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HAPAS
Roads and Bridges Agrément Certificate No 01/H047
*Third issue**

BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

Designated by Government to issue European Technical Approvals

UL-M THIN SURFACING SYSTEMS FOR HIGHWAYS

This Certificate is issued under the Highway Authorities' Product Approval Scheme (HAPAS) by the BBA in conjunction with the Highways Agency (acting on behalf of the overseeing organisations of the Department for Transport; the Scottish Executive; the Welsh Assembly Government; the Department for Regional Development, Northern Ireland), the County Surveyors' Society, the Local Government Technical Advisers' Group, and industry bodies. HAPAS Agrément Certificates are normally each subject to a review every five years.

Product

- *THIS CERTIFICATE RELATES TO UL-M THIN SURFACING SYSTEMS FOR HIGHWAYS, COMPRISING AN EVA-MODIFIED BITUMEN BINDER, LIMESTONE FILLER AND GRADED COARSE AND FINE AGGREGATES.*
- *The systems are used in conjunction with either a bond or tack coat, to enhance the adhesion to the substrate.*
- *UL-M is manufactured and delivered by companies trained and approved by Jean Lefebvre (UK) Ltd.*
- *The systems are installed only by contractors trained and approved by Jean Lefebvre (UK) Ltd using conventional paving equipment.*

These Front Sheets must be read in conjunction with the relevant Detail sheets, which provide information specific to UL-M systems.

HAPAS Requirements — Detail Sheet 1

1 Requirements

The Highways Technical Advisory Committee (HiTAC) and HAPAS Specialist Group 3 (Thin Surfacing) have agreed with the British Board of Agrément the aspects of performance to be used by the BBA in assessing the compliance of Thin Surfacing Systems with the *Guidelines Document for the Assessment and Certification of Thin Surfacing Systems for Highways*. In the opinion of the BBA, UL-M Systems, when manufactured and laid in accordance with the provisions of this Certificate can be designed to meet the relevant requirements and can achieve the Performance Levels given in Table 1 of the relevant Detail Sheet.

Regulations

2 Construction (Design and Management) Regulations 1994 (as amended)
Construction (Design and Management) Regulations (Northern Ireland) 1995 (as amended)

Information in this Certificate may assist the client, planning supervisor, designer and contractors to address their obligations under these Regulations.

See section: 4 *Manufacture, quality control, delivery and site handling* (4.1 to 4.3) of these Front Sheets.

Technical Specification

3 Description

3.1 UL-M Thin Surfacing Systems for Highways comprise a series of mixtures principally consisting of a blend of a EVA-modified bituminous binder, graded crushed coarse and fine aggregates and limestone filler. The system is used in conjunction with approved bond or tack coats, to enhance adhesion to the substrate.

3.2 The choice of aggregates, types and size used will depend on site specific details, including location, and contractual requirements for Polished Stone Value (PSV), texture depth and/or other properties (see accompanying Detail Sheets for specific UL-M systems).

3.3 The petrological types of aggregates approved for use in the system include gritstones, basalts and granites.

4 Manufacture, quality control, delivery and site handling

4.1 The systems components are manufactured, controlled and delivered in accordance with a BBA Agreed Quality Plan and includes requirements for:

- binder
- aggregate selection and approval
- plant (processing and approval)
- method of production and process control
- inspection and testing of finished product
- delivery vehicles.

4.2 Bond or tack coats may be delivered to site either in bulk by tanker or in 200 kg drums.

4.3 The systems components are not classified under the Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 (CHIP3). Material safety data sheets for handling hot asphalts will apply.

Installation

5 General

5.1 UL-M Thin Surfacing Systems for Highways are only laid by contractors approved by Jean Lefebvre (UK) Ltd using conventional paving equipment in accordance with procedures detailed in the appropriate Jean Lefebvre *Guidelines on Transportation and Laying Procedures* which include requirements for:

- transportation
- site conditions and preparation
- acceptable weather conditions and road surface temperatures
- minimum paver and rolling temperatures
- application of bond or tack coat
- paving equipment type and operation
- compaction
- joints
- handworking.

5.2 Additional guidelines for cold weather working are available and should be consulted when road surface temperatures are below 8°C. Details of the current Guidelines can be obtained from the Certificate holder.

5.3 When areas of handwork are unavoidable, it should be carried out as quickly as possible, keeping the compaction plant up with the laying. An inspection should be carried out after the initial rolling and any particular rugose areas made good by spotting up with hot material.

6 Maintenance and repair

Motorways, trunk roads and other major repairs

6.1 The damaged area is removed by planing, to provide a length of at least 15 m for resurfacing. The planed area is resurfaced using material to the same specification, in accordance with the Certificate holder's installation procedures.

Minor repairs

6.2 Minor repairs can be carried out by cutting out the damaged section and replacing it with a standard asphalt or macadam material of suitable specification agreed between Jean Lefebvre (UK) Ltd and the purchaser.

7 Additional information

7.1 The systems components are manufactured at multiple locations covering the UK by companies trained and approved by Jean Lefebvre (UK) Ltd. A list of currently approved companies is also held by the BBA.

7.2 The approval includes confirmation that the companies are able to manufacture the product in accordance with the requirements of the Sector Schemes for Quality Management in Highway

Construction, Scheme No 14, *Sector Scheme Document for the Quality Assurance of the Production of Asphalt Mixes,* as published by the Sector Scheme Advisory Committee for the Quality Assurance of the Production of Asphalt Mixes and a Quality Plan agreed with the BBA.

7.3 Jean Lefebvre (UK) Ltd carry out annual audits on binder manufacturers, approved manufacturers and laying teams.

7.4 Records of the sites and locations where the system has been laid are reported to Jean Lefebvre (UK) Ltd, who maintain a register of all works.

Bibliography

Guidelines Document for the Assessment and Certification of Thin Surfacing Systems for Highways, July 2004

Conditions of Certification

8 Conditions

8.1 This Certificate:

(a) relates only to the product that is named, described, installed, used and maintained as set out in this Certificate;

(b) is granted only to the company, firm or person identified on the front cover — no other company, firm or person may hold or claim any entitlement to this Certificate;

(c) is valid only within the UK;

(d) has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective;

(e) is copyright of the BBA;

(f) is subject to English law.

8.2 References in this Certificate to any Act of Parliament, Regulation made thereunder, Directive or Regulation of the European Union, Statutory Instrument, Code of Practice, British Standard, manufacturers' instructions or similar publication, are references to such publication in the form in which it was current at the date of this Certificate.

8.3 This Certificate will remain valid for an unlimited period provided that the product and the manufacture and/or fabrication including all related and relevant processes thereof:

(a) are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA;

(b) continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine;

(c) are reviewed by the BBA as and when it considers appropriate; and

(d) remain in accordance with the requirements of the Highway Authorities' Product Approval Scheme.

8.4 In granting this Certificate, the BBA is not responsible for:

(a) the presence or absence of any patent, intellectual property or similar rights subsisting in the product or any other product;

(b) the right of the Certificate holder to market, supply, install or maintain the product; and

(c) the actual works in which the product is installed, used and maintained, including the nature, design, methods and workmanship of such works.

8.5 Any recommendations relating to the use or installation of this product which are contained or referred to in this Certificate are the minimum standards required to be met when the product is used. They do not purport in any way to restate the requirements of the Health & Safety at Work etc Act 1974, or of any other statutory, common law or other duty which may exist at the date of this Certificate or in the future; nor is conformity with such recommendations to be taken as satisfying the requirements of the 1974 Act or of any present or future statutory, common law or other duty of care. In granting this Certificate, the BBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the installation and use of this product.

BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

In the opinion of the British Board of Agrément, UL-M Thin Surfacing Systems for Highways are fit for their intended use provided they are installed, used and maintained as set out in this Certificate. Certificate No 01/H047 is accordingly awarded to Jean Lefebvre (UL) Ltd.

On behalf of the British Board of Agrément

Date of Third issue: 13th July 2005

Chief Executive

**Original Certificate issued on 14th April 2001. This amended version issued to include revisions to text and new* Conditions of Certification.

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BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

Jean Lefebvre (UK) Ltd

UL-M 20/10 THIN SURFACING SYSTEM FOR HIGHWAYS

Roads and Bridges
Certificate No 01/H047

DETAIL SHEET 2

*Second issue**

Product

- *THIS DETAIL SHEET RELATES TO THE UL-M 20/10 THIN SURFACING SYSTEM FOR HIGHWAYS.*
- *The system is for use as a thin road surfacing, with a nominal aggregate size of 10 mm, generally laid at nominal thicknesses between 20 mm and 40 mm, covering Classification B and C defined in Table 1 of the* Guidelines Document for the Assessment and Certification of Thin Surfacing Systems for Highways.

This Detail Sheet must be read in conjunction with the Front Sheets which give additional information on the HAPAS Requirements, Regulations *and* Conditions of Certification.

Design Data

1 General

1.1 The UL-M 20/10 Thin Surfacing System for Highways is satisfactory for use as a thin surfacing system on highways.

1.2 The system is suitable for application on existing bituminous or concrete highway surfaces at a minimum temperature of 4°C, provided the surface is free from standing water or ice and that the minimum specified rolling temperature can be maintained. Details are given in the current UL-M 20/10 *Guidelines on transportation and laying procedures* (dated July 2004) and the *Guidelines for cold weather working* (dated January 1999).

1.3 When manufactured and laid in accordance with the provisions of this Detail Sheet, the system can be designed to achieve the Performance Levels given in Table 1.

Table 1 Performance Levels achieved on trial installations

Test parameter	Performance Level achieved[1]	Requirement
Texture depth	3	
untrafficked (mm)		≥1.5
after two year trafficking (mm)		≥1.0
loss between first and second year (%)		≤40
Wheel tracking	3	
rate (mean/max individual) (mm h^{-1})		≤5.0/≤7.5
rut depth (mean/max individual) (mm)		≤7.0/≤10.5
Hydraulic conductivity	2	
mean/min individual (s^{-1})		>0.06/>0.03

(1) Performance Levels are defined in Appendix B of the Guidelines Document.

2 Durability

2.1 The system has been used in the United Kingdom since 1992 and available evidence suggests that it will provide a durable wearing surface suitable for use on all classes of road.

2.2 A monitored installation trial showed that, when laid at a nominal thickness of 20 mm on a road of Stress Level 1[1] and estimated traffic level of over 3600 cv/l/d[2], the product will meet the Performance Level 3[3] requirement for retained texture.

2.3 The results of this trial, when assessed in accordance with Appendix C of the Guidelines Document, indicate that the system can be designed and laid to meet Performance Level 3[3] retained texture on sites with traffic levels of C_{max}:

site Stress Levels 1 and 2 >5000 cv/l/d[2]
site Stress Levels 3 and 4 >2500 cv/l/d[2]

(1) Site Stress Levels are defined in Appendix C of the Guidelines Document.

(2) Traffic levels are defined as commercial vehicles/lane/day (cv/l/d).

(3) Performance levels are defined in Appendix B of the Guidelines Document.

Technical Investigations

The following is a summary of the technical investigations carried out on the UL-M 20/10 Thin Surfacing System for Highways.

3 Tests

Mandatory laboratory and road tests

3.1 A series of tests was carried out on a mixture based on Gore gritstone coarse and fine aggregates laid at Pound Lane, Reading. The results of the tests are given in Tables 2 and 3.

Table 2 Mandatory laboratory tests carried out on coarse aggregate, cores taken from the installation trial or on laboratory prepared samples of the same mixture recipe

Test	Method	Results[1]	Performance Level
Coarse aggregate properties			
PSV	BS 812-114	65	n/a
AAV	BS 812-113	3.6	n/a
Wheel tracking at 60°C[2]	Appendix A.1 draft Guidelines Document		
rate (mm h^{-1})		0.7	3
rut depth (mm)		1.5	
Torque bond strength at 20±2°C on 100 mm diameter cores (kPa)[3]	Appendix A.3 draft Guidelines Document	598 (failure mainly at substrate/system interface)	n/a
Sensitivity to water retained stiffness ($ITSM_{c3}$)[4] (%)	Appendix A.2 draft Guidelines Document	103	n/a

(1) Results relate to a mixture based on Gore gritstone.

(2) Mean core thickness = 20 mm.

(3) K1-70 bond coat.

(4) Retained indirect tensile stiffness modulus at 20±0.5°C after three water conditioning cycles carried out on laboratory prepared samples.

n/a = Not applicable.

Table 3 Mandatory checks and tests carried out on the Pound Lane installation

Test	Method	Result	Specification
Initial texture depth (sand patch) (mm)	BS 598-105		
mean (all sections)		2.1	⩾1.50
minimum recorded (section)		1.6	not reported
maximum recorded (section)		2.2	n/a
Visual observations		Good uniform surface with no significant faults or abnormalities noted	

n/a = Not applicable.

Additional tests

3.2 A series of characterisation tests was carried out on the binder. See Table 4 for details.

Table 4 Binder characterisation tests

Test	Method
Softening point (°C)	BS 2000-58
unaged	
after RTFOT[1]	
after HiPAT[2]	
Penetration (dmm)	BS 2000-49
unaged	
after RTFOT[1]	
after HiPAT[2]	
Rheology G* at 25°C and 0.4 Hz (Pa)	IPPM CM/99[3]
unaged	
after RTFOT[1]	
after HiPAT[2]	
ageing index[4]	

(1) Rolling thin film oven test (RTFOT) in accordance with ASTM D 2872 : 1997.

(2) High pressure ageing test in accordance with the test method developed under the HAPAS scheme for modified binders, Draft 1.0 (October 1997).

(3) IPPM CM/99 *Test Method — Determination of the complex shear modulus and phase angle of bituminous binders.*

(4) Ageing index is defined as the ratio of complex modulus (G*) at 25°C and 0.4 Hz after and before HiPAT (High Pressure Ageing Test) conditioning.

3.3 A series of optional tests was carried out on a mixture based on gritstone coarse and fine aggregates. The results of the tests are given in Table 5.

Table 5 Optional tests

Test	Method	Result
Hydraulic conductivity (s^{-1})	DD 229	0.1
Stiffness (MPa)[1]	Guidelines Document, Appendix A.2	3900
Noise	Statistical pass-by[2] Method	
RSI_H [db(A)][3]		–5.6[4]
RSI_m [db(A)][3]		–5.2[5]
age of site when tested (months)		4–5

(1) Unconditioned indirect tensile stiffness modulus measured during water sensitivity testing on laboratory prepared cores using samples of the mixture used on the Pound Lane installation.

(2) In accordance with Draft ISO 11819-1 : 1997.

(3) Road Surface Influence (RSI_H), high speed and (RSI_m), medium speed are defined in Appendix A.8 of the Guidelines Document. They are a measure of the difference in noise, that could be expected if compared against a theoretical hot-rolled asphalt surface with 2 mm texture depth. A negative result indicates a reduction in noise level. Noise levels will vary according to specific site conditions and system characteristics including texture, age of installation, and voids content.

(4) Result from one set of measurements made on the A1 (Eaton Socon, Cambridgeshire) in 1995. Measurements for light vehicles normalised to 110 km h^{-1} and for heavy vehicles 90 km h^{-1}.

(5) Result from one set of measurements made on the A25 (Seal, Kent) in 1996. Measurements for light vehicles normalised to 80 kmh^{-1} and for heavy vehicles 70 kmh^{-1}. Testing carried out by non-BBA approved laboratory.

3.4 Independent test data relating to installations on the A1 (Eaton Socon, Cambridgeshire) and the A25 (Seal, Kent) indicate that UL-M 20/10 can be laid to provide a surface that is significantly quieter than hot-rolled asphalt with chippings. The result of measurements made on the A1 and A25 are given in Table 5.

Note: Noise levels will be affected by site specific conditions including location and the condition of the existing road and therefore the RSI_H and RSI_m values determined for the A1 at Eaton Socon and A25 at Seal may not be reproduced on other installations.

3.5 The quieter nature of UL-M surfacings generally has also been confirmed from comments made by purchasers/specifiers of the system.

SCRIM

3.6 Mean Summer SCRIM Coefficient (MSSC) data relating to UL-M 20/10 and hot-rolled asphalt, both incorporating the same gritstone aggregate sourced from Comber Quarry (Northern Ireland), on the A25 at Seal showed that UL-M 20/10 consistently produced higher values than the hot-rolled asphalt. The results of the SCRIM survey are summarised in Table 6.

Table 6 SCRIM data from the A25 at Seal

	MSSC coefficients[1]			
	1996	1997	1998	1999
UL-M 20/10	47	46	45	52
Hot-rolled asphalt +20 mm chippings	43	44	40	46

(1) MSSC can vary significantly due to specific site conditions and the aggregate (size and other physical properties) and therefore the results may not be reproduced at other locations and/or with different aggregates.

3.7 A series of tests were carried out to confirm that Performance Level 3 for wheel tracking could be maintained at installation depths to 40 mm. The results are given in Table 7.

Table 7 Test results on UL-M 20/10 measured on laboratory prepared samples made from bulk samples taken from Whitemountain, Whittlesey

Test	Method	Mean Result[1]	Performance Level
Wheel tracking at 60°C	Guidelines		
rate (mm h^{-1})	Document	0.4	
rut depth (mm)	Appendix A.1	1.8	3

(1) Mean thickness of test sample = 44 mm.

4 Investigations

Alternative aggregates

4.1 Available evidence from existing installations indicates that mixtures based on granite and basalt coarse aggregates can also be designed to perform satisfactorily.

Improvement in surface regularity

4.2 Regulation of existing deformed surfaces using a single layer of surfacing is permitted within the suggested limits of deformation given in the *Guidelines on transportation and laying procedures*.

4.3 Test data and user/specifier experience show that the system can be laid to provide an even surface with few irregularities.

4.4 Test data [provided by Jean Lefebvre (UK) Ltd] relating to changes in longitudinal irregularities measured in accordance with Appendix A.6 of the Guidelines Document indicate that the system can significantly improve the longitudinal profile of existing surfaces.

Other

4.5 An installation trial was carried out to assess the practicability of the installation and on-site quality control procedures. A visual inspection of the site concluded that it was free from significant abnormalities. Results from the installation confirmed that it complied with the contractual requirements.

4.6 A user/specifier survey relating to existing sites that were at least two years old was carried out to confirm the products' performance in use. The sites surveyed included the Trent Bridge (Nottingham), A629 (Halifax Road), M56/A5103 (Manchester), A830 (Lochnan Uamh) and Bishopton roundabout (Stratford).

4.7 Additional information relating to the A1 (Eaton Socon), A34 (Queensway), A52 (Roo Hill, North Staffordshire) and A460 (Rugeley to Cannock, Staffordshire) was also examined and provided additional evidence of acceptable performance over a longer period.

4.8 The manufacturing process was examined by inspection of an approved plant, including the methods adopted for quality control, and details were confirmed of the quality and composition of materials used. The inspection confirmed that the plant operated in accordance with the requirements of the Quality Plan and Quality System agreed with the BBA.

Bibliography

BS 598-105 : 2000 *Sampling and examination of bituminous mixtures for roads and other paved areas — Methods of test for the determination of texture depth*

BS 812-113 : 1990 *Testing aggregates — Method for determination of aggregate abrasion (AAV)*

BS 812-114 : 1989 *Testing aggregates — Method for determination of the polished-stone value*

BS 2000-49 : 1993 *Methods of test for petroleum and its products — Determination of needle penetration of bituminous material*

BS 2000-58 : 1993 *Methods of test for petroleum and its products — Determination of softening point of bitumen — Ring and ball method*

ASTM D 2872 : 1997 *Standard test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)*

BS DD 229 : 1996 *Method for determination of the relative hydraulic conductivity of permeable surfacings*

ISO 11819-1 : 1997 *Acoustics — Measurement of the influence of road surfaces on traffic noise — Statistical pass-by method*

Guidelines Document for the Assessment and Certification of Thin Surfacing Systems for Highways, July 2004

BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

On behalf of the British Board of Agrément

Date of Second issue: 13th July 2005

Chief Executive

**Original Detail Sheet issued on 14th April 2001. This amended version includes revisions to text and reference to increased installation thickness.*

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BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

Jean Lefebvre (UK) Ltd

UL-M 30/14 THIN SURFACING SYSTEM FOR HIGHWAYS

Roads and Bridges
Certificate No 01/H047

DETAIL SHEET 3
*Second issue**

Product

- *THIS DETAIL SHEET RELATES TO THE UL-M 30/14 THIN SURFACING SYSTEM FOR HIGHWAYS.*
- *The system is for use as a thin road surfacing, with a nominal aggregate size of 14 mm, generally laid at nominal thicknesses between 30 mm and 50 mm, covering the Classification C defined in Table 1 of the* Guidelines Document for the Assessment and Certification of Thin Surfacing Systems for Highways.

This Detail Sheet must be read in conjunction with the Front Sheets which give additional information on the HAPAS Requirements, Regulations *and* Conditions of Certification.

Design Data

1 General

1.1 The UL-M 30/14 Thin Surfacing System for Highways is satisfactory for use as a thin surfacing system on highways.

1.2 The system is suitable for application on existing bituminous or concrete highway surfaces at a minimum temperature of 0°C, provided the substrate is free from standing water or ice and that the minimum specified rolling temperature can be maintained. Details are given in the current UL-M 30/14 *Guidelines on transportation and laying procedures* (dated July 2004) and the *Guidelines for cold weather working* (dated January 1999).

1.3 When manufactured and laid in accordance with the provisions of this Detail Sheet, the system can be designed to achieve the Performance Levels given in Table 1.

Table 1 Performance Levels achieved on trial installations

Test parameter	Performance Level achieved/ expected[1]	Requirement
Texture depth	3[2]	
untrafficked (mm)		≥1.5
after two year trafficking (mm)		≥1.0
loss between first and second year (%)		≤40
Wheel tracking	3[2]	
rate (mean/max individual) (mm h^{-1})		≤5.0/≤7.5
rut depth (mean/max individual) (mm)		≤7.0/≤10.5

(1) Performance Levels are defined in Appendix B of the Guidelines Document.

(2) Data from UL-M 30/14 and supporting data from UL-M 20/10 (Detail Sheet 2).

2 Durability

2.1 The system has been used in the United Kingdom since 1998 and available evidence suggests that it will provide a durable wearing surface suitable for use on all classes of road.

2.2 Using an aggregate size of 14 mm in UL-M 30/14, the system can be designed to achieve initial texture depths of >1.5 mm and meet the Performance Level 3[1] requirements for retained texture.

(1) Performance levels are defined in Appendix B of the Guidelines Document.

Technical Investigations

The following is a summary of the technical investigations carried out on UL-M 30/14 Thin Surfacing System for Highways[1].

(1) UL-M 30/14 and UL-M 20/10 share common binder aggregate sources and bond coats. Test data relating to UL-M 20/10, where applicable, has been used to complete the technical investigations on the UL-M 30/14.

3 Tests

Mandatory laboratory and road tests

Wheel tracking at 60°C

3.1 Wheel tracking data on cores taken from two installations show that the system can be designed and laid to meet the Performance Level 3 requirements for rate of rutting and rut depth. The results are given in Table 2.

Table 2 Results of wheel tracking tests at 60°C

Location	Core thickness (mm) (mean/max)	Mean rate (mm h^{-1} rut depth (mm)
A140 Long Stratton	31/37	0.7/2.0
A449 Clains roundabout	25/30	0.5/1.4

Sensitivity to water

3.2 Water sensitivity test data relating to system mixtures based on gritstones were examined. The results are given in Table 3.

Table 3 Sensitivity to water

Test	Method	Result
Sensitivity to water retained stiffness ($ITSM_{cs}$)[1] (%)	Appendix A.2 Guidelines Document	95

(1) Retained indirect tensile stiffness modulus at (20 ± 0.5)°C after three water conditioning cycles carried out on laboratory prepared samples — mean of two results (88% and 101%).

Torque bond

3.3 The system shares common bond coat, binder and aggregates with UL-M 20/10. It is, therefore, expected that the torque bond data obtained on UL-M 20/14 would also apply to this system. The results of the tests are given in Table 4.

Table 4 Torque bond test

Test	Method	Result[1]
Torque bond strength at (20±2)°C (kPa) on 100 mm diameter cores	Appendix A.3 Guidelines Document	598

(1) Result relates to a UL-M 20/10 mixture based on Gore gritstone using K1-70 bond coat.

Texture depth

3.4 Sand patch texture depth measurements made on an installation on the A14 showed that the system can be designed and laid to achieve texture depths of ⩾1.5 mm. The results are given in Table 5.

Table 5 Sand patch texture depth measurements made on the A14, Haughley Bends

Test	Method	Results	Contract requirement
Initial texture depth (mm)	BS 598-105		
mean (all sections)		1.7	—
minimum recorded (section)		1.5	⩾1.2
maximum recorded (section)		1.8	—

Additional tests

3.5 A series of characterisation tests were carried out on the binder. See Table 6 for details.

Table 6 Binder characterisation tests

Test	Method
Softening point (°C)	BS 2000-58
unaged	
after RTFOT[1]	
after HiPAT[2]	
Penetration (dmm)	BS 2000-49
unaged	
after RTFOT[1]	
after HiPAT[2]	
Rheology G* at 25°C and 0.4 Hz (Pa)	IPPM CM/99[3]
unaged	
after RTFOT[1]	
after HiPAT[2]	
ageing index[4]	

(1) Rolling thin film oven test (RTFOT) in accordance with ASTM D2872 : 1997

(2) High pressure ageing test in accordance with the test method developed under the HAPAS scheme for modified binders, Draft 1.0 (October 1997).

(3) IPPM CM/99 *Test Method — Determination of the complex shear modulus and phase angle of bituminous binders.*

(4) Ageing index is defined as the ratio of the complex modulus (G*) at 25°C and 0.4 Hz after and before HiPAT conditioning.

3.6 Indirect tensile stiffness modulus data on the system is given in Table 7.

Table 7 Stiffness

Test	Method	Result
Stiffness[1] (MPa)	Guidelines Document Appendix A.2	5358[2]

(1) Unconditioned indirect tensile stiffness modulus on laboratory prepared cores.

(2) Mean of two sets of measurements from mixtures of UL-M 30/14 from installations at A140 Long Stratton and A449 Clains roundabout to Blackpole.

3.7 A series of tests were carried out to confirm that Performance Level 3 for wheel tracking could be maintained at installation depths up to 50 mm. The results are given in Table 8.

Table 8 Test results on UL-M 30/14 measured on cores taken from A406/A40 junction and Hanger Lane gyratory

Test	Method	Mean Result[1]	Performance Level
Wheel tracking at 60°C	Guidelines		
rate (mm h^{-1})	Document	2.6	
rut depth (mm)	Appendix A.1	4.1	3

(1) Mean thickness of cores = 55 mm

4 Investigations

Alternative aggregates

4.1 Available evidence from existing installations of UL-M indicates that mixtures based on granite and basalt coarse aggregates can also be designed to perform satisfactorily.

Improvement in surface regularity

4.2 Regulation of existing deformed surfaces using a single layer of surfacing is permitted within the suggested limits of deformation given in the UL-M 30/14 *Guidelines on transportation and laying procedures*.

4.3 Test data show that UL-M 30/14 can be laid to produce a surface with few irregularities and improve the longitudinal profile of existing surfaces.

Other

4.4 Information relating to an installation trial and a survey of users and/or specifiers of UL-M provided additional evidence of acceptable performance.

4.5 The manufacturing process was examined by inspection of an approved plant, including the methods adopted for quality control, and details were confirmed of the quality and composition of materials used. The inspection confirmed that the plant operated in accordance with the requirements of the Quality Plan and Quality System agreed with the BBA.

Bibliography

BS 598-105 : 2000 *Sampling and examination of bituminous mixtures for roads and other paved areas — Methods of test for the determination of texture depth*

BS 2000-49 : 1993 *Methods of test for petroleum and its products — Determination of needle penetration of bituminous material*

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ASTM D 2872 : 1997 *Standard test Method for Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Oven Test)*

Guidelines Document for the Assessment and Certification of Thin Surfacing Systems for Highways, July 2004

BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

On behalf of the British Board of Agrément

Date of Second issue: 13th July 2005

Chief Executive

**Original Detail Sheet issued on 14th April 2001. This amended version includes revisions to text and reference to increased installation thickness.*

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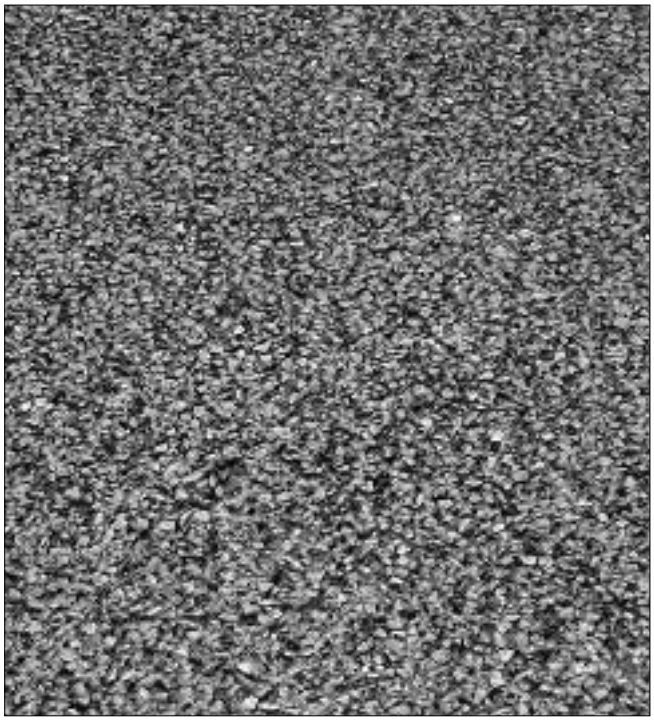
BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

Jean Lefebvre (UK) Ltd

UL-M 15/6 THIN SURFACING SYSTEM FOR HIGHWAYS

HAPAS
Roads and Bridges
Certificate No 01/H047
DETAIL SHEET 4

Product



- *THIS DETAIL SHEET RELATES TO THE UL-M 15/6 THIN SURFACING SYSTEM FOR HIGHWAYS.*
- *The system is for use as a thin road surfacing, with a nominal aggregate size of 6 mm, generally laid at nominal thicknesses between 15 mm and 25 mm, covering Classifications A and B defined in Table 1 of the* Guidelines Document for the Assessment and Certification of Thin Surfacing Systems for Highways.

This Detail Sheet must be read in conjunction with the Front Sheets which give additional information on the HAPAS Requirements, Regulations *and* Conditions of Certification.

Design Data

1 General

1.1 UL-M 15/6 Thin Surfacing System for Highways is satisfactory for use as a thin surfacing system on highways.

1.2 The product is suitable for application on existing bituminous or concrete highway surfaces at a minimum temperature of 4°C, provided the surface is free from standing water or ice and that the minimum specified rolling temperature can be maintained. Details are given in UL-M 15/6 *Guidelines on transportation and laying procedures* and the *Guidelines for cold weather working*.

1.3 When manufactured and laid in accordance with the provisions of this Detail Sheet, the product can be designed to achieve the Performance Levels given in Table 1.

Table 1 Performance Levels achieved

Test parameter	Performance Level achieved[1]	Requirement
Texture depth	2	
untrafficked (mm)		⩾1.2
after two year trafficking (mm)		⩾0.8
loss between first and second year (%)		⩽40
Wheel tracking	3	
rate (mean/max individual) (mm h^{-1})		⩽5.0/⩽7.5
rut depth (mean/max individual) (mm)		⩽7.0/⩽10.5

(1) Performance Levels are defined in Appendix B of the Guidelines Document.

2 Durability

2.1 The product has been used in the United Kingdom since 1992 and available evidence suggests that it will provide a durable surface course suitable for use on roads with Traffic Levels restricted in accordance with the details given in section 2.3.

2.2 Results from installations on the A34 at Botley and the B382 at West Byfleet showed that, when laid at a nominal thickness of 20 mm on a road of Stress Level 1[1] and estimated Traffic Levels of over 444 cv/l/d[2], the product will meet Performance Level 2[3] requirements for initial and retained texture depth.

(1) Site Stress Levels are defined in Appendix C of the Guidelines Document.

(2) Traffic Levels are defined as commercial vehicles/lane/day (cv/l/d).

(3) Performance Levels are defined in Appendix B of the Guidelines Document.

2.3 When assessed in accordance with Appendix C of the Guidelines Document, UL-M 15/6 can be designed and laid to meet Performance Level 2 requirements for texture on sites with Traffic Levels of C_{max}:

Site Stress Level 1	2500 cv/l/d
Site Stress Level 2	1000 cv/l/d
Site Stress Level 3	800 cv/l/d
Site Stress Level 4	600 cv/l/d

Technical Investigations

The following is a summary of the technical investigations carried out on the UL-M 15/6 Thin Surfacing System for Highways[1].

(1) UL-M 15/6, 20/10 and 30/14 share common binder, aggregate and bond coats. Test data relating to UL-M 20/10 and 30/14, where applicable, has been used as supporting evidence to complete investigations on UL-M 15/6.

3 Tests

Mandatory laboratory and road tests

3.1 A series of tests was carried out on UL-M 15/6 laid on the A34 at Botley and the B382 at West Byfleet. The results of the tests are given in Tables 2 and 3.

Table 2 Mandatory laboratory tests carried out on coarse aggregate, cores taken from the installation or on laboratory-prepared samples of the same mixture recipe

Test	Method	Result[1]	Performance Level
Coarse aggregate properties:			
PSV	BS 812-114	65	n/a
AAV	BS 812-113	3.6	n/a
Wheel tracking at 60°C[2]:	Appendix A.1 draft Guidelines Document		
rate (mm h^{-1})		0.4	3
rut depth (mm)		1.3	
Torque bond strength at 20±2°C on 100 mm diameter cores (kPa)[3]	Appendix A.3 draft Guidelines Document	1043 (wearing course rupture)	n/a
Sensitivity to water: retained stiffness ($ITSM_{c3}$)[4] (%)	Appendix A.2 draft Guidelines Document	97	n/a

(1) Results relate to a mixture based on Gore gritstone.
(2) Mean core thickness = 29 mm.
(3) Evatech B.
(4) Retained indirect tensile stiffness modulus at 20±0.5°C after three water conditioning cycles carried out on laboratory-prepared samples.
n/a = Not applicable.

Table 3 Mandatory checks and tests carried out on the installation on the A34 at Botley

Test	Method	Result	Specification
Initial texture depth (sand patch) (mm)	BS 598-105		
mean (all sections)		1.4	
minimum recorded (section)		1.3	⩾1.2
maximum recorded (section)		1.4	n/a

n/a = Not applicable.

Tests on the UL-M Evatech U binder

3.2 A series of characterisation tests was carried out on the binder. The results are given in Table 4.

Table 4 Binder characterisation tests

Test	Method	Result
Softening point (°C)	BS 2000-58	
unaged		54.8
after RTFOT[1]		62.4
after HiPAT[2]		77.6
Penetration (dmm)	BS 2000-49	
unaged		55
after RTFOT[1]		35
after HiPAT[2]		21
Rheology G* at 25°C and 0.4 Hz (Pa)	IPPM CM/99[3]	
unaged		2.37×10^5
after RTFOT[1]		4.16×10^5
after HiPAT[2]		1.59×10^6
ageing index[4]		6.7

(1) Rolling thin film oven test (RTFOT) in accordance with ASTM D 2872 : 1988.

(2) High pressure ageing test in accordance with the test method developed under the HAPAS scheme for modified binders, Draft 1.0 (October 1997).

(3) IPPM CM/99 *Test Method — Determination of the complex shear modulus and phase angle of bituminous binders.*

(4) Ageing index is defined as the ratio of complex modulus (G*) at 25°C and 0.4 Hz after and before HiPAT (High Pressure Ageing Test) conditioning.

4 Investigations

4.1 Available evidence from existing installations indicates that mixtures based on granite and basalt coarse aggregates can also be designed to perform satisfactorily.

4.2 Information from a survey of users and/or specifiers of UL-M provided additional evidence of acceptable performance.

4.3 The manufacturing process was examined by inspection of an approved plant, including the methods adopted for quality control, and details were confirmed of the quality and composition of materials used. The inspection confirmed that the plant operated in accordance with the requirements of the Quality Plan and Quality System agreed with the BBA.

4.4 Vehicle noise level surveys taken before and after the application of UL-M 15/6 on the A34 Botley bypass using the Statistical pass-by Backing Board method[1] were carried out by TRL Limited. The results from these surveys are detailed in Table 5.

(1) The Statistical pass-by Backing Board (SPB-BB) method is a modified version of the SPB method described in Appendix A.8 of the BBA/HAPAS Guideline. The method is for sites where required conditions[4] cannot fully be met, and therefore outside the scope of the assessment.

Table 5 Vehicle noise level — results from the A34 Botley bypass

Survey	Before			After 4 months trafficking		
Surface	HRA			UL-M 15/6		
Vehicle category	Light	H1	H2	Light	H1	H2
Reference speed km h^{-1}	80	70	70	80	70	70
Maximum noise levels[1] dB(A)	82.8	84.1	85.5	75.2	80.7	82
RSI_M[2] dB(A)		+1.6			−5.4	
Estimated reduction in traffic noise[3] dB(A)			7.0			

(1) Maximum noise levels have been adjusted according to the SPB-BB correction factor, together with a temperature correction for light vehicles.

(2) RSI_M is the Road Surface Influence measured in dB(A) for the medium-speed road category.

(3) The result indicates that with traffic conditions unchanged the estimated reduction in traffic noise due to resurfacing would be about 7 dB(A). It must be noted that noise levels will vary according to specific site conditions.

(4) Required conditions relate to the positioning of the microphone due to the topography and the surrounding built up area.

Bibliography

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On behalf of the British Board of Agrément

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