

## **INTERIM ADVICE NOTE 157/11**

### **THIN SURFACE COURSE SYSTEMS - INSTALLATION AND MAINTENANCE**

#### **Summary**

This interim advice note revises HD37/99 Chapter 6 and provides revised requirements and guidance on the project specific specification, installation and maintenance of thin surface course systems on the strategic road network.

#### **Instructions for Use**

This document shall be implemented in accordance with the implementation instructions given at Clause 4 of this document.

## **Executive Summary**

This Interim Advice Note contains advice on the project specific specification of a Thin Surface Course System covering factors to take account of when specifying the performance requirements for appropriate systems, supervising the laying of the materials and maintaining existing Thin Surface Course Systems. The risk of premature failure and reduced life, arising from laying the Thin Surface Course Systems in less than ideal conditions, is explained and such situations should be avoided whenever possible.

Interim Advice

## 1. Background

Thin surface course systems (TSCS) is a generic term covering proprietary surface course materials that are laid at a thickness less than 50 mm. A more detailed definition is given at Appendix A Clause 6.1. These materials provide a high performance, rut resistant, low noise and skid resistant layer that supports the high volume of traffic found on the strategic road network.

Thin surfacing systems have been in widespread use on English roads since 1995 and significant experience in their use has been gained. This has enabled a review of existing standards and specifications to be undertaken and a number of measures identified that will enhance the durability of these materials.

After two harsh winters, concerns were raised about the performance of TSCS on the strategic road network. This Interim Advice Note revises and clarifies existing requirements and guidance for the project specific specification of these products to ensure the optimum performance of TSCS is achieved in service.

## 2. Outline

This document assists the project specific specification of appropriate systems, supervising the laying of the material and maintaining existing surfacings, thus maximising the likely serviceable life of a thin surfacing.

## 3. Relationship

Appendix A of this document supersedes Chapter 6 of HD37/99 of the Design Manual for Roads and Bridges (DMRB).

## 4. Implementation

This IAN shall be implemented immediately except where the procurement of works, at any stage from conception through design to completion of construction, has reached a stage at which, in the opinion of the HA, use of a particular document would result in significant additional expense or delay progress (in which case the decision must be recorded in accordance with the HA's procedures).

## 5. Mutual Recognition

Any reference in this specification to a "British Standard", or to a "British Standard which is an adopted European Standard", is to be taken to include reference also to the following standards:

- (a) a standard or code of practice of a national standards body or equivalent body of any EEA state;
- (b) any international standard recognised for use as a standard or code of practice by any EEA state;

(c) a technical specification recognised for use as a standard by a public authority of any EEA state; and

(d) a European Technical Approval (ETA) issued in accordance with the procedure set out in directive 89/106/EEC.

Where there is a requirement in this specification for compliance with any part of a British Standard or a British Standard which is an adopted European Standard, that requirement may be met by compliance with any of the standards given above, provided that the relevant standard imposes an equivalent level of performance and safety provided for by a British Standard or a British Standard which is an adopted European Standard.

“EEA State” means a state which is a contracting party to the EEA Agreement

“EEA Agreement” means the agreement on a European Economic Area signed at Oporto on the 2nd of May 1992 as adjusted or amended”

## 6. Contacts

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## 7. Bibliography

Nicholls, J. C. (2010) Durability of thin surfacing systems, Part 4 Final report after nine years monitoring. TRL Report 674, Transport Research Laboratory, Crowthorne, Berkshire ISBN 978-1-84608-897-1

Nicholls, J. C. McHale, M. J. and Griffiths R D (2008) Best practice guide for durability of asphalt pavements. Road Note 42, Transport Research Laboratory, Crowthorne, Berkshire ISBN 978-1-84608-709-7

## 8. References

Design Manual for Roads and Bridges, Volume 7, HD 29  
Design Manual for Roads and Bridges, Volume 7, HD 37

Manual of Contract Documents for Highway Works, Volume 1 Specification for Highway works, Clauses 942 and 946

## 9. Withdrawal Conditions.

This Interim Advice Note shall be withdrawn either when revised interim guidance and requirements are issued that supersede this IAN or when HD 37 is updated.

## Appendix A

Interim Advice

## 6. THIN SURFACE COURSE SYSTEMS

### Background

6.1 Thin surface course systems (TSCS), or thin surfacings as they are more commonly described, are proprietary systems in which a hot bituminous bound mixture is machine-laid with a controlled screed paver onto a bond or tack coat to form, after compaction and cooling, a textured surface course less than 50mm in thickness. Mixtures consist of aggregate, filler and bituminous binder which may be modified by the addition of polymers, rubber, resins, fibres or fillers such as hydrated lime or cement. The bond or tack coat may be polymer-modified and sprayed hot or cold depending on the proprietary system used. Other types of thin surfacings using different techniques are described in the chapters on Surface Dressing (Chapter 8), and Slurry and Micro-surfacing (Chapter 10).

6.2 Initially, thin surface course systems complying with Clause 942 of the Specification (MCHW 1) were supplied with a surfacing integrity performance guarantee of 2 years. In 2008, the performance guarantee was increased to 5 years. Experience has shown that when these surfacings are specified and installed correctly they can achieve a serviceable life of up to 15 years (Nicholls C., 2010).

6.3 Proprietary thin surface course systems are suitable both for new construction and for maintenance. Thin surfacings are classified into three types depending on their thickness as follows:

- Type A <18mm
- Type B 18-25mm
- Type C >25 to <50mm

6.5 Thin surfacings are based on materials developed in other European countries over 20 years ago and are in widespread use in France and Germany. The materials generally rely on aggregate interlock to provide a material that is not prone to rutting (permanent deformation). If rutting occurs, it is usually attributable to the material in the binder course that supports the surfacing. Surface deterioration of the TSCS is likely to follow the occurrence of rutting.

6.6 Thin surface course systems have been developed to meet the UK's safety requirements, necessitating the use of high PSV aggregates and the provision of initial and retained surface texture. The first proprietary thin surface course systems were accepted for use on the strategic road network in 1994 and there are now a significant number of products for use in England that meet HA performance specifications.

6.7 Thin surfacings are not generally designed to treat pavements where structural deterioration or cracking is present in the underlying layer (whether this is asphalt, hydraulically bound material, or pavement quality concrete). Generally, structural deterioration, cracking or open joints already present in the layer directly beneath the TSCS will rapidly propagate to the surface. Such defects in the surfacing mat tend to disrupt the integrity of the TSCS resulting in a local loss of aggregate interlock. Consequently, surface disintegration (fretting) occurs, and reduced life of the surfacing is the likely outcome.

## **Benefits**

### *Rapid Construction*

6.13 Thin surface course systems offer a quick means of resurfacing roads. Faster application potentially reduces traffic management costs and costs of delay to the travelling public. Installation outputs up to 20,000 m<sup>2</sup> per day have been achieved under favourable conditions.

### *Reduced working area*

6.14 Less working width is necessary to lay and compact thin surface course systems compared to hot rolled asphalt which has to have chippings applied.

### *Lower Cost*

6.15 As thin surface course systems are thinner and quicker to lay they may be significantly less expensive per unit area than hot rolled asphalt, but more expensive than surface dressing. Where applicable, the cost of planing and spoil removal is also reduced. Traffic management and delay costs are also reduced.

### *Traffic Noise Reduction*

6.16 The flat, machine laid surfaces and uniform negative surface texture mean that thin surface course systems may be significantly quieter than conventional surfacings such as hot rolled asphalt and brushed concrete.

### *Tyre Spray Reduction*

6.17 Thin surface course systems with adequate texture depth exhibit spray suppression capability at low levels of rainfall due to their more open 'negative' surface texture. This does not however approach that of new porous asphalt. Like porous asphalt, spray reducing properties diminish with time.

### *Rut Resistance*

6.18 Due to their skeletal structure formed by the coarse aggregate particles, thin surfacings generally have a high resistance to wheel track rutting, although they are vulnerable to deformation originating in the lower pavement layers.

## **Limitations**

### *Life Expectancy*

6.19 Hot applied, machine laid thin surfacings, adapted from practice in other European countries, have been in use in the UK for 17 years. Elsewhere in Europe the products from which they have been developed have demonstrated satisfactory working lives of between 10 and 20 years. In the UK, safety considerations, in particular high speed skid resistance (surface texture requirements) are likely to limit the lives to between 7 and 15 years, depending on their thickness, void content, the level of trafficking and the condition of the underlying pavement.

6.20 The condition of the substrates on which thin surfacings are laid is critical in determining their life expectancy. A reduced working life should be anticipated for any bituminous surfacing applied over an existing surface or base that is not in a reasonably sound condition. This is particularly so for thinner systems.

### Specification

6.21 Specification requirements for Thin Surface Course systems are given in Clause 942 of the Specification (MCHW 1) with accompanying Notes for Guidance in NG 942 (MCHW 2).

6.23 The Guideline Document for HAPAS certification of TSCS requires a trafficking trial for a minimum period of 2 years, after which the product shall be defect free and shall retain an appropriate minimum texture depth in the wheel tracks. The performance of a surfacing in the trial can be used to predict the level of traffic it will be capable of withstanding, whilst achieving the required retained texture depth. The trafficking trial can also be used to carry out measurements to predict the likely traffic noise (Road Surface Influence) from the thin surfacing. Harmonised European Standards do not currently exist for these “as laid” properties of road surfacings.

6.24 For thin surfacings to perform as required the project specific specification of the systems must be drafted following the guidance in the Notes for Guidance to The Specification for Highway Works (NGSHW) and the material must be installed in accordance with the Specification for Highway Works.

### Inspection

6.25 Clause 942 and NG942 give the five-year surfacing integrity performance guarantee requirements for TSCS. Surface conditions are as defined in Appendix A of TRL Report TRL674. Photographic examples of thin surfacings in a range conditions are given in Appendix P of the same report.

6.26 In the 6 months preceding the expiration of the Surfacing Integrity Performance Guarantee period of a proprietary thin surfacing, the material must be inspected for defects as described in Clause 942 of the Specification (MCHW 1). Surfacing that do not meet the acceptance criteria, and where the condition is not attributable to the condition of the substrate, shall be notified to the supplier for correction under the terms of the guarantee.

### Design Preliminaries

6.27 The adequacy of the structure of the pavement to provide a sound and stable substrate for a TSCS shall be established before specifying a replacement surface course. Laying of TSCS on an unstable substrate will result in reduced life of the surfacing.

6.28 Determination of whether or not the existing pavement substrate is sound can be made by:

- Utilizing the pavement evaluation methods described in DMRB 7.3.2 (HD 29) to indicate that the pavement is ‘long life’;
- Examination of the existing surfacing to ensure that any rutting is limited to the material that will be removed;
- Investigation of cracking in the existing surfacing to determine that it is not caused by failure of layers below.

## Installation

6.29 Thin surface course systems are proprietary products. Consequently their design, manufacture, transportation, laying and compaction are the responsibility of the contractor.

6.30 Many of the TSCS available were originally tested for performance when laid under ideal conditions. To achieve the best possible installed performance from a TSCS, these conditions must be equalled or exceeded, as far as it is practicably possible. This is especially relevant in the case of weather, where any deterioration in weather conditions at the time of laying will have an adverse effect on the durability of the TSCS.

6.31 The HAPAS Certificate or equivalent accreditation, together with the product's Quality Plan and Installation Method Statement give minimum temperatures for laying and describe the acceptable moisture level of the substrate. These must be taken into account when planning surfacing works.

### *Adverse weather working*

6.32 Much of the compaction necessary for thin surface course systems is achieved by the screed on the paver, with the process being completed by the roller close behind the paving machine. In this respect, and because the application of chippings is unnecessary, the installation of thin surface course systems might appear straightforward. However, the thinner systems lose heat extremely rapidly and therefore should not be laid in the winter months unless the surfacing substrate is adequately pre-heated.

6.33 It is desirable to lay in conditions that exceed the minimum criteria for air temperature and dryness of the surface to be overlaid given in the certification or declaration of performance for the product. Surfacing should be scheduled to allow sufficient programme float to avoid periods of poor weather. Surfacing operations should be delayed if there is a forecast of precipitation during the planned laying period.

6.34 Minimum air temperatures are usually required to be measured on a rising thermometer. Due to restrictions on the availability of the highway for maintenance operations, thin surfacing operations may be carried out during overnight closures. In such a situation, the air temperature will usually be falling and allowances must be made to ensure that it does not fall below the minimum specified during the laying period.

6.35 Hot asphalt materials lose heat most rapidly through the effects of wind speed. Substantial heat losses will also occur if the material is laid in standing water or on to ice, due to the latent heat of melting of ice or evaporation of the water.

6.36 Some thicker TSCS can be laid and compacted successfully in air temperatures as low as 2°C and rising, provided the air is still and the substrate is dry. If however, the wind speed at a height of 2 m is 5 km/hr, then an air temperature of 10°C or more may be necessary to achieve full compaction.

6.37 In common with other bituminous materials it has been observed that TSCS laid during the winter period are likely to be less durable than those laid in the summer. Thin surfacings should normally be laid between the months of April to October inclusive as during these periods the laying criteria given in the SHW are most likely to be met or exceeded. This period may be extended if ambient temperatures above 5°C are forecast when the TSCS is planned to be laid and other weather dependent criteria for the compliant performance of the installed materials will be met.

6.38 Thin surfacings must not be laid below the minimum temperature specified in the product's HAPAS certificate or equivalent accreditation.

6.39 When laying is likely to occur at close to the minimum temperature or after rain plant must be available on site so that the existing surface can be warmed and dried by means of infra red or similar heating immediately in front of the paver. Where work must proceed when the ambient conditions are acceptable but the surface conditions do not meet the requirements described in the Quality Plan and Installation Method Statement, equipment must be provided and used on site to dry the substrate prior to paving operations. For instance, a substrate pre-heating system, that precedes the paver, may be employed.

#### *Paving at Joints*

6.42 It has been observed, from examples of thin surfacing approaching the limit of serviceability that the longitudinal joint may begin to fail before the pavement surface. The failure mechanism begins with localised fretting of aggregate at the joint, which rapidly progresses. This highlights the need to pay attention to the detail of the joint when the thin surfacing is being laid.

6.43 Wherever possible the number and length of transverse and longitudinal joints should be minimised to reduce possible areas of vulnerability.

6.44 Echelon paving is the use of multiple paving machines laying the bituminous mat in adjacent rips concurrently. The material in all the rips is compacted at the same time after the last paving machine has passed.



**Figure 6.1. The second of two paving machines laying the second rip of a TSCS so that both rips can be compacted simultaneously whilst hot.**

6.45 The use of multiple paving machines laying in echelon should be the preferred laying method as there is no discernable longitudinal joint once compaction is complete. Where laying in echelon is not possible, joints should be placed as far as possible from the wheel track zones. Where surfacing joints are placed in the wheel track zones, the durability of the surfacing will be adversely affected.

6.46 Information on the jointing of rips is given in individual products HAPAS Certificates, Quality Plans and Installation Method Statements. Those specifying works incorporating TSCS must ensure that they take account of these.

#### *Roundabouts, Bends and Junctions*

6.47 It has been observed that TSCS are more durable when smaller nominal aggregate sizes are used in locations where there are significant traffic turning movements. The surfacing requirements should be specified separately for these locations.

6.48 Thin surfacing with a nominal aggregate size greater than 10 mm should not be used on roundabouts and other bends with a radius less than 250 m which are subject to substantial sideways forces from heavy traffic.

6.49 Some junctions may also be subject to subject to substantial sideways forces from heavy traffic, where small radius turning movements are required. The nominal aggregate size at these locations shall not exceed 10mm.

6.50 Damage to the surface from turning heavy vehicles can be a significant problem on roundabouts and invariably starts at joints. This can be mitigated by carefully planning the laying to avoid joints if possible and to place essential joints in lower stress areas. Consideration should be given to closing roundabouts completely to enable continuous surfacing. The main traffic flow of heavy vehicles should be examined and paver runs planned to follow the same tracks, to minimise scrubbing of heavy vehicle tyres across joints. Thin surfacings with a small nominal aggregate size, laid to the maximum permissible thickness general give a more durable result. These thicker surfacing layers would also be more tolerant of adverse working conditions. There is less need to achieve high texture on a roundabout as traffic speeds are generally low.

#### *Bond or tack coats*

6.51 The thinner the surfacing, the greater the importance of an effective bond or tack coat to the performance of the TSCS surfacing. Emulsion bond or tack coats sprayed as a separate operation ahead of the paver should be allowed to break completely (turn from brown to black) prior to surfacing. Polymer modified bond coats are likely to provide enhanced performance and should be specified for thin surfacings laid in high stress areas.

#### **Overlaying Concrete**

6.52 Thin surface course systems are generally suitable for application to both old and new continuously reinforced concrete (CRCP) surfaces. When laying on concrete it is likely that a polymer modified bond coat will be required. Surfacing directly over jointed concrete is not generally recommended. However, if undertaken, joint sealants in the concrete substrate should be replaced by Type N2 hard sealants to BS 2499, brought up almost flush to the surface, and expanded polythene backing strips should not be used. These tend to be compressed by the roller and then recover, cracking the surface course.

## Maintenance of Existing TSCS Pavements

### *End of service life*

6.53 Research has shown that the serviceable life of a thin surfacing is most influenced by the surfacing type, aggregate size and binder content. Properties of the recovered binder (penetration grade and softening point) did not provide a sufficiently clear relationship to be used as a serviceability indicator.

6.54 Thin surfacings approaching, or at the end of their serviceable life, generally exhibit the following stages of deterioration:

- |                |  |
|----------------|--|
| <b>Stage 1</b> | Loss of isolated particles of aggregate.   |
| <b>Stage 2</b> | Substantial loss of aggregate in discrete locations, not necessarily in the wheel track, and surface disintegration at longitudinal and transverse joints. |
| <b>Stage 3</b> | Loss of integrity of the surface, with fragmentation of the mat.   |

6.55 The time period for deterioration progression from Stage 1 to Stage 3 is variable and has been reported as between 6 months and 5 years.

6.56 Research is in progress to determine a method to monitor the amount of deterioration in TSCS materials from routine traffic speed condition surveys and predict their residual life.

### *Local repairs*

6.57 The HAPAS certificates for TSCS contain instructions and guidance on appropriate methods and materials for repair of local surface defects. These must be referred to for the planning of repairs. For repairs not covered by the information in the HAPAS certificates, Clause 946 of the SHW must be used.

6.59 For small, local repairs, it is good practice to use a smaller nominal aggregate size for patching than that of the original surface i.e. patch a 14mm TSCS with 10mm TSCS.

### *Replacement of existing TSCS*

6.60 Due to the way thin surfacings behave structurally, any disturbance of the fabric of an aged thin surfacing is likely to lead to rapid deterioration.

6.61 The following actions should be avoided as far as practicable, as they have been observed to accelerate the deterioration of adjacent thin surfacings:

- Removal of painted and thermoplastic lines by pressurised water systems;
- Cutting of slots for detector loops and other traffic sensors;

### *Detector Loops*

6.63 It has been observed that any cut in a TSCS, such as those made to install detector loops may cause the material to fail prematurely. To obviate this, two alternative methods of loop installation are detailed.

6.64 Loops may be installed in the pavement layer directly beneath the TSCS, before the TSCS overlay commences or, in the case of repairs or reinstatements, the existing pavement may be planed out, loops installed and the new TSCS overlay applied.

6.65 In both cases, the induction loops are installed before the TSCS is laid. This will require coordination between those planning the resurfacing and those responsible for the induction loops to ensure that work is scheduled accordingly and that the induction loops will be installed at the correct depth and to the correct design pattern to ensure the function of the loops.

6.66 Where induction loops are installed after completion of the surfacing then the cut slots can be closed using an infra-red patching technique rather than a poured sealant. If a poured sealant is used then installation of a bond breaking layer above the wires of the loop is likely to allow future planning of the surface without damage to the detector loop.

#### *Hand Application*

6.67 It is preferable that thin surfacings should not be laid by hand except where a paver cannot operate, and then only in favourable weather conditions. Due to their low fine aggregate content, thin surface course systems appear binder rich and 'sticky' and being thin, they lose heat rapidly making them difficult to hand lay and compact satisfactorily.

## Appendix B: IAN 157/11 Thin Surface Course Systems - Installation and Maintenance in English DBFO schemes

When used on the M25 DBFO Scheme, this IAN is to be amended as follows:

Para No.	Description
General	M25 DBFO Paragraph 18 (Interpretation) of Standards List applies

When used on all other English DBFO Schemes, this IAN is to be amended as follows:

Para No.	Description
None	None