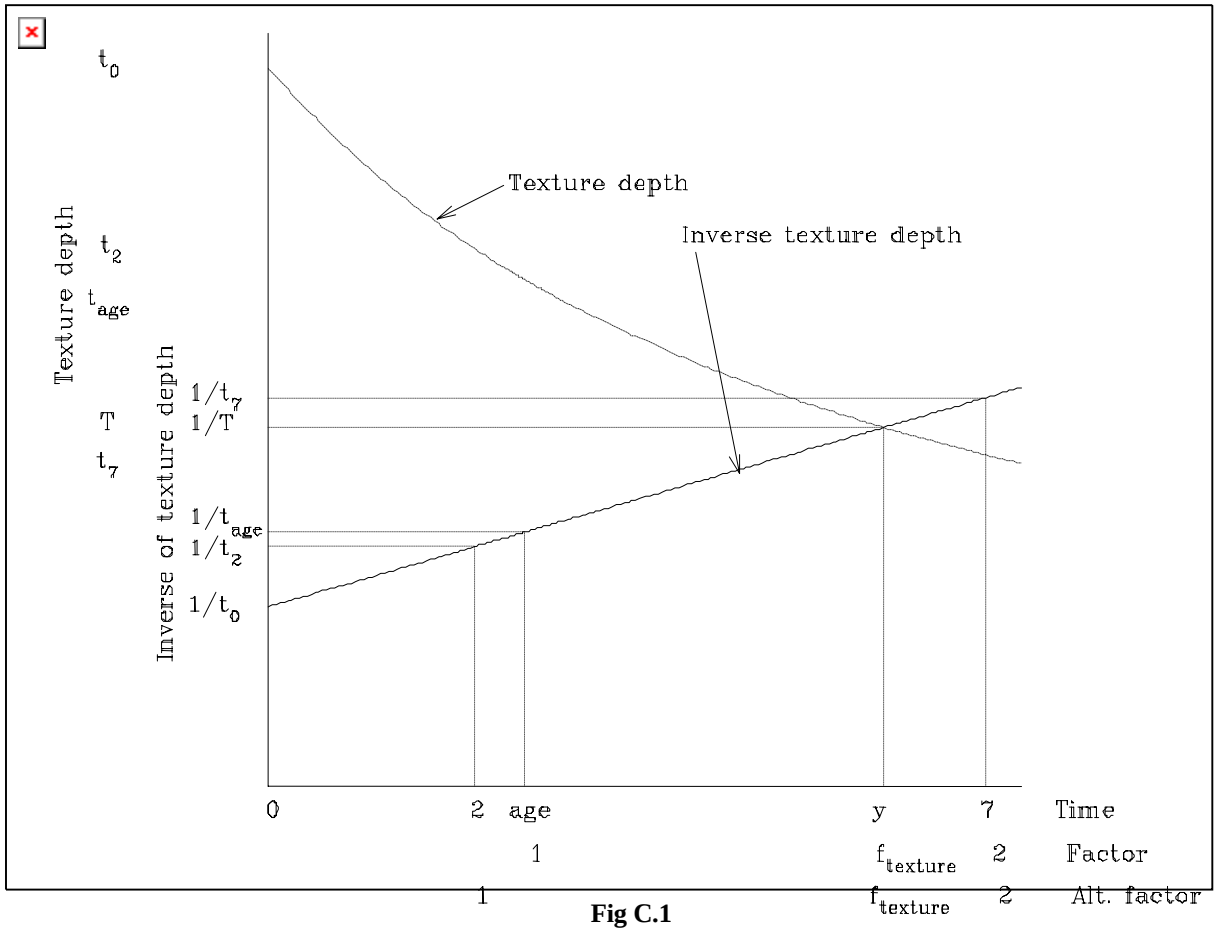

Fig C.1

Using similar triangles, it can be shown that:

$$\frac{\left(\frac{1}{t_{age}} - \frac{1}{t_0}\right)}{age} = \frac{\left(\frac{1}{T} - \frac{1}{t_0}\right)}{y}$$

$$\therefore\ y = \frac{t_{age}(t_0 - T)}{T(t_0 - t_{age})}\,age$$

And, for a factor of unity when the final measurement just meets the in-service requirement:

$$\frac{(1 - f_{texture})}{(age - y)} = \frac{(2-1)}{(7 - age)} = \frac{1}{(7 - age)}$$

$$\therefore\ f_{texture} = \frac{(7 - 2\,age + y)}{(7 - age)}$$

Substituting for y gives:

$$f_{texture} = \frac{(7 - 2age + \frac{t_{age}(t_0 - T)}{T(t_0 - t_{age})} age)}{(7 - age)}$$

$$\therefore f_{texture} = \frac{(7 - 2age)t_0 T + age\, t_0 t_{age} - (7 - age)t_{age} T}{(7 - age)T(t_0 - t_{age})}$$

APPENDIX D

ASSESSMENT OF THE SUITABILITY OF EXISTING DATA SUPPLIED BY THE APPLICANT

Assessment of existing data

Test data submitted by the applicant in support of an application for the assessment of a thin surfacing system will be assessed by the BBA. Where necessary the BBA may consult specialists or a specialist panel of normally 5 or 6 members representative of Specialist Group 3 with at least one from each of the following areas:

- Expert in the testing and interpretation of test data relating to the performance of thin surfacing materials.
- Highways authorities.
- Manufacturers / trade associations (not the manufacturer submitting the data).

The BBA shall agree with the applicant the need to consult a specialist or a specialist panel prior to the consultation taking place.

The data submitted by the applicant shall be assessed to ensure that it is valid, i.e. it should be:

- Relevant / traceable to the system proposed.
- Adequate to allow a judgement to be made of the performance in relation to the relevant mandatory tests and/or any optional tests the applicant claims for the system.

After reviewing the data submitted by the applicant the BBA will decide, (in consultation with the specialist panel, if necessary) on the need for any additional testing.

Any additional testing shall be carried out by a laboratory approved by the BBA.

Appeal by the Applicant

If the Applicant wishes to appeal against the decision taken by the BBA then the appeal shall be considered by HiTAC.

APPENDIX E DEFINITIONS AND ACRONYMS

AAV	Aggregate Abrasion Value, (as defined in BS EN 1097-8 : 2000).
ACE	The Association of Consulting Engineers
BBA	British Board of Agrément
Laboratory approved by the BBA	A laboratory approved by the BBA to carry out test work on behalf of the BBA, i.e. sub-contracted by the BBA, which may lead to the approval of a product and the issue of a BBA Certificate. Before approval the laboratory shall have demonstrated to the BBA that it has the relevant expertise, equipment and quality systems in place to carry out the work required or be UKAS accredited for the test(s).
Certificate of Conformity	A Certificate providing evidence that a material has been tested and meets any required performance / specification requirements. A Certificate of Conformity shall be traceable to a specific batch or delivery of the material and will normally be required to show the results of agreed performance / specification tests.
COSHH	Control of Substances Hazardous to Health.
CSS	County Surveyors Society
HA	Highways Agency, also representing other Overseeing Organisations including The Scottish Office Industry Department, The Welsh Office and The Department of the Environment for Northern Ireland.
HAPAS	Highway Authorities Product Approval Scheme
HD36/99	Design Manual for Roads and Bridges, Volume 7: Pavement design and maintenance, Section 5 Surfacing and Surfacing Materials, HD36/99 Surfacing Materials for new and maintenance construction.
HiTAC	Highways Technical Advisory Committee. A committee, appointed by the Council of the BBA, consisting of representatives of parties responsible for overseeing and controlling the HAPAS scheme and the work of the BBA in this area.

IAT	The Institute of Asphalt Technology
IHT	The Institution of Highways and Transportation
MBC (TAG)	Metropolitan Borough Councils Technical Advisory Group
NAMAS	National Accreditation, Measurement and Sampling
Overseeing organisation	Body responsible for a trunk road, as defined in the Design Manual for Roads and Bridges
PSV	Polished Stone Value, (as defined in BS EN 1097-8 : 2000).
RBA	Refined Bitumen Association
REAL	Road Emulsion Association Ltd
RSDA	Road Surface Dressing Association
SSCA	Slurry Surfacing Contractors Association
Specialist Group	A Specialist Group formed under the auspices of HiTAC. The objectives of the Group are to develop guidelines and offer specialist advice for the assessment and Certification of products for highways.
SRV	Skid Resistance Value (as defined in TRL Report 176).
System Loss	The wearing away and/or delamination of a system.
Texture Depth	Texture depth measured by the Sand Patch and/or the High Speed Texture Meter Methods (as defined in BS 598 -105: 2000)
Trafficking Time	The time after installation, when the system will accept normal trafficking.
TRL	Transport Research Laboratory
UKAS	The United Kingdom Accreditation Service
Visual Assessment	A procedure for assessing the visual condition of trial sites by Inspection Panel carried out in accordance with Appendix A.10

BBA HAPAS INSPECTION PANEL
Panel Member's Report Form

Panel Member:	Date of Inspection:
BBA Panel Convenor:	System:
Location:	
Weather and Road Conditions:	

	Site(s)				
	Practice (if necessary)	**1.**	**2.**	**3.**	**4.**
See Table 1 Fault below suffix					
See Table 2 on page 2 of 2 Mark					

TABLE 1 – Fault Suffixes

Suffix	**Description**	
v	Variable	Random variations from point to point within the section only, not 'traffic laning' or of obvious variations from load to load
t	Variability with traffic intensity	Marked transverse differences caused by variations in traffic intensity between lanes and wheel tracks.
+	Fatting up	
-	Loss of chippings, loss of aggregate or loose aggregate	
f	Fretting of mortar	
g	Growth of vegetation	
p	Ponding	
D	De-lamination from substrate	
S	Stripping	
C	Cracking	

APPENDIX F

BBA HAPAS INSPECTION PANEL
Panel Member's Report Form

Mark	Description
E	No discernible fault
G	No significant fault
M	Some faults but insufficient for serious problems
A	Several faults but would usually be just acceptable
S	Seriously faulted but still serviceable in the short term
P	Requires remedial treatment
B	Requires immediate remedial treatment

APPENDIX F.1

BBA HAPAS INSPECTION PANEL
BBA Convener's Report Form

System:	Location:
BBA Convenor:	Date of inspection:
Weather and Road Conditions:	

Site(s)		Individual Markings (from Panel Member's Report Form)			Fault Suffix	Panel Mark
		Assessor	Assessor	BBA Convenor		
Practice (if necessary)	**Suffix**					
	Mark					
1.	**Suffix**					
	Mark					
2.	**Suffix**					
	Mark					

Signed……. **Date……**