Design guide for road surface dressing

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with the advice of a panel representing the Industry and the Clients
under the Chairmanship of J C Nicholls, TRL

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D Trowell Road Surface Dressing Association

Road Note 39
(Sixth edition)
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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;
  - 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.

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.

**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.**

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# PART I: INTRODUCTION

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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 (Carswell, 1994; Nicholls & Frankland, 1997; Milton et al., 2001). Unfortunately, the attention paid to design, control, supervision and aftercare is frequently less with surface dressing than with more expensive forms of construction. Lack of attention to detail shortens the useful life of a surface dressing; the benefits of adequate control, particularly in the period when traffic is first allowed on the new surface dressing, cannot be emphasised too strongly.

Road Note 39 is a guide for the design of surface dressing for roads throughout the United Kingdom (UK); it is NOT a contract and should not be used as such, nor should it be used as, a specification. 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. 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. Two types of contract are in common use:

- a performance specification with design by the Contractor (in particular, with the use of BS EN 12271 (CEN, 2006).

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 CHANGES

For many years, the design of surface dressing has been carried out according to Road Note 39, which is now in its sixth edition. The principal differences from the fifth edition are:

- **CEN standards**: European standards have been introduced for aggregates and bitumen (the component materials) and are being introduced for surface dressings. Therefore, there are many changes to the standards that need to be referenced. Some of these standards make significant differences to the terminology and categories that have to be used. As far as possible, these changes have been introduced into this edition of the Road Note.

- **Nomenclature for aggregates**: The European standards for aggregate have introduced a nomenclature for aggregates of \(d/D\), where \(d\) and \(D\) are the minimum and maximum sizes. These are applicable even for single fractions as used for surface dressings. Therefore, the use of \(a/b\) for multiple system surface dressings now becomes more complex and has been discontinued in this edition.

- **Nomenclature for emulsions**: The European standard for aggregate have introduced a nomenclature for aggregates of \(d/D\), where \(d\) and \(D\) are the minimum and maximum sizes. These are applicable even for single fractions as used for surface dressings. Therefore, the use of \(a/b\) for multiple system surface dressings now becomes more complex and has been discontinued in this edition.

- **Cutback binders**: Cutback binders are no longer generally available from binder suppliers in the UK. Therefore, they have been removed from this edition, leaving all binders to be one of the varieties of bitumen emulsion.

- **Spread rates for proprietary polymer-modified binders**: Polymer-modified bitumen emulsions now represent a major part of the market. From experience gained, the rates of spread need to be such that the residual
binder on the road is at least 10% higher than that for unmodified bitumen emulsions. Most polymer-modified emulsion binders supplied in the UK have a higher binder content than the traditional minimum 67% solids content bitumen emulsion (K1-70); therefore, similar rates of spread may be used, although it is always necessary to consult the producer concerning the rates of spread that have been found to be successful for a particular intended use. Throughout this edition, the assumed binder (solids) content is 67% and for bitumen emulsions with a different proportion, the rates of spread will need to be adjusted by multiplying by 67 over the proportion declared.

- **Traffic categories:** The weight of passenger vehicles has increased, particularly with the use of people carriers and off-road vehicles becoming more widespread. Therefore, the proportion of vehicles over 1.5 tonnes (previously classified as commercial but now will include many private vehicles) is increasing and the number of roads with very low flows of medium and heavy vehicles is reducing. However, the abbreviation for medium/heavy vehicles per lane day will remain as ‘cv/l/d’ because it is also used in other documents. The lower categories of such vehicles have been increased, which also allows closer correlation with the New Roads and Street Works Act (NRSWA) road classifications.

- **Simplicity:** As far as practicable, the method has been simplified without changing the basic methodology. In particular, the use of categories for binder spread rates in the first two of the (then) three stages of the design has been discontinued.

- **Electronic documentation:** Where documents are available on the internet, the website address is given that can be used as a link. However, no distinction is made between those that can be downloaded freely and those that require payment, either for each document or as a subscription. The website addresses are correct at the time of publication, but please be aware that website pages may be changed or deleted, in which case the links will no longer be valid.

1.3 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 1988 (House of Commons, 1988);

- the Construction (Design & Management) Regulations 2007 (House of Commons, 2007); and

- the National Highways Sector Scheme 13A (Section 1.4).

1.4 SECTOR SCHEME

- The successful application of surface dressing is a skilled occupation. Contractors in possession of a quality assurance certificate ISO 9000 Series and Sector Scheme 13A 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 surface dressing contracts to be registered holders of the sector scheme, which satisfies ISO 9000. Sector Scheme 13A: Supply and Application of Surface Dressing to Road Surfaces, is defined in Appendix A to the Specification for Highway Works (MCHW 1).

- UKAS Sector Scheme documents are available from UKAS at 21-47, High Street, Feltham, TW13 4UN or from their website: http://www.ukas.com/pdfs/M4.PDF

1.5 REVISION PANEL

This Design Guide was prepared by a Panel under the chairmanship of TRL Limited. 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:

- County Surveyors’ Society (CSS)

- Highways Agency (HA)

- Quarry Products Association (QPA)

- Refined Bitumen Association (RBA)

- Road Emulsion Association Limited (REAL)

- Road Surface Dressing Association (RSDA)

- Transport Scotland (TS)

- TRL Limited (TRL)
2 CONCEPTS

2.1 REASONS FOR SURFACE DRESSING

2.1.1 Purposes
Surface dressing as a maintenance process has three purposes:

a) to provide both texture and skid resistance to the surface;

b) to seal the road surface against ingress of water; and

c) to arrest disintegration and hence extend the life of the pavement and assist sustainable development.

In addition, it can be used as a treatment:

- to provide distinctive colour to certain road surfaces, principally in urban areas; and

- to provide a more uniform appearance for a patched road.

2.1.2 Texture and skid-resistance
Resistance to skidding, which is of importance on all roads, is dependent on the texture of the surface, both ‘microtexture’ and ‘macrotexture’. Microtexture is the texture of the aggregate with a peak to trough height of 0–0.2 mm while macrotexture is the overall texture of the road, created by the distribution of the aggregate particles, with a peak to trough height of 0.2 mm–3 mm. Micro- and macrotexture are illustrated in Figure 2.1.2.

Microtexture cannot be measured directly, while macrotexture can be measured by:

- the patch test (which gives the mean texture depth) to BS EN 13036-1 (CEN, 2002a); and

- Laser-based equipment that monitors road-condition such as the survey vehicles used to carry out traffic speed condition surveys (e.g. Surface Condition Assessment of the National NEtwork of Roads (SCANNER)).

Microtexture is needed for skidding resistance at all speeds to provide grip, whilst macrotexture is more important at higher speeds in wet weather because it helps to remove water from the tyre/road interface. Surface dressing, with chippings of appropriate resistance to polishing under the action of traffic, will provide both microtexture and macrotexture.

Concrete surfaces can also be effectively retextured by surface dressing. The design options will depend upon the traffic intensity and the degree of skid-resistance required at the site.

2.1.3 Sealing
Surface dressing, with appropriate rates of spread of binder, can be effective in sealing binder-lean surfaces and hairline cracks. Repairs to cracks or the road surface generally should be carried out before surface dressing takes place.

2.1.4 Arresting disintegration and other pavement properties
If applied to the surface of a road before major patching is required, surface dressing will protect the structure and extend the period before more major, and hence costly, repairs are required (Milton et al., 2001). If surface dressing is left until the surface has begun to show signs of disintegration, the ability of a surface dressing to arrest further disintegration may be limited.

Surface dressing will not restore the riding quality of a deformed road nor will it directly strengthen the road structure. However, sealing the surface, and thereby reducing the ingress of water, will protect the structure from deterioration and extend the life of the pavement, thus providing environmental and economic benefits.
Road surfaces where vehicles brake or turn sharply need to be considered separately because the performance requirements are more onerous.

2.2 TYPES OF SURFACE DRESSING

2.2.1 General
There are several types of surface dressing that vary according to the number of layers of chippings and binder. The fundamental types (including the high-friction surfacing systems, whose design methodology is not covered in the Guide) are described below, together with factors that should be considered when selecting the type of surface dressing to be used. The robustness of the binder, in particular the use of a modified or unmodified binder in the system, is discussed in Section 5.2.6.1.

Texture, skid-resistance and noise are three properties that could be considered to reflect aspects of the performance of a surface dressing. Single surface dressing using large chippings can sometimes be considered noisy. However, the noise can be reduced by using types of surface dressing with multiple layers of aggregate and by the use of smaller-size aggregate, while maintaining the requirement for surface texture. In seeking to optimise noise and texture, there is currently no method of accurately predicting from the design parameters the noise or the texture of surface dressings after embedment.

2.2.2 Single surface dressing
The single surface dressing refers to the fundamental type of a single film of binder followed by a single layer of chippings (Figure 2.2.2). The classification excludes high-friction surfacings with resin binders (sub-Section 2.2.7). A single surface dressing has the least number of operations, uses the least amount of material and is sufficiently robust for many situations. However, there is a limit to the stresses that this type of surface dressing will withstand.

2.2.3 Racked-in surface dressing
In a racked-in surface dressing, about 90% of the chippings that would be used in a single surface dressing are laid but with a thicker layer of binder (Figure 2.2.3). The gaps in the mosaic are then filled by smaller chippings. These smaller chippings lock the larger chippings in position, producing a stable mosaic. There should be a slight excess of the smaller chippings to ensure that each larger size chipping is locked-in by the adjacent smaller size chippings. Racked-in surface dressings are principally used where traffic is heavy and/or fast.

2.2.4 Double surface dressing
A double surface dressing has two layers of chippings and two applications of binder, the second being placed between the layers of chippings (Figure 2.2.4). There are no gaps in the first layer of chippings. This type of treatment is particularly suitable for road surfaces that are binder lean, but it is also used as an alternative to a racked-in surface dressing. Generally, double surface dressings produce a marginally lower texture depth than racked-in surface dressings using the same size chippings; however, it is a quieter and more robust treatment.

2.2.5 Inverted double surface dressing
An inverted double surface dressing (previously known as pad coat and single surface dressing) is a single surface dressing with small size chippings that is applied to a road which has uneven surface hardness, possibly due to extensive patching by the utilities, followed later by a second single surface dressing with larger size chippings (Figure 2.2.5). The first single surface dressing (the pad coat) produces a more uniform surfacing which can be subsequently surface dressed. Inverted double surface dressings have also been used on very hard or hard road surfacings, such as concrete, to reduce the effective hardness of the surface. However, a racked-in surface dressing is now the generally preferred option.

2.2.6 Sandwich surface dressing
A sandwich surface dressing is a surface dressing where a layer of chippings is spread prior to a single surface dressing being applied (Figure 2.2.6). Sandwich surface dressings are principally used in situations where the road surface condition is binder rich, and also in hot weather on heavily-trafficked single carriageways. In the latter case, it is essential to ensure there is sufficient binder at the interface between the existing surface and the first layer of chippings. This binder ensures the long term durability, preventing debonding and ‘plating off’ which can otherwise occur after a few years.

2.2.7 High-friction surfacing systems
For high-risk sites requiring high skid-resistance, such as at junctions and adjacent to pedestrian crossings, the Polished Stone Value (PSV) of natural aggregates may not be sufficient and artificial aggregates, such as calcined bauxite, may be required. For use on trunk road and many local road networks, high-friction surfacing systems need to have a British Board of Agrément Highway Authorities Product Approval Scheme (BBA-HAPAS) Roads and Bridges certificate that indicates the limits on its application. Details of systems with certificates and copies of those certificates are available by enquiring for ‘high friction’ on the website www.bbacerts.co.uk/. These systems are not within the scope of this guide.
Figure 2.2.2 Single surface dressing

Figure 2.2.3 Racked-in surface dressing

Figure 2.2.4 Double surface dressing

Figure 2.2.5 Inverted double surface dressing

Figure 2.2.6 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 untrafficked 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 11.

3.2 SURFACE DRESSING OPERATIONS

Many operations are performed in surface dressing, the more important of which are listed in Table 3.2. 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 3–4 in Table 3.2. 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 7–10 in Table 3.2.

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 3.2 should be carried out to the timetable indicated in Figure 3.3. The application of surface dressing without proper site preparation is unlikely to get the most out of the treatment.

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<tr>
<td>1</td>
<td>Identify</td>
<td>Identify roads to be dressed. Advise Statutory Undertakers that any works they might foresee should be completed prior to the surface dressing being laid.</td>
</tr>
<tr>
<td>2</td>
<td>Repair</td>
<td>Repair potholes and damaged areas.</td>
</tr>
<tr>
<td>3</td>
<td>Assess</td>
<td>Measure the hardness of the road surface and assess the number of medium and heavy vehicles. Note areas of high stress – roundabouts, sharp bends, traffic lights, steep hills, altitude, etc.</td>
</tr>
<tr>
<td>4</td>
<td>Design</td>
<td>Using above data, select type of surface dressing, binder and chipping type and size.</td>
</tr>
<tr>
<td>5</td>
<td>Materials</td>
<td>Decide who should be responsible for ordering chippings* and binder with the appropriate properties.</td>
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| 6  | Contract Administration | • 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 binder 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 | Remove vegetation from the road edge, sweep, mask reflective studs and ironwork, note and record road markings.                              |
| 9  | Traffic Control & Execution | Implement warning signs and traffic control, sweep, apply the binder and chippings and roll.                                                 |
| 10 | Aftercare     | Remove surplus chippings, control the speed and path of traffic until the surface dressing has stabilised. Replace stop, give way and other road markings. Dust the surface dressing during periods of hot weather. |
| 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.                                  |
Figure 3.3 Preferred timetable of surface dressing operations

* Taking off the verge edges to expose more of the pavement, cleaning debris in front of kerbs, etc.
4 GUIDANCE DOCUMENTS

4.1 DESIGN MANUAL FOR ROAD AND BRIDGES

Advice on best practice relating to the design and specification of surface dressing is given in HD 37 (Volume 7, Section 5, Part 2 of the Design Manual for Roads and Bridges, DMRB 7.5.2). The relevant specifications are given in Clauses 919 and 922 of the Specification for Highway Works (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 www.standardsforhighways.co.uk.

4.2 RSDA CODE OF PRACTICE

Advice on best practice relating to surface dressing is given in the Code of Practice for Surface Dressing (Road Surface Dressing Association, 2007) and should be referred to when surface dressing is being considered. The 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. It is available on www.rsda-gb.co.uk or on request to the RSDA Consultant Director and can also be accessed on the Barbour Index: www.barbour-index.co.uk.

4.3 RSDA/CSS CODE OF PRACTICE FOR SIGNING AT SURFACE DRESSING SITES

Reference should also be made to the Road Surface Dressing Association/County Surveyors’ Society Code of Practice for Signing at Surface Dressing Sites (RSDA & CSS, 2007), available on www.rsda-gb.co.uk or on request to the CSS Secretary.

4.4 National Guidance Document for Surface Dressing PD 6689

National Guidance Document for surface dressing, PD 6689 (BSI, 2006b), should be referenced when considering performance specifications using BS EN 12271 (CEN, 2006).

5 MATERIALS

5.1 AGGREGATES

5.1.1 General

Chippings shall comply with BS EN 13043 (CEN, 2002b) and the guidance in Table 4 of PD 6682-2 (BSI, 2003). To avoid the risk of oversize particles, attention is drawn to Note A of Table 4 of PD 6682-2. Table 7 of PD 6682-2 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 Table 9.2.6 should be adopted.

The smallest size chippings are not always available, and other non-standard sizes between 2.8/6.3 mm and 2/4 mm 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. 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. 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 RSDA Code of Practice (available on www.rsda-gb.co.uk).

5.1.2 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.

5.1.3 Lightly-coated chippings

Lightly-coated chippings were used with cutback bitumen binders but should not be used with emulsion binders because the binder film on the aggregate can affect the ‘break’ of the emulsion.
5.1.4 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) (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.

5.1.5 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.

5.1.6 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.

5.1.7 Artificial aggregate

There are several types of artificial aggregates including blast furnace and steel slag. Calcined bauxite is not generally used in standard surface dressing, but is widely used with resin and other specialist binders to produce high friction surfacing systems. The PSV characteristics of slag differ from natural stone (Hosking, 1976). 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 rationalising the different designs required on site.

Chippings of 8/14 mm are not included in this Road Note but can be used as an alternative, particularly on softer substrates. However, they should be used with the utmost care and in particular, no loose chippings should remain on the surface when the road is open to unrestricted traffic because of the higher risk of windsreen 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 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 rationalise 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 (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 in 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-textured asphalt surfaces
Some of the binder will penetrate into an open-textured surface and, unless allowance is made for this loss, insufficient binder will be left on the surface to hold larger sizes of chippings. Accordingly, unless an inverted double surface dressing is used, the rate of spread of binder for any particular combination of lane traffic category and road surface hardness should be chosen as for an impervious surface (Section 9.2) and the size of chipping should then be reduced to one size smaller, except in the case of 2.8/6.3 mm chippings. With an inverted double surface dressing the same procedure should be followed, but for the first layer only, and the surface condition then re-evaluated.

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 (CEN, 2005) provides a framework specification to categorise bituminous emulsions, covering both modified and unmodified emulsions, for a full range of applications. 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 according to BS 434: Part 1 (BSI, 1984) will now have various notations including C69B2, C69B3, C69B4, C69BF2, C69BF3 and C69BF4 according to EN 13808. For fuller explanation, reference should be made to the National Foreword of BS EN 13808 and to BS 434-2 (BSI, 2006a).

5.3.3 Unmodified emulsions
These materials (traditionally K1-70 now named: C69B2, C69B3, C69B4, C69BF2, C69BF3 or C69BF4) constitute the traditional emulsion materials used in UK surface dressing. Whilst the design recommendations limit their use to lower traffic category low stressed sites, they can offer valuable engineering solutions in many of these situations.

5.3.4 Modified binders
Modified binders have historically been processed and procured under a proprietary regime, which essentially involves the addition of polymers or additives at some point in the production routine. In 2004 about 80% of the surface dressing in the UK used polymer-modified emulsions binders. Specification of these materials is based on Clause 922 or Clause 919 of the Specification for Highways Works (MCHW 1).

BS EN 13808 (CEN, 2005) 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, 2006a).

The major focus of the specification has been on the cohesion of the residual binder by Vialit pendulum to BS EN 13588 (CEN, 2004) and the requirement to report the rheological characteristics of the binder through the Dynamic Shear Rheometer (DSR) test to Clause 928 of the Specification for Highway Works (MCHW 1).
Different classes of 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 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 5.3.4.

Modified binders impart the following advantages to the surface dressing system:

- Reduced temperature susceptibility in service.
- Improved low temperature elasticity.
- Reduced susceptibility to bleeding at high ambient temperatures.
- Improved elasticity to bridge hairline cracks.
- Improved early 'grip' on the aggregate.
- Improved long term cohesion of the system.
- Improved durability.

Where the design leads to the option for unmodified binder or a choice between unmodified and modified binder, a balance should be considered between initial application costs and whole life cycle costs as to the most appropriate option to select.

A specialist group (SG4) was set up within British Board of Agrément as part of the Highway Authorities Product Approval Scheme (HAPAS) to look at modified binders, including modified surface dressing binders.

### 5.3.5 Spread rate corrections

Throughout this document, the rate of spread of binder is based on a 67% solids (bitumen) content in the emulsion, which may not be the case. If the solids content is known to differ from this value, the rate of spread derived from the relevant table should be corrected by multiplying by 67% over the actual percentage. For example, if an emulsion with only 60% solids content is to be used and the derived rate of spread is 1.5 L/m², then the actual target rate should be $1.5 \times 67/60 = 1.7$ L/m². Similarly, if a polymer-modified bituminous emulsion with 73% solids content is to be used and the designed rate of spread is 1.5 L/m², then the actual target rate should be 1.4 L/m² because the resultant residual binder on the road will be about 10% higher than with a 67% solids content at the same rate. Modified binders with lower solids contents may need higher spread rates, which should be provided by the supplier. All corrected rates should always be rounded off to a practical accuracy for metering.

It should be noted that emulsions with a low solids content may appear to be more economic because they are cheaper per litre, but the unit cost has to be balanced against the greater quantity required, both in terms of direct cost and transportation costs.

### Table 5.3.4 Grades of bitumen emulsions

<table>
<thead>
<tr>
<th>UK Classification</th>
<th>Minimum peak cohesion (J/cm²)</th>
<th>Vialit pendulum class (BS EN 13808)</th>
</tr>
</thead>
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<tr>
<td>Unmodified</td>
<td>0.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1</td>
</tr>
<tr>
<td>Intermediate Grade</td>
<td>1.0</td>
<td>4</td>
</tr>
<tr>
<td>Premium Grade</td>
<td>1.2</td>
<td>5</td>
</tr>
<tr>
<td>Super-Premium Grade</td>
<td>1.4</td>
<td>6</td>
</tr>
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</table>

Notes: For Vialit pendulum class 1, 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/cm². Therefore, the value stated is given for guidance only and does not constitute a specification.
# PART II: DESIGN

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<td>12</td>
<td>Surface dressing formations and subgrades, unbound bases and sub-bases, and cement-bound bases and sub-bases</td>
</tr>
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</table>
6  DESIGN METHODOLOGY

6.1 BASIC APPROACH

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 at the back of this Guide, which may be copied for use in design, if required). Three worked examples of the design method are given in the Appendix.

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 Infrastructure Division of TRL Limited. Furthermore, TRL is keen to hear about the successes and the failures with surface dressing, particularly with the less widely used types – this information will highlight the need for, and assist in, the revision of this document.

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 has meant that there will be a retained textured of 1.1 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 macrotexture that will exist after embedment has taken place (sub-Section 2.1.2), but in-service texture depth requirements can be included in job specifications. Experience is then needed to assess what macrotexture needs to be provided prior to traffic that will retain the specified macrotexture 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.

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<tr>
<th>Step</th>
<th>Parameter to be determined</th>
<th>Road Note Section</th>
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<td>Road Hardness Category</td>
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<td>3</td>
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<td>– gradients (%)</td>
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<td>– junctions/parking/pedestrian crossings</td>
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<td>– PSV</td>
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<th>Surface condition</th>
<th>Gradient</th>
<th>Speed of traffic</th>
<th>Untraveled area</th>
<th>Sum of factors</th>
<th>Rate of spread of binder</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

<table>
<thead>
<tr>
<th>Designer</th>
<th>Initials</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

* 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
6.3 DESIGN FOR QUIETER SURFACINGS

In 2003 the RSDA, with support from the Highways Agency and the County Surveyors’ Society, 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 RSDA Code of Practice (RSDA, 2007) at www.rsda-gb.co.uk.

The Ulster research demonstrated that it is possible to select a surface dressing both with the required macrotexture to maintain skid resistance and with a tyre-noise performance comparable to that of a Stone Mastic Asphalt (SMA) type thin thin surfacing.

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 be 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.

The background of Figure 7.2.1 is the maximum summer temperature averaged between 1971 and 2000 from the Meteorological Office website: (www.metoffice.com/ climate/uk/averages/index.html). 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

<table>
<thead>
<tr>
<th>Approximate location</th>
<th>Altitude above sea level</th>
<th>Surface temp. category</th>
</tr>
</thead>
<tbody>
<tr>
<td>South England, south of Nottingham and Stoke-on-Trent</td>
<td>200 m or less</td>
<td>A</td>
</tr>
<tr>
<td>Central England, north of Nottingham and Stoke-on-Trent Scotland, south of Glasgow and Edinburgh Wales</td>
<td>Over 200 m</td>
<td>B</td>
</tr>
<tr>
<td>North Scotland, north of Glasgow and Edinburgh Northern Ireland</td>
<td>200 m or less</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Over 200 m</td>
<td>D</td>
</tr>
</tbody>
</table>
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 is a property that represents the resistance of an existing road surface in a particular location to the embedment of chippings. 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, 2002) 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 10 penetration readings using the graphs in Figure 7.2.2.

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.

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.

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 of unladen weight greater than 1.5 tonnes (Mg) 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. When counting the medium and heavy vehicles, consideration must be given to some private vehicles as well as commercial vehicles because many private vehicles will have unladen weights in excess of 1.5 tonnes. A Department of Transport report published on their website (Department of Transport, 2007) gave the average weight of seven popular 5-door hatch back models in 2003 to be 1351 kg, indicating that many larger passenger vehicles, such as people carriers and off-road vehicles, are likely to exceed 1.5 tonnes.

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, Figure 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 macrotexture 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 1991 (House of Commons, 1991) road type can

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* Suitable hardness probes can be obtained from CNS Farnell Limited of Borehamwood (tel. 020 8238 6902), with the probe being that used for measuring the California Bearing Ratio of soils with the tip changed.
Figure 7.2.2 Hardness categories from depth of penetration and road surface temperature for different Surface Temperature Categories (see Table 7.2.1)

Table 7.2.3 Traffic categories

<table>
<thead>
<tr>
<th>Medium &amp; heavy vehicles / lane / day</th>
<th>0 to 50</th>
<th>51 to 125</th>
<th>126 to 250</th>
<th>251 to 500</th>
<th>501 to 1250</th>
<th>1251 to 2000</th>
<th>2001 to 2500</th>
<th>2501 to 3250</th>
<th>Over 3250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Category</td>
<td>H</td>
<td>G</td>
<td>F</td>
<td>E</td>
<td>D</td>
<td>C</td>
<td>B</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>NRSWA Road Type *</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>S</td>
<td>S</td>
</tr>
</tbody>
</table>

*Categories converted from msa to cv/l/d assuming a growth rate of 2% over the design life
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.

The conversion to the categories used in this Design Guide 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 three-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 three-lane dual carriageway.

### 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, these speeds will increase the possibility of damage from loose chippings and this increased risk 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 General surface condition
The overall condition of the existing surfacing is important in determining the most appropriate type of surface dressing in order to minimise the potential problems that can arise with certain surface conditions. This 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
- Binder lean
- Very binder lean
- Variable road hardness

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):

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gradient</strong></td>
<td>up to 5% gradient; 5% to 10% gradient; and over 10% (1 in 10)</td>
</tr>
<tr>
<td><strong>Radius of curvature</strong></td>
<td>under 100 m radius; 100–250 m radius; and over 250 m radius</td>
</tr>
<tr>
<td><strong>Junction or crossing</strong></td>
<td>approach; and non-approach</td>
</tr>
</tbody>
</table>
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 categorised by the distance that the 15 m mark is from the kerb as:

<table>
<thead>
<tr>
<th>Radius category</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 100 m radius</td>
<td>when the distance is over 1.13 m</td>
</tr>
<tr>
<td>Radius of 100 m to 250 m radius</td>
<td>when the distance is between 0.45 and 1.13 m</td>
</tr>
<tr>
<td>Over 250 m radius</td>
<td>when the distance is less than 0.45</td>
</tr>
</tbody>
</table>

7.3 PARAMETERS FOR SELECTION OF MATERIALS

7.3.1 Skid-resistance requirements

One reason for surface dressing a road may be inadequate skid-resistance in the context of the Highway Authority’s skidding policy. Skid resistance is influenced by both the macrotexture of the road surface and the microtexture of the aggregate (sub-Section 2.1.2).

Investigatory levels are given in HD 28/04 (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 36/06 (DMRB 7.5.1) 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 the Table in HD 36/06, reproduced as Figure 7.3.1. 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.

PSV levels in excess of 70 are usually achieved with calcined bauxite in high-friction surfacing systems. This type of surface dressing is the exception in that it is only laid in localized areas where required.

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 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 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 matting 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.

<table>
<thead>
<tr>
<th>Site category</th>
<th>Site description</th>
<th>IL</th>
<th>Minimum PSV required for given IL, traffic level and type of site</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td>Traffic (cv/lane/day) at design life</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0-250 251-500 501-750 751-1000 1001-2000 2001-3000 3001-4000</td>
</tr>
<tr>
<td>A1</td>
<td>Motorways where traffic is generally free-flowing on a relatively straight line</td>
<td>0.30</td>
<td>50 50 50 50 50 55 55 60 65 65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.35</td>
<td>50 50 50 50 50 60 60 60 65 65</td>
</tr>
<tr>
<td>A2</td>
<td>Motorways where some braking regularly occurs (e.g. on 300 m approach to an off-slip)</td>
<td>0.35</td>
<td>50 50 50 55 55 60 60 65 65 65</td>
</tr>
<tr>
<td>B1</td>
<td>Dual carriageways where traffic is generally free-flowing on a relatively straight line</td>
<td>0.30</td>
<td>50 50 50 50 50 55 55 60 65 65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.35</td>
<td>50 50 50 50 50 60 60 60 65 65</td>
</tr>
<tr>
<td>B2</td>
<td>Dual carriageways where some braking regularly occurs (e.g. on 300 m approach to an off-slip)</td>
<td>0.35</td>
<td>50 50 50 55 55 60 60 65 65 65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.40</td>
<td>55 60 60 65 65 65 68+ 68+ 68+ 68+</td>
</tr>
<tr>
<td>C</td>
<td>Single carriageways where traffic is generally free-flowing on a relatively straight line</td>
<td>0.35</td>
<td>50 50 50 55 55 60 60 65 65 65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.40</td>
<td>55 60 60 65 65 65 68+ 68+ 68+ 68+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.45</td>
<td>60 60 65 65 65 68+ 68+ 68+ 68+ 68+</td>
</tr>
<tr>
<td>G1/G2</td>
<td>Gradients &gt;5 % longer than 50 m as per HD 28</td>
<td>0.45</td>
<td>55 60 60 65 65 65 68+ 68+ 68+ 68+ HFS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.50</td>
<td>60 60 68+ 68+ HFS HFS HFS HFS HFS</td>
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<tr>
<td></td>
<td></td>
<td>0.55</td>
<td>68+ HFS HFS HFS HFS HFS HFS HFS</td>
</tr>
<tr>
<td>K</td>
<td>Approaches to pedestrian crossings and other high risk situations</td>
<td>0.50</td>
<td>65 65 65 68+ 68+ 68+ HFS HFS HFS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.55</td>
<td>68+ HFS HFS HFS HFS HFS HFS HFS</td>
</tr>
<tr>
<td>Q</td>
<td>Approaches to major and minor junctions on dual carriageways and single carriageways where frequent or sudden braking occurs but in a generally straight line</td>
<td>0.45</td>
<td>60 65 65 68+ 68+ 68+ 68+ 68+ 68+ 68+ HFS</td>
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<tr>
<td></td>
<td></td>
<td>0.50</td>
<td>65 65 65 68+ 68+ 68+ 68+ 68+ 68+ 68+ 68+ HFS</td>
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<td></td>
<td></td>
<td>0.55</td>
<td>68+ 68+ HFS HFS HFS HFS HFS HFS</td>
</tr>
<tr>
<td>R</td>
<td>Roundabout circulation areas</td>
<td>0.45</td>
<td>50 55 60 60 65 65 68+ 68+ HFS HFS</td>
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<tr>
<td></td>
<td></td>
<td>0.50</td>
<td>68+ 68+ 68+ HFS HFS HFS HFS HFS</td>
</tr>
<tr>
<td>S1/S2</td>
<td>Bends (radius &lt;500 m) on all types of road, including motorway link roads; other hazards that require combined braking and cornering</td>
<td>0.45</td>
<td>50 55 60 60 65 65 68+ 68+ 68+ 68+ HFS HFS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.50</td>
<td>68+ 68+ 68+ HFS HFS HFS HFS HFS HFS HFS</td>
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<tr>
<td></td>
<td></td>
<td>0.55</td>
<td>HFS HFS HFS HFS HFS HFS HFS HFS</td>
</tr>
</tbody>
</table>

Note: Designers should always ensure that they are using the current version of this table, which is available on: www.standardsforhighways.co.uk/dmrb/vol7/section5/hd3606.pdf

Figure 7.3.1 Minimum PSV of chippings (as defined in the Design Manual for Roads and Bridges)
### Surface Temperature Category A & B (Warmer)

<table>
<thead>
<tr>
<th>Size and type of surface dressing</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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</thead>
<tbody>
<tr>
<td>8/14 mm single</td>
<td></td>
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<tr>
<td>6.3/10 mm single</td>
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<tr>
<td>8/14 &amp; 2.8/6.3 mm racked-in</td>
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<td></td>
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<tr>
<td>2.8/6.3 mm single</td>
<td></td>
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<tr>
<td>6.3/10 &amp; 2.8/6.3 or 2/4 mm racked-in</td>
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<tr>
<td>8/14 &amp; 2.8/6.3 mm double</td>
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<tr>
<td>6.3/10 &amp; 2.8/6.3 or 2/4 mm double</td>
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</tr>
</tbody>
</table>

**Early Season**

**Late Season**

### Surface Temperature Category C & D (Colder)

<table>
<thead>
<tr>
<th>Size and type of surface dressing</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/14 mm single</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>6.3/10 mm single</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8/14 &amp; 2.8/6.3 mm racked-in</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.8/6.3 mm single</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.3/10 &amp; 2.8/6.3 or 2/4 mm racked-in</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8/14 &amp; 2.8/6.3 mm double</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.3/10 &amp; 2.8/6.3 or 2/4 mm double</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Early Season**

**Late Season**

**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**
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. 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
- Binder lean
- Very binder lean

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 macadam 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 (CEN, 2002a) 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 it insufficient to hold the chippings of the surface dressing in place. A pad coat surface dressing layer, followed by a second layer of surface dressing to provide the specified surface characteristics is often a good, successful solution (an inverted double surface dressing).

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 m 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 per cent.

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 SURFACE DRESSING TYPES

Reference should be made to Chapter 2 for guidance on the performance levels of different types of surface dressings.

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.

<table>
<thead>
<tr>
<th>Existing surface characteristic</th>
<th>Traffic Category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H</td>
</tr>
<tr>
<td>Very hard and homogeneous</td>
<td>Yes</td>
</tr>
<tr>
<td>Hard and homogeneous</td>
<td>Yes</td>
</tr>
<tr>
<td>Normal and homogeneous</td>
<td>Yes</td>
</tr>
<tr>
<td>Soft and homogeneous</td>
<td>Yes</td>
</tr>
<tr>
<td>Very soft and homogeneous</td>
<td>Yes</td>
</tr>
<tr>
<td>Fatting up in wheel tracks</td>
<td>Yes</td>
</tr>
<tr>
<td>High macrotexture or fretted</td>
<td>Yes</td>
</tr>
<tr>
<td>Porous</td>
<td>Yes</td>
</tr>
<tr>
<td>Very variable</td>
<td>Defects</td>
</tr>
<tr>
<td>Extensive patching</td>
<td>E</td>
</tr>
<tr>
<td>Severe bleeding and extensive blackening</td>
<td></td>
</tr>
</tbody>
</table>

The surface dressing can be designed to meet the most onerous performance requirements in terms of macrotexture and levels of defects to BS EN 12272-2 (CEN, 2003).

It is difficult to maintain high macrotexture, especially in the wheel tracks and for high-speed roads. Texture requirements for low speed roads may be achievable.

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 (CEN, 2003) and the requirements should not be specified.

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
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.

A more extensive version of Figure 8.1 detailing the level of macrotexture and the potential for defects is given as Table 8.2 in HD 37/99 (DMRB 7.5.2), which is available on www.standardsforhighways.co.uk/dmrb.

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 described in Section 2.2. 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. The chart for the lower traffic category roads (on which the majority of surface dressing is undertaken) has been very much simplified compared to Road Note 39 (Fifth Edition) in order to help the designer. 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;
- the resisting of damage by parked cars; and
- the 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 macrotexture 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.
Is current road surface suitable for surface dressing? (See Figure 8.1)

Yes

Is it a carriageway?

No

Go to Chapter 11

Yes

Is traffic category G or H?

No (A to F)

Go to Figure 8.3b

Yes

No for G

Are the site conditions easy?
(If rural road, no turning, no sharp bends, junctions <1 per km and no hills; if urban, no on-street parking, etc.)

Yes

Single Surface Dressing with Unmodified Binder

No for H

Single Surface Dressing with Unmodified or Intermediate Grade Binder

No to all

Do the site conditions include: Radius <250 m; Speed >50 km/h; Gradient >10%; Approach to pedestrian crossing or traffic lights; or On-street parking?

Yes to any

Racked-in Surface Dressing or Double Surface Dressing with Intermediate Grade Binder (Notes 1 and 2) (Double surface dressings are superior in urban areas where tyre/road noise generation may be a problem)

No

Is road hardness category very hard, hard, normal and homogeneous? (Generally similar and consistent, not tracked, not patched, etc.)

Yes

Racked-in Surface Dressing or Sandwich Surface Dressing with Intermediate Grade Binder or Unmodified Binder (Note 2)

No

Yes

Is road hardness category soft, or very soft and homogeneous?

Variable and/or patched or fatted-up wheel tracks

Sandwich, Inverted or Double Surface Dressing with Intermediate Grade Binder (Note 2) (Less binder application or larger chippings in wheel tracks, more binder on high-textured areas, patches treated separately, etc.)

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.

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
Is current road surface suitable for surface dressing? (See Figure 8.1)

Yes

Is it a carriageway?

Yes

Is traffic category A to F?

Yes

Do the site conditions include: Approach to traffic lights, pedestrian crossing or roundabout?

Yes

Is traffic category A, B or C?

No (D, E or F)

Do the site conditions include: Bends with radius <50 m; Roundabouts; Gradients >10%; or Major junctions?

Yes to any

Porous surface condition or high macrotexture or fretted?

Yes to any

Is surface condition homogeneous or tracks of consistent texture?

Yes

(Extensive patching, variable hardness, variable texture, fatted-up – especially in wheel tracks)

No

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

No

Exit – use an alternative treatment

No

Go to Chapter 11

No

Go to Figure 8.3a

No (G or H)

Go to Figure 8.3a

Yes

High-Friction Surface Dressing (At lower traffic levels, e.g. category F, a Double Surface Dressing with Premium Binder may be suitable)

Racked-in Surface Dressing with Premium Grade Binder or, particularly where tyre/road noise generation is a problem, **Double Surface Dressing with Premium Binder**

Double Surface Dressing with Premium Grade Binder or, particularly where tyre/road noise generation is a problem, **Double Surface Dressing with Premium Grade Binder**

Unsuitable for a surface dressing

Racked-in or Double Surface Dressing with Intermediate Binder or Single Surface Dressing with Premium Binder

Unsuitable for a surface dressing

Sandwich Surface Dressing with Premium or Intermediate Binder or Inverted Double Surface Dressing for variable high textured areas (Experienced designer required)

Figure 8.3b Selection of type of surface dressing for heavily-trafficked sites
9 DESIGN CONSIDERATIONS OF SURFACE DRESSING CHIPPINGS AND BINDERS

This Edition of Road Note 39 is fundamentally different from the previous one in that the chipping and binder components for the various types of surface dressing are considered together. These are set out in Section 9.2.

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 100–105 % shoulder to shoulder coverage (Heslop et al., 1982) as determined by BS EN 12272-1 (CEN, 2002c). 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.

9.1.2 Racked-in surface dressing
The primary chipping should be spread to provide about 90% shoulder-to-shoulder coverage as measured by BS EN 12272-1 (CEN, 2002c). 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.

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

<table>
<thead>
<tr>
<th>Nominal size of chipping</th>
<th>Range of spread rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(kg/m²)</td>
</tr>
<tr>
<td>2.8/6.3 mm</td>
<td>7–10</td>
</tr>
<tr>
<td>6.3/10 mm</td>
<td>9–13</td>
</tr>
<tr>
<td>8/14 mm</td>
<td>12–16</td>
</tr>
</tbody>
</table>

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 (CEN, 2002c). The second layer should be 100–105% 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 (CEN, 2002c). 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 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 is used (sub-Section 5.3.5).

<table>
<thead>
<tr>
<th>Traffic Category</th>
<th>Hardness Category of Road Surface</th>
<th>Very Hard</th>
<th>Hard</th>
<th>Normal</th>
<th>Soft</th>
<th>Very Soft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of Chipping</td>
<td>Binder Rate</td>
<td>Size of Chipping</td>
<td>Binder Rate</td>
<td>Size of Chipping</td>
<td>Binder Rate</td>
<td>Size of Chipping</td>
</tr>
<tr>
<td>(mm)</td>
<td>(L/m²)</td>
<td>(mm)</td>
<td>(L/m²)</td>
<td>(mm)</td>
<td>(L/m²)</td>
<td>(mm)</td>
</tr>
<tr>
<td>A</td>
<td>(a)</td>
<td>(a)</td>
<td>(a)</td>
<td>(b)</td>
<td>(b)</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>6.3/10</td>
<td>1.8</td>
<td>(a)</td>
<td>(a)</td>
<td>(a)</td>
<td>(b)</td>
</tr>
<tr>
<td>C</td>
<td>6.3/10</td>
<td>1.8</td>
<td>6.3/10</td>
<td>1.6</td>
<td>(a)</td>
<td>(a)</td>
</tr>
<tr>
<td>D</td>
<td>2.8/6.3</td>
<td>1.5</td>
<td>6.3/10</td>
<td>1.6</td>
<td>(a)</td>
<td>(a)</td>
</tr>
<tr>
<td>E</td>
<td>2.8/6.3</td>
<td>1.5</td>
<td>6.3/10</td>
<td>1.6</td>
<td>6.3/10</td>
<td>1.6</td>
</tr>
<tr>
<td>F</td>
<td>2.8/6.3</td>
<td>1.5</td>
<td>2.8/6.3</td>
<td>1.5</td>
<td>6.3/10</td>
<td>1.6</td>
</tr>
<tr>
<td>G</td>
<td>2.8/6.3</td>
<td>1.5</td>
<td>2.8/6.3</td>
<td>1.5</td>
<td>2.8/6.3</td>
<td>1.5</td>
</tr>
<tr>
<td>H</td>
<td>2.8/6.3</td>
<td>1.5</td>
<td>2.8/6.3</td>
<td>1.5</td>
<td>2.8/6.3</td>
<td>1.5</td>
</tr>
</tbody>
</table>

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).

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 is used (sub-Section 5.3.5).
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 is used (sub-Section 5.3.5).

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 is used (sub-Section 5.3.5).

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

<table>
<thead>
<tr>
<th>Traffic Category</th>
<th>Very Hard</th>
<th>Hard</th>
<th>Normal</th>
<th>Soft</th>
<th>Very Soft</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Size of Chipping</td>
<td>Binder Rate</td>
<td>Size of Chipping</td>
<td>Binder Rate</td>
<td>Size of Chipping</td>
</tr>
<tr>
<td></td>
<td>(mm)</td>
<td>(L/m²)</td>
<td>(mm)</td>
<td>(L/m²)</td>
<td>(mm)</td>
</tr>
<tr>
<td>A</td>
<td>10 &amp; 6</td>
<td>1.9 (c)</td>
<td>10 &amp; 6</td>
<td>2.0 (c)</td>
<td>14 &amp; 6</td>
</tr>
<tr>
<td>B</td>
<td>10 &amp; 6</td>
<td>1.9 (c)</td>
<td>10 &amp; 6</td>
<td>2.0 (c)</td>
<td>14 &amp; 6</td>
</tr>
<tr>
<td>C</td>
<td>10 &amp; 4</td>
<td>1.9 (c)</td>
<td>10 &amp; 4</td>
<td>1.8 (c)</td>
<td>14 &amp; 6</td>
</tr>
<tr>
<td>D</td>
<td>10 &amp; 4</td>
<td>1.9 (c)</td>
<td>10 &amp; 4</td>
<td>1.8 (c)</td>
<td>14 &amp; 6</td>
</tr>
<tr>
<td>E</td>
<td>10 &amp; 4</td>
<td>1.9 (c)</td>
<td>10 &amp; 4</td>
<td>1.8 (c)</td>
<td>14 &amp; 6</td>
</tr>
<tr>
<td>F</td>
<td>10 &amp; 6</td>
<td>1.9 (c)</td>
<td>10 &amp; 6</td>
<td>1.8 (c)</td>
<td>10 &amp; 6</td>
</tr>
<tr>
<td>G</td>
<td>10 &amp; 4</td>
<td>2.0 (c)</td>
<td>10 &amp; 4</td>
<td>1.9 (c)</td>
<td>10 &amp; 6</td>
</tr>
<tr>
<td>H</td>
<td>10 &amp; 6</td>
<td>2.0 (c)</td>
<td>10 &amp; 6</td>
<td>1.9 (c)</td>
<td>10 &amp; 6</td>
</tr>
</tbody>
</table>

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 and Figure 8.3b).
(d) The size of chipping is given as ‘D1&D2’ where D1 is the upper sieve size of the first set of chippings to be used and D2 is the upper sieve size of the second set of chippings to be used.

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 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 9.2.6a for single surface dressings (traffic categories G and H) and Table 9.2.6b for other sites. In the case of two layer systems (double surface dressings and inverted double surface dressings), the correction factors in Table 9.2.6b should be applied as follows:

First Layer

Apply adjustments from Table 9.2.6b for road surface condition only.

Second Layer

1. Apply adjustments from Table 9.2.6b for chipping size and shapes.

2. Other adjustments are applied as shown in Table 9.2.6b for normal surface condition and the remaining adjustments as found on site.

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

<table>
<thead>
<tr>
<th>Traffic Category</th>
<th>Primary Chipping Size</th>
<th>Binder Rate, First Layer</th>
<th>Binder Rate, Second Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(mm)</td>
<td>(L/m²)</td>
<td>(mm)</td>
</tr>
<tr>
<td>A</td>
<td>10 &amp; 6</td>
<td>1.2</td>
<td>14 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>14 &amp; 6</td>
<td>1.0</td>
<td>10 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>(b)</td>
<td>(b)</td>
</tr>
<tr>
<td>B</td>
<td>10 &amp; 6</td>
<td>1.2</td>
<td>14 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>14 &amp; 6</td>
<td>1.0</td>
<td>10 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>(b)</td>
<td>(b)</td>
</tr>
<tr>
<td>C</td>
<td>10 &amp; 6</td>
<td>1.2</td>
<td>14 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>14 &amp; 6</td>
<td>1.0</td>
<td>10 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>(b)</td>
<td>(b)</td>
</tr>
<tr>
<td>D</td>
<td>10 &amp; 6</td>
<td>1.2</td>
<td>14 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>14 &amp; 6</td>
<td>1.0</td>
<td>10 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>(b)</td>
<td>(b)</td>
</tr>
<tr>
<td>E</td>
<td>10 &amp; 6</td>
<td>1.2</td>
<td>14 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>14 &amp; 6</td>
<td>1.0</td>
<td>10 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>(b)</td>
<td>(b)</td>
</tr>
<tr>
<td>F</td>
<td>10 &amp; 6</td>
<td>1.2</td>
<td>14 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>14 &amp; 6</td>
<td>1.0</td>
<td>10 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>(b)</td>
<td>(b)</td>
</tr>
<tr>
<td>G</td>
<td>10 &amp; 6</td>
<td>1.2</td>
<td>14 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>14 &amp; 6</td>
<td>1.0</td>
<td>10 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>(b)</td>
<td>(b)</td>
</tr>
<tr>
<td>H</td>
<td>10 &amp; 6</td>
<td>1.2</td>
<td>14 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>14 &amp; 6</td>
<td>1.0</td>
<td>10 &amp; 6</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>(b)</td>
<td>(b)</td>
</tr>
</tbody>
</table>

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 and Table 8.3b).
(c) The size of chipping is given as ‘D₁&D₂’ where D₁ is the upper sieve size of the first set of chippings to be used and D₂ is the upper sieve size of the second set of chippings to be used.

### Table 9.2.4 Spread rates for sandwich surface dressings

<table>
<thead>
<tr>
<th>Primary Chipping Size</th>
<th>8/14 mm</th>
<th>6.3/10 mm</th>
<th>6.3/10 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary Chipping</td>
<td>2.8/6 mm</td>
<td>2.8/6 mm</td>
<td>2/4 mm</td>
</tr>
<tr>
<td>Binder Spread Rate</td>
<td>1.7 L/m²</td>
<td>1.5 L/m²</td>
<td>1.5 L/m²</td>
</tr>
</tbody>
</table>

### 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 9.2.6a for single surface dressings (traffic categories G and H) and Table 9.2.6b for other sites. In the case of two layer systems (double surface dressings and inverted double surface dressings), the correction factors in Table 9.2.6b should be applied as follows:

1. **First Layer**
   - Apply adjustments from Table 9.2.6b for road surface condition only.

2. **Second Layer**
   - 1. Apply adjustments from Table 9.2.6b for chipping size and shapes.
   - 2. Other adjustments are applied as shown in Table 9.2.6b for normal surface condition and the remaining adjustments as found on site.
<table>
<thead>
<tr>
<th>Influence</th>
<th>Property</th>
<th>Effect (L/m²)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Season</td>
<td>Early and mid season</td>
<td>0</td>
<td>Late season work is very risky especially with 6.3/10 mm chippings – double surface dressing is recommended if the work has to be completed. (see Figure 7.3.2).</td>
</tr>
<tr>
<td></td>
<td>Late season</td>
<td>+0.2</td>
<td></td>
</tr>
<tr>
<td>Aggregate type</td>
<td>Crushed rock or slag</td>
<td>0</td>
<td>Gravel is only appropriate for Traffic Categories G and H.</td>
</tr>
<tr>
<td></td>
<td>Gravel</td>
<td>+0.1</td>
<td></td>
</tr>
<tr>
<td>Flakiness*</td>
<td>Index 10 % to 15 %</td>
<td>0</td>
<td>Flakiness index should conform to PD 6882-2. Adjustment is only required for non-conforming aggregates. Very cubical chippings (&lt;10 %) require more binder to hold them initially. Flaky chippings (&gt;20/25 %) will result in early loss of texture depending on traffic.</td>
</tr>
<tr>
<td></td>
<td>Index 15% to 20/25 %</td>
<td>-0.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Index &lt;10%, or &gt; 20/25 %</td>
<td>Consider design</td>
<td></td>
</tr>
<tr>
<td>Shade</td>
<td>Un-shaded, open to sun</td>
<td>-0.1</td>
<td>Shaded areas are cooler and, therefore, the road is effectively harder so more binder is required.</td>
</tr>
<tr>
<td></td>
<td>Partially shaded</td>
<td>+0.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fully shaded</td>
<td>+0.2</td>
<td>Double surface dressing is recommended for fully shaded areas (see Table 9.2.3).</td>
</tr>
<tr>
<td>Surface condition (consider suitability, see Figure 8.1 and type of surface dressing Figure 8.3a)</td>
<td>Very binder rich</td>
<td>-0.3</td>
<td>6.3/10 mm chippings are recommended for Traffic Category G, binder rich, soft road surfaces, without any adjustment.</td>
</tr>
<tr>
<td></td>
<td>Binder rich</td>
<td>-0.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Texture in wheel tracks</td>
<td>+0.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Binder lean / porous</td>
<td>+0.2</td>
<td>A pad coat is recommended to normalise and seal porous road surfaces (see Section 9.2.4).</td>
</tr>
<tr>
<td></td>
<td>Very binder lean and porous, high macrotexture, or variable and hard.</td>
<td>Not suitable</td>
<td>Double surface dressing with intermediate binder is recommended for variable hard and binder lean substrates (see Table 9.2.3).</td>
</tr>
<tr>
<td>Gradient</td>
<td>&gt; 5 % uphill</td>
<td>-0.3</td>
<td>The gradient affects the traffic stress on the surface dressing and, therefore, the rate of embedment. For uphill sections, 6.3/10 mm chippings are recommended without any adjustment.</td>
</tr>
<tr>
<td></td>
<td>&lt; 5 %</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 5 % downhill</td>
<td>+0.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 10 % downhill</td>
<td>Not suitable</td>
<td>Racked-in or double surface dressing is recommended with Intermediate Grade binder for Traffic Category G hills and downhill high-speed sections (see Tables 9.2.2 and 9.2.3).</td>
</tr>
<tr>
<td>Speed of traffic</td>
<td>High speed (≥50 mph limit)</td>
<td>Not suitable</td>
<td>Racked-in or double dressing with intermediate binder is recommended for high-speed Traffic Category G and H roads (see Tables 9.2.2 and 9.2.3).</td>
</tr>
<tr>
<td>Local traffic</td>
<td>Design range</td>
<td>0</td>
<td>Untrafficked areas (such as hatched sections, between the wheel tracks and edges of carriageways) require more binder.</td>
</tr>
<tr>
<td></td>
<td>Effectively untrafficked</td>
<td>+0.2</td>
<td></td>
</tr>
</tbody>
</table>

*For aggregate sizes of greater than 6 mm, use 20%. For aggregates of size 6 mm or less, use 25%.

**Notes:**
1. The maximum cumulative adjustment to rate of spread of binder is +0.4 L/m² or -0.2 L/m².
2. Descriptions of the properties are given in Section 7.4.
### Table 9.2.6b  Secondary factors influencing the rate of spread of binder for sites other than single surface dressings on lightly-trafficked sites

<table>
<thead>
<tr>
<th>Influence</th>
<th>Property</th>
<th>Effect (L/m²)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Season</td>
<td>Early and mid season</td>
<td>0</td>
<td>Late season work is very risky.</td>
</tr>
<tr>
<td></td>
<td>Late season</td>
<td>+0.2</td>
<td></td>
</tr>
<tr>
<td>Aggregate type</td>
<td>Crushed rock or slag</td>
<td>0</td>
<td>Gravel is only appropriate for traffic categories F, G and H.</td>
</tr>
<tr>
<td></td>
<td>Gravel</td>
<td>+0.1</td>
<td></td>
</tr>
<tr>
<td>Flakiness*</td>
<td>Index &lt;10%</td>
<td>+0.1</td>
<td>The flakiness index should conform to PD 6882-2. Adjustment is</td>
</tr>
<tr>
<td></td>
<td>Index 10% to 20/25%</td>
<td>0</td>
<td>only required for non-conforming aggregates.</td>
</tr>
<tr>
<td></td>
<td>Index &gt; 20/25%</td>
<td>-0.1</td>
<td></td>
</tr>
<tr>
<td>Chipping size</td>
<td>Size smaller</td>
<td>-0.1</td>
<td>The chipping size appropriate to the traffic category can be changed to</td>
</tr>
<tr>
<td></td>
<td>‘Design’ size</td>
<td>0</td>
<td>the adjacent size if required.</td>
</tr>
<tr>
<td></td>
<td>Size larger</td>
<td>+0.2</td>
<td></td>
</tr>
<tr>
<td>Shade</td>
<td>Un-shaded, open to sun</td>
<td>0</td>
<td>Shaded areas are cooler and, therefore, the road is effectively</td>
</tr>
<tr>
<td></td>
<td>Partially shaded</td>
<td>+0.1</td>
<td>harder so more binder is required.</td>
</tr>
<tr>
<td></td>
<td>Fully shaded</td>
<td>+0.2</td>
<td></td>
</tr>
<tr>
<td>Surface</td>
<td>Very binder rich</td>
<td>-0.1</td>
<td>The road condition will affect how much binder is required to provide</td>
</tr>
<tr>
<td>condition</td>
<td>Binder rich &amp; normal</td>
<td>0</td>
<td>similar conditions at the interface.</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Binder lean</td>
<td>+0.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Very binder lean / porous</td>
<td>+0.2</td>
<td></td>
</tr>
<tr>
<td>Gradient</td>
<td>&gt; 5% uphill</td>
<td>-0.1</td>
<td>The gradient affects the stresses applied to the surfacing.</td>
</tr>
<tr>
<td></td>
<td>&lt; 5%</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 5% downhill</td>
<td>+0.1</td>
<td>Roads subject to high traffic speeds induce greater surface stress.</td>
</tr>
<tr>
<td></td>
<td>&gt; 10% downhill</td>
<td>+0.2</td>
<td></td>
</tr>
<tr>
<td>Speed of traffic</td>
<td>High speed (≥50 mph limit)</td>
<td>+0.1</td>
<td>Roads subject to high traffic speeds induce greater surface stress...</td>
</tr>
<tr>
<td></td>
<td>Low speed (&lt;50 mph limit)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Local traffic</td>
<td>Design range</td>
<td>0</td>
<td>Hard shoulders (unless a contra flow is planned) and sizeable areas</td>
</tr>
<tr>
<td></td>
<td>Effectively untrafficked</td>
<td>+0.2</td>
<td>with hatched lines to exclude traffic are effectively untrafficked.</td>
</tr>
</tbody>
</table>

*For aggregate sizes of greater than 6 mm, use 20 %. For aggregates of size 6 mm or less, use 25%.

**Notes:**

1. Care must be taken when the cumulative effect of the adjustments in this table indicates an additional amount of binder of more than 0.2 L/m². Normally, an adjustment of +0.2 L/m² should be considered a maximum. If the total adjustment calculated is greater than +0.2 L/m², the original design may need to be revised.

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 mm and 6.3/10 mm).

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 (CEN, 2002b).

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 –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. The rates of spread are given in Table 11.2.3.

The target rates of spread of binder should be corrected using the adjustments in sub-Section 9.2.6a, 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/m².

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:
Plant and equipment should be suitable for use in the particular surroundings without causing damage. All ironwork should be properly masked. Binder should not be allowed to come into contact with gates, walls or surfaces other than those to be dressed. A full application of chippings should be made to cover all the sprayed area but excessive application should be avoided. All loose chippings should be swept off as soon as a close mosaic has been established. 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.

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 11.2.3 Target rates of spread of emulsion binder on footways and cycleways

<table>
<thead>
<tr>
<th>Type of Surface Dressing</th>
<th>Condition of existing surface</th>
<th>Chipping size (mm)</th>
<th>Rate of spread of binder (L/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Surface Dressing</td>
<td>Very binder rich</td>
<td>2/5</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>Binder rich</td>
<td>2/5</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>2/5</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Binder lean</td>
<td>2/5</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>Very binder lean</td>
<td>2/5</td>
<td>1.7</td>
</tr>
<tr>
<td>Double Surface Dressing</td>
<td>First layer</td>
<td>2.8/6.3</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>Second layer</td>
<td>2.8/6.3</td>
<td>1.4</td>
</tr>
</tbody>
</table>

### Table 12 Target rates of spread of binders

<table>
<thead>
<tr>
<th>Type of Chippings</th>
<th>Nominal Size of Chippings</th>
<th>Material Type</th>
<th>Unmodified Bitumen Emulsion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushed rock, gravel and slag</td>
<td>2.8/6.3 mm</td>
<td>Formations and subgrade</td>
<td>Single surface dressing rate of spread 1.8 L/m³ to 2.2 L/m³ depending on surface texture and porosity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unbound base and sub-base</td>
<td>Double surface dressing rate of spread 1.3 L/m³ for each application</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cement-bound base and sub-base</td>
<td>Single surface dressing rate of spread 1.8 L/m³ to 2.2 L/m³ depending on surface texture and porosity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cement bound base as a temporary road surface</td>
<td>Double surface dressing rate of spread 1.3 L/m³ for each application</td>
</tr>
</tbody>
</table>
# PART III: APPLICATION OF THE DESIGN

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Specification</td>
</tr>
<tr>
<td>14</td>
<td>Application on site</td>
</tr>
<tr>
<td>15</td>
<td>Acknowledgements</td>
</tr>
<tr>
<td>16</td>
<td>References</td>
</tr>
</tbody>
</table>
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 satisfactory durable surface dressing when carried out by competent 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. In any case, the Contractor should be in possession of a quality assurance certificate to the ISO 9000 series and accreditation to Sector Scheme 13A (Section 14.5).

13.2 RECIPE SPECIFICATION WITH DESIGN BY CLIENT

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

13.3 PERFORMANCE SPECIFICATION WITH DESIGN BY CONTRACTOR

A client wishing to procure on the basis of a performance specification should use BS EN 12271 (CEN, 2006) with the National Guidance Document PD 6689 (BSI, 2006b).

13.4 RECORDS

13.4.1 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 author at TRL so that this aspect of performance may be incorporated more fully in future editions of this Design Guide.

13.4.2 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

13.4.3 Construction details

The construction records need to include the following, for which Table 13.4.3 can be used as a standard proforma:

- Location, date and time
- Weather and road conditions when spraying
### Construction Record Proforma

**Road number:**

**Date of Construction**

**Time Start:**

**Time Finish:**

**Weather:** Sunny Cloudy Showers Drizzle

**Air Temp:** °C

**Humidity:** %

**Road Condition:**

**Road Temp:** °C

### Chippings

**Supplier:**

**Quarry:**

**Depot:**

**1st Layer**

- **Size:**
- **PSV:**
- **AAV:**
- **LAV:**
- **Sample Ref. No.:**

**Condition:**

- **Dry**
- **Damp**

**Tonnage:** T

- **Area:** m²
- **Ave. rate of speed:** L/m²

**Spot check (box) results:**

<table>
<thead>
<tr>
<th></th>
<th>kg/m²</th>
<th>kg/m²</th>
<th>kg/m²</th>
<th>kg/m²</th>
<th>kg/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**2nd Layer**

- **Size:**
- **PSV:**
- **AAV:**
- **LAV:**
- **Sample Ref. No.:**

**Condition:**

- **Dry**
- **Damp**

**Tonnage:** T

- **Area:** m²
- **Ave. rate of speed:** L/m²

**Spot check (box) results:**

<table>
<thead>
<tr>
<th></th>
<th>kg/m²</th>
<th>kg/m²</th>
<th>kg/m²</th>
<th>kg/m²</th>
<th>kg/m²</th>
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<tbody>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Binder

**Supplier:**

**Binder Type:**

**Sample Ref. No.:**

**1st Layer**

- **Quantity used:** L
- **Area:** m²
- **Ave. rate of speed:** L/m²

**2nd Layer**

- **Quantity used:** L
- **Area:** m²
- **Ave. rate of speed:** L/m²

### Plant

**Sprayer Reg. Number:**

**Sprayer Type:**

**Cone test:**

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Spray bar height:** mm

**Pressure:** bar/psi

**Temp:** °C

**Gritter type:**

Tailgate Self propelled Expanding Roller type:

Pneumatic Steel (vibrate) Steel (static)

**Sweeper type:**

Suction Brush

Before:

|   | Yes | No | After:
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Traffic control:**

- Speed control vehicle
- Stop/Go boards
- Traffic lights

### Signing

**Before:**

**After:**

- How long were the signs left in place after surface dressing?

### Weather after surface dressing:

**Overnight temp.:** °C

**Traffic control following surface dressing:**

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Inspections

**Date**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**Texture**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Signature:**

**Name:**

**Date:** / /

*Highlight or delete as appropriate.*

**Figure 13.4.3** Construction record proforma (based on form in *IAT guidelines for surface dressing in Ireland*)
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 RSDA Code of Practice (available on www.rdsa-gb.co.uk). 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, 2006) and the RSDA/ CSS Code of Practice for Signing at Surface Dressing Sites (RSDA & CSS, 2002) (Section 14.4).

14.3 WEATHER CONDITIONS

If the temperature is too low after construction, embedment will not take effect and the chippings will be totally reliant on adhesion from the binder to hold it in place. This constraint is also applicable during construction, not only because it is indicative of subsequent conditions but also 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 for it 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 those given in Table 14.3 for the particular binder type.

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

Table 14.3 Ideal pavement temperature range for surface dressing application

<table>
<thead>
<tr>
<th>Binder</th>
<th>Grade</th>
<th>Temperature Movement *</th>
<th>Min. Temp. Chippings</th>
<th>Maximum Temperature ‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitumen emulsion</td>
<td>Unmodified</td>
<td>Rising or stable</td>
<td>10 °C</td>
<td>30 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Falling</td>
<td>12 °C</td>
<td>35 °C</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Rising or stable</td>
<td>10 °C</td>
<td>35 °C</td>
<td>40 °C</td>
</tr>
<tr>
<td></td>
<td>Falling</td>
<td>12 °C</td>
<td>40 °C</td>
<td>42 °C</td>
</tr>
<tr>
<td>Premium or Super-Premium</td>
<td>As for Intermediate Grade emulsions unless otherwise advised by the supplier</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Binder</th>
<th>Grade</th>
<th>Temperature Movement *</th>
<th>Min. Temp. Chippings</th>
<th>Maximum Temperature ‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resin binders</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* 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.
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, 2006) 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 which is now embedded in Chapter 8. It incorporates the relevant guidance from the Red Book – Safety at Street Works and Road Works. The RSDA/CSS Code of Practice (RSDA & CSS, 2002) is available on www.rdsa-gb.co.uk or on request from the Secretary of the County Surveyors’ Society.

14.5 NATIONAL HIGHWAY SECTOR SCHEME 13A

This National Highway Sector Scheme document provides a relevant quality assurance framework to BS ISO 9001 (International Standardisation Organisation, 2000) which complies with BS EN 12271 (CEN, 2006) 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 2007 (House of Commons, 2007) to employ a competent contractor. Compliance with the Sector Scheme requirement is assured by independent audit by the Certification Bodies appointed by United Kingdom Accreditation Service. The document is available at:


The list of all registered installers is available by email from NHSScheduleofsuppliers@lantra.co.uk.
15 ACKNOWLEDGEMENTS

This Road Note was produced by a Panel representing all sides of the industry with the Chairman and Secretariat provided by the Infrastructure Division of TRL Limited. The Chairman would like to acknowledge the help so freely given not only by the members of the Panel but also by their colleagues who provided advice and assistance. The Panel members, with their affiliations, were:

- J C Nicholls, Chairman (TRL Limited)
- J Baxter, Road Surface Dressing Association
- J F Booth, County Surveyors Society (Environmental Services Group Limited)
- R Chapman, County Surveyors Society (North Lincolnshire Council)
- B J Gilbert, Road Emulsion Association Limited (Jobling Purser Limited)
- M W Heslop, Highways Agency (Acland Investments Limited)
- J Keayes, Road Emulsion Association Limited
- D Millar, Transport Scotland
- G Schofield, Road Emulsion Association Limited (Total Bitumen)
- C D Southwell, Refined Bitumen Association (Nynas UK AB)
- N Toy, Quarry Products Association (Tarmac Group Limited)
- D Trowell, Road Surface Dressing Association (Balfour Beatty plc)
- C Roberts, Secretary (TRL Limited)

The Panel is grateful to Colin Jones, who carried out the technical review of this Road Note.

16 REFERENCES


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www.trl.co.uk


www.bsonline.bsi-global.com


www.bsonline.bsi-global.com


- (MCHW 1) Volume 1: Specification for Highway Works. www_standardsforhighways.co.uk/mchw/vol1/index.htm


- (DMRB 7.2.1) HD 24/94 Traffic assessment. www_standardsforhighways.co.uk/dmrb/vol7/section2/hd2406.pdf
- (DMRB 7.3.1) HD 28/04 Skidding resistance. www_standardsforhighways.co.uk/dmrb/vol7/section3/hd2804.pdf
- (DMRB 7.5.1) HD 36/06 Surfacing material for new and maintenance construction. www_standardsforhighways.co.uk/dmrb/vol7/section5/hd3606.pdf
- (DMRB 7.5.2) HD 37/99 Bituminous surfacing materials and techniques. www_standardsforhighways.co.uk/dmrb/vol7/section5/hd3799.pdf


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www.rdsa-gb.co.uk/cop/6%20Guidance%20to%20Timing%20of%20Works.htm.

Road Surface Dressing Association and County Surveyors’ Society (2002*). Code of practice for signing at surface dressing sites. Richard Wills, CSS Honorary Secretary and Treasurer, Lincolnshire County Council, City Hall, Lincoln LN1 1DN.
www.rdsa-gb.co.uk/cop/codeindex.htm.
APPENDIX

WORKED EXAMPLES

<table>
<thead>
<tr>
<th>Example</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Example 1: Single surface dressing</td>
<td>48</td>
</tr>
<tr>
<td>A2</td>
<td>Example 2: Racked-in surface dressing</td>
<td>52</td>
</tr>
<tr>
<td>A3</td>
<td>Example 3: Double surface dressing</td>
<td>56</td>
</tr>
</tbody>
</table>
A.1 EXAMPLE 1: SINGLE SURFACE DRESSING

West-bound lane of a county two-lane single carriageway urban road with no pedestrian crossings or on street parking (for details, see Figure A.1b).

(Notes: In practice, the other lane would also be designed at the same time.)

<table>
<thead>
<tr>
<th>Traffic category:</th>
<th>Table 7.2.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum PSV:</td>
<td>Figure 7.3.1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Road hardness category</td>
<td>Figure 7.2.2, South category, &lt;200 m altitude</td>
</tr>
<tr>
<td>Type of surface dressing</td>
<td>Figure 8.3a (Figure A.1a)</td>
</tr>
<tr>
<td>Chipping size</td>
<td>Table 9.2.1</td>
</tr>
<tr>
<td>Target rate of spread:</td>
<td>Table 9.2.1</td>
</tr>
<tr>
<td>Binder type:</td>
<td>Figure 8.3a/ Designer/Contracter choice</td>
</tr>
<tr>
<td>Season:</td>
<td>July</td>
</tr>
<tr>
<td>Aggregate type:</td>
<td>Designer/Contractor choice</td>
</tr>
<tr>
<td>Flakiness index:</td>
<td>Material supplier</td>
</tr>
<tr>
<td>Chipping size</td>
<td>Design</td>
</tr>
</tbody>
</table>

**Section 1: 0–250 m westbound, and Section 4: 350 m–500 m westbound**

| Shade: | Unshaded |
| Surface Condition: | Normal |
| Radius: | >250 m |
| Gradient: | Less than 5% |
| Speed limit: | 40 mph |
| Local traffic: | Design range |

**Section 2: 250 m–300 m westbound**

| Shade: | Partially unshaded |
| Surface condition: | Normal |
| Radius: | >250 m |
| Gradient: | Less than 5% |
| Speed limit: | 40 mph |
| Local traffic: | Design range |

**Section 3: 300 m–350 m westbound**

| Shade: | Fully shaded |
| Surface Condition: | Normal |
| Radius: | >250 m |
| Gradient: | >10% downhill (See Note 1) |
| Speed limit: | 40 mph |
| Local traffic: | Design range |

Record of design: Figure A.1b

Notes:
1. The gradient of 10% for Section 3 is on the borderline for a racked-in or double surface dressing but, because it is only 50 m long, it is not rational to change the chipping size. Nevertheless, if accidents have occurred or speeds are above 50 mph (see 8.3a), it might be prudent to design the entire site using 10/6 mm. The lane uphill would require 1.9 L/m² and the downhill section 2.2 L/m² for racked-in.
2. If the road were close to houses, a double surface dressing would be preferable from the point of view of noise generation.
Because this is a seaside town road, late season work may be enforced and the rates would have to be increased accordingly or double surface dressing specified. The use of coloured chippings may also be required, although the 60 PSV requirement for the hills might restrict the choice.

**Figure A.1a** Selection of type of surface dressing for Example 1
### Design of road surface dressing to Road Note 39 (Sixth Edition)

<table>
<thead>
<tr>
<th>Road number:</th>
<th>B3456</th>
<th>Region / Area:</th>
<th>Wessex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section location:</td>
<td>Seafront Road, Seaportham</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length:</td>
<td>500 m</td>
<td>Width:</td>
<td>7.4 m</td>
</tr>
<tr>
<td>No. of lanes:</td>
<td>2</td>
<td>Area:</td>
<td>3700 m²</td>
</tr>
<tr>
<td>Lanes(s):</td>
<td>E</td>
<td>Medium/Heavy traffic:</td>
<td>cv/l/d</td>
</tr>
<tr>
<td>Traffic category:</td>
<td>*</td>
<td>Traffic speed limit:</td>
<td>30 mph</td>
</tr>
<tr>
<td>Latitude:</td>
<td>*</td>
<td>Temperature category:</td>
<td>A B C D</td>
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<tr>
<td>Temperature category:</td>
<td>A B C D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road hardness probe depth:</td>
<td>6.0 mm</td>
<td>at</td>
<td>30 °C</td>
</tr>
<tr>
<td>Minimum PSV:</td>
<td>50</td>
<td>Max. AAV:</td>
<td>12</td>
</tr>
<tr>
<td>Category:</td>
<td>Very hard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existing surface characteristics:</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General surface condition:</td>
<td>Very binder rich</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radius of curvature:</td>
<td>Under 100 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junction or crossing:</td>
<td>Approach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall gradient:</td>
<td>Up to 5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of dressing:</td>
<td>Single</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chipping size:</td>
<td>8/14 mm</td>
<td></td>
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<tr>
<td>Aggregate type:</td>
<td>Crushed rock</td>
<td></td>
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</tr>
<tr>
<td>Flakiness index:</td>
<td>Less than 10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bitumen emulsion binder:</td>
<td>Unmodified</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seasonal risk category:</td>
<td>High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Binder spread category:</td>
<td>First layer</td>
<td>1.5 L/m²</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Season</td>
<td>Aggregate type</td>
<td>Flakiness</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>----------------</td>
<td>------------</td>
</tr>
<tr>
<td>0-250</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>250-300</td>
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<td>300-350</td>
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</tr>
<tr>
<td>350-500</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Designer:</td>
<td>Craig Roberts</td>
<td>Initials:</td>
<td>CR</td>
</tr>
</tbody>
</table>

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

**Figure A.1b** Record of design for Example 1
## Construction Record Proforma

**Road number:** B3456  
**Location:** Wessex

**Date of Construction:** 30 / 07 / 07  
**Time Start:** 10.00  
**Time Finish:** 15.00

**Weather:** Sunny  
**Air Temp:** 21°C  
**Humidity:** 58.4%

**Road Condition:** Dry  
**Road Temp:** 26°C

### Chippings

**Supplier:** Aggregate Industries  
**Quarry:** Bardon Hill  
**Depot:** Bardon Hill

**1st Layer**
- **Size:** 6
- **PSV:** 50
- **Condition:** Dry
- **Tonnage:** 50 T
- **Area:** 3700 m²
- **Ave. rate of speed:** 10 kg/m²
- **Spot check (box) results:**
  - L/m²
  - kg/m²

**2nd Layer**
- **Size:**
- **PSV:**
- **Condition:** Dry
- **Tonnage:**
- **Area:** m²
- **Ave. rate of speed:**
- **Spot check (box) results:**
  - L/m²
  - kg/m²

### Binder

**Supplier:** Nynas  
**Binder Type:** Duramulas  
**Sample Ref. No.:** XYZ790

**1st Layer**
- **Quantity used:** 10138 L
- **Area:** 7400 m²
- **Ave. rate of speed:** 1.37 L/m²
- **Spot check (box) results:**
  - L/m²
  - kg/m²

### Plant

**Sprayer Reg. Number:** RF 05 BPT  
**Sprayer Type:** ACMAR  
**Cone test:** Yes

**Spray bar height:** 450 mm  
**Pressure:** 9 bar/psi  
**Temp:** 85°C

**Gritter type:** Tailgate  
**Roller type:** Pneumatic  
**Sweeper type:** Suction

**Traffic control:** Speed control vehicle  
**Signs left in place after surfacing:**

**Before:**
- 10 mph speed limit and temporary traffic control
- 20 mph advisory limit and no road markings

**After:**
- No road markings
- How long were the signs left in place after surface dressing? 7 days

### Signing

**Weather after surface dressing:** Sunny  
**Overnight temp.:** 14°C

**Traffic control following surface dressing:** Yes

<table>
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<th>Texture</th>
<th>Comments</th>
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<td></td>
</tr>
<tr>
<td>01/03/08</td>
<td>1.7 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>/ / mm</td>
<td></td>
</tr>
</tbody>
</table>

**Signature:** Craig Roberts  
**Date:** 01/03/08

*Highlight or delete as appropriate.*

Figure A.1c Record of Construction for Example 1
A.2 EXAMPLE 2: RACKED-IN SURFACE DRESSING

Nearside eastbound lane of a trunk dual two-lane carriageway road uphill leading into a single carriageway with large hatched area (for details, see Figure A.2b).

(Note: In practice, the other lanes would also be designed at the same time.)

Traffic category: Table 7.2.3

Minimum PSV: Figure 7.3.1

Road hardness category Figure 7.2.2, South category, <200 m altitude

Type of surface dressing Figure 8.3a (Figure A.2a)

Chipping size Table 9.2.2

Target rate of spread: Table 9.2.2

Binder type: Figure 8.3b/Designer/Contractor choice

Season: September

Aggregate type: Designer/Contractor choice

Flakiness index: Material supplier FL 15

Chipping size Design

Section 1: 0–500 m eastbound (Lane 1 dual)

Shade: Unshaded

Surface Condition: Normal

Radius: >250 m

Gradient: Less than 5%

Speed limit: 70 mph

Local traffic: Design range

Section 2: 500 m–700 m eastbound (single)

Shade: Unshaded

Surface condition: Normal

Radius: >250 m

Gradient: Less than 5%

Speed limit: 60 mph

Local traffic: Design range

Section 3: 700 m–1250 m eastbound (single)

Shade: Unshaded

Surface Condition: Binder lean

Radius: >250 m

Gradient: Over 10% uphill

Speed limit: 60 mph

Local traffic: Design range

Record of Design: Figure A.2b
Is current road surface suitable for surface dressing? (See Figure 8.1)

Yes

Is it a carriageway?

Yes

Is traffic category A to F?

Yes

Do the site conditions include: Approach to traffic lights, pedestrian crossing or roundabout?

No

Is traffic category A, B or C?

Yes

Is road hardness category very hard, hard, or normal and homogeneous?

Yes

High-Friction Surface Dressing (At lower traffic levels, e.g. category F, a Double Surface Dressing with Premium Binder may be suitable)

No

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

Unsuitable for a surface dressing

No (G or H)

Yes

Go to Figure 8.3a

No to all

Is road hardness category very hard, hard, or normal and homogeneous?

Yes

High-Friction Surface Dressing (At lower traffic levels, e.g. category F, a Double Surface Dressing with Premium Binder may be suitable)

No

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

Unsuitable for a surface dressing

Yes to any

Double Surface Dressing with Premium Grade Binder, High Friction Surface Dressing may be considered

No to all

Porous surface condition or high macrotexture 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 very hard?

Yes

Double Surface Dressing with Premium Grade Binder

No

Racked-in or Double Surface Dressing with Intermediate Binder or Single Surface Dressing with Premium Binder

No

Unsuitable for a surface dressing

No to both

Is road hardness category normal or speed limit <50 mph?

Yes to either

Sandwich Surface Dressing with Premium or Intermediate Binder or Inverted Double Surface Dressing for variable high textured areas (Experienced designer required)

No to all

(Extensive patching, variable hardness, variable texture, fatted-up – especially in wheel tracks)

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

---

*Figure A.2a* Selection of type of surface dressing for Example 2
**Design of road surface dressing to Road Note 39 (Sixth Edition)**

<table>
<thead>
<tr>
<th>Road number:</th>
<th>A99</th>
<th>Region / Area:</th>
<th>Northern Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section location:</td>
<td>Candal Bypass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length:</td>
<td>1250 m</td>
<td>Width:</td>
<td>15 - 7.5 m</td>
</tr>
<tr>
<td>Lanes(s):</td>
<td>E</td>
<td>Medium/Heavy traffic:</td>
<td>600-700 cv/l/d</td>
</tr>
<tr>
<td>Traffic speed limit:</td>
<td>*</td>
<td>60 mph</td>
<td></td>
</tr>
<tr>
<td>Traffic category:</td>
<td>A</td>
<td>B</td>
<td>C (single)</td>
</tr>
<tr>
<td>Latitude:</td>
<td>*</td>
<td>South</td>
<td>Central</td>
</tr>
<tr>
<td>Road hardness probe depth:</td>
<td>8.0 mm</td>
<td>at</td>
<td>30 °C</td>
</tr>
<tr>
<td>Category:</td>
<td>*</td>
<td>Very hard</td>
<td>Hard</td>
</tr>
<tr>
<td>Existing surface characteristics:</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General surface condition:</td>
<td>*</td>
<td>Very binder rich</td>
<td>Normal</td>
</tr>
<tr>
<td>Radius of curvature:</td>
<td>*</td>
<td>Under 100 m</td>
<td>100 - 250 m</td>
</tr>
<tr>
<td>Junction or crossing:</td>
<td>*</td>
<td>Approach</td>
<td>Non-approach</td>
</tr>
<tr>
<td>Overall gradient:</td>
<td>*</td>
<td>Up to 5 %</td>
<td>6 - 10 %</td>
</tr>
<tr>
<td>Type of dressing:</td>
<td>*</td>
<td>Single</td>
<td>Racked-in</td>
</tr>
<tr>
<td>Chipping size:</td>
<td>*</td>
<td>8/14 mm</td>
<td>6.3/10 mm</td>
</tr>
<tr>
<td>Aggregate type:</td>
<td>*</td>
<td>Crushed rock</td>
<td>Blast furnace slag</td>
</tr>
<tr>
<td>Flakiness index:</td>
<td>*</td>
<td>Less than 10 %</td>
<td>10 % to 25 %</td>
</tr>
<tr>
<td>Bitumen emulsion binder:</td>
<td>*</td>
<td>Unmodified</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Seasonal risk category:</td>
<td>*</td>
<td>High</td>
<td>Significant</td>
</tr>
<tr>
<td>Binder spread category:</td>
<td>First layer</td>
<td>2.0 L/m²</td>
<td>Second layer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>Season</th>
<th>Aggregate type</th>
<th>Flakiness</th>
<th>Increase of chipping size</th>
<th>Shade</th>
<th>Surface condition</th>
<th>Gradient</th>
<th>Speed of traffic</th>
<th>Untrafficked area</th>
<th>Sum of factors</th>
<th>Rate of spread of binder</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-250</td>
<td>+0.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-0.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>+0.2</td>
<td>2.2 L/m²</td>
</tr>
<tr>
<td>500-700</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-0.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>+0.2</td>
<td>2.2 L/m²</td>
</tr>
<tr>
<td>700-1250</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>+0.2</td>
<td>-0.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>+0.2</td>
<td>2.2 L/m²</td>
</tr>
</tbody>
</table>

Designer: Craig Roberts

Initials: CR

Date: 14 / 02 / 07

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

**Figure A.2b** Record of design for Example 2 (*Sum reduced from 0.3 because that exceeds limit*)
## Construction Record Proforma

**Road number:** A99  
**Location:** Candal Bypass

**Date of Construction:** 18 / 09 / 07  
**Time Start:** 10.00  
**Time Finish:** 14.30

**Weather:** Sunny  
**Air Temp:** 18°C  
**Humidity:** 67.2%

**Road Condition:** Dry  
**Road Temp:** 20°C

### Chippings

**Supplier:** Tamac  
**Quarry:** Birthley  
**Depot:** Birthley

<table>
<thead>
<tr>
<th>Layer</th>
<th>Size</th>
<th>PSV</th>
<th>AAV</th>
<th>LAV</th>
<th>Quantity used</th>
<th>Area</th>
<th>Ave. rate of speed</th>
<th>Spot check (box) results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>14</td>
<td>50/68</td>
<td>-</td>
<td>-</td>
<td>28875 L</td>
<td>13125 m²</td>
<td>2.2 L/m²</td>
<td>12.5 kg/m³, 11.5 kg/m³, 12.0 kg/m³</td>
</tr>
<tr>
<td>2nd</td>
<td>6</td>
<td>50/68</td>
<td>-</td>
<td>-</td>
<td>170 T</td>
<td>1600 m²</td>
<td>5 kg/m²</td>
<td>4.8 kg/m², 5.3 kg/m², 5.0 kg/m²</td>
</tr>
</tbody>
</table>

### Binder

**Supplier:** Colas

<table>
<thead>
<tr>
<th>Layer</th>
<th>Binder Type</th>
<th>Sample Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Premium 80</td>
<td>ABC125</td>
</tr>
</tbody>
</table>

**Quality used:** 28875 L  
**Area:** 13125 m²  
**Ave. rate of speed:** 2.2 L/m²  
**Spot check (carpet tile) results:** 2.25 L/m², 2.20 L/m², 2.15 L/m²

### Plant

<table>
<thead>
<tr>
<th>Sprayer Reg. Number</th>
<th>Sprayer Type</th>
<th>Cone test</th>
<th>Sprayer Type</th>
<th>Cone test</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR 03 TSD</td>
<td>Phoenix</td>
<td>Yes</td>
<td>Phoenix</td>
<td>No</td>
</tr>
</tbody>
</table>

**Spray bar height:** 450 mm  
**Pressure:** 15 bar/psi  
**Temp:** 90°C

**Gritter type:** Tailgate  
**Roller type:** Pneumatic

**Sweeper type:** Suction  
**Before:** Yes  
**After:** Yes  
**How soon?** 24 h

**Traffic control:** Speed control vehicle

### Signing

**Before:** Traffic lights and 10 mph speed limit  
**After:** Traffic lights and 10 mph speed limit and no road markings

**How long were the signs left in place after surface dressing?** 10 days

**Weather after surface dressing:** Cloudy but dry  
**Overnight temp.:** 8°C

### Spot check (box) results

<table>
<thead>
<tr>
<th>L/m²</th>
<th>m²</th>
<th>Ave. rate of speed</th>
<th>L/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Traffic control following surface dressing

<table>
<thead>
<tr>
<th>L/m²</th>
<th>m²</th>
<th>Ave. rate of speed</th>
<th>L/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Date Texture Comments**

<table>
<thead>
<tr>
<th>Date</th>
<th>Texture</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>25/03/08</td>
<td>1.6 mm</td>
<td></td>
</tr>
<tr>
<td>20/09/08</td>
<td>1.5 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mm</td>
<td></td>
</tr>
</tbody>
</table>

**Signature:** Craig Roberts  
**Name:** Craig Roberts  
**Date:** 29/09/08

* Highlight or delete as appropriate.

---

**Figure A.2c** Record of Construction for Example 2
A.3 EXAMPLE 3: DOUBLE SURFACE DRESSING

Northbound lane of a single rural carriageway (for details, see Figure A.3b).

(Note: In practice, both lanes would also be designed at the same time.)

Traffic category: Table 7.2.3
Minimum PSV: Figure 7.3.1
Road hardness category: Figure 7.2.2, South category, <200 m altitude
Type of surface dressing: Figure 8.3a (Figure A.3a)
Chipping size: Table 9.2.1
Target rate of spread: Table 9.2.1
Binder type: Figure 8.3a/Designer/Contracter choice
Aggregate type: Designer/Contractor choice
Flakiness index: Material supplier
Chipping size: Design

Section 1: 0–500 m northbound
Aggregate type: Crushed rock
Chipping size: Design
Flakiness of chippings: 10-25%
Surface condition: Binder lean
Radius: >250 m
Gradient: Over 10% downhill5%
Shade: Partially shaded
Late season work: Low risk
Speed of traffic: <50 mph
Rate of spread of binder: Table 9.2.6a

Section 2: 500 m–1700 m northbound
Aggregate type: Crushed rock
Chipping size: Design
Flakiness of chippings: 10-25%
Surface condition: Normal
Radius: >250 m
Gradient: 5% to 10% downhill
Shade: Unshaded
Local traffic: Design range
Late season work: Low risk
Speed of traffic: <50 mph
Rate of spread of binder: Table 9.2.6a

Section 3: 1700 m–2000 m northbound
Aggregate type: Crushed rock
Chipping size: Design
Flakiness of chippings: 10-25%
Surface condition: Binder rich
Radius: >250 m
Gradient: Less than 5%
Shade: Partially shaded
Local traffic: Design range
Late season work: Low risk
Speed of traffic: <50 mph
Rate of spread of binder: Table 9.2.6a

Record of Design: Figure A.3b
Is current road surface suitable for surface dressing? (See Figure 8.1)

Yes

Is it a carriageway?

Yes

Is traffic category A to F?

Yes

Do the site conditions include: Approach to traffic lights, pedestrian crossing or roundabout?

Yes

Yes to any

High-Friction Surface Dressing (At lower traffic levels, e.g., category F, a Double Surface Dressing with Premium Binder may be suitable)

No

Yes

Is road hardness category very hard, hard, or normal and homogeneous?

Yes

Double Surface Dressing with Premium Grade Binder, High Friction Surface Dressing may be considered

No

Yes

Is road hardness category normal or speed limit $<50$ mph?

Yes

Racked-in or Double Surface Dressing with Intermediate Binder or Single Surface Dressing with Premium Binder

No

No to both

Unsuitable for a surface dressing

Do the site conditions include: bends with radius $<50$ m; Roundabouts; Gradients $>10\%$; or Major junctions?

Yes

Yes to any

Inverted double Surface Dressing with Intermediate Grade Binder

No

Yes

Porous surface condition or high macrotexture or fretted?

Yes

Yes to any

Racked-in Surface Dressing with Premium Binder or, particularly where tyre / road noise generation is a problem, Double Surface Dressing with Premium Binder

No

Yes

Is surface condition homogeneous or tracks of consistent texture?

Yes

Is road hardness category hard or very hard?

Yes

Unsuitable for a surface dressing

No

Racked-in or Double Surface Dressing with Intermediate Binder or Single Surface Dressing with Premium Binder

No

No to all

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

**Figure A.3a** Selection of type of surface dressing for Example 3
### Design of road surface dressing to Road Note 39 (Sixth Edition)

<table>
<thead>
<tr>
<th>Road number:</th>
<th>Region / Area:</th>
<th>Yorkshire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section location:</td>
<td>Moorland Road</td>
<td></td>
</tr>
<tr>
<td>Length:</td>
<td>2000 m</td>
<td></td>
</tr>
<tr>
<td>Width:</td>
<td>8.0 m</td>
<td></td>
</tr>
<tr>
<td>No. of lanes:</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Area:</td>
<td>16000 m²</td>
<td></td>
</tr>
<tr>
<td>Lanes(s):</td>
<td>NB</td>
<td></td>
</tr>
<tr>
<td>Traffic category:</td>
<td>Medium/Heavy traffic: 400 cvl/d</td>
<td></td>
</tr>
<tr>
<td>Traffic speed limit:</td>
<td>40 mph</td>
<td></td>
</tr>
<tr>
<td>Latitude:</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Temperature category:</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Road hardness probe depth:</td>
<td>4.0 mm</td>
<td></td>
</tr>
<tr>
<td>Minimum PSV:</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Max. AAV:</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Category:</td>
<td>Very hard</td>
<td></td>
</tr>
<tr>
<td>Existing surface characteristics:</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>General surface condition:</td>
<td>Very binder rich</td>
<td></td>
</tr>
<tr>
<td>Radius of curvature:</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Junction or crossing:</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Overall gradient:</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Type of dressing:</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Chipping size:</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Aggregate type:</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Flakiness index:</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Bitumen emulsion binder:</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Seasonal risk category:</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Binder spread category:</td>
<td>First layer 1.1 L/m² Second layer 1.2 L/m²</td>
<td></td>
</tr>
</tbody>
</table>

#### Seasonal Risk Category

<table>
<thead>
<tr>
<th>Location</th>
<th>Season</th>
<th>Aggregate type</th>
<th>Flakiness</th>
<th>Increase of chipping size</th>
<th>Shade</th>
<th>Surface condition</th>
<th>Gradient</th>
<th>Speed of traffic</th>
<th>Untrafficked area</th>
<th>Sum of factors</th>
<th>Rate of spread of binder</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-500</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>+0.2/0.3</td>
<td>1.3 &amp; 1.5 L/m²</td>
</tr>
<tr>
<td>500-1700</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>+0.1</td>
<td>1.3 &amp; 1.5 L/m²</td>
</tr>
<tr>
<td>1700-2000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>+0.1</td>
<td>1.3 &amp; 1.5 L/m²</td>
</tr>
</tbody>
</table>

**Designer:** Craig Roberts  
**Initials:** CR  
**Date:** 01 / 01 / 06

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

**Figure A.3b** Record of design for Example 3
### Construction Record Proforma

**Road number:** A6666  
**Location:** Moorland Road, Yorkshire

**Date of Construction:** 13 / 08 / 06  
**Time Start:** 11.15  
**Time Finish:** 16.00

**Weather:** Sunny  
**Air Temp:** 25°C  
**Humidity:** 61%

**Road Condition:** Dry  
**Road Temp:** 28°C

#### Chippings

**Supplier:** Lafarge  
**Quarry:** Marfield  
**Depot:** Marfield

<table>
<thead>
<tr>
<th>Layer</th>
<th>Size</th>
<th>PSV</th>
<th>AAV</th>
<th>LAV</th>
<th>Sample Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>10</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>PQR456</td>
</tr>
<tr>
<td>2nd</td>
<td>6</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>PQR457</td>
</tr>
</tbody>
</table>

**Tonnage:** 144 T  
**Area:** 16000 m²  
**Ave. rate of speed:** 9 kg/m²

**Spot check (box) results:** 8.8 kg/m², 9.2 kg/m², 9.0 kg/m², kg/m²

#### Binder

**Supplier:** Total  
**Binder Type:** Emulsis Ultra  
**Sample Ref. No.:** PQR458

<table>
<thead>
<tr>
<th>Layer</th>
<th>Quantity used</th>
<th>Area</th>
<th>Ave. rate of speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>17600 L</td>
<td>16000 m²</td>
<td>1.15 L/m²</td>
</tr>
</tbody>
</table>

**Spot check (carpet tile) results:** 1.13 L/m², 1.17 L/m², 1.15 L/m², L/m²

**Quantity used:** 21600 L  
**Area:** 16000 m²  
**Ave. rate of speed:** 1.35 L/m²

**Spot check (carpet tile) results:** 1.30 L/m², 1.40 L/m², 1.35 L/m², L/m²

#### Plant

**Sprayer Reg. Number:** HN 54 LOP  
**Sprayer Type:** Phoenix  
**Cone test:** Yes

**Spray bar height:** 450 mm  
**Pressure:** 15 bar/psi  
**Temp:** 89°C

**Gritter type:** Tailgate  
**Roller type:** Pneumatic  
**Sweeper type:** Suction

**Traffic control:** Speed control vehicle

#### Signing

**Before:** 10 mph and traffic lights  
**After:** 20 mph advisory limit and no road markings

**How long were the signs left in place after surface dressing?** 5 days

**Weather after surface dressing:** Sunny  
**Overnight temp.:** 16°C

**Traffic control following surface dressing:** Yes

#### Texture

<table>
<thead>
<tr>
<th>Date</th>
<th>Texture</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/03/08</td>
<td>1.5 mm</td>
<td></td>
</tr>
<tr>
<td>01/08/07</td>
<td>1.5 mm</td>
<td></td>
</tr>
<tr>
<td>01/08/08</td>
<td>1.4 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mm</td>
<td></td>
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</tbody>
</table>

**Signature:** C Roberts  
**Name:** Craig Roberts  
**Date:** 18 / 08 / 08

*Highlight or delete as appropriate.*

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**Figure A.3c** Record of Construction for Example 3
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**PROFORMA FOR RECORD OF CONSTRUCTION DATA**

**Design of road surface dressing to Road Note 39 (Sixth Edition)**

<table>
<thead>
<tr>
<th>Road number:</th>
<th>Region / Area:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Section location:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Length:</th>
<th>Width:</th>
<th>No. of lanes:</th>
<th>Area:</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>m</td>
<td></td>
<td>m²</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lanes(s):</th>
<th>Medium/Heavy traffic:</th>
<th>cv/l/d</th>
<th>NRSWA road type:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Traffic speed limit:</th>
<th>mph</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Traffic category:</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Latitude:</th>
<th>South</th>
<th>Central</th>
<th>North</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Road hardness probe depth:</th>
<th>mm</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Temperature category:</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Category:</th>
<th>Very hard</th>
<th>Hard</th>
<th>Normal</th>
<th>Soft</th>
<th>Very soft</th>
<th>Variable</th>
</tr>
</thead>
</table>

| Existing surface characteristics: | |
|----------------------------------| |

<table>
<thead>
<tr>
<th>General surface condition:</th>
<th>Very binder rich</th>
<th>Normal</th>
<th>Very binder lean</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Radius of curvature:</th>
<th>Under 100 m</th>
<th>100 – 250 m</th>
<th>Over 250 m</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Junction or crossing:</th>
<th>Approach</th>
<th>Non-approach</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Overall gradient:</th>
<th>Up to 5 %</th>
<th>5 – 10 %</th>
<th>Over 10 %</th>
<th>Uphill</th>
<th>Downhill</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Type of dressing:</th>
<th>Single</th>
<th>Racked-in</th>
<th>Double</th>
<th>Inverted double</th>
<th>Sandwich</th>
<th>High-friction</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Chipping size:</th>
<th>8/14 mm</th>
<th>6.3/10 mm</th>
<th>2.8/8.3 mm</th>
<th>6.3/10 &amp; 4/2 mm</th>
</tr>
</thead>
</table>

| 8/14 & 2.8/6.3 mm | |
|-------------------| |

<table>
<thead>
<tr>
<th>Aggregate type:</th>
<th>Crushed rock</th>
<th>Blast furnace slag</th>
<th>Steel slag</th>
<th>Gravel</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Flakiness index:</th>
<th>Less than 10%</th>
<th>10 % to25%</th>
<th>15% to 20%</th>
<th>More than 20%</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Bitumen emulsion binder:</th>
<th>Unmodified</th>
<th>Intermediate</th>
<th>Premium grade</th>
<th>Super premium grade</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Seasonal risk category:</th>
<th>High</th>
<th>Significant</th>
<th>Low</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Binder spread category:</th>
<th>First layer</th>
<th>L/m²</th>
<th>Second layer</th>
<th>L/m²</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>Aggregate type</th>
<th>Flakiness</th>
<th>Increase of chipping size</th>
<th>Shade</th>
<th>Surface condition</th>
<th>Gradient</th>
<th>Speed of traffic</th>
<th>Untrafficced area</th>
<th>Sum of factors</th>
<th>Rate of spread of binder</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>L/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Designer:</th>
<th>Initials:</th>
<th>Date:</th>
</tr>
</thead>
</table>

* Highlight or delete as appropriate. Shaded box indicates data that a client should provide when seeking tenders.
# Construction Record Proforma

**Road number:**

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

**Weather:**
- Sunny
- Cloudy
- Showers
- Drizzle

**Air Temp:** °C  
**Humidity:** %

**Road Condition:**
- Dry
- Damp

**Road Temp:** °C

## Chippings

**Supplier:**  
**Quarry:**  
**Depot:**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Size</th>
<th>PSV</th>
<th>AAV</th>
<th>LAV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Condition:**
- Dry
- Damp

**Tonnage:** T  
**Area:** m²  
**Ave. rate of speed:** L/m²

**Spot check (box) results:**
- kg/m²
- kg/m²
- kg/m²
- kg/m²
- kg/m²

## binder

**Supplier:**  
**Binder Type:**  
**Sample Ref. No.:**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Quantity used</th>
<th>L</th>
<th>Area</th>
<th>m²</th>
<th>Ave. rate of speed</th>
<th>L/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Spot check (carpet tile) results:**
- L/m²
- L/m²
- L/m²
- L/m²
- L/m²

## Plant

**Sprayer Reg. Number:**  
**Sprayer Type:**  
**Cone test:**
- Yes
- No

**Spray bar height:** mm  
**Pressure:** bar/psi  
**Temp:** °C

**Gritter type:**
- Tailgate
- Self propelled
- Expanding
- Pneumatic
- Steel (vibrate)
- Steel (static)

**Roller type:**
- Speed control vehicle
- Stop/Go boards
- Traffic lights

**Sweeper type:**
- Suction
- Brush

**Before:**

**After:**

**How soon?** h

**Sweeper type:**

**Before:**

**After:**

**How long were the signs left in place after surface dressing?**

## Signing

**Weather after surface dressing:**  
**Overnight temp.:** °C

**Traffic control following surface dressing:**
- Yes
- No  
**Time maintained:** h

### Date | Texture | Comments
--- | --- | ---
/ / | mm | 
/ / | mm | 
/ / | mm | 
/ / | mm | 

**Signature:**  
**Name:**  
**Date:** / /

* Highlight or delete as appropriate.
Design guide for road surface dressing

Road Note 39 is a guide for the design of surface dressing for roads throughout the UK. This Sixth Edition is produced by a panel representing all sides of the industry and has been comprehensively updated to take account of standards, nomenclature, materials and traffic categories. The advice in the guide will be indispensable to those drawing up specifications. Methods and recommendations are presented to provide guidance on the choice and design of an appropriate surface dressing.

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| PPR023 | Comparison of tyre/road noise for a range of surfaces on the A47, A447, A511 and B582 in Leicestershire. M H Balsom, P M Nelson and C Summers. 2005 |
| CT40.5 | Bituminous road design and construction update (2005-2007) |
| CT68.4 | Deterioration of road surfaces update (2003-2007) |