

## CIP DENSIPHALT GROUTED MACADAM SURFACE COURSE

### CIP DENSIPHALT

This Certificate is issued under the Highway Authorities' Product Approval Scheme (HAPAS) by the British Board of Agrément (BBA) in conjunction with the Highways Agency (HA) (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 SCOPE AND SUMMARY OF CERTIFICATE

This Certificate relates to CIP Densiphalt, a grouted macadam surface course for trafficked areas exposed to low-speed traffic, heavy loads and fuel spillages.

#### AGRÉMENT CERTIFICATION INCLUDES:

- factors relating to compliance with HAPAS requirements
- factors relating to compliance with Regulations where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal five-yearly review.

#### KEY FACTORS ASSESSED

**Surface characteristics** — a standard brush finish can provide a satisfactory initial texture depth, skid resistance and erosion index (see section 5).

**Mechanical resistance** — the system has a satisfactory resistance to trafficking and loadings associated with its intended use (see section 6).

**Sensitivity to water and diesel** — the system has a satisfactory retained stiffness after conditioning in water and diesel (see section 7).

**Durability** — the system has been used in the UK since 1997 and available evidence indicates that it will provide a durable surface course for use on trafficked areas exposed to low-speed traffic, heavy loads and fuel spillages (see section 9).



The BBA has awarded this Agrément Certificate to the company named above for the system described herein. This system has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément



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*The BBA is a UKAS accredited certification body — Number 113. The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at [www.bbacerts.co.uk](http://www.bbacerts.co.uk)*

*Readers are advised to check the validity of this Agrément Certificate by either referring to the BBA's website ([www.bbacerts.co.uk](http://www.bbacerts.co.uk)) or contacting the BBA direct.*

# HAPAS Requirements

## Requirements

The Highways Technical Advisory Committee (HiTAC) has agreed with the BBA the aspects of performance to be used in the assessment of CIP Densiphalt. In the opinion of the BBA, CIP Densiphalt, when manufactured and installed in accordance with the provisions of this Certificate can be designed to provide an alternative to conventional bituminous or concrete surface courses for use on trafficked areas exposed to low-speed traffic, heavy loads and fuel spillages.

Additional requirements of the overseeing organisations for surface course products on highways are given in the Manual of Contract Documents for Highway Works (MCHW), Volumes 1 and 2, Series 900 and 1000.

## Regulations

### Construction (Design and Management) Regulations 2007

### Construction (Design and Management) Regulations (Northern Ireland) 2007

Information in this Certificate may assist the client, CDM co-ordinator, designer and contractors to address their obligations under these Regulations.

See section: *2 Manufacture, quality control, delivery and site handling (2.2 and 2.6).*

## General

This Certificate relates to CIP Densiphalt, a grouted macadam surface course for use on trafficked areas exposed to low-speed traffic, heavy loads and fuel spillages

## Technical Specification

### 1 Description

1.1 CIP Densiphalt comprises a proprietary (0/10 mm) open-graded asphalt receiving course, incorporating 100/150 penetration binder to BS EN 12591 : 2000 and a proprietary cementitious grout.

1.2 The system is used in conjunction with a K1-40 bitumen emulsion tack coat conforming to BS EN 13808 : 2005, to seal and enhance the adhesion to the substrate.

1.3 The system can be laid at a nominal thickness of between 30 mm to 50 mm.

### 2 Manufacture, quality control, delivery and site handling

#### Receiving course

2.1 The receiving course is manufactured to the Certificate holder's mix specification in conventional asphalt plants approved by the Certificate holder. Quality control is by visual inspection and compositional analysis.

2.2 The receiving course is delivered to site in accordance with BS 594987 : 2007.

2.3 The receiving course is not classified under *The Chemicals (Hazard Information and Packaging for Supply) Regulations 2002* (CHIP3). Standard material safety data sheets for hot asphalts apply.

#### Cementitious grout

2.4 The grout is manufactured, controlled and delivered by the Certificate holder in accordance with a BBA Agreed Quality Plan and Method Statement, which includes requirements for:

- incoming raw material inspection and testing
- method of production and process control
- in-process inspection and testing
- final inspection and testing
- delivery considerations and on-site storage.

2.5 The cementitious powder for the grout is delivered either in 1000 kg or 250 kg bulk bags.

2.6 The cementitious grout is not classified as 'dangerous for supply'. However, in addition to the recommendations in the Certificate holder's safety data sheets, normal procedures for storage and handling of cement and fillers should be observed.

## Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on CIP Densiphalt.

## Design Considerations

3.1 CIP Densiphalt is satisfactory for use as a surface course in trafficked areas where low-speed traffic, heavy loads and fuel spillages occur. Typical uses include; container storage areas, car parks, service areas and their associated access roads or similar.

3.2 The system can be applied to a bituminous or concrete substrate provided the underlying layers of the pavement are stable, and have sufficient load spreading capabilities to support the imposed loading of the CIP Densiphalt surface course during installation and expected service life.

3.3 CIP Densiphalt can be used as part of new or maintenance pavement construction.

3.4 Construction joints are not required with the system, however, where it is laid over an existing concrete surface any existing joints should be retained in the new surface to reduce the possibility of reflective cracking. If a crack control system, eg a geotextile reinforcement, is considered then the Certificate holder should be consulted for its suitability.

### 4 Practicability of installation

#### Receiving course

4.1 The receiving course is installed only by contractors approved by the Certificate holder using conventional paving equipment.

#### Cementitious grout

4.2 The cementitious grout is applied only by contractors trained and approved by the Certificate holder using proprietary grout mixing and application equipment.

4.3 Full penetration of the grout must be achieved.

### 5 Surface characteristics

#### Initial texture depth

5.1 The standard brush finish for the system can achieve a satisfactory initial (prior to trafficking) surface texture (see Table 3 in the *Technical Investigations* part of this Certificate).

#### Initial skid resistance

5.2 The standard brush finish for the system can achieve a satisfactory initial (prior to trafficking) skid resistance value (SRV) (see Table 3 in the *Technical Investigations* part of this Certificate).

#### Erosion index before and after diesel immersion and freeze/thaw

5.3 The standard brush finish for the system can achieve an erosion index of 0 measured before and after immersion in diesel and freeze/thaw (see Table 2 in the *Technical Investigations* part of this Certificate).

### 6 Mechanical resistance

#### Resistance to permanent deformation

6.1 The system has been designed to have a greater resistance to rut rate and rut depth when compared to conventional asphalt surface courses (see Table 2 in the *Technical Investigations* part of this Certificate).

#### Compressive strength

6.2 The system can achieve a one-day compressive strength of 4.8 MPa (see Table 2 in the *Technical Investigations* part of this Certificate).

#### Flexural strength (control and after freeze/thaw)

6.3 At 28 days the system can achieve a flexural strength of 2.8 MPa and results indicate no significant loss of flexural strength after freeze/thaw conditioning (see Table 2 in the *Technical Investigations* part of this Certificate).

#### Torque bond strength

6.4 The system, when manufactured and laid in accordance with the provisions of this Certificate, can achieve a satisfactory torque bond strength (see Table 2 in the *Technical Investigations* part of this Certificate).

### 7 Sensitivity to water and diesel

#### Sensitivity to water

7.1 The retained stiffness of the product has been measured after conditioning in water. The results indicate that the system is not significantly affected after such exposure (see Table 2 in the *Technical Investigations* part of this Certificate).

#### Sensitivity to diesel

7.2 The retained stiffness of the product has been measured after conditioning in diesel. The results indicate that provided full penetration of the grout is achieved, the system is not significantly affected (see Table 2 in the *Technical Investigations* part of this Certificate).

## 8 Maintenance

This system is not subject to any routine maintenance.

## 9 Durability

9.1 The system has been used in the UK since 1997 and available evidence indicates that it can provide a satisfactory alternative to conventional bituminous and concrete surface course materials that are exposed to low-speed traffic, heavy loads and fuel spillages.

9.2 Where full penetration of the grout is achieved, and substrates are structurally sound with load-spreading capabilities adequate to accommodate the imposed loading associated with the installation of the system and end use, available evidence suggests that the system will provide a durable surface course with a working life in excess of a conventional asphalt surfacing.

# Installation

## 10 Procedures

### Receiving course

10.1 The receiving course is installed by contractors approved by the Certificate holder in accordance with the Certificate holder's installation procedures and a BBA Agreed Method Statement which includes recommendations for:

- preparatory works at the laying site
- preparation of the substrate
- laying
- compaction
- limiting weather conditions.

10.2 In addition, the recommendations given in BS 594987 : 2007, Section 6.2 *Laying in adverse conditions* should be considered when installing the receiving course.

### Cementitious grout

10.3 The grout is applied by the Certificate holder in accordance with the Certificate holder's installation procedures which includes recommendations for:

- spread rates of the grout
- limiting weather conditions
- compaction
- receiving course requirements.

10.4 The grout can only be applied when the receiving course has been compacted and has cooled to temperatures below 30°C.

10.5 The grout is applied to the receiving course and spread with brooms and squeegees. Grout movement through the receiving course is by natural percolation. The grout should completely fill the receiving course. This is achieved by adding grout until asphalt is no longer visible and air bubbles have stopped rising to the surface.

10.6 Grout spread rate is calculated by measuring the square-metre coverage versus the tonnage of grout used.

10.7 The grout should not be applied to the receiving course if free standing water, ice or snow is present, or during periods of heavy rain, or if exposure to frost is likely to occur during initial curing.

### Curing

10.8 The curing time of the grout varies with ambient conditions. The Certificate holder recommendations are given in Table 1.

Table 1 Guidance on hours to trafficking<sup>(1)</sup>

Type of use	Temperature °C				
	25	20	15	10	5
Pedestrian traffic	10	12	16	24	41
Vehicular traffic eg commercial vehicles, cars	19	24	32	48	81
Exposure to oil	95	120	160	240	405

(1) The Certificate holder should be consulted if there is any doubt as to when the surface should be trafficked.

## 11 Repairs

In the event of damage during the installation or during service, the system can be repaired by removing the damaged area and reinstating the system in accordance with the procedures given in section 10.

## 12 Tests

A series of laboratory and road tests was carried out on the system. The results of the tests are detailed in Tables 2 and 3.

*Table 2 Results from laboratory tests carried out on cores taken from a witnessed installation trial of CIP Densiphalt at Bicton Industrial Estate, Kimbolton, Cambridgeshire*

Test	Mean result	Method
Wheel tracking at 60°C <sup>(1)</sup> rate (mm h <sup>-1</sup> ) rut depth (mm)	0.2 0.4	Appendix A.1 Guidelines document
Torque bond strength at 20±2°C (kPa)	1440 <sup>(2)</sup>	Appendix A.3 Guidelines document
Sensitivity to water retained stiffness (ITSM <sub>c3</sub> ) <sup>(3)</sup> (%)	135.6	Appendix A.2 Guidelines document
Sensitivity to diesel retained stiffness (ITSM <sub>c3</sub> ) <sup>(4)</sup> (%)	64.7 <sup>(5)</sup>	Appendix A.5 Guidelines document
Erosion index measured after scuffing at 45°C control after diesel immersion <sup>(6)</sup> after freeze/thaw	0 <sup>(7)</sup> 0 <sup>(7)</sup> 0 <sup>(7)</sup>	Report 176 Appendix G: Test procedure for scuffing
Compressive strength (MPa) 1 day	4.8	BS EN 12390-3
Flexural strength (MPa) 28 days 28 days (freeze/thaw) <sup>(8)</sup>	2.8 2.7	BS EN 12390-6

(1) Mean core thickness = 51 mm.

(2) Mode of failure = Interface failure. Cores taken at 6 days and tested at 33 days after installation. CIP Densiphalt was applied to a bituminous substrate with a K1-40 tack coat.

(3) Retained indirect stiffness modulus at 20 ± 0.50°C after three water conditioning cycles.

(4) Retained indirect stiffness modulus after three diesel conditioning cycles.

(5) Surface unaffected, however, underside of core, and cored faces, showed some damage due to diesel penetration.

(6) Surface immersed only.

(7) No damage to surface.

(8) Freeze/thaw conditioning in accordance with BS EN 12371 : 2001.

*Table 3 Road tests — carried out on CIP Densiphalt using 0/10 mm, cliffe hill aggregate, with a standard brush finish on trial site area at Bicton Industrial Estate, Kimbolton, Cambridgeshire*

Test	Result <sup>(1)</sup>	Method
Texture depth initial <sup>(2)</sup> retained <sup>(3)</sup>	1.0–1.3 –	BS 598-105
Skid resistance initial <sup>(2)</sup> retained <sup>(3)</sup>	65.8–70.0 –	TRL Road Note 27 <sup>(4)</sup>

(1) Range of results measured.

(2) Initial measured approximately one month after installation.

(3) Retained measurements not available.

(4) Road Research Laboratory Note 27 : 1960 *Instructions for Using the Portable Skid Resistance Tester*.

## 13 Investigations

13.1 A trial was carried out to assess the practicability of the installation and on-site quality control procedures for the receiving course and the cementitious grout. A visual inspection of the site concluded that it was free from significant abnormalities.

13.2 A user/specifier survey relating to the performance in use was carried out which confirmed the system performance and durability in applications typical of those quoted within this Certificate.

13.3 The manufacturing process for the cementitious powder was examined by inspection of the factory and the methods adopted for quality control, and the quality and composition of the materials used. The inspection confirmed that the plant operated in accordance with requirements of the Quality Plan and Quality System agreed with the BBA.

13.4 The BBA carried out additional visits to existing sites to confirm the visual performance of the system.

13.5 Test data relating to CIP Densiphalt carried out by Scott Wilson Pavement Engineering on behalf of the Certificate holder has been used to support the *Technical Investigations*.

## 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 594987 : 2007 *Asphalt for roads and other paved areas — Specification for transport, laying and compaction and type testing protocols*
- BS EN 12371 : 2001 *Natural stone test methods — Determination of frost resistance*
- BS EN 12390-3 : 2002 *Testing hardened concrete — Compressive strength of test specimens*
- BS EN 12390-6 : 2000 *Testing hardened concrete — Tensile splitting strength of test specimens*
- BS EN 12591 : 2000 *Bitumen and bituminous binders — Specifications for paving grade bitumens*
- BS EN 13808 : 2005 *Bitumen and bituminous binders — Framework for specifying cationic bituminous emulsions*  
*Guidelines Document for the Assessment and Certification of Thin Surfacing Systems for Highways*, July 2004
- TRL Report 176 : 1997 *Laboratory tests on high-friction surfaces for highways*
- Manual of Contract Documents for Highway Works, Volume 1 *Specification for Highway Works*, August 1998 (as amended)
- Manual of Contract Documents for Highway Works, Volume 2 *Notes for Guidance on the Specification for Highway Works*, August 1998 (as amended)

## 14 Conditions

14.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is granted only to the company, firm or person named on the front page — no other company, firm or person may hold or claim any entitlement to this Certificate
- is valid only within the UK
- has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English law.

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

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

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate
- remain in accordance with the requirements of Highways Authorities' Product Approval Scheme.

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

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- individual installations of the product/system, including the nature, design, methods and workmanship of or related to the installation
- the actual works in which the product/system is installed, used and maintained, including the nature, design, methods and workmanship of such works.

14.5 Any information relating to the manufacture, supply, installation, use and maintenance of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used and maintained. It does 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; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any 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 manufacture, supply, installation, use and maintenance of this product/system.