

DESIGN GUIDE FOR ROAD SURFACE DRESSING

by D Bateman

With the advice of a panel representing the Industry and the Clients under the Chairmanship of Dr H L Robinson, The Road Surface Treatments Association

Road Note 39 (Seventh Edition)

TRL Limited

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With the advice of the following Panel representing the Industry and the Clients under the Chairmanship of Dr H L Robinson, RSTA

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DESIGN GUIDE FOR ROAD SURFACE DRESSING

EXECUTIVE SUMMARY

Road Note 39 is a guide for the design of surface dressing for roads throughout the United Kingdom. The document is divided into three parts for ease of use, each part having a different purpose. The parts and their purposes are as follows:

- Part I – Introduction: General information on the scope of the document and general guidance on the reasons for surface dressing, the types of surface dressing and surface dressing operations. Also included are details of preparatory work with consideration of the necessary work to be carried out prior to the surface dressing of roads and footways to enhance the quality and maximise the life of the surface dressing.
- Part II – Design: Details of the parameters used and the method employed to design a suitable surface dressing for specific conditions. Within this method, the design for the rate of spread of the binder is divided into two stages, dictated by the availability of information. These stages are the:
  - basic design based on information about the site; and
  - local adjustments with the properties of the component materials and along the site with changes in site conditions.

  Both stages need to be completed to optimise the design and hence maximise the probability of achieving a successful surface dressing.

- Part III – Application of the design: Explanation of the types of specification that can be prepared with the designs together with general guidance on the application of the designs to the site. Also included are appendices giving examples of the design process and information on some less common situations.

Road Note 39 is a design guide; it is NOT prepared as, nor should it be used as, a specification. The results of the design process can be used to prepare specifications, but the advice in this Design Guide has not been drafted in a form that can be used directly as a specification. However, it is expected that the advice contained will be indispensable to those drawing up specifications.

The procedure for the design of surface dressings for highways consists of the steps shown below. However, the design of a surface dressing following the requirements set out in the tables and figures in these references without an understanding of the principles of the design method, as described in the totality of this Road Note, can lead to inappropriate decisions.

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DESIGN GUIDE FOR ROAD SURFACE DRESSING

PART I – INTRODUCTION

1. FOREWORD

1.1 Scope

Surface dressing can be used successfully on all types of roads, from the country lane that carries only an occasional vehicle to trunk roads and motorways carrying thousands of vehicles a day. It provides a simple but cost-effective form of maintenance that can play an important part in a highway infrastructure asset management plan.

Surface dressing has inherent advantages over other options for road surface renewal: its conservative use of material over thicker asphalt overlays and the avoidance of the need to take up, and subsequently process, existing pavement layers. Used appropriately surface dressing can be an important contributor to minimising the whole life cost of road pavements.

Surface dressing can also help with network resilience by being designed correctly for full temperature regime and by acting as the surfacing layer to prevent water penetration and help avoid damage caused by cold weather, ice and snow.

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- Part I – Introduction: General information on the scope of the document and general guidance on the reasons for surface dressing, the types of surface dressing and surface dressing operations. Also included are details of preparatory work with consideration of the necessary work to be carried out prior to the surface dressing of roads and footways to enhance the quality and maximise the life of the surface dressing.
- Part II – Design: Details of the parameters used and the method employed to design a suitable surface dressing for specific conditions. All stages need to be completed to optimise the design and hence maximise the probability of achieving a successful surface dressing.
- Part III – Application of the design: Explanation of the types of specification that can be prepared with the designs together with general guidance on the application of the designs to the site. Also included are appendices giving examples of the design process and information on some less common situations.

Although this Design Guide is not a contract and should not be used as such, it may be used to support such a contract. There are three types of contract:

- a recipe specification with design by the Client and Supply and Application by the Contractor in accordance with MCHW1 clause 919 Surface dressing: Recipe Specification.
- a performance specification where the contractor shall have a mandatory CE mark for the surface dressing product and is responsible for the design, materials, installation and for providing a performance guarantee, in accordance with MCHW 1 clause 922 Surface Dressing, Design, Application and Performance Specification and/or BS EN 12271 Surface Dressing Requirements.
- a performance specification where for Highways England Strategic Road Network (motorways and trunk roads) the contractor meets the requirements of MCHW1 clause 923 Cold Applied Ultra-Thin Surfacing.

It is essential that the allocation of responsibility for the design should be made clear in any contract. Also, for recipe specifications, the rate of spread in the tables for "zero adjustment" (nominal) rates should not be taken as the target rate for budgeting purposes; flexibility should be allowed in a tender for increasing the binder rate, or even changing the type of surface dressing, to allow for local conditions.

1.2 Health and Safety

Health and Safety aspects are not within the scope of this design guide, but all parties involved in surface dressing should take full account of the requirements of:

- The Health and Safety at Work, etc, Act 1974 (House of Commons, 1974).
- The Management of Health & Safety at Work Regulations 1999 (House of Commons, 1999).
- The Control of Substances Hazardous to Health (COSHH) Regulations 2002 (House of Commons, 2002).
- The Construction (Design & Management) Regulations 2015 (House of Commons, 2015).
- National Highways Sector Scheme (NHSS) 13 (Section 1.3).

1.3 Sector Scheme

The successful application of surface dressing is a skilled occupation. Contractors certificated to BS EN ISO 9001 Quality Management Systems standard awarded by a Certification Body accredited by UKAS and Sector Scheme 13 have shown that they have the necessary skills and capability to ensure that surface dressing is applied in a safe, consistent and effective way. For this reason, many Highway Authorities make it a mandatory requirement for contractors wishing to tender for recipe surface dressing contracts using MCHW1 clause 919 to be registered holders of the Sector Scheme, which satisfies ISO 9001.

End Performance (Design, Application & End Product Performance) Surface Dressing is now regulated under BS EN 12271 and CE Marking. The Declaration of Performance is made more robust by using contractors who are registered to Sector Scheme 13 although Sector Scheme 13 is no longer mandatory on these types of contracts. Sector Scheme 13: The Supply and Application of Surface Treatments to Road Surfaces, is defined in Appendix A to the *Specification for Highway Works* (MCHW 1). UKAS sector scheme documents are available from UKAS, 2, Pine Trees, Chertsey Lane, Staines-on-Thames, TW18 3HR or from their website www.ukas.com

1.4 Revision Panel

This Design Guide was prepared by a Panel under the chairmanship of the RSTA. The Panel was drawn from organisations representing all sides of the industry, including customers, producers and material suppliers. The organisations represented on the Panel were:

- Association of Directors of Environment, Economy, Planning and Transport (ADEPT)
- Highways England (HE)
- Mineral Products Association (MPA)
- Eurobitume UK (EBUK)
- Local Government Technical Advisors Group (TAG)
- Road Emulsion Association (REA)
- The Road Surface Treatments Association (RSTA)
- TRL (TRL)
- Transport Scotland (TS)
- Transport Northern Ireland (TNI)
- CSS Wales (CSSW)

2. CONCEPTS

Detailed information covering the key concepts of Surface Dressing is published in the RSTA ADEPT Code of Practice for Surface Dressing available from **www.rsta-uk.org/publications.htm**

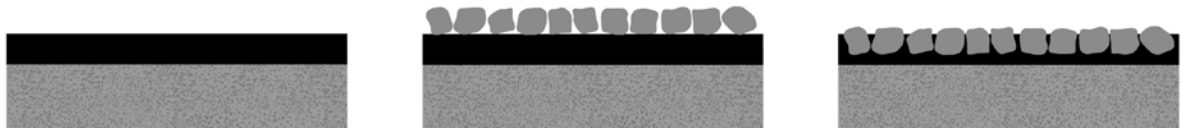

Figure 2.1 – Schematic Representation of Single Surface Dressing

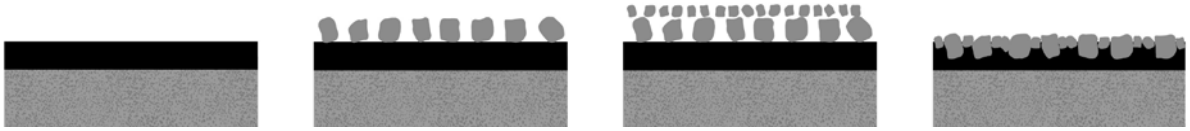

Figure 2.2 – Schematic Representation of Racked-In Surface Dressing

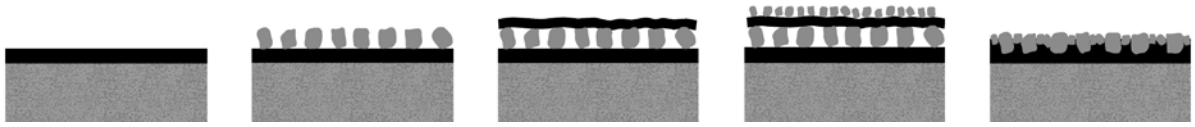

Figure 2.3 – Schematic Representation of Double Surface Dressing

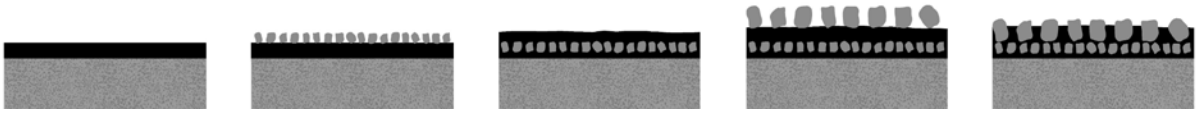

Figure 2.4 – Schematic Representation of Inverted Double Surface Dressing

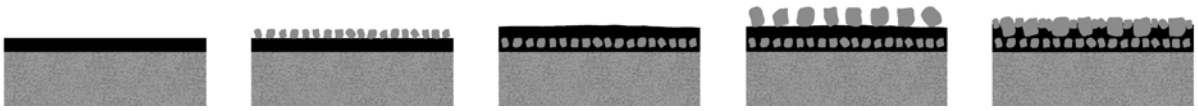

Figure 2.5 – Schematic Representation of Inverted Double Surface Dressing using a Racked-In top dressing

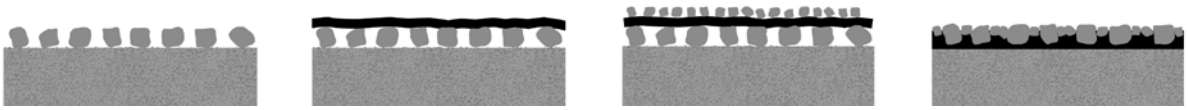

Figure 2.6 – Schematic Representation of Sandwich Surface Dressing

3. GENERAL PRINCIPLES

3.1 Pavement type

The majority of pavements that are surface dressed are highways, and therefore this design guide has traditionally catered for road surface dressing. However, the technique is also applicable to footways, cycleways and un-trafficked areas including central reserves of dual carriageways. The basic method has to be modified for these types of situation, and advice on them is given in Chapter 10.

3.2 Surface dressing operations

Many operations are performed in surface dressing, the more important of which are listed in Table 4.3.1. The table sets out the operations in the order in which they are normally performed. However, these operations are not necessarily all undertaken by the same organisation.

Part II of this Design Guide is primarily aimed at covering items 3 and 4 in Table 4.3.1. The guiding principles in the assessment of sites and the design of surface dressing are that the type selected for a particular site should be sufficiently robust to retain the chippings, and that the size of chipping should be selected to take account of embedment by traffic. Part III gives information on where to find guidance on items 7 to 10 in Table 4.3.1.

3.3 Timetable for surface dressing

In order to minimise the potential for failures, the surface dressing should be undertaken in the correct season (Sub-Section 7.3.2) with the correct materials (Chapter 5) and on a correctly prepared site (Section 14.1). In order to be able to routinely achieve these conditions, the surface dressing operations in Table 4.3.1 should be carried out to the timetable indicated in Figure 4.3.1. The application of surface dressing without proper site preparation is unlikely to get the most out the treatment.

4. GUIDANCE DOCUMENTS

4.1 Manual of Contract Documents for Highway Works

The relevant specifications are given in Clauses 919, 922, and 923 of the *MCHW* (Volume 1 of the *Manual of Contract Documents for Highway Works*, MCHW 1) and associated guidance in *Notes for Guidance on the Specification for Highway Works* (MCHW 2). These documents can be obtained from http://www.standardsforhighways.co.uk.

4.2 RSTA / ADEPT Code of Practice

Advice on best practice relating to surface dressing is given in the *RSTA / ADEPT Code of Practice for Surface Dressing* (The Road Surface Treatments Association) and must be referred to when surface dressing is being considered. The RSTA / ADEPT Code of Practice for Surface Dressing gives information and advice on all aspects of surface dressing and includes checklists designed to give advice on pre-contract, on-site and post-contract considerations. The *RSTA / ADEPT Code of Practice for Surface Dressing* is available on https://www.rsta-uk.org/publications/.

4.3 RSTA / ADEPT Code of Practice for Signing at Surface Dressing Sites

Reference should also be made to the Road Surface Treatments Association/ADEPT Code of Practice for signing at surface dressing sites (RSTA/ADEPT), available on https://www.rsta-uk.org/publications/.

Table 4.3.1 – Surface Dressing Operations

No.	Operation	Description
1	Identify	Identify roads to be dressed. Advise Statutory Undertakers that any works they might foresee should be completed prior to the surface dressing being laid.
2	Repair	Repair potholes and damaged areas.
3	Assess	Measure the hardness of the road surface when the road temperature is between 15 - 35 °C and assess the number of medium and heavy vehicles. Note areas of high stress – roundabouts, sharp bends, traffic lights, steep hills, altitude, etc.
4	Design	Using above data, select type of surface dressing, binder and chipping type and size.
5	Materials	Decide who should be responsible for ordering chippings* and binder with the appropriate properties.
6	Contract Administra-tion	Contracts should be let well in advance of the work to secure skilled contractors and the best equipment. Select tenderers. Evaluate tenders, including discussions on polymer modified binders and surface dressing types, aggregate sources, methods, programmes of work and resources to be used.
7	Method of Working	Agree method of working and traffic control between Client and Contractor. Where necessary, give advance warning to those likely to be inconvenienced by the work.
8	Site Preparation	Complete patching a year ahead of the surface dressing season to repair potholes, ruts and cracks. Remove excess binder on the road surface using high pressure water retexturing. Remove vegetation from the road edge (clear the sidings) to restore the maximum road width and to ensure drainage to prevent standing water. Sweep, mask or remove reflective studs and ironwork, note and record road markings, remove multi layered centre line road marking. Remove tree hazards for spray tanker drivers and chipping spreaders.
9	Traffic Control & Execution	Implement warning signs and traffic control, sweep, apply the binder and chippings and roll. Comply fully with the requirements in the Code of practice for Signing at Surface Dressing sites.
10	Aftercare	Remove surplus chippings following the guidance on post sweeping within the RSTA / ADEPT Code of Practice for Surface Dressing. Swept chippings are not regarded as a waste and can be stored and reclaimed for further use. Control the speed and path of traffic until the surface dressing has stabilised. Replace

No.	Operation	Description
		stop, give way and other road markings. Dusting is not aftercare when required several months after application. It is more of a remedial measure to resolve blackening or fatting up.
11	Record	Keep a record of the materials used, including their application rates, and the weather conditions, including air and ground temperatures together with relative humidity at the time of surface dressing because an emulsion binder is being used. Note any unusual occurrences during the work.
12	Inspect	Inspect the work regularly during the early life and record any deficiencies. Progressively extend the period between inspections, but inspect after the first frost and after periods of sub-zero temperatures.
13	Investigate	Where defects have occurred, assess the reason and, in extreme cases, consider the need for remedial works.

* chippings need to be ordered well in advance.

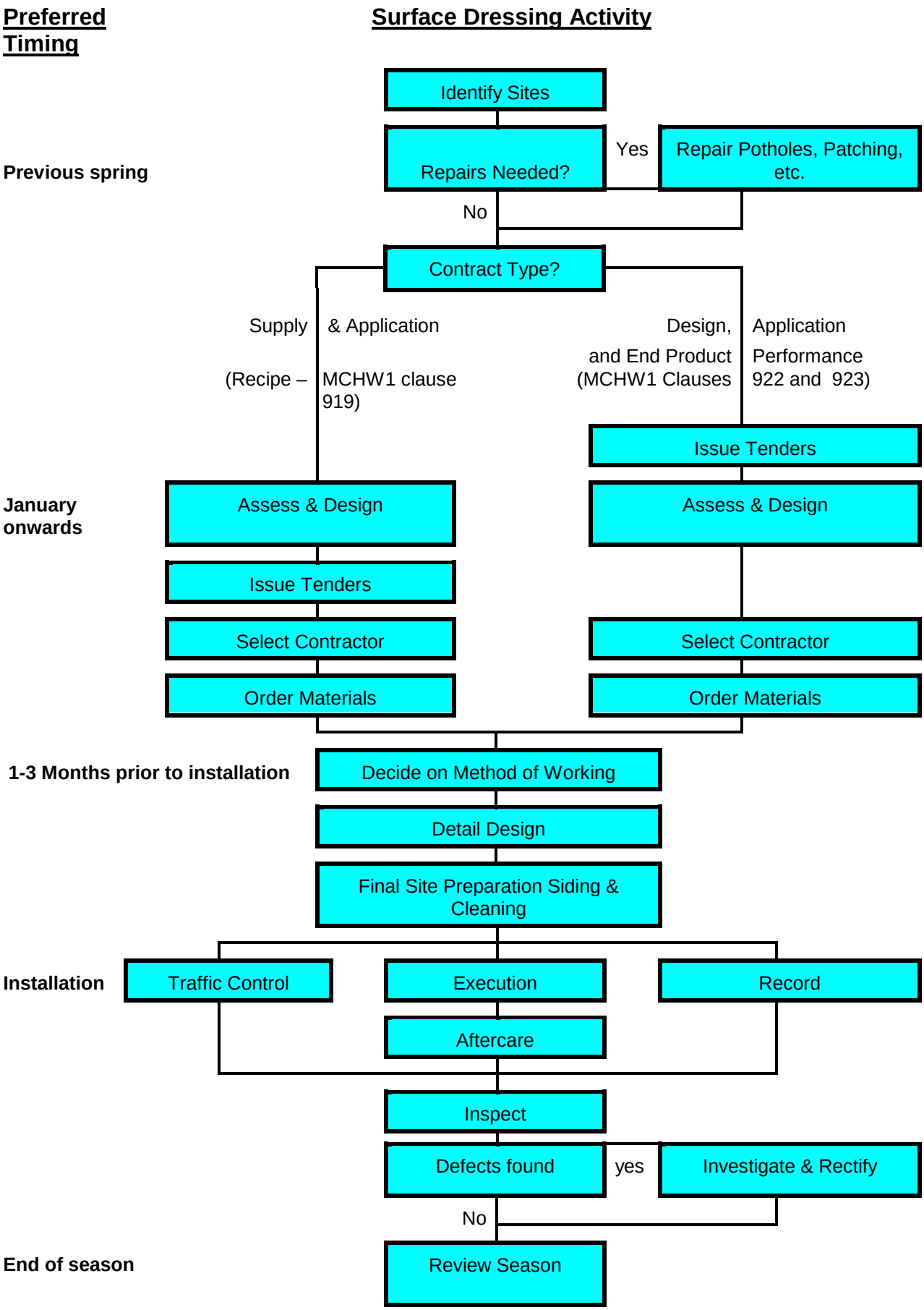

Figure 4.1 – Preferred Timetable of Surface Dressing Operations

4.4 National Guidance Document for Surface Dressing PD 6689

National Guidance Document for Surface Dressing, PD 6689 (BSI) should be referenced when considering performance specifications using BS EN 12271 (BSI)

5. MATERIALS

5.1 Aggregates

5.1.1 General

Chippings shall comply with BS EN 13043 (BSI) and the recommendations in Table 4 of PD 6682-2:2009+A1:2013 (BSI) National Guidance Document for Aggregates for Bituminous Mixtures and Surface Treatments for Roads, Airfields and Other Trafficked Areas. - Guidance on the use of BS EN 13043.

Table 5.1.1 Nominal Size designations according to BS EN 13043 and this Road Note

Type of Surface Dressing	Nominal Size	BS EN 13043 Designation	RN 39 Designation for Rate of Spread Tables
Single	10 mm	6.3/10 mm	S10
Single	6 mm	2.8/6.3 mm	S6
Racked-In	14 mm & 6 mm	8/14 mm & 2.8/6.3 mm	R14
Racked-In	10 mm & 6 mm	6.3/10 mm & 2.8/6.3 mm	R10
Racked-In	10 mm & 4 mm	6.3/10 mm & 2/4 mm	R10
Double	14 mm & 6 mm	8/14 mm & 2.8/6.3 mm	D14
Double	10 mm & 6 mm	6.3/10 mm & 2.8/6.3 mm	D10

To avoid the risk of oversize particles, attention is drawn to Note A of Table 4 of PD 6682-2: **2009+A1:2013**. Table 7 of PD 6682-2:**2009+A1:2013** also gives guidance on specifying the flakiness of aggregates for surface dressing and it is recommended that this guidance is followed to avoid having to make adjustments to binder spray rates that will accommodate the shape of chippings. If chippings with compliant flakiness are not available, the guidance in Sub-section 9.2.6 should be adopted.

The smallest size chippings are not always available, and other non-standard sizes between 2.8/6.3 and 2/4 are used. If used, consideration needs to be given to what influence the particular non-standard size will have on the design.

The cleanliness of chippings is important in achieving good adhesion to the binder film. Table 4 in PD6682 recommends maximum fines (passing 63 micron) content of 1.0 % for surface dressing chippings. A thin film of dust on the chipping will prevent adhesion and can lead to early life failure. For this reason, all chippings must be thoroughly washed prior to delivery. Double washing is used to reduce the fines content further e.g. 0.5%. It should be noted that damp chippings work well with emulsion binders provided the weather is appropriate for surface dressing.

Samples of chippings to be used should be tested for compliance as deliveries are received.

Further guidance on chippings for surface dressing is published in the *RSTA / ADEPT Code of Practice for Surface Dressing* and is available on https://www.rsta-uk.org/publications/

Crushed gravel chippings

The majority of chippings used are of crushed rock or slag, and the values for the basic binder-spread rates (Section 9.2) are based on their use. However, crushed gravel can be used on roads if they comply with the required aggregate properties but a correction must be applied in the determination of the final binder-spread rate (Sub-Section 9.2.6). The use of uncrushed gravel should be avoided.

5.1.2 Aggregate selection for primary layer

Chippings for single surface dressings and for the primary layer in multiple layer surface dressings should have the required minimum Polished Stone Value (PSV) (Sub-Section 7.3.1). However, the attainment of the relevant PSV limit does not imply that the aggregate has suitable properties to withstand crushing and abrasion, the latter being a surrogate for aggregate wear (durability). Therefore, limits on the maximum Los Angeles Value (normally 30) and Aggregate Abrasion Value (normally 12) of the aggregate may be required for certain sites and traffic intensities.

For Surface Dressing there is some evidence to suggest the AAV should be lower (i.e. 8 or less) than the figures quoted in HD36:2006 Table 3.3 to maintain adequate texture depth. This is particularly applicable on more heavily trafficked roads.

5.1.3 Aggregate selection for secondary layer

The secondary layer of smaller chippings used in racked-in and double surface dressings pack round the chippings in the primary layer, "locking" them in position. Strength is of minor importance and there are advantages in having a weaker aggregate, such as some types of slag. Because the smaller aggregate in a racked-in surface dressing has less contact with the vehicle tyres, PSV is of less importance but, in any event, the PSV should not be less than 50; this is not the case with double surface dressings where both layers of chippings need to have the appropriate PSV. However, cleanliness of the racked-in (secondary) chipping, together with soundness (good resistance to crushing and attrition) is vital. Introduction of dust into the system directly via the secondary chipping or through attrition significantly hinders binder adhesion to the larger primary aggregate and also hinders secondary stabilisation of the surface dressing through chipping re-orientation and secondary wetting.

5.1.4 Chippings for very hard substrate

On very hard substrates, particularly on roads in traffic categories A and B, resistance to crushing is important and specifying a lower Los Angeles value should be considered. Aggregates with an AAV not exceeding 10 should be specified for single surface dressings but this may not be attainable where a higher PSV aggregate is also required and in these circumstances the use of a multiple layer surface dressing should be considered. Multiple layer surface dressings are more closely packed which reduces abrasion.

5.1.5 Artificial aggregate

There are several types of manufactured aggregates including blast furnace and steel slag. The PSV characteristics of slag differ from natural stone. The specific gravity of blast furnace and steel slag is

very different. Steel slag is generally heavier than natural stone and blast furnace slag is lighter. These differences in specific gravity require the spread rate of chippings to be adjusted so that approximately the same volume of the respective slag is applied to the road surface.

5.2 Size of chippings

5.2.1 Single surface dressing

The recommended size of chippings to suit the amount of traffic and the hardness of the substrate of the existing road surface is given in Chapter 9; alternative sizes of chippings are also appropriate if they are given for those conditions in Table 9.2.6. The sizes recommended are related to the mid-point of each traffic category: lighter traffic conditions may make the next smaller size more appropriate. Surface dressings with larger-size chippings should be carried out early in the season in order to ensure adequate embedment before the onset of cold weather. The size of chippings may also be changed to assist in rationalizing the different designs required on site.

8/14 mm chippings should be used with the utmost care and in particular loose chippings should be removed from the surface before the road is opened to unrestricted traffic because of the higher risk of windscreen damage.

5.2.2 Racked-in surface dressing

The recommended size of chippings to suit the traffic and the substrate hardness is given in Chapter 9. However, alternative sizes of chippings may be selected to cater for particular noise or macro-texture requirements. The sizes of the chippings recommended are related to the mid-point of each traffic category: lighter traffic conditions may make the next smaller size more appropriate. Surface dressings with 8/14 mm and 2.8/6.3 mm size chippings should be carried out early in the season to maximize embedment before the onset of cold weather

The size of chippings may be changed to rationalize the number of different designs required at a site.

5.2.3 Double surface dressing

The recommended chipping sizes are as for racked-in surface dressing in Chapter 9.

5.2.4 Inverted double surface dressing

The first layer of chipping is normally 2.8/6.3 mm. The recommended size for the second layer is as for single surface dressings and racked-in surface dressings (Chapter 9) for the surface hardness category after the first layer has been installed.

5.2.5 Sandwich surface dressing

The recommended chipping sizes are as for racked-in and double surface dressings chosen to reflect the extent of the “excess” binder on the surface.

5.2.6 Specific lanes

5.2.6.1 Carriageways with multiple lanes

Heavy vehicles are not permitted in the outside lane of dual three- and four-lane carriageways, but these lanes still carry light commercial vehicles and heavy private vehicles within the classification of Medium/Heavy traffic. All lanes of dual carriageways that carry different traffic levels should always be designed separately.

5.2.6.2 Hard shoulders

Hard shoulders of all dual carriageways take little medium and heavy traffic under normal circumstances. However, contraflow and other temporary traffic conditions are often introduced for which a single surface dressing will be inadequate. A double surface dressing is generally recommended in order to ensure that adequate texture depth is provided and to provide an extremely high initial stability of the surface dressing.

5.2.6.3 Hard strips

Hard strips at the edge of carriageways that are not wide enough to accommodate four-wheeled vehicles without them straddling lanes will take no heavy traffic in normal circumstances. Therefore, they will be classified as traffic category H with a 2.8/6.3 mm recommended single size of chipping irrespective of the surface hardness.

5.2.6.4 Adjustment for use over open and negatively textured asphalt surfaces

Some of the binder will penetrate into an open and negatively textured surface and, unless allowance is made for this loss, insufficient binder may be left on the surface to hold larger sizes of chippings. The use of a pad coat followed by a racked-in surface dressing has been used successfully to help resolve this problem; however it may not always be necessary. See RSTA Code of Practice.

5.3 Binders

5.3.1 Introduction

Binders for surface dressing have been specifically designed to enable storage, transportation and application of highly viscous bituminous materials in a state that can be readily handled. The principal method for modern materials to achieve this aim is to use a cationic bituminous emulsion. Bitumen emulsion is a dispersion of fine bituminous particles within a continuous aqueous phase which coalesce (or break) on contact with the road surface and chippings. The residual binder will build up cohesive strength as the aqueous phase (water) evaporates. Good drying weather is essential to ensure early stability against traffic forces.

5.3.2 BS EN 13808

BS EN 13808 (BSI) provides a framework specification to categorise bituminous emulsions, covering both modified and unmodified emulsions, for a full range of applications. The binder description (Nomenclature) is based on the chemical nature, the nominal binder content of the emulsion, the type of binder (whether it contains flux oil, polymers etc.) and the chemical stability. Hence, the previous K1-70 category will now have various notations including C69B2, C69B3, C69BF2, or C69BF3 according to EN 13808. For more detailed explanation, reference should be made to the National Annex of BS EN 13808 (BSI) and to BS 434-2 (BSI).

5.3.3 Unmodified emulsions

These materials (traditionally K1-70 now named: C69B2, C69B3, C69BF2, or C69BF3) constitute the unmodified emulsion materials used in United Kingdom surface dressing. The design recommendations limit their use to lower traffic category low stressed sites and they can offer valuable engineering solutions in many of these situations.

5.3.4 Polymer modified binders

Polymer modified binders have historically been processed and procured under a proprietary regime, which essentially involves the addition of polymers and/or additives during production.

BS EN 13808 (BSI) also provides the framework for specifying these emulsions. The presence of the letter "P" in the nomenclature defines the emulsion as a polymer-modified emulsion e.g. C69BP3, see BS 434-2 (BSI).

Different classes of polymer modified binders are specified, based on the minimum levels of peak cohesion. The more highly modified materials tend to exhibit higher levels of cohesion over a greater temperature range and be applicable to higher traffic category and/or stress situations on the road. It should be noted, however, that cohesion provides only one characteristic of the binder and will not in isolation provide all the required information to predict performance, especially in terms of: breaking behaviour, adhesion, healing, chipping-orientation and long term durability. The grades are as described in Table 5.3.1.

Table 5.3.1 Grades of bituminous emulsions

UK Classification	**Minimum peak cohesion** (J/cm²)	**Pendulum Cohesion Class** (BS EN 13808:2013)
Unmodified	0.7[(a)]	5
Intermediate Grade	1.0	4
Premium Grade	1.2	3
Super-Premium Grade	1.4	2

Notes: (a) For an unmodified binder there is no requirement for the minimum peak cohesion value, although it is expected that the majority of unmodified binders will have a minimum value greater than 0.7 J/cm^2. Therefore, the value stated is given for guidance only and does not constitute a specification.

Where the design leads to the option for unmodified binder or a choice between unmodified and polymer modified binder, a balance should be considered between initial application costs and whole life cycle costs as to the most appropriate option to select. Further guidance on the specification and application of bitumen emulsions can be found on the Road Emulsion Association's "Technical Datasheets" webpage http://www.rea.org.uk/technical.htm.

DESIGN GUIDE FOR ROAD SURFACE DRESSING

PART II – DESIGN

6. DESIGN METHODOLOGY

6.1 Basic approach

Assuming the road site is suitable for surface dressing the design methodology follows the steps in Table 6.1, which provides an index to the sections within this document concerning the various steps an engineer should take when designing a surface dressing. It forms a useful aide-memoire, but an engineer will need to use judgment on the applicability of these steps to a specific scheme, particularly for roads carrying heavy traffic at high speeds.

The designs should be properly documented, preferably on a proforma specifically prepared for the purpose. An example of a suitable form is shown in Figure 6.1 (repeated as Appendix D, which may be copied for use in design, if required). Four worked examples of the design method are given in Appendix A.

The design method described in this Design Guide can be used for the appropriate type of surface dressing and constituent materials for most situations. If there are any problems, advice may be sought from engineers experienced with the design method or, particularly in the case of problems with the documentation, from the Road Surface Treatments Association.

Table 6.1 – Operations in Designing Surface Dressing

Step	Parameter to be determined	Road Note Section
1	Surface Temperature Category	Table 7.2.1
2	Road Hardness Category (road hardness probe & temperature required from prior testing)	Table 7.2.2
3	Traffic – flows and speeds – medium and heavy vehicle figures	(from Highway Authority)
4	Traffic Category	Table 7.2.3
5	Geometric Features – bends (radius) – gradients (%) – junctions/parking/pedestrian crossings	(from Highway Authority)
6	Chipping Properties - Type - PSV - AAV - Shape (Flakiness)	(from Specification) Sub-Section 7.3.1
7	Type of Surface Dressing	Figures 8.3a or 8.3b
8	Chipping size(s) / Binder Spread Rate and local adjustments	Section 9.2
9	Chipping Spread Rate	Section 9.1

Design of Road Surface Dressings to Road Note 39 (Seventh Edition)

Road number:		Region/Area:					
Section location:							
Length:	m	Width:	m	No. of lanes:		Area:	m^2
Lane(s)		Medium/Heavy Traffic:	cv/l/d			NRSWA road type:	
Traffic Speed: *	mph						
Traffic category: *	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*
Location: *	South	Central	North				
Temperature Category: *	*A*	*B*	*C*	*D*			
Road Hardness (RH) probe depth:	mm	at	°C	Min. PSV:		Max. AAV:	
RH Category: *	Very Hard	Hard	Normal	Soft	Very Soft	Variable	
Surface condition: *	Very binder rich	Binder Rich	Normal	Texture in wheel tracks	Binder lean/Porous		
Radius of curvature: *	Under 100 m	100 – 250 m	over 250 m				
Junction or crossing: *	Approach	Non-approach					
Overall gradient: *	up to 5 %	5 – 10 %	Over 10 %				
Expected Month on Site:							
	Uphill	Downhill					

Type of surface dressing: *	Single	Racked-In	Double	Inverted Double	Sandwich	
Chipping size: *	8/14 mm	6.3/10 mm	2.8/6.3 mm	Other:		
	8/14 & 2.8/6.3 mm	6.3/10 & 2.8/6.3 mm	6.3/10 & 4/2 mm			
Aggregate type: *	Crushed rock	Blast-furnace	Steel slag	Gravel		
Flakiness index: *	Less than 10 %	10 % to 15 %	15 % to 20 %	More than 20 %		
Bituminous emulsion binder:	Unmodified	Intermediate	Premium Grade	Super-Premium		
Seasonal risk category:	High	Significant	Low			
Binder spread rate	First layer	L/m²	Second layer *	L/m²		

Location	Season	Aggregate type	Flakiness	Increase of chipping size	Shade	Surface condition	Gradient	Traffic Speed	Untrafficked area	Sum of factors	Rate of spread of binder
											L/m²
											L/m²
											L/m²
											L/m²

Designer:		Initials:		Date:	/ /

* Highlight or delete as appropriate. Shaded box indicates data that a Client should provide when seeking tenders

Figure 6.1 – Suitable Proforma for Recording Designs

6.2 Design for texture depth

The basic approach has been developed around a method to consistently achieve a texture depth that is acceptable after embedment with trafficking. For major roads, designing to this Road Note and PD 6689 (BSI) has meant that there will be a retained textured of 1.5 mm or 1.2 mm whilst, for lower traffic categories, it may be less.

At present there is no definitive method to design for the macro-texture that will exist after embedment has taken place, but in-service texture depth requirements can be included in job specifications. Experience is then needed to assess what macro-texture needs to be provided prior to traffic that will retain the specified macro-texture at the end of the set period. If a texture depth that is outside the normal range is required, then the chipping sizes will need to be increased or decreased, according to the type of dressing being used, by an experienced designer. The extent of the change required has not been quantified in this Road Note.

6.3 Design for quieter surfacing's

In 2003 the RSTA commissioned research at the University of Ulster into the complex mechanisms involved in the generation of tyre / road noise. From this research, a methodology for selecting the type of surface dressing to minimise tyre / road noise was developed. This methodology is based on the guidance in this Road Note and is published in the RSTA/ADEPT Code of Practice for Surface Dressing Part 8 available at: www.rsta-uk.org/publications.

The University of Ulster research demonstrated that it is possible to select a surface dressing both with the required macro-texture to maintain skid resistance and with a tyre-noise performance comparable to that of a thin surface course system (TSCS).

7. INPUT PARAMETERS

7.1 Subdivision of parameters

The values for different parameters are derived from different aspects of the design. These aspects are:

- Selection of the type of surface dressing.
- Selection of the type of component materials (binder and chippings).
- Calculation of the rates of spread of binder and chippings.
- Local adjustments to the above values along the site with changes in conditions.

Some parameters are needed for more than one aspect of the design; in particular, all those needed for determining the binder spread rate are also used in the selection of the type of surface dressing. Therefore, the parameters to be considered are:

- Parameters for selecting the type of surface dressing.
- Parameters for selecting the component materials.

7.2 Parameters for selecting the type of surface dressing and the rates of spread

7.2.1 Surface Temperature Categories

The climate in the UK is not uniform, with the average temperature lower in the north. At lower temperatures, there is less opportunity for the chippings to become embedded in the substrate and, hence, more binder is required to hold the chippings during the winter. The altitude of the site also influences the properties of the binder required to retain the chippings because of the change in temperature. Also, the deliberate use of larger chippings and more binder at high altitude may be useful on minor roads to assist traction in winter.

In this Design Guide, the location and altitude are covered by four surface temperature categories. As a starting point, these categories can be defined from Table 7.2.1, with the locations shown in Figure 7.2.1. However, the climate in the UK is not uniform so that the definitions of the categories are only intended to be a general guide and consideration should be given to the local climate. For example, variations in average temperatures can be found in deep valley floors and around coastlines. In particular, the moderating influence of the Gulf Stream should be considered where appropriate. The critical factor is the road surface temperature at the time of surface dressing and immediately afterwards. At lower temperatures, there is less opportunity for the chippings to be embedded in the substrate and, hence, more binder is required and/or a different type of surface dressing may be preferable to hold the chippings during the winter.

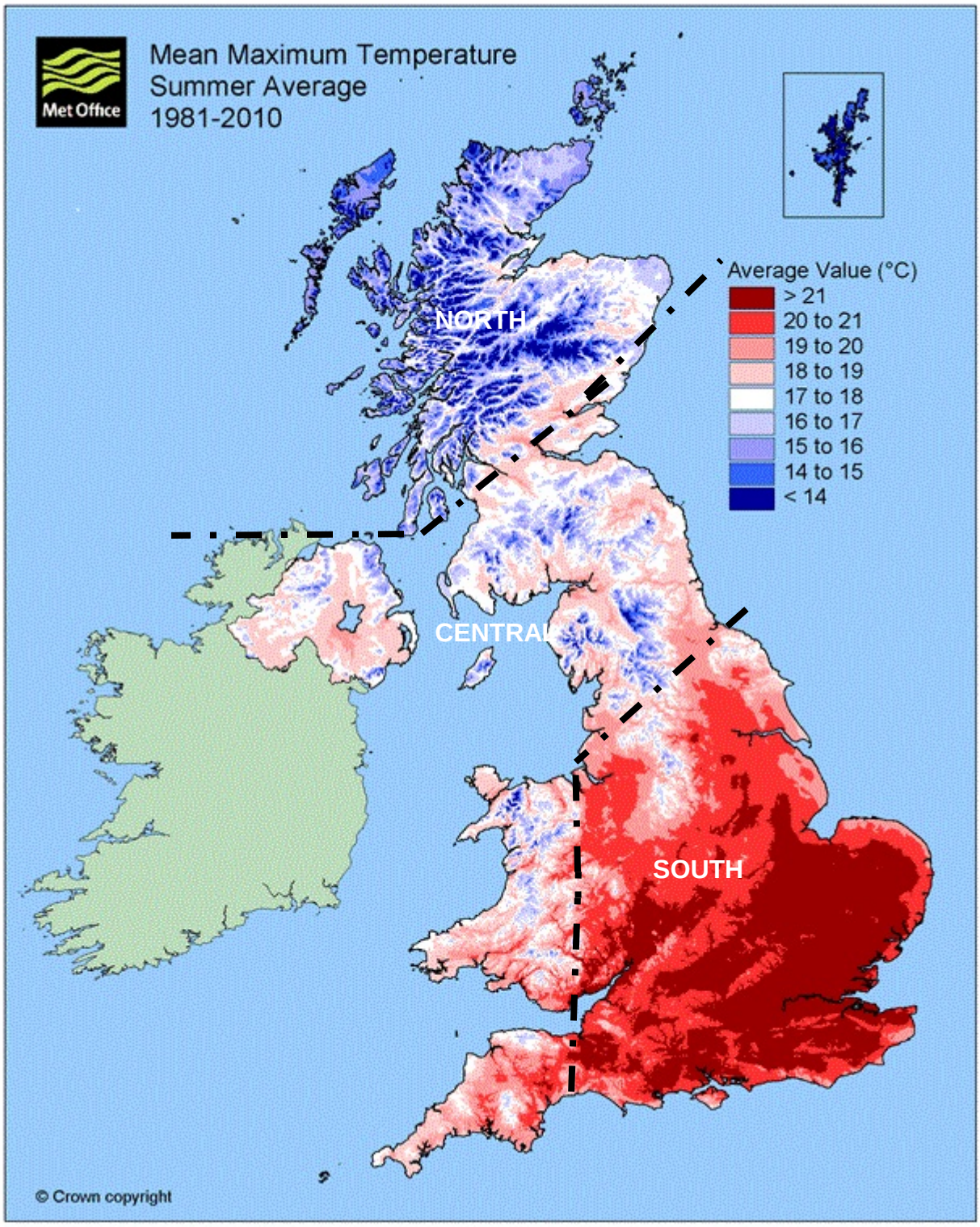

Figure 7.2.1 – Locations to determine approximate Surface Temperature Categories over Meteorological Office data on mean summer maximum temperatures

Table 7.2.1 – Approximate Surface Temperature Categories

Approximate Location	Altitude above sea level	Surface Temp. Category
South – England, south of Liverpool to Middlesbrough, excluding Devon and Cornwall	200 m or less	A
	Over 200 m	B
Central – England north of Leeds to Middlesbrough, Devon, Cornwall, Wales, Northern Ireland and Scotland south of Glasgow to Aberdeen	200 m or less	
	Over 200 m	C
North – Scotland, north of Glasgow to Aberdeen.	200 m or less	
	Over 200 m	D

The background of Figure 7.2.1 is the maximum summer temperature averaged between 1981 and 2010 from the Meteorological Office website. The map shows the extent of local variation that needs to be considered when identifying which category to allocate to a site. Local knowledge is necessary, with most Highway Authorities holding road sensor information that will enable them to identify road temperatures at any time during the year; such data can be used to check whether the location is typical of its geographic position.

7.2.2 Road hardness

Road hardness (RH) is a property that represents the resistance of an existing road surface in a particular location to the embedment of chippings and is particularly important for soft and very soft surfaces. As such, it is a property influenced by the local climate as well as the surfacing material because the hardness of all asphalt surfacing material is temperature dependent. The property is a fundamental component of the existing road surface in the specific location that is used to select the correct size of chipping. If there are areas with significant visual differences in the surfacing, the site should be divided up into such areas. A representative length of the nearside wheel-track in each lane of each area should be selected with no length representing more than 1 lane kilometre. Measurements are made on each representative length using the method described in BS 598-112 (BSI), using a hardness probe*. For the test, the surface temperature, which should preferably be between 15 °C and 35 °C, is recorded and the hardness category determined from the mean of a set of ten penetration readings using the graphs in Figure 7.2.2. It is also possible to use the Mexe-probe CBR with the tip as defined in BS 598-112.

Particular attention should be paid to determining the hardness category when Figure 7.2.2 indicates a category close to an adjacent hardness band. Interpolation between the graphs for areas close to a change in Surface Temperature Category may be necessary. Negative textured road surfaces (TSCS) are always 'hard' as the probe comes into contact with hard aggregate in the interstices.

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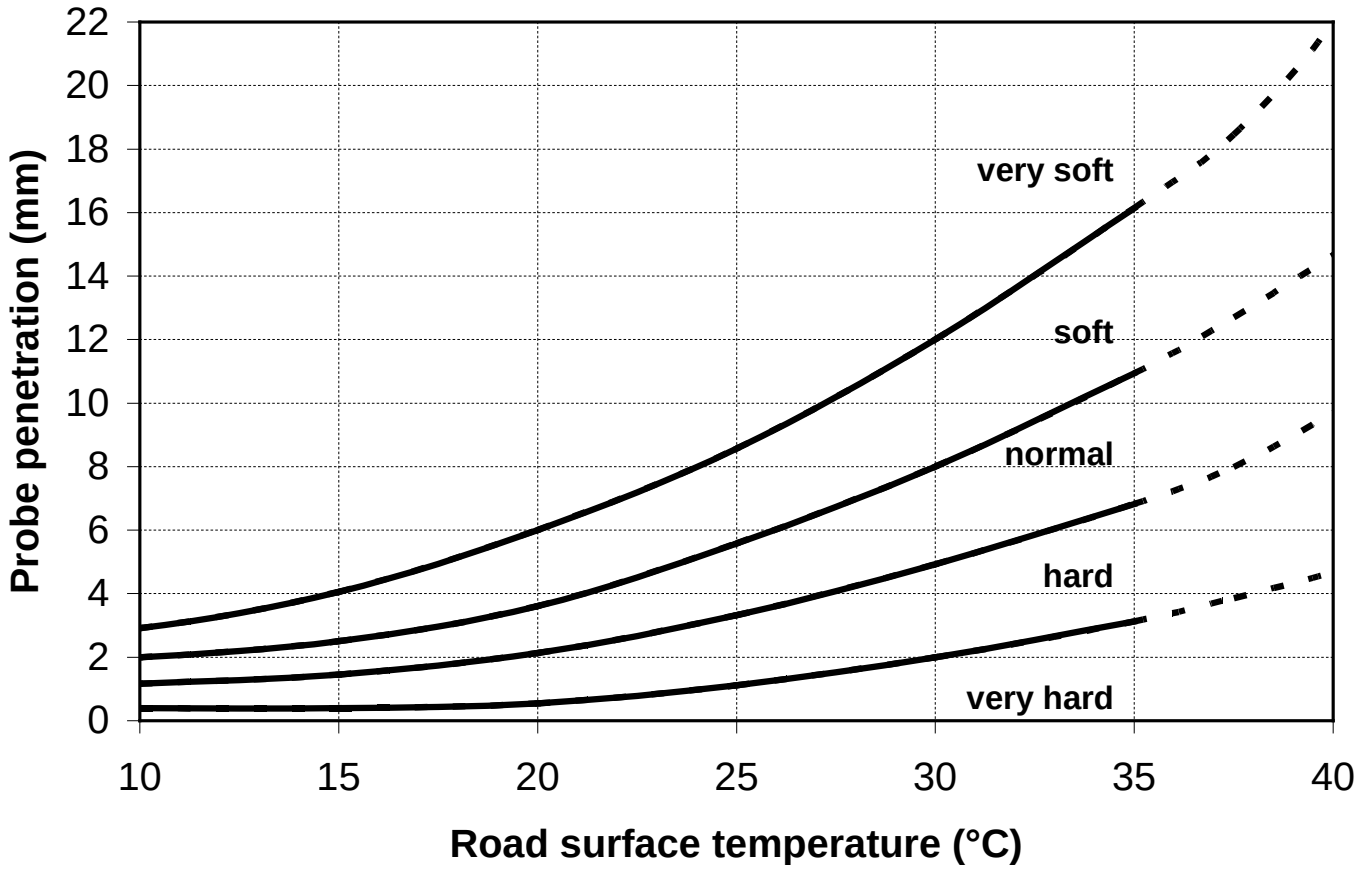
* BS 598 – 112: Method for the use of road surface hardness probe

Hardness Probe Suppliers

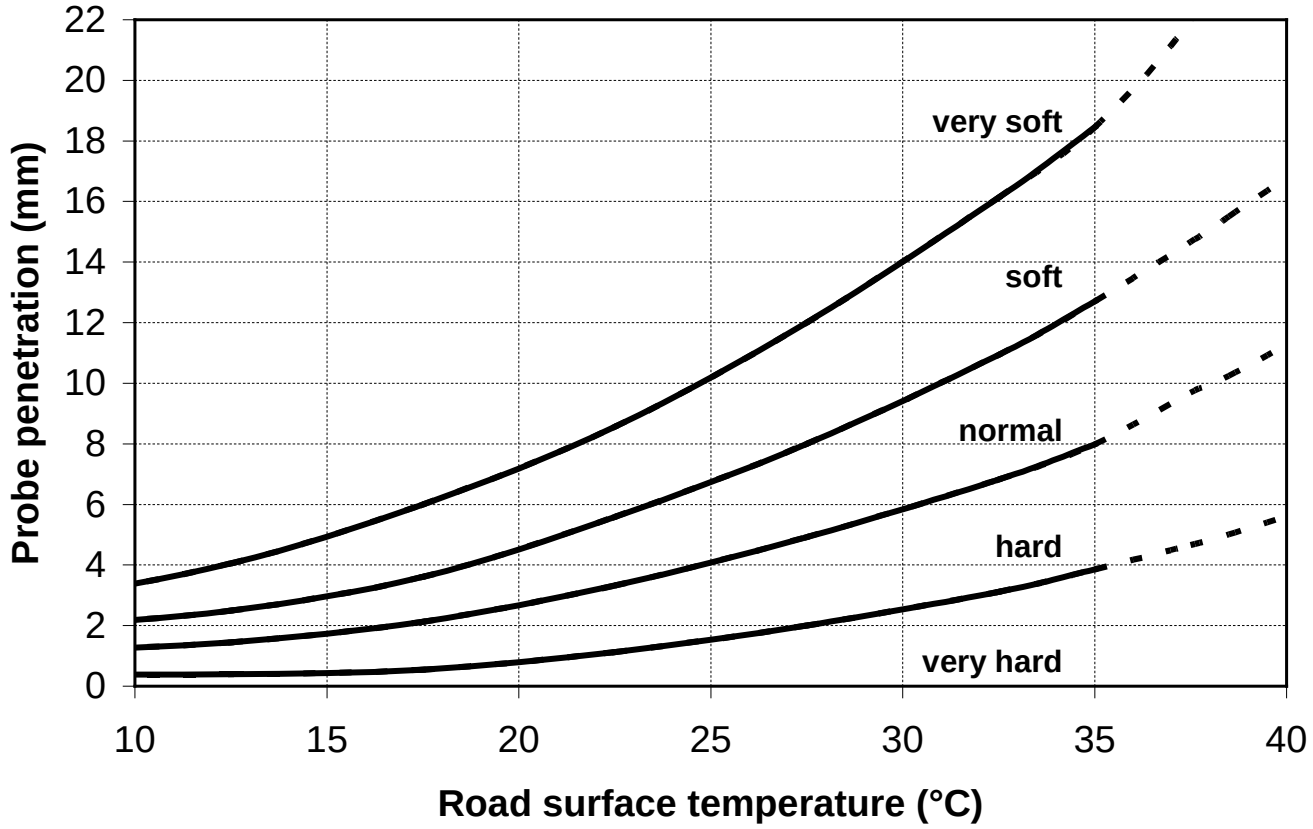
Materials Testing Equipment Limited. Gilwilly Industrial Estate, Penrith, Cumbria. CA11 9BQ
Tel: 01768 865302
http://www.materialstestingequip.com/contact.htm

Ideally, road hardness should be measured in the season prior to that in which the surface dressing is to be carried out. An alternative to *in situ* assessment is the use of 150 mm diameter cores that have been extracted from the road for some other purpose; these can be tested for hardness in the laboratory.

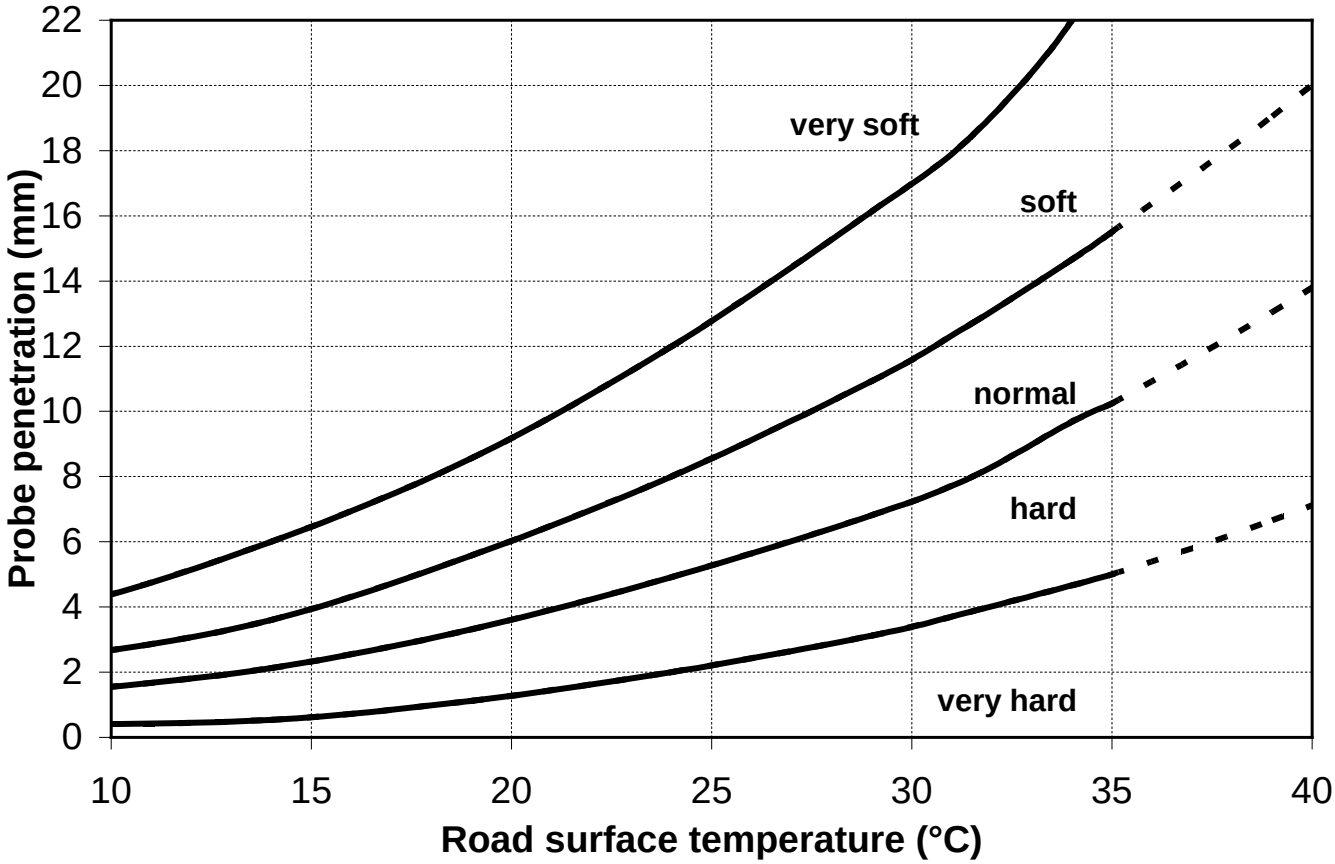
Concrete road surfaces present extreme resistance to embedment of chippings under the action of traffic and are classified as 'very hard'. Conversely, patched areas of asphalt surfacings are usually softer than the rest of the road and may need to be considered separately from the rest of the site.



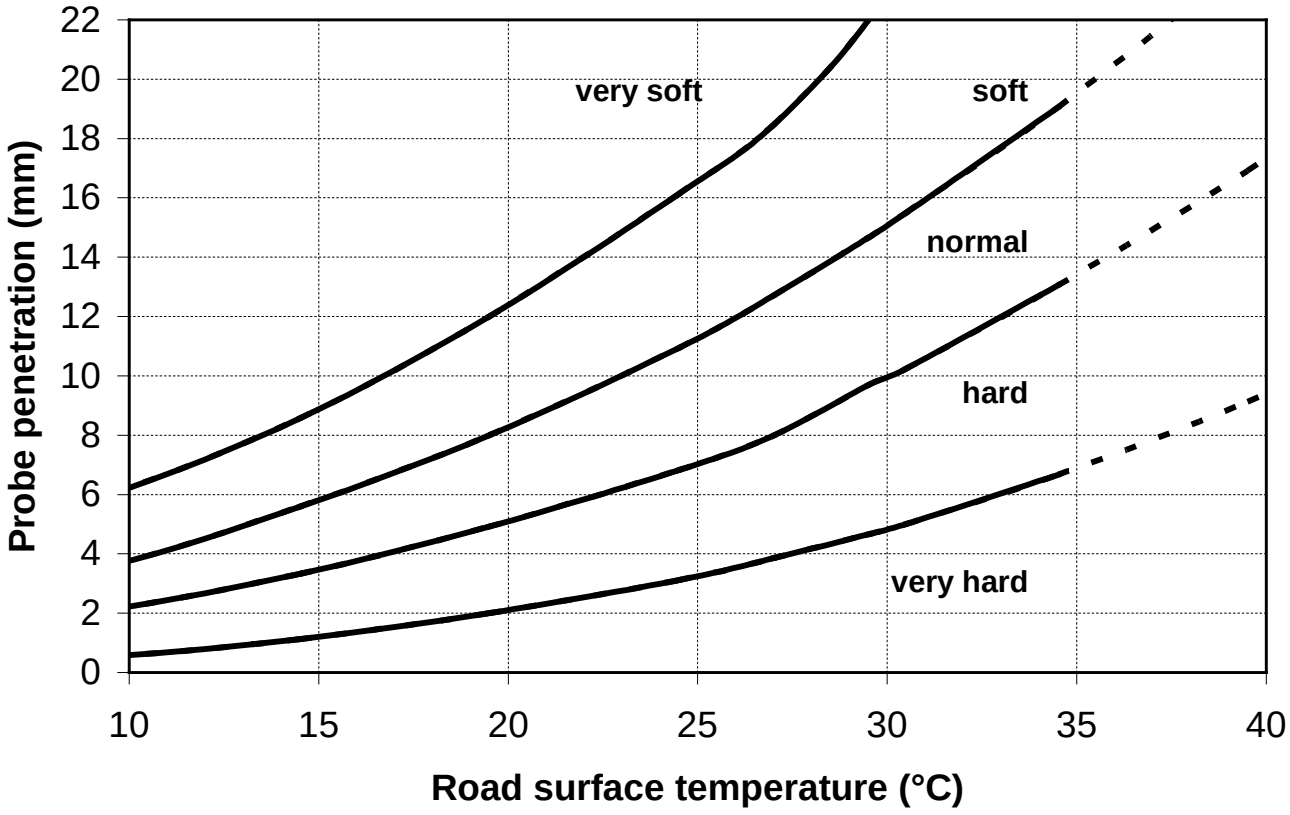
Category A (South below 200m)



Category B (South above 200m, Central below 200m)



Category C (Central over 200m and North below 200m)



Category D. (North over 200m)

Figure 7.2.2 – Hardness categories from depth of penetration and road surface temperature for different Surface Temperature Categories (see Table 7.2.1)

7.2.3 Traffic categories

A major factor in selecting a type of surface dressing is the anticipated volume of traffic that each lane of the road is required to carry. Because medium and heavy vehicles cause most of the embedment of chippings, the principal measure of traffic for design purposes is the number of medium and heavy vehicles per day currently travelling in the lane under consideration. Medium and heavy vehicles are defined as vehicles with a gross weight in excess of 3.5 tonnes and the day is nominally a 24 hour period. However, a manual count would usually be made between 06.00 and 22.00 hours and the value obtained multiplied by 1.06 to estimate the 24-hour figure.

Eight traffic categories (A to H) are used in the design method. (Other traffic categories using different demarcation values are referred to in Road Note 39 for which the classifications have been set by others for other uses – in particular, Table 7.3.1 for polished stone value requirements and sub-Clause NG 922 of the *Notes for Guidance for the Specification for Highway Works* (MCHW 2) for macro-texture performance requirements). The relevant category for a lane can be obtained for a particular site from Table 7.2.3. For dual carriageways and other major roads, the traffic flows should be known and can be used directly.

As an alternative for other roads, the New Roads and Street Works Act (House of Commons, 1991) road type can be combined with an estimate of whether it is in the upper or lower section of the classification. The Act mandated Highway Authorities to categorise their roads by traffic flows in order that they can inform the Statutory Undertakers of the standard to which repairs to excavation have to

be carried out. Whilst the categories are in terms of million standard axles (msa) during the design life, the Highway Authorities will have derived these data from knowledge of the traffic flow, including medium and heavy vehicles. Therefore, the Highway Authorities should have access to a representative traffic flow (in medium and heavy vehicles per day) which can be a guide to the designer.

Where no information is available to enable road categories to be derived, reference should be made to *'Well Maintained Highways - Code of Practice for Highway Maintenance Management" Section 8, Table 1 Carriageway Hierarchy.*

http://www.ukroadsliaisongroup.org/en/UKRLG-and-boards/uk-roads-board/wellmaintained-highways.cfm

The conversion to the categories used in this Road Note has been calculated on a 2% growth rate. In the event of no information being available, a manual count can be made. The count should be over at least an hour and be at an appropriate time for the local traffic pattern; the conversion to daily rate will depend on the time when the count is made and the local traffic pattern.

On two-way roads with one lane in each direction, the traffic on each lane is assumed to be half the sum in both directions. On single-track roads, the total traffic must be used. Narrow roads with the two directions sharing a common offside wheel-track should be designed with half the total traffic for the nearside wheel-tracks and with all the traffic for the central one.

Lane 1 (i.e. the nearside or left-hand lane) of both dual carriageway and three-lane roads usually carries the majority of medium and heavy vehicles. Conversely, in urban streets, parked vehicles may force moving traffic towards the crown of the road. Therefore, it is necessary to consider different specifications for each lane of multi-lane roads. The proportion of medium and heavy traffic using lane 1 of a multi-lane carriageway can be calculated according to Figure 3.3 of HD 24 (DMRB 7.2.1). The remaining medium and heavy traffic on a 3-lane motorway should be using lane 2 as they are excluded from Lane 3. For surface dressing purposes, it is usually adequate to estimate that two-thirds of the medium and heavy vehicles are in Lane 1 and one-third in Lane 2 of a 3-lane dual carriageway.

Table 7.2.3 – Traffic Categories

Medium & heavy vehicles / lane / day	0 to 50	51 to 125	126 to 250	251 to 500	501 to 1250	1251 to 2000	2001 to 2500	2501 to 3250	Over 3250
Traffic Category	H	G	F	E	D	C	B	B	A
NRSWA Road Type	4	4	3	3	2	1	1	0	0

7.2.4 Traffic speed

On lower category roads, or individual lanes of roads (traffic categories H, G and F), on which the traffic is moving at relatively high speeds, this needs to be taken into account in the selection of the type of surface dressing (Figures 8.3a and 8.3b). Where the surface dressing is likely to be subjected to regular high speeds (i.e. permitted speed of 50 mph and above), consideration should be given to a stronger surface dressing such as a racked-in or double surface dressing which are recommended on the more heavily-trafficked roads (Figure 8.3b).

7.2.5 Surface condition

The overall condition of the existing surfacing is important in determining the most appropriate type of surface dressing in order to improve durability for certain surface conditions. The Design Guide uses surface condition categories for the purposes of selecting the type of surface dressing (Figures 8.3a and 8.3b) which are:

- Very binder rich
- Binder rich
- Normal
- Texture in wheel tracks
- Binder lean/Porous

For variable road hardness see RSTA Code of Practice.

Allocation to a particular category is a subjective assessment that should be carried out by an experienced person.

7.2.6 Highway layout

The gradient, the tightness of bends and the extent of any super-elevation will affect the stresses imposed by vehicles on the road surfacing. Similarly, there are additional stresses due to sharp deceleration and turning at junctions and crossings. Therefore, when considering the appropriate type of surface dressing, the inclusion of some of these factors needs to be considered to ensure that a sufficiently robust surface dressing is designed and constructed. The following categories are used in the selection of the type of surface dressing (Figures 8.3a and 8.3b):

- Gradient – up to 5 % gradient; 5 % to 10 % gradient; and over 10 % (1 in 10) gradient.
- Radius of curvature – under 100 m radius; 100 – 250 m radius; and over 250 m radius
- Junction or crossing – approach; and non-approach

The presence and extent of lengths for which different categories apply should be taken into account in deciding whether to divide a site for the purposes of design (Section 8.2). The gradient for representative lengths of a site can be obtained as described in Sub-Section 7.4.2. The radius can be obtained from surveys from TRACS or SCANNER data or on site using two tapes. If a 30 m tape is stretched with both ends on the edge of the kerb, the radius can be categorized by the distance that the 15 m mark is from the kerb as:

- Under 100 m radius – when the distance is over 1.13 m
- 100 m to 250 m radius – when the distance is between 0.45 and 1.13 m
- Over 250 m radius – when the distance is less than 0.45 m

7.3 Parameters for selection of materials

7.3.1 Skid-resistance

One reason for surface dressing a road may be inadequate skid-resistance in the context of the Highway Authority's skid policy. Skid resistance is influenced by both the macro-texture of the road surface and the micro-texture of the aggregate.

Investigatory levels for the Strategic Road Network are given in HD 28/15 (DMRB 7.3.1) for various classifications of site in terms of the skid-resistance, as defined by the Mean Summer SCRIM

Coefficient (MSSC), at either 50 km/h or 20 km/h, with the SCRIM values being measured by a Sideway-force Coefficient Routine Investigation Machine.

The PSV of the aggregate in the road surface and the flow of medium and heavy vehicle traffic have been found to correlate with the skid-resistance of the road for a particular material type. The relationships between skid-resistance, traffic and the required PSV of the aggregate have been established and HD 36 sets out the required minimum PSV of chippings for new construction and maintenance works on trunk roads and motorways. The requirements for different areas of a site can be found using Table 3.1 in HD 36 and, for traffic levels of 250 cv/lane/day or less, and Table 7.3.1 below (Warwickshire County Council).
However, although the skidding requirements may vary along a site, the use of different aggregates of varying PSV on the different lengths of a site is usually impractical.

Note: Further information related to local roads is available from www.rsta-org/publications.

For traffic levels over 250 cvld refer to IAN 156 Table 3.1a for guidance on selecting the minimum PSV for a given investigatory level, traffic level and site category and Table 3.3 in HD36/06 part of the DMRB for guidance on selecting AAV related to traffic levels. Experience shows that a maximum AAV of 8 performs well on heavily trafficked high speed roads however for more lightly trafficked roads blastfurnace slag with AAV above 8 has also shown good performance.

Table: 7.3.1 Recommended PSV levels for less heavily trafficked local roads

Site Description	**Minimum PSV required for given IL, traffic level and type of site**			
	IL	Traffic (cv/lane/day) at design life		
		0-20	21-100	101-250
Single carriageways and dual carriageways where traffic is generally free-flowing on a relatively straight line.	**0.35**	50	50	50
	0.40	50	50	50
	0.45	55	55	55
Approaches to major and minor junctions or other hazards on all-purpose single carriageways and dual carriageways where frequent or sudden braking occurs but in a generally straight line, including pedestrian crossings and mini-roundabouts	**0.45**	55	55	55
	0.50	55	55	60
	0.55	60	60	65
Gradients (>5%) longer than 50 m	**0.45**	55	55	55
	0.50	55	55	60
	0.55	60	60	65
Bends on all types of road (<500 m radius); roundabout circulation areas except mini roundabouts; approaches to hazards that require combined braking and cornering.	**0.45**	55	60	60
	0.50	60	60	65
	0.55	65	68+ or HFS	68+ or HFS

Notes: 1. Shaded lines are the proposed default Investigatory levels for each Site Description but each authority will have a skid policy which defines the IL for their network ref HD28.

2. Where '68+' material is listed in this Table, none of the three most recent results from consecutive tests relating to the aggregate to be supplied shall fall below 68.

3. HFS means that high friction surfacing complying with MCHW 1 Clause 924 will be required.

4. Refer to HD36 for sites carrying more than 250 cvld in the absence of a local skid policy.

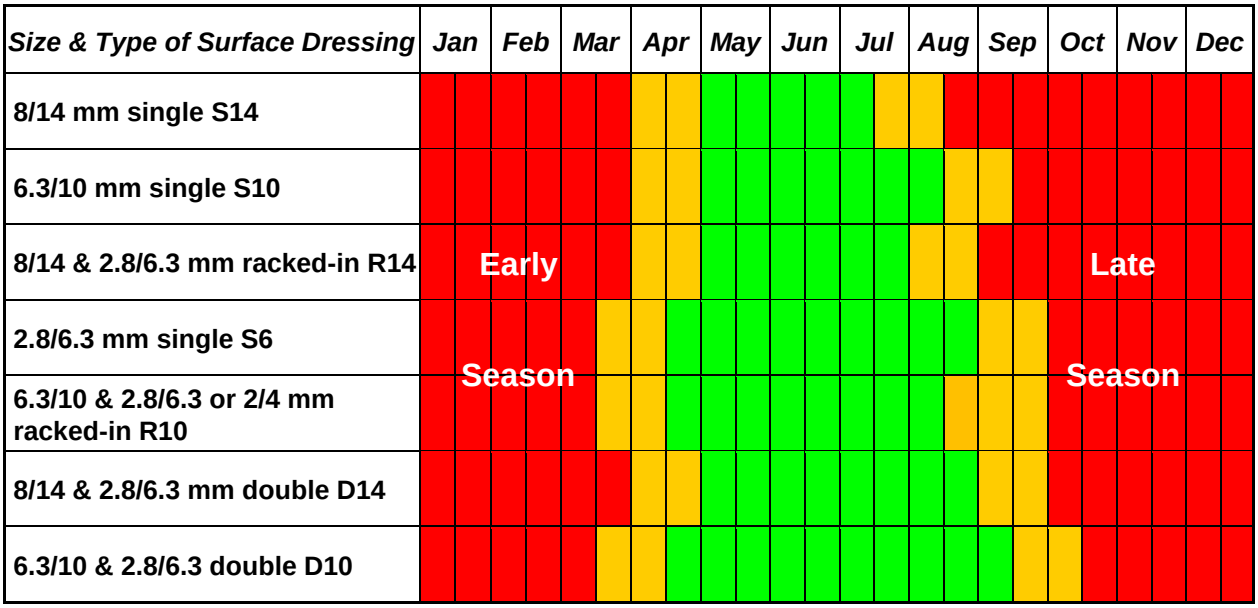
7.3.2 Seasons

Surface dressing is a seasonal activity primarily because the long-term stability of the treatment is dependent upon the chippings becoming embedded in the substrate and/or reoriented into a stable mosaic before the onset of cold weather. If a stable mosaic does not form, the chippings are liable to be removed by traffic. The general principle is that larger chipping sizes should be used as early in the season as possible because they are more dependent on embedment for stability. Use of modified binders may reduce the susceptibility of a surface dressing to early failures. Double and multiple-layered surface dressings have better aggregate interlock and are, therefore, much less susceptible to failures due to lack of embedment.

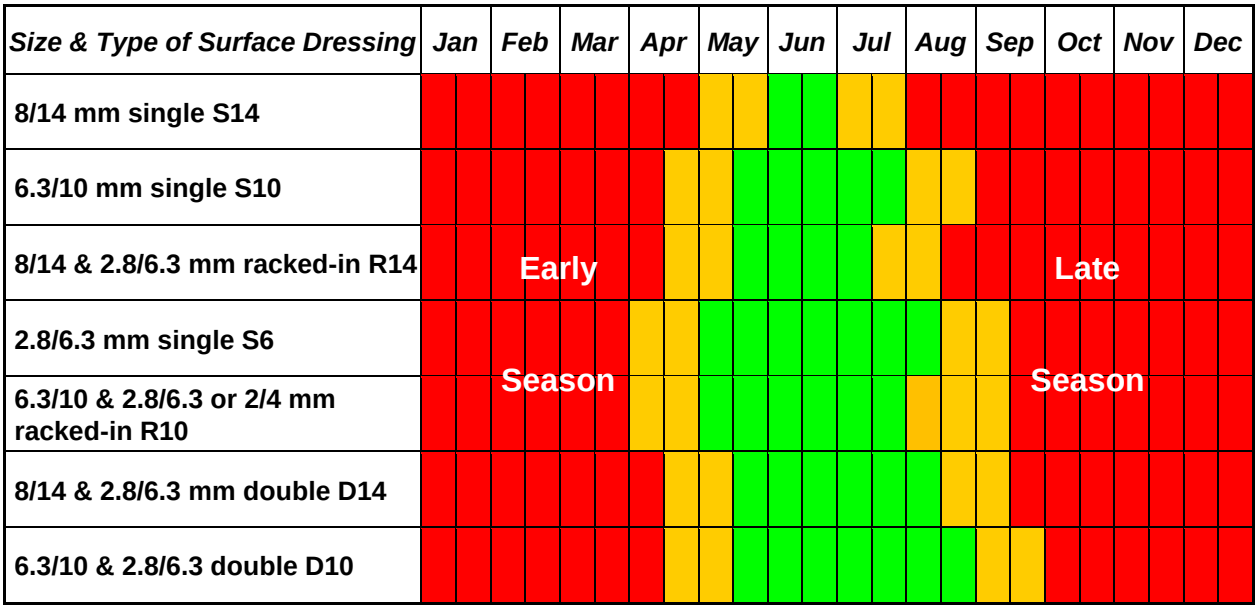
The seasons that apply in the UK for the surface dressing products are given in Figure 7.3.2.

The surface dressing types are coded for convenience in Figures 7.3.2, 9.2.1, 9.2.2 and 9.2.3. S is for single, D for double and R for racked-in and the chipping sizes are the maximums so S6 is a 2.8/6.3 chipping single surface dressing.

Surface Temperature Category A & B (refer to 7.2.1)



Surface Temperature Category C & D (refer to 7.2.1.)



	High risk	Surface dressing should not be undertaken because of the probability of failure.
	Significant risk	There is some risk of failure (higher in late season) so extra care in the design and execution of the system is required. There is a good possibility of success in favourable weather conditions.
	Low risk	Normally successful provided the weather conditions are appropriate for the product.

Notes:
1. The surface temperature categories refer to those detailed in sub-section 7.2.1
2. Late season work on fast, heavily-trafficked roads is not recommended because of the consequences of any failure.
3. 2.8/6.3 mm chippings should not be substituted for 6.3/10 mm chippings just to allow late season working.

Figure 7.3.2 – Surface Dressing Season

The seasons are only a guide because the weather in any one year may be such that the period when surface dressing can be expected to be carried out successfully may be reduced or extended to take account of:

- High humidity conditions
- Long-term weather forecasts
- The consequences that would result from a failure, usually determined by the class of road to be dressed
- Overnight temperatures
- Other local situations

Therefore, although Figure 7.3.2 takes account of the effect that different surface temperature categories have on the surface dressing season, it should be understood that the season can also be affected by other regional and climatic variations. Figure 7.3.2 should be regarded as a guide and contracts compiled on the basis of a performance-related or end-product specification, where the risk is the responsibility of the contractor, should not be restricted.

Late season single 10mm surface dressing has the highest proportion of failures due to low overnight temperatures and a higher risk of poor weather in the weeks following the work.

Any sites dressed in the 'significant risk' periods at the end of the season should be viewed as late season work and, therefore, more susceptible to winter failures. Accommodation for this factor should be made by increasing the rate of application of binder using the factor given in Table 9.2.6. However, the application of additional binder, whilst increasing the probability of surviving the following winter, will also increase the risk of fatting up during subsequent summers. Thick films take longer to fully break than thin ones so it may be prudent to switch from a Racked-in to a double surface dressing in late season.

Within any season, no binder is totally tolerant of extreme weather conditions. Emulsions will break slowly in cold or wet conditions or when the humidity is high. When the humidity is over 80 %, emulsion break can be delayed and breaking agents may become necessary (for e.g. high speed and heavily trafficked roads). Rain can also adversely affect binder systems, principally the initial adhesion of chippings.

Weather forecasts should always be obtained before carrying out surface dressing operations.

7.4 Parameters for adjustment to local conditions

7.4.1 Surface condition

Local variations in the condition of the existing surfacing need to be allowed for in the rate of spread of binder. The variations should be such that for all conditions:

- Sufficient binder is present for the initial retention of the chippings prior to longer term embedment.
- Excess binder is avoided which could fat up.

For the purposes of the local corrections in Table 9.2.6, the five categories of surface condition are:

- Very binder rich
- Binder rich
- Normal
- Texture in wheel tracks
- Binder lean/Porous

As for the overall surface condition (Sub-Section 7.2.5), allocation to a particular category is a subjective assessment, which should be carried out by an experienced person. Allowance should be

made for asphalt substrates less than one year old, which tend to have a relatively high binder demand. The texture depth of the existing surface, determined in accordance with BS EN 13036-1 or from machine surveys can be used to assess the extent to which an asphalt surface is open-textured, thus requiring more binder.

Surface dressing is increasingly being specified as a maintenance treatment for negative texture road surfaces. On such surfaces it is important to provide some sort of seal to the surface in order that the binder does not seep into the open textured surface, leaving insufficient to hold the chippings of the surface dressing in place. A pad coat surface dressing layer, followed by a second layer of single or racked-in surface dressing to provide the specified surface characteristics has been used successfully. See RSTA Code of Practice.

7.4.2 Gradient

The gradient of the road affects stresses imposed on its surfacing, since traffic travelling uphill tends to push chippings into the road surface whereas traffic travelling downhill has the opposite effect and can provide more surface stress due to braking. In the Design Guide, five categories of gradient are used for the purposes of local corrections in Table 9.2.6:

- Over 10 % (1 in 10) uphill gradient
- 5 % to 10 % uphill gradient
- Less than 5 % gradient
- 5 % to 10 % downhill gradient
- Over 10 % downhill gradient

The gradient can be obtained from SCANNER or TRACS surveys or on site using a 1 metre straight edge and measuring the distance between the bottom of the straight edge and the road when the straight edge is held in a level position. The distance expressed in centimetres is equal to the gradient in percent.

7.4.3 Shade

Areas of asphalt road surface shaded by trees, or in the shadow of buildings, bridges or tunnels, tend to be cooler and thus more resistant to chipping embedment than areas in the sun. To account for this effect, the rate of spread of binder should be increased in shady areas by the amount shown in Table 9.2.6. This correction is not required for concrete surfaces.

7.4.4 Local traffic

Some areas of a road may be subject to significantly less traffic than the rest, but may not be sufficiently large to warrant a separate design. Such areas include hard shoulders and edge strips on dual carriageways (unless a contra flow is planned) and sizeable areas with hatched lines to exclude traffic. All these areas are effectively untrafficked and the rate of application of binder should be increased in order to compensate for the lack of embedment of chippings.

8. SELECTION OF TYPE OF SURFACE DRESSING

Reference should be made to Chapter 2 for schematic representation of the different types of surface dressings and to the RSTA/ADEPT Code of Practice for Surface Dressing.

8.1 Suitability of existing surface characteristics

Figure 8.1 indicates the limits of performance that may be expected for a given substrate condition and should be considered when performance levels are specified. Specifications should not demand higher levels of performance than the existing road characteristics permit.

Except where “Yes” is shown in Figure 8.1, an experienced surface dressing designer should be consulted and it may be necessary to accept a reduced life. Options include higher binder application rate or smaller chipping size for porous areas and reduced binder rate or larger chippings in the wheel tracks of soft roads. Inverted double surface dressings may provide a solution to seal porous areas and to normalise variable existing surfaces.

Double surface dressings and sandwich surface dressings with Premium Grade emulsion or Super-Premium Grade have greater stability. Although macro-texture may not be as great initially as for a single or racked-in surface dressing, they resist loss of macro-texture with time and traffic. They are also used where initial stability is critical and excess chippings are unacceptable; this may include areas where there are pedestrians.

If the surface characteristics include crazing or cracking, the structural condition of the pavement is suspect and the surface dressing can only be a temporary measure. However, the waterproofing properties of surface dressing, especially when combined with geotextile fabric or fibres, may reduce moisture in the structure and improve the condition (RSTA/ADEPT Code of Practice for Surface Dressing and RSTA/ADEPT Guidance on the use of Stress Absorbing Membrane Interlayers (SAMI) in Surface Dressing).

Existing surface characteristic	Traffic Category							
	H	G	F	E	D	C	B	A
Very Hard and homogeneous	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hard and homogeneous	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Normal and homogeneous	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Soft and homogeneous	Yes	Yes	Yes	Yes	Texture	Texture	E	
Very Soft and homogeneous	Yes	Yes	Yes	Texture	E	E		
Fatting up in wheel tracks	Yes	Yes	Texture	Texture	E	E		
High macro-texture or fretted	Yes	Yes	Yes	Yes	Defects	Defects	E	
Porous	Yes	Yes	Yes	Defects	Defects	E		
Very variable	Defects	Defects	Defects	Defects	Defects	E	E	
Extensive patching	E	E	E	E	E			
Severe bleeding & extensive blackening								

Yes	The surface dressing can be designed to meet the most onerous performance requirements in terms of macro-texture and levels of defects to BS EN 12272-2 (BSI).
Texture	It is difficult to maintain high macro-texture, especially in the wheel tracks and for high-speed roads. Texture requirements for low speed roads may be achievable.
Defects	It is difficult to design a surface dressing that will meet the most onerous requirements for the test method of visual assessment of defects to BS EN 12272-2 (BSI) and the requirements should not be specified.
E	In some circumstances, a suitable surface dressing may be designed by an expert to meet less onerous performance levels. Extra care in execution is required.
	Surface dressing is not an appropriate treatment.

Figure 8.1 – Effect of Existing Road Surface Characteristics on Achievable Performance Levels

8.2 Sections within a site

The surface of a road to be surface dressed may vary, either longitudinally or transversely, along its length. Therefore, it may be reasonable, and indeed desirable, to divide a site into different sections and apply different surface dressings and/or components to sections of road which are subject to different traffic stresses, such as different lanes of dual carriageways, junctions, substantial lengths of roads with sharp bends or steep gradients. Also sites which are subjected to regular on street parking should be treated differently.

However, it is not practical to change the type or components of the surface dressing at frequent intervals along the site and the designer will need to rationalise any changes into long sections for which they are essential and practical. Local changes in surface condition may be best catered for by selecting a type of surface dressing and components applicable to address the worst condition to be met within the section, or locally applying extra binder where problems of shaded areas / short steep

gradients etc need to be overcome. Such changes on site demand the employment of experienced personnel, trained to recognise possible problem areas and implement the required action.

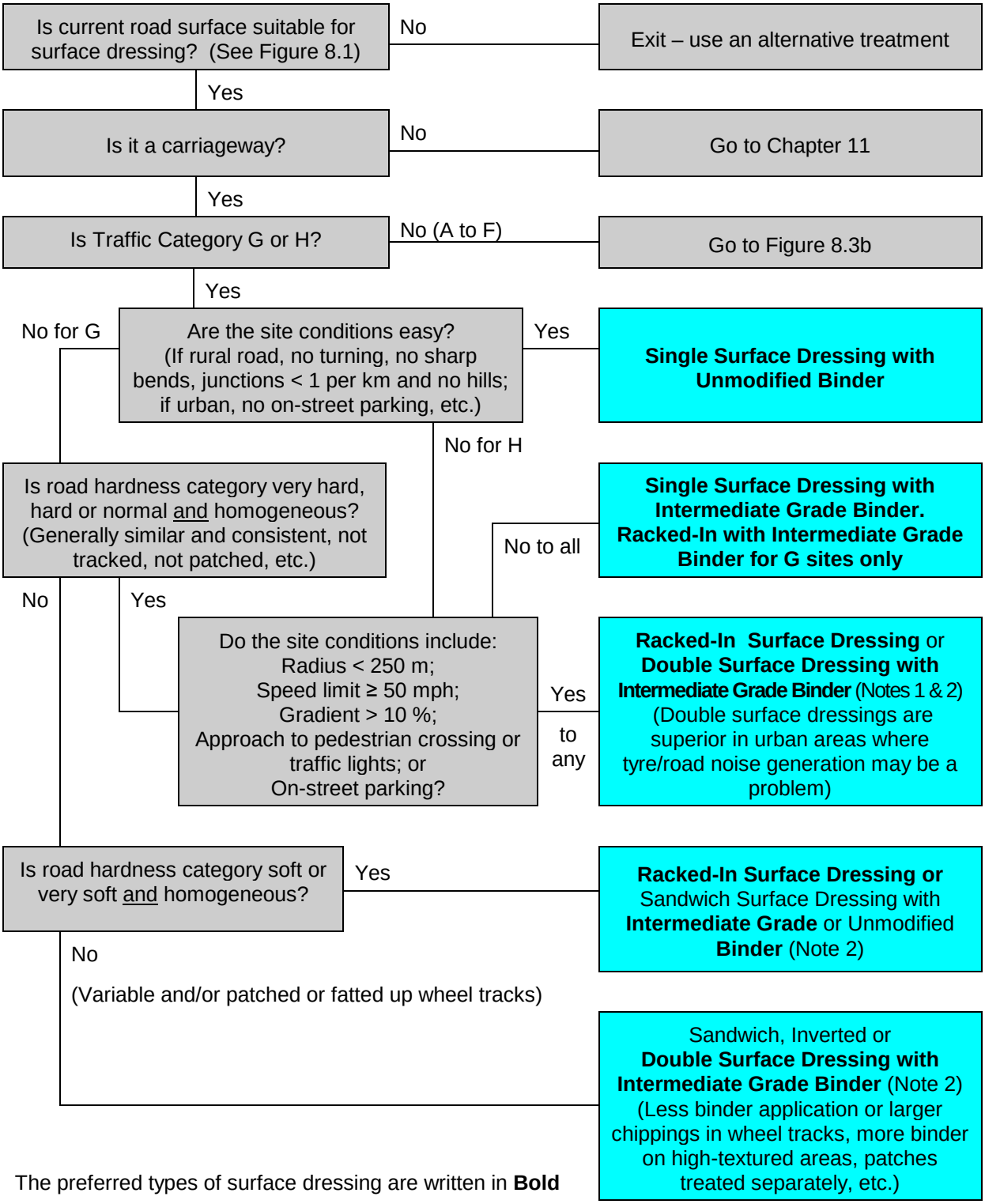
8.3 Type of surface dressing for a section

The types of surface dressing available are illustrated in Section. Figures 8.3a and 8.3b give recommendations for the type of surface dressings which can be expected to be the most successful under different circumstances. Figure 8.3b (for more highly trafficked roads) gives advice on the more sophisticated surface dressings. For those options with modified binders, the choice of Intermediate or Premium Grade Emulsion will depend on the severity of the traffic stresses and other factors such as:

- the condition of the existing surface (Figure 8.1);
- the need to reduce initial chipping loss;
- the need to protect pedestrians e.g. from binder pick up on shoes;
- the resisting of damage by parked cars; and
- pressure to open the road quickly.

Whilst Figures 8.3a and 8.3b can be used to identify one type of surface dressing that is suitable for consideration, the type selected is not necessarily the only one that can be used in the circumstances. Further, there may be reasons, other than those included in the decision tree, for using a different type. The effect of tyre/road noise generation is one example where careful design of double surface dressing may satisfy the macro-texture requirements and also reduce noise from traffic. This is of increasing importance in urban areas.

The type indicated in Figures 8.3a or 8.3b may be regarded as over- or under-design, in which case consideration should be given to a less or more expensive option, respectively. Possible reasons could include when the road has a limited structural life, when the traffic intensity is expected to change in the foreseeable future or when the road has a strategic importance for reasons other than traffic flow. All these considerations should be taken into account when choosing the most appropriate type of surface dressing.



The preferred types of surface dressing are written in **Bold**

Note 1: High-friction surfacing may be considered depending on site difficulty and quality of substrate. For further information refer to RSTA/ADEPT Code of Practice for High Friction Surfacing

Note 2: Where initial stability is required (junctions to major roads, pedestrian areas, fast commuter runs, on-street parking, etc.), Intermediate Grade Binder or above may be required. Double surface dressings have greater stability than racked-in surface dressings and are more tolerant of varying surface condition and road hardness. Racked-in and double surface dressings may assist prevention of tearing at junctions, slip lanes, on hills, etc.

Figure 8.3a – Selection of Type of Surface Dressing for Lightly-Trafficked Sites

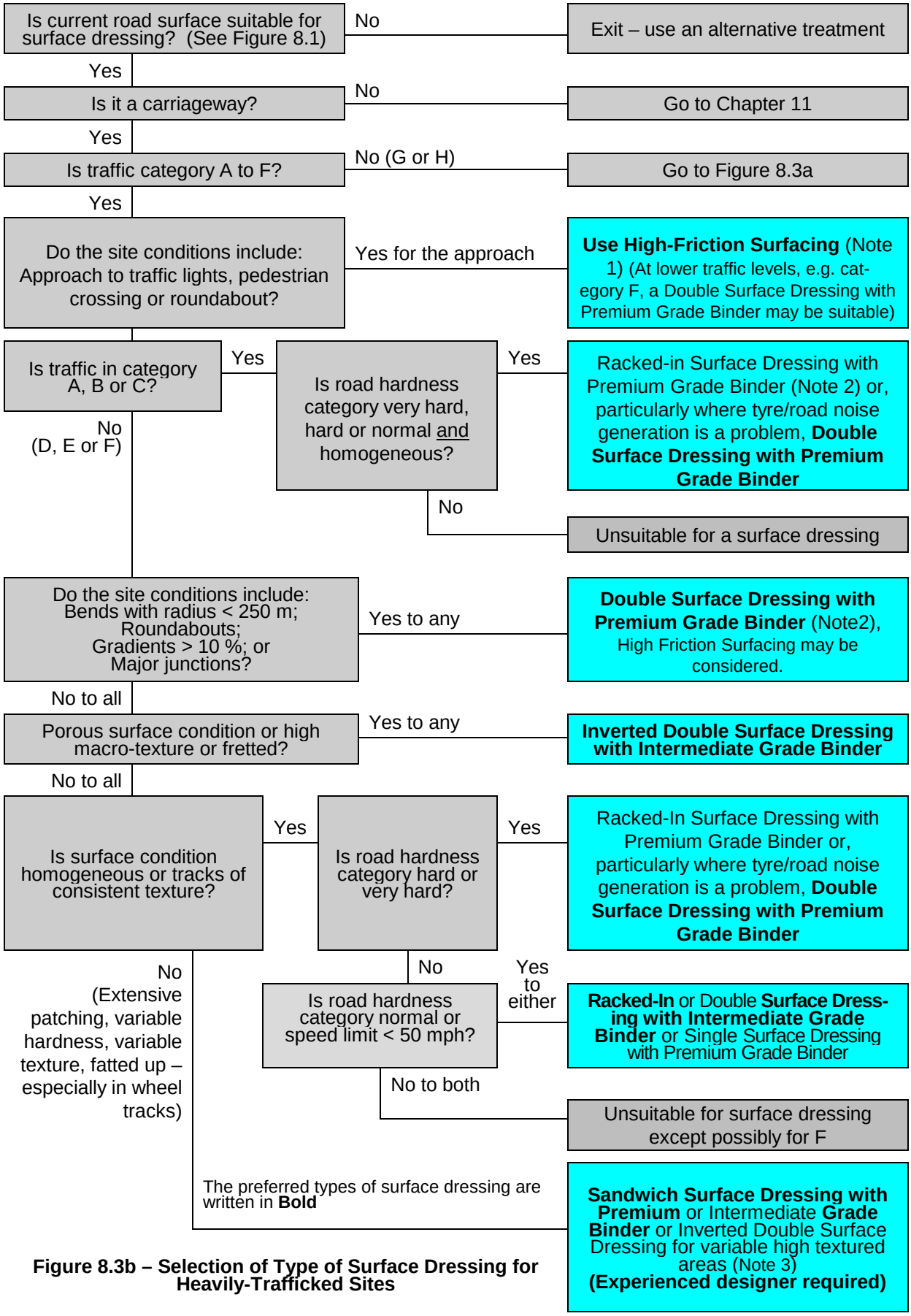


Figure 8.3b – Selection of Type of Surface Dressing for Heavily-Trafficked Sites

Note 1: High-friction surfacing may be considered depending on site difficulty and quality of substrate.

Note 2: On high stress sites Super Premium Grade binder may be more appropriate**.**

Note 3: Where initial stability is required (junctions to major roads, pedestrian areas, fast commuter runs, on-street parking, etc.), Intermediate Grade Binder or above may be required. Double surface dressings have greater stability than racked-in surface dressings and are more tolerant of varying surface condition and road hardness. Racked-in and double surface dressings may assist prevention of tearing at junctions, slip lanes, on hills, etc.

9. DESIGN CONSIDERATIONS OF SURFACE DRESSING CHIPPINGS AND BINDERS

9.1 Chippings – rates of spread

9.1.1 Single surface dressing

The quantity of chippings applied must be sufficient to cover the film of binder. The chippings should be spread at a rate to achieve 100 to 105 % shoulder to shoulder coverage determined by BS EN 12272-1 (BSI). The specific quantity required will depend on factors such as the size, shape and relative density. However, guidance for estimating quantities is given in Table 9.1.1.

Table 9.1.1 – Typical range of rate of spread of chippings for single surface dressings to achieve shoulder to shoulder cover

Nominal size of chipping	Range of Spread Rates	
	(kg/m²)	(m²/tonne)
2.8/6.3 mm	8 – 11	125 – 91
6.3/10 mm	10 – 14	100 – 71
8/14 mm	12 – 16	83 – 62

9.1.2 Racked-in surface dressing

The primary chipping should be spread to provide about 90 % shoulder to shoulder coverage (Heslop *et al.*, 1982) as measured by BS EN 12272-1 (BSI). If combinations of chippings are used in which the secondary chippings are large relative to the primary (e.g. 6.3/10 mm and 2.8/6.3 mm instead of 6.3/10 mm and 2/4 mm), the rate of spread of primary chippings may need to be reduced further in order to leave interstices for the secondary chippings.

The secondary chippings should be spread so that there is an excess. The amount necessary will depend on the ratio of the two sizes used, location and the method of spreading. At minor junctions and other locations where traffic will turn across the new surface dressing, it is advantageous to use a greater excess of smaller chippings in order to reduce the possibility of damage from turning traffic in the early life of the surface dressing.

9.1.3 Double surface dressing

The rate of spread of the first layer should be 95 % shoulder-to-shoulder coverage as measured by BS EN 12272-1 (BSI). The second layer should be 100 to 105 % based on the same method of measurement. The actual quantity required will depend upon factors such as the size, shape and

relative density of the chippings. Chippings should be selected on the same basis as for racked-in surface dressings (Sub-Section 9.1.2).

9.1.4 Inverted double surface dressing

Both layers of chippings should be spread to achieve 100 to 105 % shoulder-to-shoulder coverage as measured by BS EN 12272-1 (BSI). All surplus chippings from the first layer must be removed before the second layer of chipping is applied.

9.1.5 Sandwich surface dressing

The rate of spread of chippings is as for double surface dressings (Sub-Section 9.1.3).

9.2 Rate of spread of bituminous emulsion binder and chipping sizes for various combinations of traffic categories and surface hardness

9.2.1 Single surface dressings

The design of the binder spread rate for single surface dressings is done by reference to Table 9.2.1 with the binder rate then being adjusted for different local conditions from Sub-Section 9.2.6. The rate of spread of binder, after adjusting for secondary factors as described in Sub-Section 9.2.6, is based on 67 % binder content bitumen emulsions and needs to be adjusted if a different binder content emulsion is used.

Table 9.2.1 – Recommended Nominal Size of Chipping and Target Rates of Spread of Binder at Spraying Temperature for Single Surface Dressings

Traffic Category	Hardness Category of Road Surface									
	Very Hard		Hard		Normal		Soft		Very Soft	
	Size of Chipping (mm)	Binder Rate (L/m²)	Size of Chipping (mm)	Binder Rate (L/m²)	Size of Chipping (mm)	Binder Rate (L/m²)	Size of Chipping (mm)	Binder Rate (L/m²)	Size of Chipping (mm)	Binder Rate (L/m²)
A	(a)		(a)		(a)		(b)		(b)	
B	S10	1.8 (c)	(a)		(a)		(a)		(b)	
C	S10	1.8 (c)	S10	1.6 (c)	(a)		(a)		(b)	
D	S6	1.5 (c)	S10	1.6 (c)	(a)		(a)		(a)	
E	S6	1.5 (c)	S10	1.6 (c)	S10	1.6 (c)	S10	1.6 (c)	(a)	
F	S6	1.5 (c)	S6	1.5 (c)	S10	1.6 (c)	S10	1.6 (c)	(a)	
G	S6	1.5	S6	1.5	S6	1.5	S10	1.6	(a)	
H	S6	1.5	S6	1.5	S6	1.5	S6	1.4	S6	1.4

Notes: (a) Multiple layer surface dressing preferred – see Figures 8.3a and 8.3b.

(b) Conditions not suitable for single surface dressings – see Figure 8.3b.

(c) Polymer-modified versions of this type of binder are preferred in those conditions – see Section 5.3.4 and Figure 8.3b.

d) The surface dressing types are coded for convenience: S is for single and the chipping sizes are the maximums so S6 is a 2.8/6.3 chipping single surface dressing and S10 is a 6.3/10 chipping.

9.2.2 Racked-in surface dressings

The design of binder spread rate for racked-in surface dressings is done by reference to Table 9.2.2 with the binder rate then being adjusted for different local conditions from Sub-Section 9.2.6. The rate of spread of binder, after adjusting for secondary factors as described in Sub-Section 9.2.6, is based on 67 % binder content bitumen emulsions and needs to be adjusted if a different binder content emulsion is used.

Table 9.2.2 – Recommended nominal size of chippings and target rates of spread of binder at spraying temperature for racked-in surface dressings

Traffic Category	Hardness Category of Road Surface									
	Very Hard		Hard		Normal		Soft		Very Soft	
	Size of Chipping [d] (mm)	Binder Rate (L/m²)	Size of Chipping [d] (mm)	Binder Rate (L/m²)	Size of Chipping [d] (mm)	Binder Rate (L/m²)	Size of Chipping [d] (mm)	Binder Rate (L/m²)	Size of Chipping [d] (mm)	Binder Rate (L/m²)
A	R10	1.9 [c]	R14	2.1 [c]	R14	2.0 [c]	(b)		(b)	
B	R10	1.9 [c]	R10	1.8 [c]	R14	2.0 [c]	(b)		(b)	
C	R10	1.9 [c]	R10	1.8 [c]	R14	2.0 [c]	(b)		(b)	
D	R10	1.9 [c]	R10	1.8 [c]	R14 R10	2.0 [c] 1.8 [c]	R14	2.0	R14	1.9
E	R10	1.9 [c]	R10	1.8 [c]	R10	1.8 [c]	R14 R10	2.0 1.8	R14	1.9
F	R10	2.0 [c]	R10	1.9 [c]	R10	1.9 [c]	R10	1.8	R10	1.6
G	R10	2.0	R10	2.0	R10	1.9	R10	1.9	R10	1.7
H	(a)		(a)		(a)		R10	1.9	R10	1.7

Notes: (a) Racking-in system considered unnecessary in most circumstances, single dressing sufficient – see Figure 8.3a.

(b) Conditions not suitable for racked-in surface dressings – see Figure 8.3b.

(c) Polymer modified versions of this type of binder are preferred in those conditions – see Section 5.3.4 and Figure 8.3b.

(d) The surface dressing types are coded for convenience: R is for racked-in surface dressing and the chipping sizes are the maximums so R10 is a 6.3/10 mm primary chipping layer racked-in with a 2.8/6.3 or a 2/4mm chipping.

9.2.3 Double surface dressings

The design of binder spread rate for double surface dressings is done by reference to Table 9.2.3 with the binder rate then being adjusted for different local conditions from Sub-Section 9.2.6. The rate of

spread of binder, after adjusting for secondary factors as described in Sub-Section 9.2.6, is based on 67 % binder content bitumen emulsions and needs to be adjusted if a different binder content emulsion is used.

Table 9.2.3 – Recommended nominal size of chippings and target rates of spread of binder at spraying temperature for double surface dressings

Traffic Category	Hardness Category of Road Surface														
	Very Hard			Hard			Normal			Soft			Very Soft		
	Size of Chipping [c]	Binder Rate, first layer (L/m²)	Binder Rate, second layer (L/m²)	Size of Chipping [c] (mm)	Binder Rate, first layer (L/m²)	Binder Rate, second layer (L/m²)	Size of Chipping [c] (mm)	Binder Rate, first layer (L/m²)	Binder Rate, second layer (L/m²)	Size of Chipping [c] (mm)	Binder Rate, first layer (L/m²)	Binder Rate, second layer (L/m²)	Size of chipping [c] (mm)	Binder Rate, first layer (L/m²)	Binder Rate, second layer (L/m²)
A	D10	1.1	1.2 [b]	D14 D10	1.2 1.0	1.3 [b] 1.2 [b]	D14 D10	1.2 1.0	1.1 [b] 1.0 [b]	(a)			(a)		
B	D10	1.1	1.2 [b]	D14 D10	1.2 1.0	1.3 [b] 1.2 [b]	D14 D10	1.2 1.0	1.1 [b] 1.0 [b]	(a)			(a)		
C	D10	1.1	1.2 [b]	D10	1.0	1.2 [b]	D14 D10	1.2 1.0	1.1 [b] 1.0 [b]	(a)			(a)		
D	D10	1.1	1.2 [b]	D10	1.0	1.2 [b]	D14 D10	1.2 1.0	1.2 [b] 1.1 [b]	D14	1.0	1.1	D14	0.8	1.0
E	D10	1.1	1.2 [b]	D10	1.1	1.2 [b]	D10	1.0	1.1 [b]	D14 D10	1.0 0.8	1.1 1.0	D14	0.8	1.0
F	D10	1.2	1.2 [b]	D10	1.1	1.2 [b]	D10	1.0	1.1 [b]	D14 D10	1.0 0.8	1.2 1.1	D14	0.8	1.1
G	D10	1.2	1.3 [b]	D10	1.1	1.3 [b]	D10	1.0	1.2 [b]	D10	1.0	1.1	D10	0.8	1.0
H	D10	1.2	1.3 [b]	D10	1.1	1.3 [b]	D10	1.0	1.2	D10	1.0	1.1	D10	0.8	1.0

Notes: (a) Conditions not suitable for double surface dressings – see Table 8.3b.

(b) Polymer-modified versions of this type of binder are preferred in those conditions – see Section 5.3.4 and Table 8.3b.

(c) The surface dressing types are coded for convenience: D is for double surface dressing and the chipping sizes are the maximums so D10 is a 6.3/10 mm primary chipping layer followed by a 2.8/6.3 secondary chipping layer.

9.2.4 Sandwich surface dressings

The design of binder spread rate for sandwich surface dressings is done by reference to Table 9.2.4 with the binder rate then being adjusted for different local conditions from Sub-Section 9.2.6. The rate of spread of binder, after adjusting for secondary factors as described in Sub-Section 9.2.6, is based

on 67 % binder content bitumen emulsions and needs to be adjusted if a different binder content emulsion is used.

Table 9.2.4 – Binder Spread Rates for Sandwich Surface Dressings

Primary Chipping Size	8/14 mm	6.3/10 mm	6.3/10 mm
Secondary Chipping Size	2.8/6 mm	2.8/6 mm	2/4 mm
Binder Spread Rate	1.7 L/m²	1.5 L/m²	1.5 L/m²

9.2.5 Inverted double surface dressings

The binder spread rate for the first layer of an inverted double surface dressing should be as recommended in Table 9.2.1 for single surface dressings using the relevant hardness category with only the adjustment for the relevant road surface condition from Sub-Section 9.2.6 being applied.
The binder spread rate for the second layer of an inverted double surface dressing should be as recommended in Table 9.2.1 for single surface dressings and Table 9.2.2 for Racked-in surface dressings using a normal surface hardness category with adjustments as recommended in Sub-Section 9.2.6 other than for road surface condition.

9.2.6 Adjustments for local conditions

The adjustment of the binder spread rates for all types of surface dressings to allow for different local conditions is done by reference to Table 9.2.6. In the case of two layer systems (Double Surface dressings and Inverted Double Surface Dressings), the correction factors in Table 9.2.6 should be applied as follows:

First Layer		Apply adjustments from Table 9.2.6 for road surface condition only.
Second Layer	1	Apply adjustments from Table 9.2.6 for chipping size and shape.
	2	Other adjustments are applied as shown in Table 9.2.6 for normal surface condition and the remaining adjustments as found on site.

Table 9.2.6 – Secondary factors influencing the rate of spread of binder

Influence	Property	Effect (L/m²)	Comments
Season	Early and mid-season Late season	0 +0.2	Late season work is very risky especially with S10, double surface dressing is recommended if the work has to be completed, see Fig 7.3.2.
Aggregate type	Crushed rock or slag Gravel	0 +0.1	Gravel is only appropriate for Traffic Categories G and H.
Shape	Flakiness category FI_{10} FI_{15} FI_{20} FI_{25} and above	 +0.1 0 -0.1 Consider design	Flakiness index should conform to PD 6882-2. Adjustment is only required for non-conforming aggregates. Very cubical chippings, FI_{10}, require more binder to hold them initially. Flaky chippings (>FI_{20}) may result in early loss of texture depending on traffic.
Shade	Un-shaded, open to sun Partially shaded Fully shaded	0 +0.1 +0.2	Shaded areas are cooler and, therefore, the road is effectively harder so more binder is required. Double surface dressing is recommended for fully shaded areas (see Table 9.2.3).
Surface condition (Consider suitability, see Figure 8.1 and type of surface dressing Figures 8.3a and 8.3b)	Very binder rich Binder rich Normal Texture in wheel tracks Binder lean / porous Very binder lean and porous, high macro-texture, or variable and hard.	-0.2 -0.1 0 +0.1 +0.2 Consider Design	For variable soft binder rich areas a sandwich surface dressing should be considered. Above F traffic category if there is tracking due to being binder rich, larger chippings should be considered for the wheel tracks as part of a double surface dressing. A pad coat is recommended to normalise and seal porous road surfaces (see Section 9.2.4). Double surface dressing with intermediate binder is recommended for variable hard and binder lean substrates (see Table 9.2.3).
Gradient	> 5 % uphill < 5 % > 5 % downhill > 10 % downhill	-0.2 0 +0.1 +0.2	The gradient affects the traffic stress on the surface dressing and, therefore, the rate of embedment. Racked-in or double surface dressings are recommended for hills and downhill high-speed sections (see Tables 9.2.2 and 9.2.3).
Traffic Speed	High speed (≥50 mph limit) Low speed (<50 mph limit)	+0.1 0	Roads subject to high-speed traffic induce greater surface stress. Racked-in or double surface dressings with premium binders are recommended.
Local traffic	Design range Effectively un-trafficked	0 +0.2	Un-trafficked areas, such as hatched sections, and also between the wheel tracks and edges of carriageways, require more binder. Hard shoulders, unless a contra flow is planned, and sizeable areas with hatched lines to exclude traffic are effectively untrafficked.

Notes:

1. The maximum cumulative adjustment to rate of spread of binder is +0.4 L/m^2 or -0.2 L/m^2.
2. Descriptions of the properties are given in Section 7.4

10. SURFACE DRESSING RETREAD AND OTHER FORMS OF RECYCLED ROAD PAVEMENT

There are two forms of recycled pavement. *In situ* processing, of which the commonest type is "retread", and off-site processing, often adjacent to the site, which involves remixing the excavated pavement in either a hot- or cold-mix asphalt plant. Both these processes will result in a substrate which is, to some degree, porous and, subject to a careful assessment of the degree of porosity, will require an increase in the spray rate of 0.1 L/m² to 0.2 L/m² above the recommended rates. In most cases, an inverted double dressing should be considered (two single dressings of the same size could be used e.g. 6.3/10 & 6.3/10).

11. SURFACE DRESSING FOOTWAYS AND CYCLEWAYS

11.1 General

The application of surface dressing to footways and cycleways offers the engineer the same benefits as the application of surface dressings to roads, but has several different aspects that must be taken into account. Nevertheless, the same criteria should be adopted as for conventional surface dressings on roads in order to achieve a successful finish.

The binder must be applied at the correct rate of spread and at the correct temperature. If possible, the plant should be purpose-built to carry out the work. Small self-propelled sprayer units with narrow spray bars are available, some of which combine the spraying and the chipping application unit. Separate small self-propelled chipping spreaders are also available as an option to hand-chip spreading.

The principles set out in this document with regard to health and safety, early use and aftercare of roads are equally applicable to footways and cycleways.

11.2 Design

11.2.1 General

Single surface dressings are generally used for footways and cycleways because they use small size aggregate. However, on cement-bound and water-bound construction, double surface dressing is advisable.

On rural footways that are only used occasionally, the prime consideration is durability and extra binder and chippings may be of long term benefit. However, in housing estates and in urban locations, the convenience and safety of footway users must take precedence.

11.2.2 Chippings

The slip resistance on footways and cycleways is not as critical as the skid resistance for road surface dressings, but some Highway Authorities do have slip resistance criteria. Therefore, the PSV of chippings for footway surface dressings is generally not as critical as it is for work on roads. Consequently, the engineer has an opportunity to use materials where colour, shape and local availability of chippings are of greater importance. Nevertheless, the chippings should comply with the requirements of BS EN 13043 (BSI).

The single surface dressing chippings are normally 2/5 mm, a non-standard size between the 2/4 mm and 2.8/6.3 mm sizes with particles in the range 2 mm to 5 mm. The 2.8/6.3 mm size should be used for sites with occasional vehicular traffic and/or heavy pedestrian or cycle traffic. The double surface dressing chippings for use on water-bound pavements or cement bound materials are normally 2.8/6.3 mm for both layers.

11.2.3 Binder

Generally, polymer-modified emulsions are used because of their early cohesion and strength. On sites which are more highly stressed (such as vehicular crossings gaining access to properties), it is recommended that a Premium Grade emulsion is used because these binders are less susceptible to such stresses. Furthermore, double surface dressings are sometimes used for vehicular crossings. The varying weather conditions that have occurred in recent years also provide further support for the use of polymer-modified binders. Polymer modified binders are also very helpful on footways and cycleways to reduce the risk of bleeding and fatting up. The rates of spread are given in Table 11.2.3.

Table 11.2.3 – Target Rates of Spread of Emulsion Binder on Footways and Cycleways

Type of Surface Dressing	Condition of existing surface	Chipping size (mm)	Rate of spread of binder (L/m^2)
Single Surface Dressing	Very binder rich	2/5	1.3
	Binder rich	2/5	1.4
	Normal	2/5	1.5
	Binder lean	2/5	1.6
	Very binder lean	2/5	1.7
Double Surface Dressing	First layer	2.8/6.3	0.9
	Second layer	2.8/6.3	1.4

The target rates of spread of binder should be corrected using the adjustments in Sub-Section 9.2.6, as is required for surface dressings on roads. However, because of the more limited data for footways and cycleways, the resultant values should only be quoted in a range of ± 0.1 L/m^2.

11.3 Application

It is essential when applying surface dressings on footways and cycleways that the users of the site are considered at every stage. The main points to be considered, both on urban and rural sites, are:

a) Plant and equipment should be suitable for use in the particular surroundings without causing damage.

b) All ironwork should be properly masked.

c) Binder should not be allowed to come into contact with gates, walls or surfaces other than those to be dressed.

d) An extensive uniform application of chippings should be applied to cover all the sprayed area but excessive application should be avoided.

e) All loose chippings should be swept off as soon as a close mosaic has been established.

f) Advance warning of the work should be given to local residents.

Footway and cycleway surface dressings are routinely applied before and after the road surface dressing season, although they are best applied during the normal season. Embedment of chippings does not occur on footways in the same way as it does on roads. In footway and cycleway surface dressings, the binder has to provide the bond between the chipping and the surface and adequate rates of spread of binder are essential to achieve this adhesion.

Rolling is usually done with a rubber-coated roller not exceeding 1.5 tonnes, although steel-wheeled rollers can also be used.

12. SURFACE DRESSING FORMATIONS AND SUBGRADES, UNBOUND BASES AND SUB-BASES AND CEMENT-BOUND BASES AND SUB-BASES

The aim of sealing these surfaces using surface dressing is to protect them from weather damage and site traffic during construction. Cementitious materials may be cured by sealing them immediately after laying. Double surface dressings are used on unbound surfaces where they are to be trafficked and single surface dressings are used on cement bound materials. When cement bound materials are to be the final structural layer then a double surface dressing is used.

The recommended components are an unmodified emulsion binder with 67 % bitumen content and 2.8/6.3 mm chippings (used for both layers of double dressings when polymer-modified binders may be considered depending on the intended use).

Table 12 – Target Rates of Spread of Binder

Type of Chippings	Nominal Size of Chippings	Material Type	Unmodified Bitumen Emulsion
Crushed rock, gravel and slag	2.8/6.3 mm	Formations and subgrade	Single surface dressing rate of spread 1.8 L/m² to 2.2 L/m² depending on surface texture and porosity
		Unbound base and sub-base	Double surface dressing rate of spread 1.3 L/m² for each application
		Cement-bound base and sub-base	Single surface dressing rate of spread 1.8 L/m² to 2.2 L/m² depending on surface texture and porosity
		Cement bound base as a temporary road surface	Double surface dressing rate of spread 1.3 L/m² for each application

DESIGN GUIDE FOR ROAD SURFACE DRESSING

PART III – APPLICATION OF THE DESIGN

13. SPECIFICATION

13.1 General

Part II of this document utilises the accumulated experience of many specifiers and practitioners over many years to produce designs for surface dressing that will, in all normal circumstances, result in a competent durable surface dressing when carried out by skilled contractors using sound techniques. The resulting design should be satisfactory whether the Client, the Contractor or a consultant carries it out.

This Design Guide is not a contract and should not be used as such, although it may be used to support such a contract. Two types of contract are in common use:

- a recipe specification with design by the Client; and
- a performance specification with design by the Contractor.

It is essential that the allocation of responsibility for the design be made clear in any contract.

Whoever carries out the design must fully understand the surface dressing process and its capabilities because it is impossible to cover all possibilities in any Design Guide. There are some combinations of factors of traffic, turning, braking, surface characteristics and late-season working which make it imperative that a good understanding of the process is held by the designer to ensure success.

There are an increasing number of options for the type of surface dressing and it is recommended that serious consideration be given to using a performance specification where the contractor installs a CE marked Surface Dressing product. In any case, the Contractor should be in possession of a quality assurance certificate to the ISO 9000.

A client wishing to procure on the basis of a recipe specification should use Clause 919 of the MCHW1 (www.standardsforhighways.co.uk/mchw/vol1/index.htm).

13.2 Performance specification with design by contractor

A client wishing to procure on the basis of a Performance Specification should use Clause 922 of the MCHW1 (www.standardsforhighways.co.uk/mchw/vol1/index.htm) or refer to example specifications in Annex A of PD 6689

13.3 Records

13.3.1 General

It is essential to keep accurate and honest records of all surface dressing operations if Clients, Contractors and practitioners are to be able to learn from success and failures and continuously improve on design and construction techniques. Records of past surface dressing work, considered in the light of the subsequent performance, should be used as input in the design for future work.

The essential records required may be treated under two main areas, design details and construction details. In addition, details of any inspection are useful to understand the effectiveness of the options used given the conditions prevailing.

Any data on the texture depth and on the tyre/road noise generation from surface dressings after embedment, together with the values of the design parameters, should be sent to the RSTA so that this aspect of performance may be incorporated more fully in future editions of this Design Guide.

Records should be made available to clients upon request.

13.3.2 Design details

The assessment and design records need to include the following, for which the standard proforma (Figure 6.1) can be retained as the record:

- Road assessment records
- Nature, condition and area of the road surface
- Traffic records
- Design records

13.3.3 Construction details

The construction records need to include the following, for which Table 13.3.3 can be used as a standard proforma:

- Location, date and time
- Weather and road conditions when spraying
- Chippings, details and rate of spread
- Binder details and rate of spread
- Plant details
- Type and amount of compaction
- Signage in use
- Aftercare details
- Weather conditions immediately after the work

Table 13.3.3 is repeated, which may be copied for use in maintaining records, if required.

13.3.4 Inspection details

Some comments from the various inspections carried out after completion of the work may also be recorded on the construction record proforma (Table 13.3.3). The date will indicate whether the inspection is “Day After”, “Pre Winter” (after first frost) or “Post Winter however, this proforma may not be suitable for Factory Production Control (FPC) requirements in accordance with BS EN 12271.

Table 13.3.3 – Construction Record Proforma

Road Number:			Location:						
Date of Construction:	/ /		Time Start:			Time Finish:			
Weather: *	Sunny	Cloudy	Showers	Drizzle	Air Temp:	ºC	Humidity:	%	
Road Condition: *	Dry	Damp					Road Temp.:	ºC	

Chippings

Supplier:			Quarry:			Depot:			
1st Layer	Size:		PSV:		AAV:		Flakiness:		
	Condition: *	Dry	Damp		Sample Ref. No.:				
	Tonnage:	T	Area:	m²	Ave. rate of spread:	kg/m²			
	Spot check (box) results:	kg/m²	kg/m²	kg/m²	kg/m²	kg/m²			
2nd Layer	Size:		PSV:		AAV:		Flakiness:		
	Condition: *	Dry	Damp		Sample Ref. No.:				
	Tonnage:	T	Area:	m²	Ave. rate of spread:	kg/m²			
	Spot check (box) results:	kg/m²	kg/m²	kg/m²	kg/m²	kg/m²			

Binder

Supplier:			Type of binder:			Sample Ref. No.:			
1st Layer	Quantity used:	L	Area:	m²	Ave. rate of spread:	L/m²			
	Spot check (carpet tile) results:	L/m²	L/m²	L/m²	L/m²	L/m²			
2nd Layer	Quantity used:	L	Area:	m²	Ave. rate of spread:	L/m²			
	Spot check (carpet tile) results:	L/m²	L/m²	L/m²	L/m²	L/m²			

Plant

Sprayer Reg. No.:			Sprayer type:	Slot Jet/ Swirl Jet		Cone/jet test: BS1707 cert.*	Yes	No	
Spray bar height:	mm		Pressure:	bar/psi		Temp.:	ºC		
Gritter type: *	Tailgate	Self-propelled	Expanding	Combined machines					
Roller type: *	Pneumatic	Steel (vibrate)	Steel (static)			Other (specify):			
Sweeper type: *	Suction	Brush	Before: *	Yes	No	After: *	Yes	No	
						How soon:	h		
Traffic control: *	Speed control vehicle		Stop/Go boards			Traffic lights			

Signing

Attach sketches for signing during and after

During:	
After:	
How long were the signs left in place after surface dressing:	

Aftercare

Weather after surface dressing:			Overnight temp.:	ºC
Traffic control following surface dressing:	Yes	No	Time maintained:	h

Inspections

Date	Texture	Comments
/ /	mm	
/ /	mm	
/ /	mm	
/ /	mm	

Signature:		Name:		Date:	/ /

* Delete as appropriate

14. APPLICATION ON SITE

14.1 General

Practical advice on surface dressing practice and the selection and preparation of roads for surface dressing is given in the RSTA/ADEPT Code of Practice (available on www.rsta-uk.org). The Code of Practice also gives guidance on "after care" for the protection of the newly installed surface dressing during the period of early life vulnerability.

14.2 Plan of work

The principal operations that require to be planned are given in Table 3.2. Careful planning of surface dressing operations is required to achieve the potential productivity and minimise traffic disruption. Guidance on traffic management is given in Chapter 8 of the Traffic Signs Manual (Department for Transport) and the RSTA / ADEPT Code of Practice for Signing at Surface Dressing Sites (RSTA & ADEPT) (Section 14.4) – under revision by RSTA and ADEPT and expected to be re-issued in time for the 2017 season.

14.3 Weather conditions

If the temperature is too low after application, embedment will not take effect and the chippings will be totally reliant on adhesion from the binder. This constraint is also applicable during application, because it is indicative of subsequent conditions and because of the extended time that emulsions will take to break. If the temperature is too high during laying, the binder will not hold the chippings adequately to form a sturdy mosaic, an important aspect in the early life of any surface dressing. Ideally, surface dressing should only be carried out when the pavement temperature is between the values given in Table 14.3 for the particular binder type.

Table 14.3 – Ideal pavement temperature range for surface dressing application

Binder	Grade	Temperature Movement *	Min. Temp. #	Maximum Temperature ‡	
				Traffic Cats A to E	Traffic Cats F to G
Bitumen emulsion	Unmodified	Rising or stable	10 °C	30 °C	35 °C
		Falling	12 °C	35 °C	40 °C
	Intermediate	Rising or stable	10 °C	35 °C	40 °C
		Falling	12 °C	40 °C	42 °C
	Premium or Super-Premium	As for Intermediate Grade emulsions unless otherwise advised by the supplier			

* The different values, which depend on the temperature movement at the start of the process, are to allow for changes during the work.

‡ Adequate provisions for after care must be taken when the maximum temperature is approached.

Chipping temperatures should be similar to pavement temperature before application particularly in cold weather.

14.4 Traffic control

At road works, the free movement of vehicles is likely to be impaired. Although surface dressing operations are of short duration and may not impose the same restrictions as other maintenance processes, measures should be taken to ensure that the effects of surface dressing works are reduced to a minimum. There is a statutory responsibility to warn road users of obstructions on the highway in connection with road works, including surface dressing. All traffic management, during both the work and the aftercare, should be in accordance with the relevant statutory instruments and orders. Chapter 8 of the *Traffic Signs Manual* (Department for Transport) is the standard for all aspects of signing and management of traffic at static and mobile road works on the network and should be used to help all those engaged in road works to meet their statutory obligations. Whilst it is not itself a statutory instrument (except in Northern Ireland), all Highway Authorities and Contractors should comply with the principles outlined in Chapter 8 and establish a safe method of working.

Specific advice on traffic control at surface dressing sites is given in the RSDA / County Surveyors' Society's Code of Practice (*RSTA/ADEPT)* which is now embedded in Chapter 8. The Code of Practice incorporates the relevant guidance from the "Red Book" – Safety at Street Works and Road Works. The RSTA / ADEPT Code of Practice (RSDA & ADEPT) is available on www.rsta-uk.org or on request from the Secretary of ADEPT.

14.5 National Highway Sector Scheme 13

The NHSS 13 document provides a relevant quality assurance framework to BS ISO 9001 (BSI) and sets out the requirements for a qualified workforce. Selecting a contractor accredited to the Sector Scheme is the simplest way for a client to meet his obligations under *The Construction (Design & Management) Regulations 2015* (House of Commons, 2007) to employ a competent contractor. Compliance with the Sector Scheme requirement is assured by independent audit by the Certification Bodies accredited by UKAS. The document is available at www.ukas.com. The list of all registered suppliers is available from www.**lantra**-awards.co.uk/**Schedule-of-Suppliers**

15. ACKNOWLEDGEMENTS

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T Collett	TAG (Mouchel)	
M F W Heslop	Highways England (Acland)	
J Keayes	Road Emulsion Association	
D Millar	Transport Scotland (TRL Scotland))	

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https://www.warwickshire.gov.uk/highwayservicestandards

Well Maintained Highways. *Code of Practice for Highway Maintenance Management*, TSO

APPENDIX A: WORKED EXAMPLES OF DESIGN METHOD

A.1 Example 1, Single Surface Dressing

Kill Lane Housing Estate, Ballyshan, Northern Ireland. 5,000 m^2 (Location – Central)

Site is located at an altitude of less than 200m above sea level.

It is five roads in a housing estate. There are a few minor junctions and cross-overs.

No traffic count has been received from the Client.

The site has an average speed of less than 30 mph.

The site has houses with entrances to driveways.

There are a series of shallow curves of over 250m radius.

A gradient of less than 5% and there are some areas of partial shade from overhanging trees.

Hardness probe tests show an average depth reading of 5mm at 28°C.

The job is programmed for June.

As no traffic count is available, reference should be made to *'Well Maintained Highways - Code of Practice for Highway Maintenance Management" Section 8, Table 1 Carriageway Hierarchy,* which indicates a traffic category of H. (NRSWA Road Type 4)

The design suggests a crushed rock aggregate with PSV of 50, although the local Skidding Policy specifies 55 PSV minimum.
(*See Table: 7.3.1 - Recommended PSV levels for less heavily trafficked local roads*)

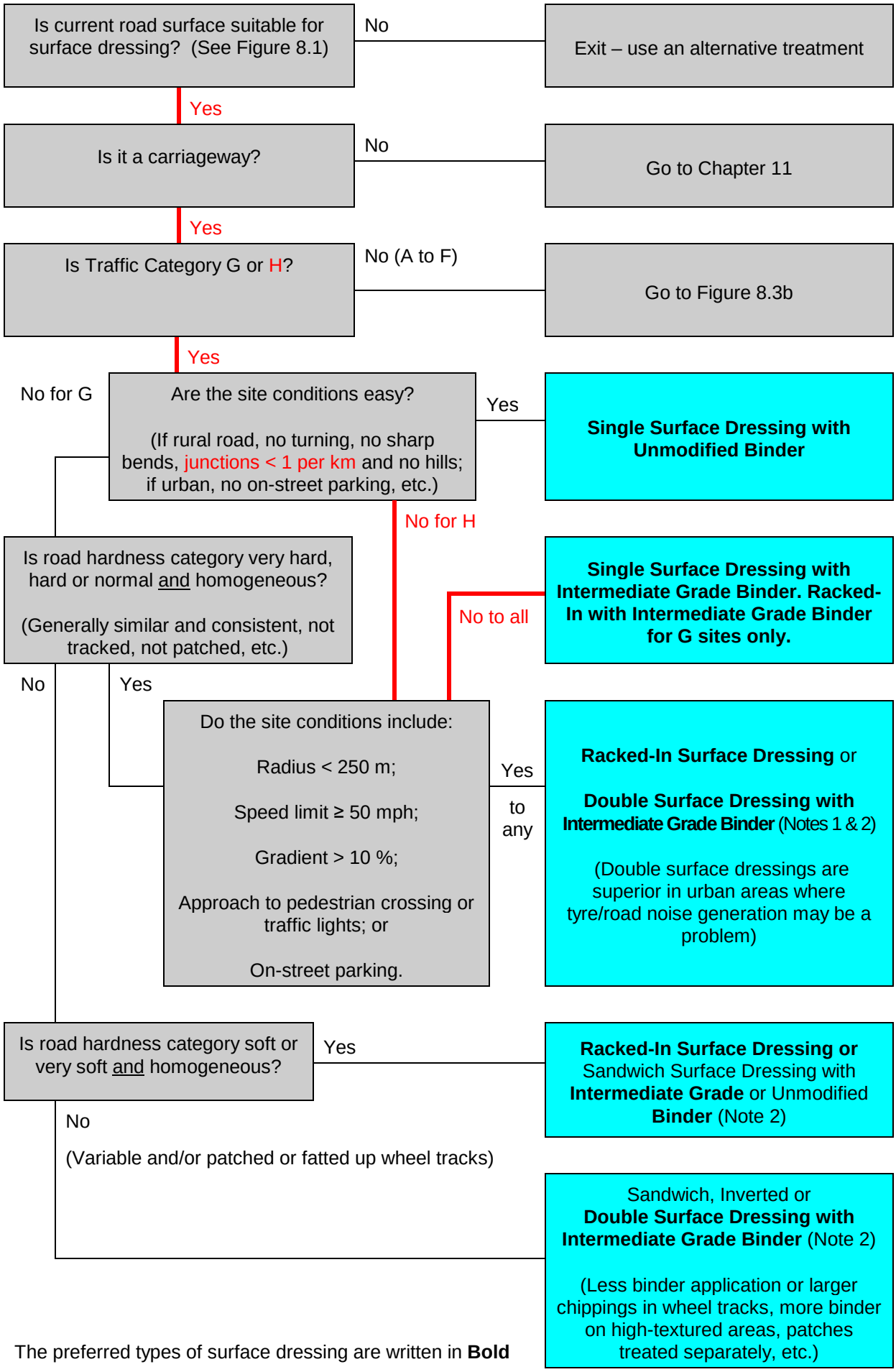
The flakiness index of the proposed aggregate is 15%.

The existing surface is an asphalt concrete (macadam) surface laid about 15 years ago.

Surface condition is normal.

Please note:

a) **This site is fictitious: any resemblance to any existing site is purely coincidental.**
b) **The design is for illustration purposes only and no responsibility can be accepted for the accuracy of the data.**



The preferred types of surface dressing are written in **Bold**

Road number:		Region/Area:	**Northern Ireland.**				
Section location:	**Kill Lane Housing Estate, Ballyshan, Northern Ireland.**						
Length:	m	Width:	m	No. of lanes:	**2**	Area:	5,000 m^2

Lane(s)	2	Medium/Heavy Traffic:	0 - 20 cv/l/d	NRSWA road type:	4
Traffic Speed: *	30 mph				

Traffic category: *	~~A~~	~~B~~	~~C~~	~~D~~	~~E~~	~~F~~	~~G~~	H

Location: *	~~South~~	Central	~~North~~	Temperature Category: *	~~A~~	B	~~C~~	~~D~~

Road hardness probe depth:	5 mm	at	28 °C	Min. PSV:	55	Max. AAV:	10

Road Hardness Category: *	~~Very Hard~~	Hard	~~Normal~~	~~Soft~~	~~Very Soft~~	~~Variable~~

Surface condition: *	~~Very binder rich~~	~~Binder rich~~	Normal	~~Texture in wheel tracks~~	~~Binder lean/Porous~~

Radius of curvature: *	~~Under 100 m~~	~~100 – 250 m~~	over 250 m	Expected Month on Site:	
Junction or crossing: *	~~Approach~~	~~Non-approach~~		June	
Overall gradient: *	up to 5 %	~~5 – 10 %~~	~~Over 10 %~~	~~Uphill~~	~~Downhill~~

Type of surface dressing: *	Single	~~Racked-In~~	~~Double~~	~~Inverted Double~~	~~Sandwich~~	

Chipping size: *	~~8/14 mm~~	~~6.3/10 mm~~	2.8/6.3 mm	~~Other:~~
	~~8/14 & 2.8/6.3 mm~~	~~6.3/10 & 2.8/6.3 mm~~	~~6.3/10 & 4/2 mm~~	

Aggregate type: *	Crushed rock	~~Blast furnace~~	~~Steel slag~~	~~Gravel~~
Flakiness index: *	~~Less than 10 %~~	10 % to 15 %	~~15 % to 20 %~~	~~More than 20 %~~

Bituminous emulsion binder:	~~Unmodified~~	Intermediate	~~Premium Grade~~	~~Super-Premium~~

Seasonal risk category:	~~High~~	~~Significant~~	Low

Binder spread rate:	First layer	1.5 L/m²	Second layer *	

Location	Season	Aggregate type	Flakiness	Increase of chipping size	Shade	Surface condition	Gradient	Traffic Speed	Untrafficked area	Sum of factors	Rate of spread of binder
	0	0	0	0							L/m²
											L/m²
					+ 0.1	0	0	0	0	+ 0.1	1.6 L/m²
											L/m²

Designer:		Initials:		Date:	/ /

* Highlight or delete as appropriate. Shaded box indicates data that a Client should provide when seeking tenders

A.2 Example 2, Racked-in surface dressing

Kirk Lane, Auldtown, Scotland – 2.5km (Location – North)

Site is located at an altitude of 50m above sea level: it is two lane single carriageway with average width 6.1m. It runs from west to east.

Traffic count received from Client is 72 cvld.

The site has a speed limit of 50 mph.

The site has four minor junctions with unclassified roads and some entrances to farms.

There are a series of shallow curves of over 250m radius.

A gradient of less than 5%.

There is one section 500m long with full shade from overhanging trees.

Hardness probe tests show an average depth reading of 5mm at 28 °C.

The job is programmed for June.

The design requires a crushed rock aggregate with PSV of 55.
(*See Table: 7.3.1 - Recommended PSV levels for less heavily trafficked local roads*)

The flakiness index of the proposed aggregate is 15% (FI_{10}).

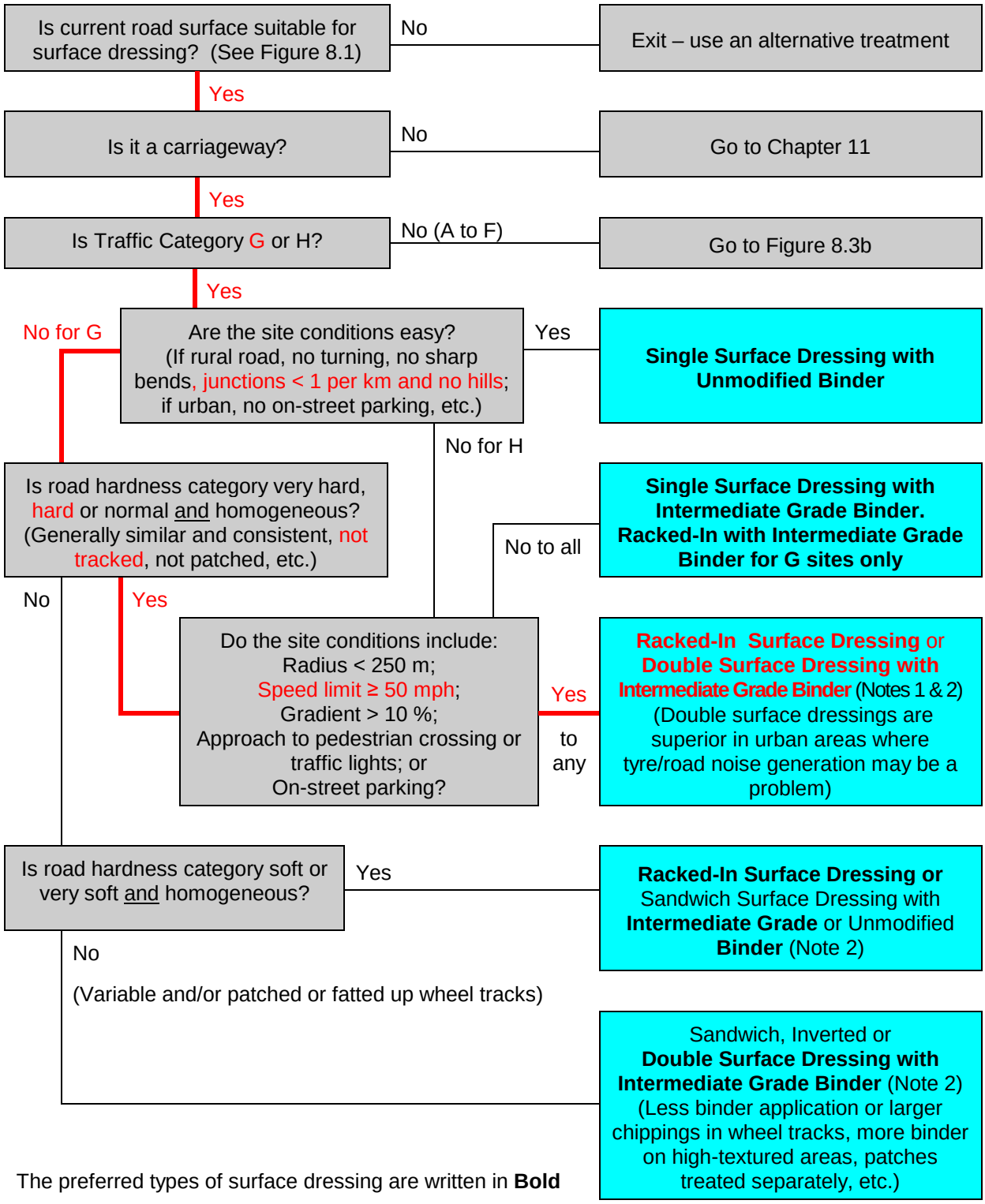
The existing surface is an asphalt concrete (close textured macadam) surface laid about 15 years ago.

Surface condition is hard and homogeneous with texture in the wheel tracks under the trees.

Please note:

a) **This site is fictitious: any resemblance to any existing site is purely coincidental.**

b) **The design is for illustration purposes only and no responsibility can be accepted for the accuracy of the data.**



The preferred types of surface dressing are written in **Bold**

Road number:		Region/Area:	**Northern Scotland**		
Section location:	**Kirk Lane, Auldtown, Scotland**				
Length:	2,500 m	Width:	6.10 m	No. of lanes:	**2**
Area:	15,250 m^2				
Lane(s)	**2**	Medium/Heavy Traffic:	**72** cv/l/d	NRSWA road type:	**4**
Traffic Speed: *	50 mph				

Traffic category: *	~~A~~	~~B~~	~~C~~	~~D~~	~~E~~	~~F~~	G	~~H~~

Location: *	~~South~~	~~Central~~	North	Temperature Category: *	~~A~~	~~B~~	C	~~D~~

Road hardness probe depth:	**5** mm	at	28 °C	Min. PSV:	**55**
Max. AAV:	**8**				

Road Hardness Category: *	~~Very Hard~~	Hard	~~Normal~~	~~Soft~~	~~Very Soft~~	~~Variable~~

Surface condition: *	~~Very binder rich~~	~~Binder Rich~~	~~Normal~~	Texture in wheel tracks	~~Binder lean/porous~~

Radius of curvature: *	~~Under 100 m~~	~~100 – 250 m~~	over 250 m	Expected Month on Site:	**June**
Junction or crossing: *	Approach	~~Non-approach~~			
Overall gradient: *	up to 5 %	~~5 – 10 %~~	~~Over 10 %~~	~~Uphill~~	~~Downhill~~

Type of surface dressing: *	~~Single~~	Racked-In	~~Double~~	~~Inverted Double~~	~~Sandwich~~	

Chipping size: *	~~8/14 mm~~	~~6.3/10 mm~~	~~2.8/6.3 mm~~	~~Other:~~
	~~8/14 & 2.8/6.3 mm~~	6.3/10 & 2.8/6.3 mm	~~6.3/10 & 4/2 mm~~	

Aggregate type: *	Crushed rock	~~Blast-furnace~~	~~Steel slag~~	~~Gravel~~
Flakiness index: *	~~Less than 10 %~~	10 % to 15 %	~~15 % to 20 %~~	~~More than 20 %~~

Bituminous emulsion binder:	~~Unmodified~~	Intermediate	~~Premium Grade~~	~~Super-Premium~~

Seasonal risk category:	~~High~~	~~Significant~~	Low

Basic binder spread rate from Tables:	First layer	2.0 L/m²	Second layer *	L/m²

Location	Season	Aggregate type	Flakiness	Increase of chipping size	Shade	Surface condition	Gradient	Traffic Speed	Untrafficked area	Sum of factors	Rate of spread of binder
Fully shaded 500 m section					+ 0.2	+0.1	0	+0.1	0	+ 0.4	2.4 L/m²
Remainder of site, normal surface condition					0	0	0	+0.1	0	+0.1	2. 1 L/m²

Designer:		Initials:		Date:	/ /

This G category site has a speed limit of 50 mph and has more than 1 junction per km. From 8.3a the choice is a racked-in surface dressing or a double surface dressing. The road runs west to east so the fully shaded section that has texture in the wheel tracks is cold and often damp. The frequency of minor junctions indicates that a 55 PSV chipping is recommended (Table 7.3.1).

A double surface dressing under the trees would be preferable in terms of durability, if funds permit. If the humidity is high and there are poor drying conditions a double surface dressing under the trees section is preferable for early stability.

Type of surface dressing: *	~~Single~~	~~Racked-In~~	Double	~~Inverted Double~~	~~Sandwich~~	

Chipping size: *	~~8/14 mm~~	~~6.3/10 mm~~	~~2.8/6.3 mm~~	~~Other:~~
	~~8/14 & 2.8/6.3 mm~~	6.3/10 & 2.8/6.3 mm	~~6.3/10 & 4/2 mm~~	

Aggregate type: *	Crushed rock	~~Blast-furnace~~	~~Steel slag~~	~~Gravel~~
Flakiness index: *	~~Less than 10 %~~	10 % to 15 %	~~15 % to 20 %~~	~~More than 20 %~~

Bituminous emulsion binder:	~~Unmodified~~	Intermediate	~~Premium Grade~~	~~Super Premium~~

Seasonal risk category:	~~High~~	~~Significant~~	Low

Basic binder spread rate from Tables:	First layer	1.1 L/m²	Second layer * 1.3L/m²

Location	Season	Aggregate type	Flakiness	Increase of chipping size	Shade	Surface condition	Gradient	Traffic Speed	Untrafficked area	Sum of factors	Rate of spread of 2nd binder layer
Fully shaded 500m section	0	0	0	0	+ 0.2	Applied to First Layer only – so +0.1 gives 1.2L/m²	0	+0.1	0	+ 0.3	1.6 L/m²

Designer:		Initials:		Date:	/ /

* Highlight or delete as appropriate. Shaded box indicates data that a Client should provide when seeking tenders

Under the trees, fully shaded section, the design is: D10 1st layer 1.2L/m² with 2nd layer at 1.6L/m² using intermediate grade binder; and for the remainder R10 at 2.1L/m².

A.3 Example 3, Double Surface Dressing

Heol Capel, Hendref, Wales. 2.5km. (Location – Central)

The site is located at an altitude of more than 200m above sea level.

It is a single carriageway feeder road 7.35 m wide within the town carrying 575 cv/l/d and is a bus route.

The speed limit is 40 mph, reducing to 30 mph.

There are some side roads entering the site at various locations, two are major junctions.

There is no on-street parking.

The average hardness probe test results show a 7mm depth at 29 °C.

There are several areas of partial shade from buildings.

An approach to a pedestrian crossing will be treated with High Friction Surfacing and will not be included for a surface dressing.

The site is programmed for late May/early June.

The design requires a crushed rock aggregate with PSV of 65.
(*For traffic levels over 250 cv/l/d refer to IAN 156 Table 3.1a for guidance on selecting the minimum PSV*)

The flakiness index of the proposed aggregate is less than10% (FI_{10}).

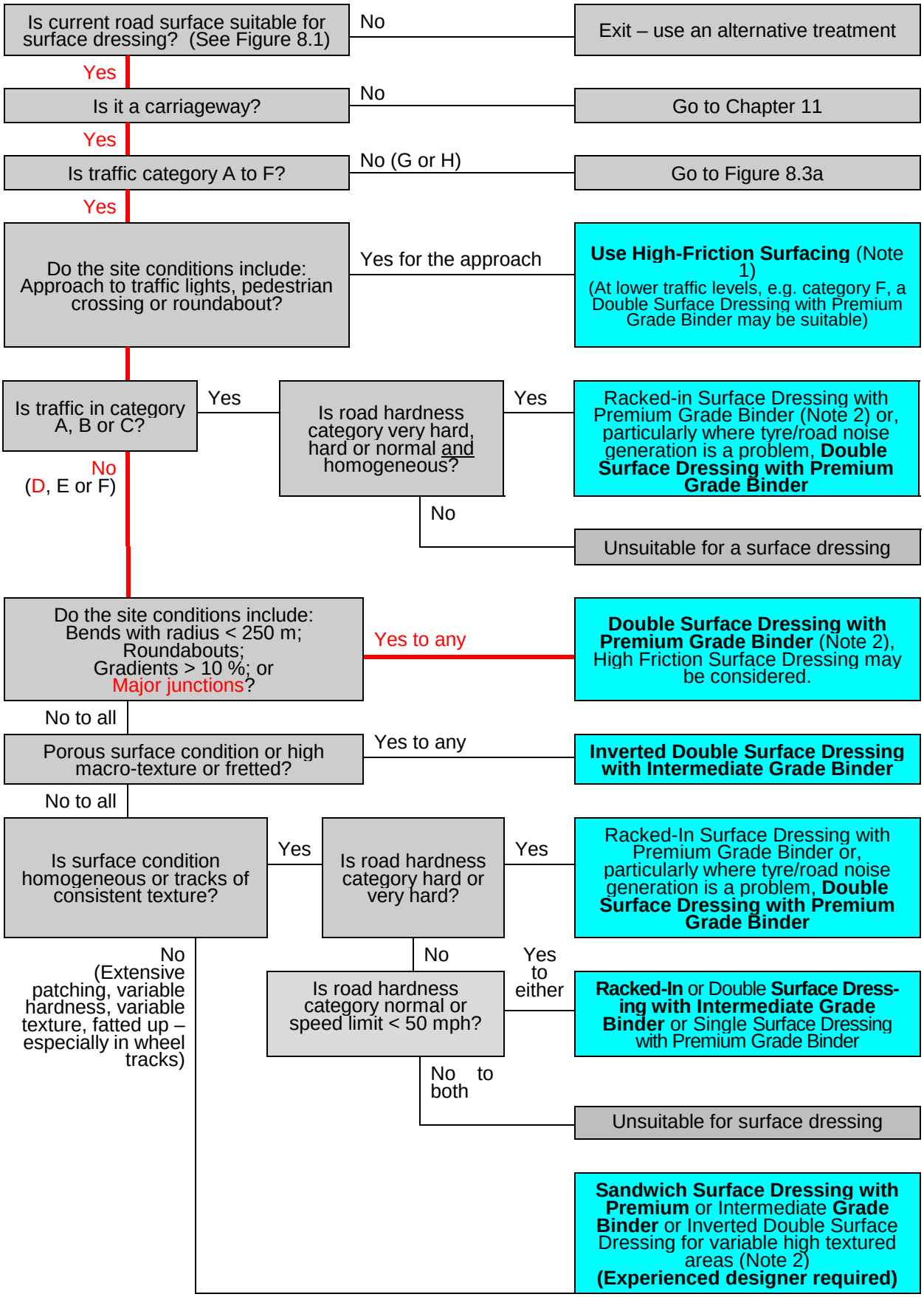
The existing surface is a 12 year old surface dressing that has become polished and showing signs of minor deterioration.

The surface condition is described as normal (not fatted up or tracked or porous or high macro-texture and fairly homogeneous).

Please note:

a) **This site is fictitious: any resemblance to any existing site is purely coincidental.**

b) **The design is for illustration purposes only and no responsibility can be accepted for the accuracy of the data.**


Is current road surface suitable for surface dressing? (See Figure 8.1)
No
Exit – use an alternative treatment
Yes
Is it a carriageway?
No
Go to Chapter 11
Yes
Is traffic category A to F?
No (G or H)
Go to Figure 8.3a
Yes
Do the site conditions include: Approach to traffic lights, pedestrian crossing or roundabout?
Yes for the approach
Use High-Friction Surfacing (Note 1)
(At lower traffic levels, e.g. category F, a Double Surface Dressing with Premium Grade Binder may be suitable)
Is traffic in category A, B or C?
Yes
Is road hardness category very hard, hard or normal and homogeneous?
Yes
Racked-in Surface Dressing with Premium Grade Binder (Note 2) or, particularly where tyre/road noise generation is a problem, Double Surface Dressing with Premium Grade Binder
No
(D, E or F)
No
Unsuitable for a surface dressing
Do the site conditions include: Bends with radius < 250 m; Roundabouts; Gradients > 10 %; or Major junctions?
Yes to any
Double Surface Dressing with Premium Grade Binder (Note 2), High Friction Surface Dressing may be considered.
No to all
Porous surface condition or high macro-texture or fretted?
Yes to any
Inverted Double Surface Dressing with Intermediate Grade Binder
No to all
Is surface condition homogeneous or tracks of consistent texture?
Yes
Is road hardness category hard or very hard?
Yes
Racked-In Surface Dressing with Premium Grade Binder or, particularly where tyre/road noise generation is a problem, Double Surface Dressing with Premium Grade Binder
No
(Extensive patching, variable hardness, variable texture, fatted up – especially in wheel tracks)
No
Is road hardness category normal or speed limit < 50 mph?
Yes to either
Racked-In or Double Surface Dressing with Intermediate Grade Binder or Single Surface Dressing with Premium Grade Binder
No to both
Unsuitable for surface dressing
Sandwich Surface Dressing with Premium or Intermediate Grade Binder or Inverted Double Surface Dressing for variable high textured areas (Note 2)
(Experienced designer required)

Road number:		Region/Area:	**South West Wales**		
Section location:	**Hoel Capel, Hendref, Wales**				
Length:	2,500 m	Width:	7.35 m	No. of lanes:	**2**
Area:	18,375 m^2				

Lane(s)	2	Medium/Heavy Traffic:	575 cv/l/d	NRSWA road type:	2
Traffic Speed: *	40 mph				

Traffic category: *	~~A~~	~~B~~	~~C~~	D	~~E~~	~~F~~	~~G~~	~~H~~

Location: *	~~South~~	Central	~~North~~	Temperature Category: *	~~A~~	~~B~~	C	~~D~~

Road hardness probe depth:	7 mm	at	29 °C	Min. PSV:	65	Max. AAV: 8

Road Hardness Category: *	~~Very Hard~~	Hard	~~Normal~~	~~Soft~~	~~Very Soft~~	~~Variable~~

Surface condition: *	~~Very binder rich~~	~~Binder rich~~	Normal	~~Texture in wheel tracks~~	~~Binder lean/porous~~

Radius of curvature: *	~~Under 100 m~~	~~100 – 250 m~~	over 250 m	Expected Month on Site:	May / June
Junction or crossing: *	Approach	~~Non-approach~~			
Overall gradient: *	up to 5 %	~~5 – 10 %~~	~~Over 10 %~~	~~Uphill~~	~~Downhill~~

Type of surface dressing: *	~~Single~~	~~Racked-In~~	Double	~~Inverted Double~~	~~Sandwich~~	

Chipping size: *	~~8/14 mm~~	~~6.3/10 mm~~	~~2.8/6.3 mm~~	~~Other:~~
	~~8/14 & 2.8/6.3 mm~~	6.3/10 & 2.8/6.3 mm	~~6.3/10 & 4/2 mm~~	

Aggregate type: *	Crushed rock	~~Blast-furnace slag~~	~~Steel slag~~	~~Gravel~~
Flakiness index: *	Less than 10%	~~10 % to 15 %~~	~~15 % to 20 %~~	~~More than 20 %~~

Bituminous emulsion binder:	~~Unmodified~~	~~Intermediate~~	Premium Grade	~~Super Premium~~

Seasonal risk category:	~~High~~	~~Significant~~	Low

Binder spread rate:	First layer	1.0 L/m^2	Second layer *	1.2 L/m^2

Location	Season	Aggregate type	Flakiness	Increase of chipping size	Shade	Surface condition	Gradient	Traffic Speed	Untrafficked area	Sum of factors	Rate of spread of binder 2nd Layer
	0	0	+0.1	0		Applied to First Layer Only – no change so 1.0L/m^2					
					+0.1		0	0	0	+0.2	1.4 L/m^2

Designer:		Initials:		Date:	/ /

* Highlight or delete as appropriate. Shaded box indicates data that a Client should provide when seeking tenders

The design recommended is D10 1st layer of premium grade binder 1.0L/m^2 and 2nd layer at 1.4L/m^2.

If this work was delayed until late August or beginning of September the 2nd layer would need to be at 1.6L/m^2.

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Appendix B: **Possible Highway Authority Example of a Check Table for Target Rates of Spread, Product Types and PSV for Traffic Site Categories H, G and F for unshaded and normal substrates with texture in the wheel tracks.** (Further Tables for various surface conditions and softer roads would need to be developed. This Authority uses S10 on rural H roads which is not considered in Table 9.2.1).

Site Description	Traffic (Commercial Vehicles per Lane per Day) and approximate (RN39 letter categories)		
	0-20 (H)	21-100 (G)	101-250 (F)
Single carriageway easy site	50 PSV S6 1.6L/m^2 S10* rural only	55 PSV S6 1.5L/m^2, S10* or R10 1.9L/m^2	55 PSV R10 1.8L/m^2, S10* or D10 1.2L/m^2 2nd 1.3L/m^2
Single carriageway greater stress If rural road, some turning or sharp bends, junctions > 1 per km and/or hills If urban, on-street parking.	55 PSV S6 1.6L/m^2	55 PSV R10 2.0L/m^2 or D10 1.2L/m^2 2nd 1.4L/m^2	60 PSV R10 1.9L/m^2 or D10 1.2L/m^2 2nd 1.3L/m^2
Dual carriageways lane 1 (consider lane 2 separately increase RoS by at least 0.2L/m^2 or consider S6)	55 PSV R10 2.0L/m^2	55 PSV R10 2.0L/m^2 or D10 1.2L/m^2 2nd 1.4L/m^2	60 PSV D10 1.2L/m^2 2nd 1.3L/m^2
Gradients > 5%, uphill	55 PSV R10 1.9L/m^2	60 PSV D10 1.1L/m^2 2nd 1.2L/m^2	60 PSV D10 1.0L/m^2 2nd 1.2L/m^2
Gradients > 5%, downhill	55 PSV R10 2.1L/m^2	60 PSV D10 1.2L/m^2 2nd 1.4L/m^2	60 PSV D10 1.2L/m^2 2nd 1.3L/m^2

*Note S10 needs a special design with a high rate of spread for lightly trafficked roads. R10 is generally preferred.

Key to Table

	Very easy sites, binders with an unmodified or Intermediate Grade Binder with single surface dressing (S)
	Higher speed and/or moderately difficult sites, Intermediate Grade Binder with single surface dressing (S) or racked-in (R)
	Difficult sites with higher IL, Intermediate or Premium Grade Binder with racked-in (R) or double surface dressing (D) for enhanced durability
	Difficult stressed sites, Premium or Super Premium Grade Binder with double (D). Traffic speeds upon opening greater than 40 mph.

Rates of spread should be reduced by 0.2L/m^2 for binder rich soft substrates and increased by 0.2L/m^2 for fully shaded substrates and by 0.2L/m^2 for existing high macro-texture. For double surface dressings these changes are applied to the 2nd layer of binder.
If a particular design is significantly different from the Table then it should be checked.

APPENDIX C: INDEX

APPENDIX D: PROFORMA FOR RECORDING DESIGNS

Design of road surface dressings to Road Note 39 (Seventh Edition)

Road number:		Region/Area:					
Section location:							
Length:	m	Width:	m	No. of lanes:		Area:	m^2
Lane(s)		Medium/Heavy Traffic:	cv/l/d			NRSWA road type:	
Traffic Speed: *	mph						
Traffic category: *	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*
Location: *	South	Central	North	Temperature Category: *	*A*	*B*	*C*	*D*
Road Hardness (RH) probe depth:	mm	at	°C	Min. PSV:		Max. AAV:	
RH Category:*	Very Hard	Hard	Normal	Soft	Very Soft	Variable	
Surface condition: *	Very binder rich	Binder rich	Normal	Texture in wheel tracks	Binder lean/porous		
Radius of curvature: *	Under 100 m	100 – 250 m	over 250 m	Expected Month on Site:			
Junction or crossing: *	Approach	Non-approach					
Overall gradient: *	up to 5 %	5 – 10 %	Over 10 %	Uphill	Downhill		

Type of surface dressing: *	Single	Racked-In	Double	Inverted Double	Sandwich	

Chipping size: *	8/14 mm	6.3/10 mm	2.8/6.3 mm	Other:
	8/14 & 2.8/6.3 mm	6.3/10 & 2.8/6.3 mm	6.3/10 & 4/2 mm	

Aggregate type: *	Crushed rock	Blast-furnace	Steel slag	Gravel
Flakiness index: *	Less than 10 %	10 % to 15 %	15 % to 20 %	More than 20 %
Bituminous emulsion binder:	Unmodified	Intermediate	Premium Grade	Super-Premium

Seasonal risk category:	High	Significant	Low

Binder spread rate: First layer L/m² Second layer * L/m²

Location	Season	Aggregate type	Flakiness	Increase of chipping size	Shade	Surface condition	Gradient	Traffic Speed	Untrafficked area	Sum of factors	Rate of spread of binder
First Layer											L/m²
											L/m²
											L/m²
											L/m²

Designer: Initials: Date: / /

* Highlight or delete as appropriate. Shaded box indicates data that a Client should provide when seeking tenders

APPENDIX E: PROFORMA FOR RECORD OF CONSTRUCTION DATA

Design of road surface dressings to Road Note 39 (Seventh Edition)

Road Number: | Location:

Date of Construction: / / | Time Start: | Time Finish:

Weather: * Sunny | Cloudy | Showers | Drizzle | Air Temp: ºC | Humidity: %

Road Condition: * Dry | Damp | Road Temp.: ºC

Chippings

Supplier: | Quarry: | Depot:

1st Layer Size: | PSV: | AAV: | Flakiness:

Condition: * Dry | Damp | Sample Ref. No.:

Tonnage: T | Area: m² | Ave. rate of spread: kg/m²

Spot check (box) results: kg/m² | kg/m² | kg/m² | kg/m² | kg/m²

2nd Layer Size: | PSV: | AAV: | Flakiness:

Condition: * Dry | Damp | Sample Ref. No.:

Tonnage: T | Area: m² | Ave. rate of spread: kg/m²

Spot check (box) results: kg/m² | kg/m² | kg/m² | kg/m² | kg/m²

Binder

Supplier: | Type of binder: | Sample Ref. No.:

1st Layer Quantity used: L | Area: m² | Ave. rate of spread: L/m²

Spot check (carpet tile) results: L/m² | L/m² | L/m² | L/m² | L/m²

2nd Layer Quantity used: L | Area: m² | Ave. rate of spread: L/m²

Spot check (carpet tile) results: L/m² | L/m² | L/m² | L/m² | L/m²

Plant

Sprayer Reg. No.: | Sprayer type: | Cone test: * Yes | No

Spray bar height: mm | Pressure: bar/psi | Temp.: ºC

Gritter type: * Tailgate | Self-propelled | Expanding

Roller type: * Pneumatic | Steel (vibrate) | Steel (static) | Other (specify):

Sweeper type: * Suction | Brush | Before: * Yes | No | After: * Yes | No

How soon: h

Traffic control: * Speed control vehicle | Stop/Go boards | Traffic lights

Signing Attach sketches for signing during and after

During:

After:

How long were the signs left in place after surface dressing:

Aftercare

Weather after surface dressing: | Overnight temp.: ºC

Traffic control following surface dressing: Yes | No | Time maintained: h

Inspections

Date	Texture	Comments
/ /	mm	
/ /	mm	
/ /	mm	
/ /	mm	

Signature: | Name: | Date: / /

* Delete as appropriate