Department for Transport

Practical Guide to Street Works

HAUC (UK)

HIGHWAY AUTHORITIES & UTILITIES COMMITTEE

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Acknowledgements

This guide is intended as a quick user-friendly reference document for use by site operatives and supervisors involved with the reinstatements of openings in highways under the New Roads and Street Works Act 1991.

This guide is **NOT** a replacement or abbreviated version of the Code of Practice, **Specification for the Reinstatement of Openings in Highways (Second Edition [England], June 2002)**, which has been approved by the Secretary of state under Section 71 of the 1991 Act. That Code provides practical guidance on the standards required in relation to materials, workmanship and standard of reinstatement of street works carried out by utilities and other undertakers with apparatus in the street. Failure to comply with the Code will be evidence of a breach of an undertaker's statutory obligations.

This Guide serves a different purpose and is intended to provide practical advice to assist good workmanship and promote the highest standards of reinstatement by site operatives and supervisors. It includes relevant reference material from the Specification for the Reinstatement of Openings in Highways (Second Edition [England], June 2002). Where direct reference is made to the Specification, the relevant section number is given in brackets (See Section n.nn).

e.g

SROH Table S1.1

Text, tables and figures ***reproduced*** from the Specification are presented on a yellow background, with a reference to the relevant section. **The symbol in the margin identifies these references in the text.**

Figure and table numbers from the Specification are given in the left margin.

FULL COMPLIANCE WITH THE SPECIFICATION IS REQUIRED IN ALL CASES.

The use of photographs provided by Bomag, National Joint Utilities Group (NJUG), Terex, TRL Limited and Wacker (Great Britain) Limited within this document is gratefully acknowledged.

Contents

Contents (continued)

Preface by HAUC (UK)

HAUC (UK) is acutely aware of the importance of good quality reinstatements which reflect directly on all who are involved in working on the streets and managing such work. This Guide is a welcome addition and will assist all involved in street works operations but particularly the practitioners who carry out the works.

CAUTION

The methods and procedures listed in this Guide describe the standard recommended techniques used for excavation and reinstatement. However, not all possible variations can be covered in a summary document. Utility, Contractor and Contract requirements may result in techniques being used that are not described in this document. These other techniques may have additional engineering requirements and legal obligations associated with them. The planning and undertaking of the reinstatement process must take account of these obligations.

How to use this Guide

This Practical Guide is designed to be used mainly by Street Works Operatives. It may also be used as a reference for Supervisors. Items which target Supervisor level are highlighted in the text by the use of 'Supervisor boxes'.

The Guide is divided into Sections (see Contents page). The information is presented in the order a reinstatement is undertaken, from signing, excavating, reinstating and then leaving the completed job. Each section is typically broken down to cover:

- Specifications details
- checks, with hints and tips of what to look out for
- a list of tasks to be completed
- Health and Safety issues to be aware of

Symbols have been used to highlight certain kinds of information. The meaning of each symbol is as follows:

Details from the Specification

For general information

Important information and reminders

Tasks to be completed

Compaction

Materials

Tools and equipment

Checks

Health and safety

List of reference documents

British Standards Institution:

- BS 598: Part 105: Sampling and examination of bituminous mixtures for roads and other paved areas: Methods of test for determination of texture depth.
- BS 812: Part 113: Testing aggregates. Method for determination of aggregate abrasion value (AAV).
- BS 4987: Part 1: Coated macadam (asphalt concrete) for roads and other paved areas. Specification for constituent materials and for mixtures.
- BS 5075: Part 2: Concrete admixtures. Specification for air-entraining admixtures.

Construction Information Sheet No 8. Safety in Excavations. HSE.

Construction Information Sheet No 40. Construction (Design and Management) Regulations 1994. HSE.

Construction Information Sheet No 47 (Avoiding Danger from Underground Services). HSE.

Dewatering of Underground Ducts and Chambers. Pollution Prevention Guidelines (PPG20). Environment Agency.

Guidelines for the Planning, Installation and Maintenance of Utility Services in Proximity to Trees. NJUG 10 April 1995

Guidelines on the Positioning and Colour Coding of Utility Apparatus. NJUG (2003).

Guidelines for the Planning, Installation and Maintenance of Utility Services in Proximity to Trees. NJUG (1995).

Health and Safety at Work Act 1974.

Health and Safety in Construction, HSG150, HSE.

Management of Health and Safety Regulations, 1998.

Manual of Contract Documents for Highway Works. Volume 1: Specification for Highway Works.

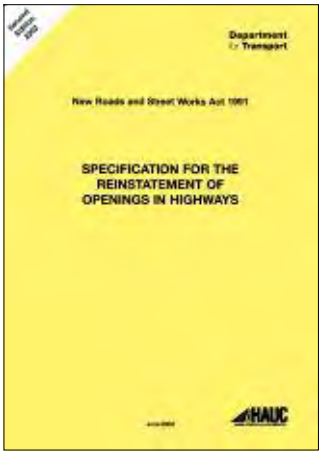
Protecting the Public: Your Next Move, HSG151, HSE.

Safety at Street Works and Road Works – a code of practice (Second edition). TSO 2001.

Specification for the Reinstatement of Openings in Highways (Second edition). TSO 2002.

1. Introduction

Methods and materials used for excavating and reinstating Street Works must comply with the details described in the **Specification for the Reinstatement of Openings in Highways (2002)** ('Specification' or 'SROH' are used as shorter names in this Guide).



The Specification requires that all excavation and reinstatement work is carried out to a high standard. For this reason:

- the work must be well planned
- health and safety rules must be followed
- correct materials and methods must be used

This Guide covers the equipment and tasks required to complete excavations and reinstatements correctly **(for complete details, see the Specification)**. All permanent reinstatements should be completed to a standard that ensures they have a long service life.

Supervisor

The types of excavations and trenches covered are:

- small excavations – openings with surface area 2m^2 or less
- narrow trenches – 300mm width or less, and surface area greater than 2m^2
- deep openings – depth of cover over buried apparatus greater than 1.5m
- other openings – all excavations and trenches with surface area greater than 2m^2

2. Specification designs and categories

Roads, footways, footpaths and cycle tracks will have been constructed to one of these designs:

- Flexible/Composite (i.e. part bitumen)
- Rigid (i.e. concrete)
- Modular (i.e. setts, blocks, paving slabs etc.)

Reinstatements in roads, footways, footpaths and cycle tracks will normally match the original construction (although local variations may apply). The SROH uses the new terms from the European Standards for reinstatement construction and the table below lists the old and new terms. The new terms (current) will be used throughout this Guide.

Current SROH terms	Old term
surface course	wearing course
binder course	basecourse
base (roadbase)	roadbase
materials to BS 4987	macadam

The term **subgrade** is also used in this Guide to describe the naturally occurring soil that exists beneath the construction.

The types of material to be used in a reinstatement and the layer thickness will depend on the category of road, footway, footpath or cycle track. Roads are divided into 5 categories, depending on the traffic they carry. Traffic is measured in millions of standard axles (msa). The road categories are:

SROH Table S1.1

SROH classification		Approx. percentage of highway network	Typical national classification	Typical local classification
Road	Traffic (msa)			
Type 0	over 30 to 125	less than 1	Motorway	High-speed dual
Type 1	over 10 to 30	less than 1	Class A	Strategic routes
Type 2	over 2.5 to 10	less than 5	Class A or B	Main or secondary distributor roads
Type 3	over 0.5 to 2.5	less than 9	Class B or C	Local roads
Type 4	up to 0.5	less than 84	Unclassified	Local access roads

2. Specification designs and categories (continued)

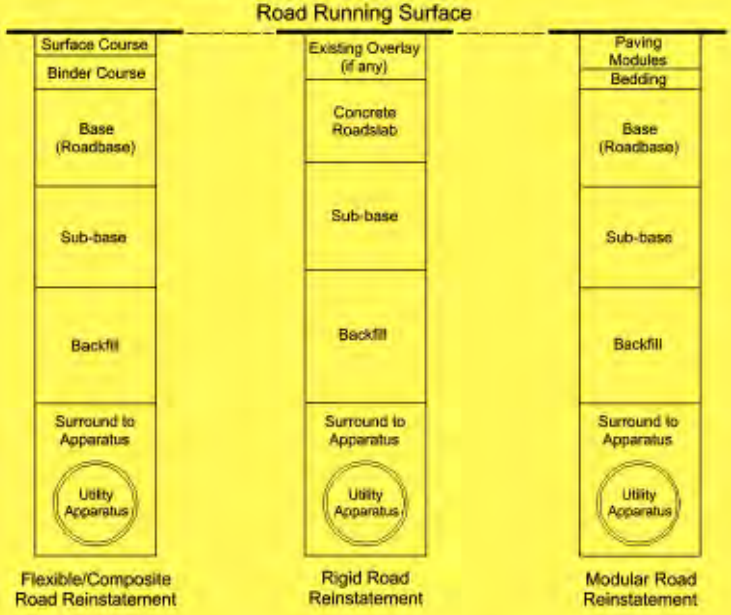
SROH Section S1.4

Footways, footpaths and cycle tracks are divided into 3 categories:

- High duty – for busy pedestrian/cycle routes
- High amenity – routes with special or decorative surfaces
- Others – routes which are neither high duty or high amenity (most footways, footpaths and cycle tracks fall into this category)

The details of typical layers, for reinstatement designs, in roads are shown below.

Figure A 2.1 Typical reinstatement structure within recognised road designs



Supervisor

Before commencing the excavation, the road classification must be:

- confirmed, and
- checked

3. Tools and equipment

The tools and equipment required to carry out reinstatements will vary depending on the location and types of utilities involved. Different utilities may require specific equipment, e.g. to form trenches to appropriate dimensions and to compact various materials to meet the requirements of the Specification. For this reason, you will require a standard set of tools and equipment to complete each type of reinstatement.

The reinstatement tasks may also be broken down into different stages, such as:

- excavation
- repair or installation of apparatus
- placing bedding/surround
- backfilling granular/cohesive materials
- reinstating surfacing materials, e.g. bituminous, concrete or modular
- applying surface finishes

Depending on your company's procedures, each stage of the reinstatement may require a different set of standard tools. Details of the standard kits your Company recommends may be listed on the following page.

In this Guide, tasks are undertaken using industry standard equipment. Where you use different tools or equipment, you must follow your Company's recommended procedures to complete the tasks.

4. Signing, lighting and guarding

Safe use of signs

Detailed requirements for traffic safety measures at road works are given in the 'Safety at Street Works and Road Works (2002)' Code of Practice (CoP). The main points are:

1. Fix signs properly:

   To prevent signs, lights or guarding equipment being being blown over or moved out of position by wind or by passing traffic:

   - place sandbags at a low level to prevent movement (alternatively, use equipment with ballast already in it)
   - do not use barrels or kerbstones as they could be dangerous if hit by traffic. Never use road pins

2. Location of signs:

   - place the first sign far enough from the works to give adequate warning of the hazard (see Safety at Street Works CoP)
   - where signs have to be placed on a footway, they should be positioned to minimise inconvenience or hazard to pedestrians
   - if drivers can no longer obey a permanent traffic sign, consult with your Supervisor to decide if the sign needs to be covered for the duration of the works

- **It is your responsibility to sign, guard, light and maintain your works safely.**
- **All site personnel must wear a high visibility jacket or waistcoat (on dual carriageways with a speed limit of 50mph or more, jackets must meet national standards for colour and reflectivity). You may also need other protective clothing or equipment for your personal safety.**
- **It is management's responsibility to provide the signs, guarding and personal protective equipment. It is your responsibility to use them in the right way.**
- **Always consult your Supervisor if you are in any doubt about correct procedures or if you are concerned about safety.**





4. Signing, lighting and guarding (continued)

Safe use of signs (continued)

3. Undertake regular checks:

- regularly check that signs have not been moved, damaged or have become dirty, especially when the site is left unattended for a period of time. Ensure all signs are kept clean
- in times of poor visibility or bad weather, you may need to provide additional signs or stop working. Check with your Supervisor
- all sites must be checked daily

When undertaking Street Works, the following points should be considered.

- preplanning
- road layout
- traffic
- setting out the site
- layout of signs
- any additional requirements
- statutory safety measures when undertaking the work
- planning for emergencies

5. Undertaking excavations

Planning

Good planning means thinking about everyone who comes into contact with the excavation, including yourself, other workers and the general public.

For all excavations, you must plan ahead to reduce the risk of:

- collapse of the trench (even shallow trenches can be dangerous)
- materials and equipment falling into the excavation and injuring workers
- undercutting nearby structures (including walls, scaffolding, etc.)
- accidental contact with underground services

Tasks when excavating

Good excavating methods include:

- watch out for unexpected pipes and cables
- use hand digging to confirm the position of pipes and cables (especially plastic pipes which may not be detected with locating equipment):
  - mechanical plant and power tools must not be used within 0.5m of underground services
  - use spades and shovels rather than picks and forks, which may cut through cables
- treat all pipes and cables as live
- unless you are advised on site by the owner of the pipe or cable that it is safe to do so, you must not cut or break out pipes or cables
- support exposed apparatus to prevent damage
- report any suspected damage to apparatus
- plans of other utilities' plant should be available on site before you start excavating

5. Undertaking excavations (continued)

Supervisor

There are a number of documents which give advice on Health and Safety aspects of excavations and measures to reduce pollution. The ones most relevant to Street Works include:

- Health and Safety at Work Act 1974
- Management of Health and Safety Regulations 1998
- Safety in excavations: HSE Construction Information Sheet No 8
- HSE Construction Information Sheet No 47 (Avoiding danger from Underground Services)
- Construction (Design and Management) Regulations 1994: HSE Construction Information Sheet No 40
- Health and safety in construction, HSG150, HSE
- Protecting the public: Your next move, HSG151, HSE
- Dewatering of underground ducts and chambers. Pollution Prevention Guidelines (PPG20), Environment Agency

6. Trench sidewall support

For difficult or unstable ground conditions, trench sidewall supports are required before any worker can safely enter an excavation. All excavations must be assessed for trench collapse regardless of depth. The following risks should be considered:

- accidental collapse of the excavation
- persons being struck, trapped or buried by falling material
- persons, vehicles or plant falling into the excavation
- underground pipes or cables
- adjacent structures

There are many different types of trench support systems including:

- simple sheets and props
- trench boxes
- hydraulic wallings

The excavation support system must be:

- designed for the purpose
- installed during excavation
- remain in place throughout the works
- withdrawn during backfilling

An excavation which requires a trench support system must be supervised by a competent and trained person. To ensure the support system is performing as intended, the excavation needs to be inspected by the competent person:

- **at the start of every shift**
- **after any event that is likely to have affected the excavation's strength or stability, for example after any accidental fall of rock, earth or other material**

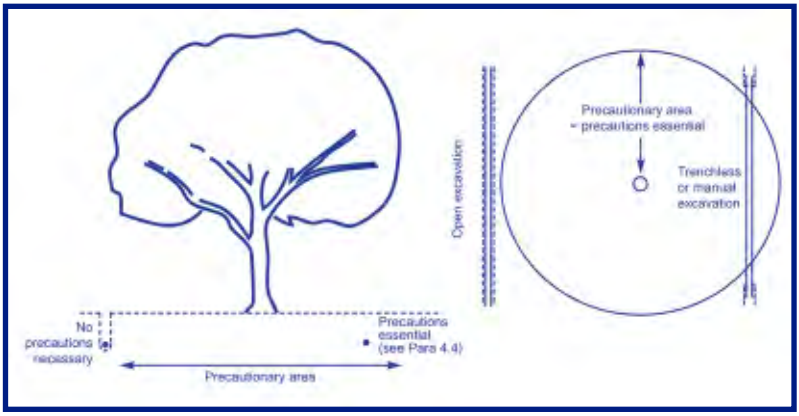
7. Precautions for protecting trees

Excavating around trees

When excavating and reinstating close to trees, you should follow the advice in NJUG10 (Guidelines for the planning, installation and maintenance of utility services in proximity to trees). (See NJUG10 Section 4)

A precautionary area must be set out. This area is calculated by measuring the girth (diameter) of the tree at chest height and multiplying by 4. This measurement is used as the radius of a circle centred on the tree, as shown here:

(NJUG10 Figure 3)



You should avoid placing an excavation within the precautionary area wherever possible. Where the excavation passes through the precautionary area, the following methods should be used:

- dig by hand or use trenchless methods – do not excavate with machinery
- when hand digging:
  - try not to damage fine roots
  - do not cut roots over 25mm diameter
  - where necessary, prune roots using handsaw or secateurs, making a clean cut, and make as small a wound as possible

7. Precautions for protecting trees (continued)

Reinstating around trees

Full compaction of backfill that contains roots would result in damage to the condition of the tree. To avoid damage during reinstating, the voids around the roots must be backfilled as follows:

SROH Section S1.10

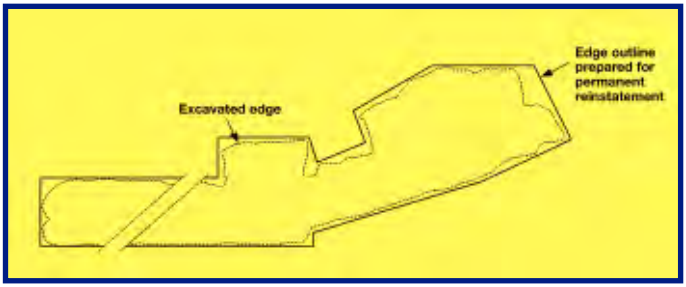
- inert granular materials, mixed with topsoil or sharp sand, must be placed around the roots
- if a root barrier is present, it should be reinstated to its original condition
- outside the highway limits (verges and unmade ground), use the excavated soil for backfilling. The backfill should not be compacted, but should be lightly tamped. The final level of the reinstatement should be slightly proud of the surrounding surface
- the use of heavy mechanical plant in the precautionary area should be avoided
- equipment and materials should not be stored in the precautionary area
- when compacting, ensure that exhaust gases are not discharged directly into nearby hedges
- careless damage to trunks and branches of trees should always be avoided. Do not lean any equipment or materials (e.g. kerb slabs) against trees

8. Excavating surfacings – bitumen bound

Tasks

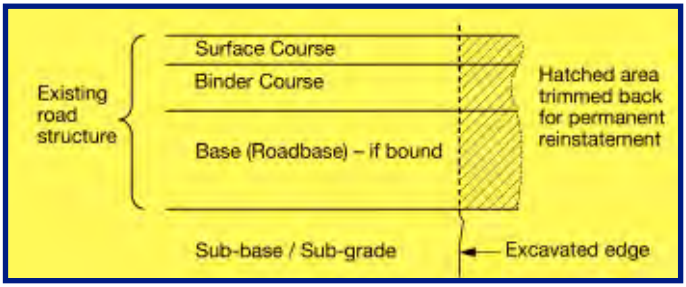
1. Remove surfacing layers to full depth:
   - use of a roadsaw or a hand-held disc-cutter is recommended to give a good vertical edge. A jackhammer may then be used to remove material, provided its use does not damage the adjacent road surface.
   - all edges must be trimmed and squared off to give a regular plan shape, as shown here:

SROH Figure S6.1



   - all bitumen bound edges must be smooth and vertical, and have no significant undercutting, as shown here:

SROH Figure S6.2



8. Excavating surfacings – bitumen bound (continued)

Tasks (continued)

2. Trim lines:

   a) For roads:

   Where the trimmed edge of your excavation is within 250mm of the following features:

   - the road edge
   - kerbing
   - other fixed features (drains, manhole covers etc.)
   - other reinstatements

   you must extend the trimline to include the feature. Only the surface course of this extra area needs to be excavated and reinstated (provided the lower layers have not been damaged).

   b) For footways, footpaths and cycle tracks:

   Where trim-lines for the reinstatement edges are within 150mm of the features listed above, the trimlines should be extended to include the feature. Only the surface course of this extra area needs to be excavated and reinstated (provided the lower layers have not been damaged).

Examples of incorrect trimming

8. Excavating surfacings – rigid roadslabs

Tasks:

1. Remove the roadslab (normally concrete) to full depth.
   - the method of excavation will depend on whether you use **edge taper support** or **dowel bar support**
   - generally, all edges must be trimmed and squared off to give a regular plan shape (see earlier diagram in this Section for excavating bitumen bound surfacings)
   - any cracked sections within an adjacent road slab should be removed and included within the area to be reinstated
   - where the trimmed edge of your excavation is within 300mm of the road slab edge, a joint, another reinstatement or ironwork, you must extend the trim line to include the feature

2. For rigid roadslabs to be reinstated using ***edge taper support***:
   a) If the surface of the roadslab is the running surface of the road:
      - the excavation must be marked out using a pavement saw to a depth of 30mm with a 10mm tolerance. The remainder of the exposed face should be roughcut and at an angle of 27 degrees to the vertical, with an 18 degree tolerance, as shown below

   b) In all other cases:
      - the exposed face should be roughcut as described previously in 2 a) above. Cutting using a roadsaw is also acceptable

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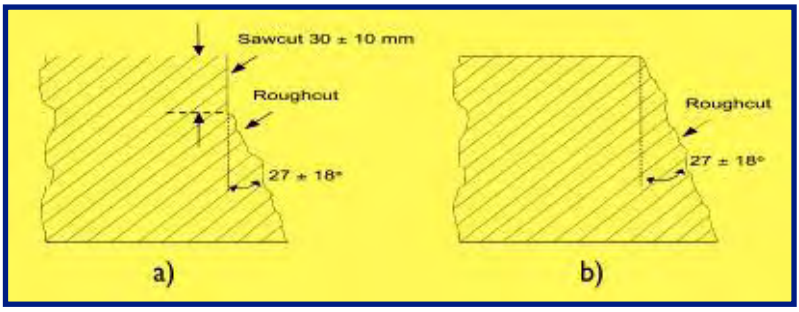
SROH Figure S7.1



8. Excavating surfacings – rigid roadslabs (continued)

Tasks continued:

3. For rigid roadslabs to be reinstated using ***dowel bar support***:
   a) If the surface of the roadslab is the running surface of the road:
      - the excavation should be marked out using a pavement saw to a minimum depth of 20mm. Any unsawn section of the slab should be left roughcut to give an essentially vertical surface

   b) In all other cases:
      - the exposed face should be roughcut as described above. Cutting using a roadsaw is also acceptable

8. Excavating surfacings – rigid surface in footways

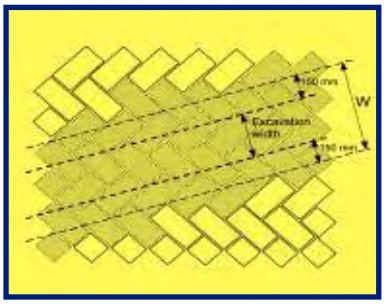
Tasks:

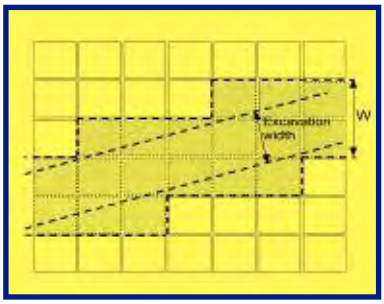
1. For concrete surface slabs in footways:
    - use of a roadsaw is recommended to give a good vertical edge. A jackhammer may then be used to remove material, provided its use does not damage the adjacent road surface
    - where the trimmed edge of your excavation is within 150mm of the road edge, kerbing, other fixed features (drains, manhole covers etc.), or other reinstatements, you must extend the trim line to include the feature

8. Excavating surfacings – modular

Tasks:

1. Remove modules:





SROH Figures S2.1A and B

- for modules up to 300mm, all modules within 150mm of the excavation (as shown above left) must be removed
- for modules larger than 300mm, all modules overlapping the excavation (as shown above right) must be removed
- during the works take care to avoid disturbing additional modules (setts, concrete blocks, brick pavers or paving slabs), as this is likely to weaken the structure and make reinstatement more difficult
- if other modules are affected by your excavation, they must also be removed
- you will need to remove one module to gain access to the remainder. It may be necessary to damage this first module to obtain access to the remaining modules
- remove modules and store safely for re-use or disposal. For interim reinstatements, the existing modules should be re-used. If the modules are too badly damaged, a bituminous mixture should be used for the interim reinstatement. If in doubt, check with your Supervisor (see Appendix 12 of the Specification)

2. Remove bedding material.

9. Excavating below surfacing layers

Tasks:

1. Remove any loose surfacing materials and ensure trench edges are in a stable condition.
2. Excavate sub-base, backfill or subgrade as required:
   - avoid undercutting the vertical wall of the excavation
   - use of a mechanical digger within 500mm of underground apparatus is not recommended
3. Install trench sidewall support (if required – see Section 7).
4. Protect the excavation by limiting build up of water. Both surface and ground water should not be allowed to collect in the excavation:
   - for surface water – using sandbags, make a barrier to divert water away to an appropriate drainage point
   - for ground water – form a sump to collect water and then pump away to an appropriate drainage point
5. Excavated material which will be re-used in the excavation should be protected with sheeting. To avoid contamination, care should be taken to ensure that re-usable and unacceptable material are stored separately.

If any materials such as cobbles or setts that may be of historical or archaeological interest are encountered during an excavation, work should be halted. The Local Highway Authority should be informed and given the opportunity to inspect the site.

If any materials such as cobbles or setts (that may be of historical or archaeological interest) are encountered during an excavation, work should be halted. The Local Highway Authority should be informed and given the opportunity to inspect the site.

10. Notes on compaction

Effects of poor compaction

Where reinstatements fail, the problem is often due to poor compaction of the layers in the reinstatement. This can lead to:

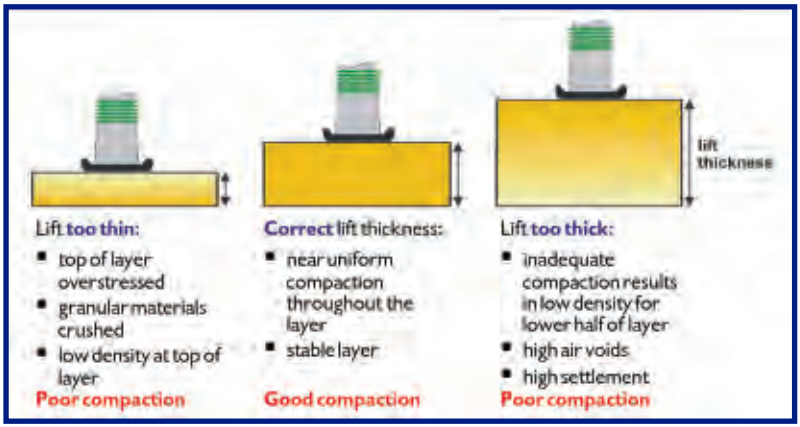
- breakdown of the reinstatement. Signs of breakdown include:
  - settlement at the reinstatement surface
  - cracking and spalling of surface
  - pooling of water at the surface
- poor ride quality for vehicles

Further consequences may include:

- increased risk of accidents for vehicles and pedestrians
- increased risk of damage to underground apparatus
- the reinstatement having to be redone in the future

Tips for good compaction:

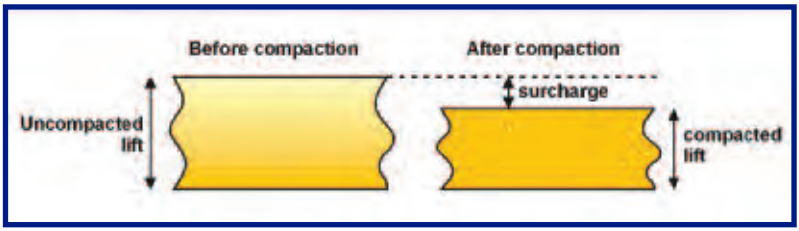
1. Check materials.
2. Select suitable compaction plant.
3. Check for correct lift thickness:
   - for granular and cohesive backfills, the recommended uncompacted layer thickness is 125mm. A suitably marked wooden peg can be used to help achieve the correct thickness of the uncompacted layer
   - achieving the correct layer thickness is important to ensure good compaction of the layer



10. Notes on compaction (continued)

4. Use correct surcharge:

- surcharge is the additional thickness of uncompacted material required to achieve the compacted lift thickness. It is normally quoted as a percentage (%)



Surcharge values for typical compacted lift thicknesses

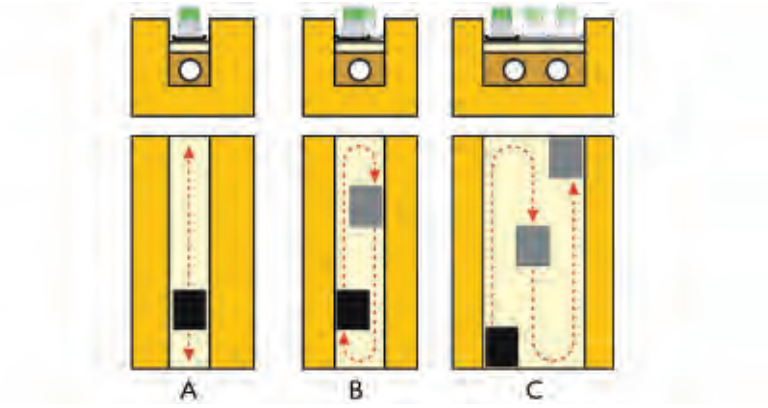
	Compacted lift thicknesses (in mm)					
% surcharge	40	50	60	100	150	200
10%	4	5	6	10	15	20
15%	6	7.5	9	15	22.5	30
20%	8	10	12	20	30	40
25%	10	12.5	15	25	37.5	50
30%	12	15	18	30	45	60
35%	14	17.5	21	35	52.5	70
40%	16	20	24	40	60	80

- suitable surcharges are:
  - for granular backfills, the surcharge for GSB (Type 1) is typically 25%. e.g. 25mm for a compacted lift thickness of 100mm
  - for cohesive backfills, the surcharge can vary between 25% and 40%, e.g. between 37.5mm and 60mm for a compacted lift thickness of 150mm
  - for surfacing materials, the surcharge is around 40%. However, the surcharge for certain materials such as Stone Mastic Asphalt (SMA) can vary considerably
- selecting the correct surcharge to use for a particular material takes experience and practice

10. Notes on compaction (continued)

5. Check that the temperature of hot-lay material is in the specified range at the time of delivery and at the time of compaction (see Annex 9 of this Guide).
6. Follow correct procedures for compacting in confined spaces (around boxes etc.). Alternative compaction plant for areas of restricted access (including small excavations and trenches less than 200 mm width) are described in Table A8.3 (see Annex 7 of this Guide).

Counting compactor passes



- a single pass of any compactor is when the foot, roll or plate has covered the entire surface area of a layer (Figure A)
- when the width of an excavation is 50mm greater than the width of the compactor (Figure B), the layer has to be compacted with two (or more) overlapping passes of the compactor
- irrespective of how many overlapping passes are required to cover the entire surface area of the layer (Figure C), all the overlapping passes are counted as ONE PASS of the compactor for that layer

Good compaction depends on using:

- **the correct material**
- **the correct surcharge and compacted lift thickness**
- **specified compaction equipment**
- **the correct number of compaction passes**

Good compaction is vital for ensuring long-term performance of your reinstatement.

10. Notes on compaction (continued)

Compaction of bituminous surfacing materials

The method specified in the SROH for compacting bituminous materials depends on the width of the excavation or trench. The standard method relies on compacting the bituminous material with sufficient compactor passes to achieve an air voids target (air voids are the empty spaces in the material).

The air voids content cannot be measured by eye. When the reinstatement has been completed, the compacted bituminous material is sampled, by coring, and the air voids content calculated. The air voids content of the samples must comply with the range specified in the SROH for that type of material (see Annex 10 of this Guide).

For excavations and trenches less than 250mm wide, coring and calculation of air voids content is not required. The compaction method relies on using a set number of compactor passes, which are listed in the SROH (further details are described in Section 21 of this Guide).

11. Preparing subgrade

Function of subgrade

1. Subgrade is the naturally occurring soil that is found below roads, footways, footpaths and cycle tracks.
2. Subgrade supports all the other layers in the reinstatement. The subgrade must be well prepared so that the reinstatement has a long service life.
3. For some reinstatements, you may not need to excavate to the depth of the subgrade.

Tasks:

1. Check that the depth of the excavation is correct (check with Supervisor).
2. Complete any subgrade drainage to ensure there is no standing water in the excavation.
3. Trim the surface of the subgrade.
4. Repair any defects:
    - excavate any soft spots
    - remove any mud and slurry
    - replace unacceptable material with suitable backfill
    - compact new backfill as required
5. Compact the subgrade to seal.
6. Check the final tolerance of the surface of the subgrade.

12. Working with buried apparatus

At each site it is important to identify and mark the location of underground cables and pipes. This should be undertaken using up to date utility records in conjunction with suitable cable location equipment.

The types of underground apparatus you may encounter include:

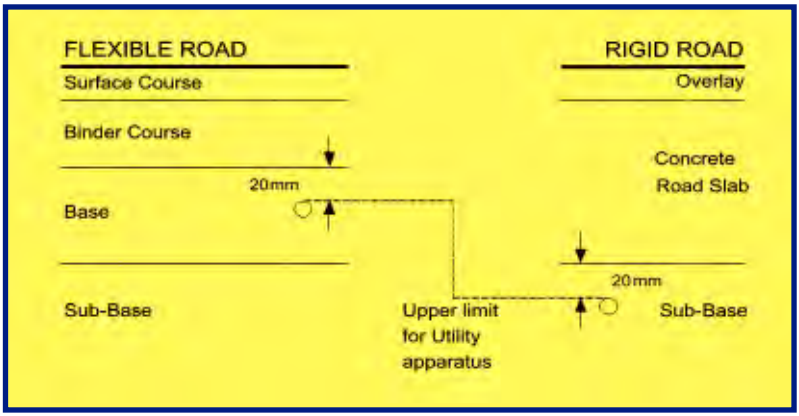
- water mains (plastic or metallic)
- gas mains (plastic or metallic)
- sewers and drains (plastic, clay or concrete)
- telecommunication and television cables (plastic, earthenware or metallic)
- electricity (low and high voltage) cables (plastic)

The **NJUG guidance** on the range of duct and cable colours used for buried apparatus is presented in Annex 5 of this Guide. The guidelines reflect common practice, but you must not assume that all apparatus encountered will conform to these colour codings. Until you are certain, you must proceed with caution.

You need to follow your Company's guidelines for dealing with each type of buried apparatus. If your excavation causes damage to other buried apparatus, you must inform your Supervisor. Following Company policy, the Supervisor will decide what action to take.

Apparatus greater than 20mm external diameter is not normally permitted within the upper layers of roads, footways, footpaths and cycle tracks. The upper limit for the position of apparatus 20mm or less is shown as follows:

SROH Figure S1.1



12. Working with buried apparatus (continued)

Tasks

1. Preparation:
   a) If apparatus is buried, carefully remove the material surrounding the existing apparatus. As the apparatus is uncovered, you must support it to minimise the risk of damage (the utility owner should be contacted to provide advice on the support mechanism to be used).
   b) If a new installation, check that the subgrade is to the correct tolerance. Make good any defects (excess moisture, contamination etc).
   c) If other buried apparatus is found (including apparatus crossing the width of the trench), install a suitable support.
2. Repair, replace or install apparatus as required. You must follow your company's guidelines for completing these tasks. You may need to use further apparatus support.
3. Using suitable finefill material and compaction equipment that will not damage the apparatus, backfill the voids around the apparatus carefully.

13. Reinstating backfill

The five main Specification classes of backfill materials are:

- Class A – Graded granular material
- Class B – Granular materials
- Class C – Cohesive/granular materials
- Class D – Cohesive materials
- Class E – Unacceptable

Full details on the identification and selection of backfill materials are presented in Annex 1 of this Guide.

Tasks

1. Check the surround to apparatus is to the correct tolerance. Make good any defects (excess moisture, contamination etc.).
2. Identify suitable backfill material (see Annex 1 of this Guide).
3. Identify suitable compaction plant.
4. Check the required lift thickness (check with Supervisor). For maximum and minimum compacted layer thickness see Table A2.3 in Annex 8 of this Guide.
5. Find the number of compaction passes from Table A8.1 (see Annex 6 of this Guide).
6. Place and level backfill material to correct uncompacted lift thickness (including correct surcharge).
7. Compact with the number of passes stated in Table A8.1 (see Annex 6 of this Guide).
8. Repeat for further layers as required.
9. Check tolerance of final backfill layer (check with Supervisor).

Good compaction of backfill is vital for ensuring long-term performance of the reinstatement.

14. Reinstating sub-base

The sub-base spreads the load from the upper layers and from traffic. The sub-base must be placed and compacted to a high standard, so that the reinstatement has a long life. Good methods of construction include:

- applying the correct number of compaction passes
- checking sub-base surface is to the correct tolerance
- checking for defects (contamination, loose material, etc.)

Tasks

1. Check the backfill layer is to the correct tolerance. Make good any defects (excess moisture, weak spots, contamination etc.).
2. Identify suitable sub-base material.
3. Identify suitable compaction plant.
4. Check the thickness of sub-base required.
5. Decide on the number and thickness of lifts required to complete the sub-base. For maximum and minimum compacted layer thickness see Table A2.3 in Annex 8 of this Guide.
6. For each lift, find the number of compaction passes required for your compaction plant (see Table A8.1 in Annex 6 of this Guide).
7. Place and level backfill material to correct uncompacted lift thickness, including correct surcharge.
8. Compact with the number of passes stated in Table A8.1.
9. Repeat for further lifts as required.
10. Check tolerance of completed sub-base.
11. Ensure that the edges of the reinstatement are trimmed and squared off to give a regular plan shape (see Section 8 of this Guide).

Good compaction of backfill is vital for ensuring long-term performance of the reinstatement.

15. Reinstating upper layers

For most designs (see Section 2), subgrade, apparatus and surround, backfill and sub-base are reinstated in a standard way. For the upper layers, the method of reinstatement depends on the design of the road, footway, footpath or cycle track. However, the final as laid profile must comply with the performance requirements of the Specification (see Annex 11 of this Guide for further information).

There are two types of reinstatement:

- permanent – a high quality first time reinstatement, or to replace an interim reinstatement
- interim – a temporary reinstatement done on the first visit. Must be replaced with a permanent reinstatement

Your Supervisor will tell you what methods and materials are to be used for the type of reinstatement you are working on. Guidance on each method is described in the following Sections.

The methods for reinstating the main types of designs are described in detail in the following pages:

Design	Category	Layer	Material	See Section
Flexible / composite	Roads and footways	Base (roadbase)	Bitumen bound, cement bound and granular materials	16
		Binder course	Bitumen bound materials	20/21
		Surface course	Bitumen bound materials	20/21
Roads	Roads	Roadslab	Concrete – edge taper support	17
	Roads	Roadslab	Concrete – dowel bar support	17
	Footways	Surface slab	Concrete	18
Modular	Roads and footways	Bedding	Sand or mortar	19
	Roads and footways	Paving modules	Setts, cobbles, pavers and slabs	19

Other less commonly used types of materials may also be used in the design. Examples include:

- Alternative Reinstatement Materials, ARMs (including foamed concrete). These materials are described in Annex 3 of this Guide
- Cold-lay Surfacing Materials (PCSMs and DSMs). These materials are described in Annex 4 of this Guide

16. Reinstating base (roadbase) for flexible/composite roads and footways

Tasks

1. Check the sub-base layer is to the correct tolerance. Make good any defects (excess moisture, contamination etc.).
2. Identify suitable base (roadbase) material.
3. Identify suitable compaction plant.
4. Check the thickness of base (roadbase) required (check with Supervisor).
5. Decide on the number and thickness of lifts required to complete the base (roadbase). For maximum and minimum compacted layer thickness see Table A2.2 and A2.3 in Annex 8 of this Guide.
6. For each lift, identify the number of compaction passes required for your compaction plant (see Table A8.1 in Annex 6 for GSB 1 and CBM 3, and Table A8.3 in Annex 7 for bituminous mixtures).
7. For hot-lay bituminous mixtures, use a temperature probe to check that the mixture is at the correct temperature at the time of delivery and compaction (see Table A2.4 in Annex 9 of this Guide). For further information, see Section 21 and 22.
8. Place and level material to correct uncompacted lift thickness, including the correct surcharge.
9. Compact with the number of passes stated in the appropriate Table detailed in Task 6.
10. Repeat for further lifts as required.
11. Check tolerance of completed base (roadbase) (check with Supervisor).

Supervisor

A flexible construction is a structure where the base (roadbase) is composed of either bituminous and/or granular material.

A composite construction consists of a structure where the base (roadbase) is composed of lean mix concrete or other cement bound granular material, normally with bituminous surfacing layers.

17. Reinstating roadslab for rigid roads

There are two methods of reinstating rigid roadslabs:

- **edge taper support** (described below)
- **dowel bar support** (described on the following page)

Tasks for edge taper support

1. Check that the roadslab edge has been prepared as detailed in Section 8 of this Guide.
2. Check the sub-base layer is to the correct tolerance. Make good any defects (excess moisture, contamination etc.) and install a slip membrane (if required).
3. Install steel mesh reinforcement (where required). The new mesh should be attached (lapped and wired, etc.) to the existing reinforcement. A minimum of 150mm of existing reinforcement should be exposed for lapping.
4. Take delivery or site batch C40 concrete.
5. Clean and wet edges of existing slab.
6. Place and level concrete (air entrainment in the top 50mm).
7. Texture the surface of the concrete (groove or brush), to match the existing surface.
8. Remove any excess concrete from the work area.
9. Place curing membrane and secure.

Supervisor

A rigid construction has a structure where the surface slab also performs the function of the base (roadbase), is of pavement quality concrete and may be reinforced. Under certain circumstances, a rigid road that has been overlaid may be deemed to be a composite construction. (Refer to Section S7 of the Specification for further details).

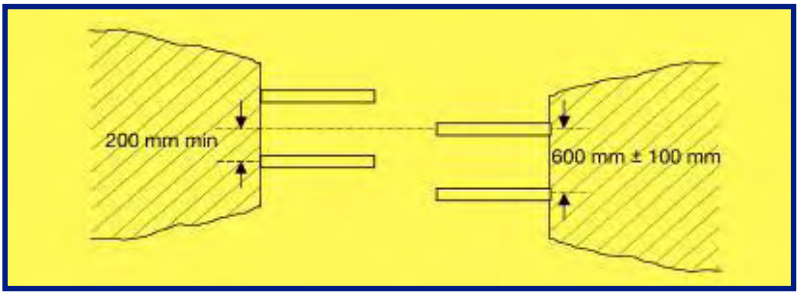
An air entraining admixture complying with BS 5075: Part 2 should be used in concrete in at least the top 50mm of surface slabs. See SHW Clause 1001 for variations.

17. Reinstating roadslab for rigid roads (continued)

Tasks for dowel bar support

1. Check that the edge of the roadslab has been prepared as detailed in Section 8 of this Guide.
2. Check the sub-base layer is to the correct tolerance. Make good any defects (excess moisture, contamination etc.) and install a slip membrane (if required).
3. Cut dowel bars to required length:
   - maximum length = 400mm
   - minimum length = width of reinstatement minus 50mm
4. Drill holes to accept dowel bars. All holes must be drilled at 600mm centres (with a 100mm tolerance) and offset by at least 200mm, as shown here:

SROH Figure S7.2



5. Insert dowel bars.
6. Install steel mesh reinforcement (where required). The new mesh should be attached (lapped and wired, etc) to the existing reinforcement. A minimum of 150mm of existing reinforcement should be exposed for attachment.
7. Take delivery or site batch C40 concrete.
8. Clean and wet edges of existing slab.
9. Place and level concrete. Note that you must use air entrained concrete for at least the top 50mm of the roadslab.
10. Texture the surface of the concrete (groove or brush), to match the existing surface.
11. Remove any excess concrete from the work area.
12. Place curing membrane and secure.

18. Reinstating surface slab for rigid footways

Equipment and materials

Standard equipment and materials for constructing the surface slab include:

- hand tools – including shovels, pick, trowel, float, hard bristle brush, measuring tape etc
- C30 (minimum strength) concrete
- air entrained concrete must be used where the existing concrete surface slab has been air entrained
- slip membrane and curing membrane (impermeable polythene or similar)

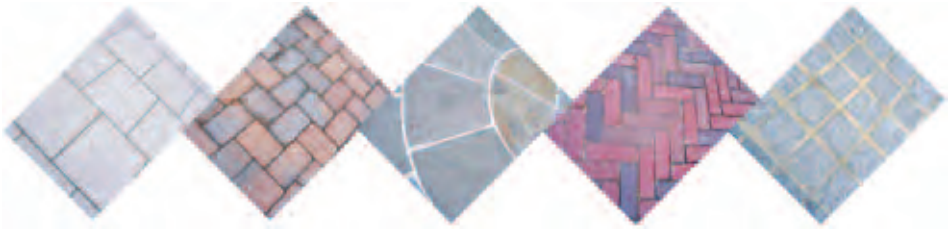
Tasks

1. Once excavation is complete, check that the edge of the existing surface slab is straight, smooth and vertical. All openings must be squared off.
2. Check the sub-base layer is to the correct tolerance. Make good any defects (excess moisture, contamination etc.) and install a slip membrane (if required).
3. Take delivery of C30 (minimum strength) concrete or site batch for small excavations.
4. Where required, use C30 air entrained concrete.
5. Clean and wet edges of existing surface slab.
6. Place and level concrete.
7. Texture the surface of the concrete (groove or brush), to match the existing surface.
8. Remove any excess concrete from the work area.
9. Place curing membrane and secure.

19. Reinstating modules

Tasks

1. Check that all necessary materials for reinstatement are on site. Remember any damaged modules will need to be replaced.
2. Check the sub-base layer is to the correct tolerance. Make good any defects (excess moisture, contamination etc.).
3. When using sand bedding, place and compact the sand to the required tolerance. The typical compacted thickness of bedding should be 25mm.
4. When using mortar bedding, place and level in order to accept slabs etc. to the required tolerance.
5. Match and place modules to fit existing layout or bond.
6. Modules (cobbles, setts, pavers, flags and slabs) placed on bedding sand may require compaction. To limit damage, the vibrating plate should be fitted with a neoprene cover.
7. Match existing jointing. Brush jointing sand, or point with suitable grout, in the spaces between modules.
8. Remove excess materials from surface.



20. Notes on hot-lay bituminous materials

Main types of hot-lay mixtures

Bitumen bound materials (often called blacktop) are made up of:

- bitumen
- crushed rock
- sand

There are many hot-lay bitumen bound mixtures which are permitted for reinstating the binder course and surface course layers of reinstatements. The use of different mixtures will result in finished surfacing layers which have different characteristics, in terms of:

- texture (positive or negative)
- skid resistance
- noise
- generation of spray

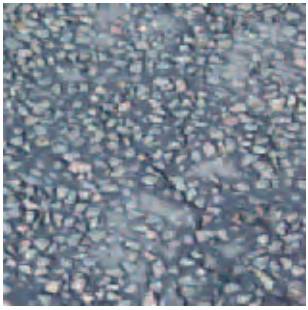
Bitumen bound materials are usually described in the Specification using:

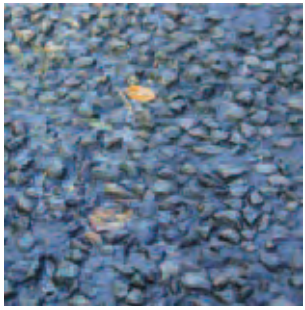
- the typical size of the largest crushed rock in the mix (e.g. 10 mm)
- the grade of bitumen used (e.g. 125 pen). The pen number indicates the performance of the bitumen – 50 pen is the strongest, 190 pen is the weakest

The main surfacing mixtures for permanent or interim reinstatements are:

1. Hot Rolled Asphalt (HRA):

- contains large amounts of bitumen, fine crushed rock and sand
- has a high strength
- is long lasting

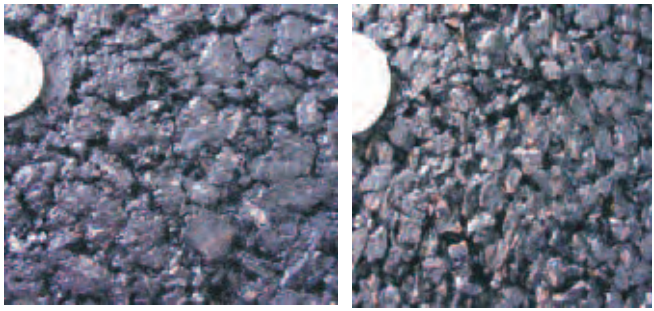




Typical HRA materials

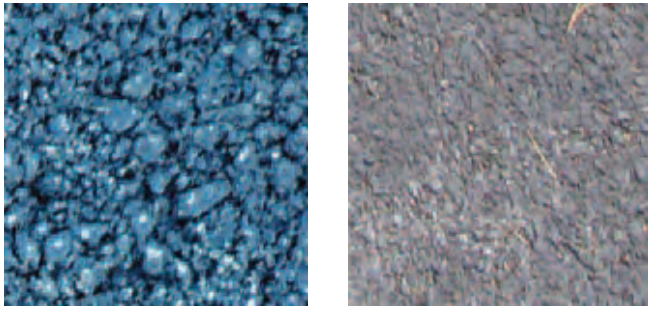
20. Notes on hot-lay bituminous materials (continued)

2. Stone Mastic Asphalt (SMA):
   - comprises a coarse aggregate content partly filled with a mastic binder. The mastic is made up of fines, filler and binder. The composition of the mastic is a crucial factor in the performance of SMA
   - has a high stiffness
   - reduces traffic noise



Typical SMA materials

3. Mixtures to BS 4987:
   - include Close Graded/Dense materials
   - compared to standard HRA:
     - contain more coarse crushed rock and less sand
     - have slightly lower strength and can have a shorter service life



Typical BS 4987 materials

20. Notes on hot-lay bituminous materials (continued)

The main mixtures available for use as surface course are:

- HRASC – Hot Rolled Asphalt Surface Course
- SMASC – Stone Mastic Asphalt Surface Course
- CGSC – Close Graded Surface Course
- DSC – Dense Surface Course

The main mixtures available for use as binder course are:

- HRABC – Hot Rolled Asphalt Binder Course
- SMABC – Stone Mastic Asphalt Binder Course
- DBC – Dense Binder Course

Reference checklist for main bitumen bound mixtures:

Mixture	Layer	Road type (0 to 4)	Footways, footpaths and cycle tracks
HRA	HRASC	Y	Y
	HRABC	Y	Y
SMA	SMASC	Y	N
	SMABC	Y	N
BS4987	CGSC	Y	–
	DSC	–	Y
	DBC	Y	Y

Other types of hot-lay mixtures

There are a number of other types of bitumen bound materials, including:

- high friction surfacings
- porous asphalt
- coloured surfacings
- thin surface course systems
- surface treatments

Full details of these materials can be found in the Specification (Appendix A2)

20. Notes on hot-lay bituminous materials (continued)

Checks on hot-lay mixtures

Where hot-lay mixtures are delivered, you must check the delivery ticket to ensure that the correct material has been delivered. You should also check:

- is the mixture at the correct temperature? (see Table A2.4 in Annex 9 of this Guide)
- was it mixed recently?
- does it look okay?
- is it mobile when shovelled?
- is the aggregate size correct?
- is the aggregate fully coated by the bitumen?
- has the large aggregate separated from the mix during transportation?

All bituminous material must be tested to check that it meets the requirements of the Specification. Samples of the materials should be regularly taken and sent for testing to a laboratory, holding current UKAS accreditation, unless otherwise agreed.

If you have any doubts about the quality of materials, take a sample of the mixture and send it to the laboratory for testing. The sample should be about six shovelfuls, taken from throughout the load and should be placed in a lined paper sack.

Supervisor

For small excavations, the use of a hot box to store bituminous materials at the correct temperature prior to laying may be beneficial.

Whether this is a practical option will depend on the requirement and location of the works being undertaken.

20. Notes on hot-lay bituminous materials (continued)

Safeguards

When working with bitumen bound materials, you must take the following precautions:

- always wear the correct personal protection (coverall, boots, gloves, etc.)
- when bitumen is hot, it produces fumes. These must not be inhaled as they can be harmful to your health. If bitumen is used in the open air, the risk is very low
- molten bitumen is much hotter than boiling water and will burn your skin. If an accident happens:
  - bathe areas affected with cold water and seek medical advice
- when bitumen is cold, it can still affect the skin and eyes. If direct contact with eyes occurs:
  - wash with water and seek medical advice
- bitumen bound materials can take between 15 and 30 minutes (but may take longer) to cool down to a temperature which is cool to the touch. For this reason, a reinstatement completed using hot-lay bituminous materials should not be immediately opened to the public. If in doubt, check using a temperature probe. This is especially important in residential areas, where young children may be playing

21. Reinstating hot-lay bituminous surfacing layers

Details of the following designs are found in the Specification:

- flexible roads – Appendix A3.0 to A3.5
- composite roads – Appendix A4.0 to A4.5
- rigid roads – Appendix A5.0 to A5.2
- modular roads (interim) – Appendix A6.1 to A6.3
- flexible, rigid, and modular footways, footpaths and cycle tracks – Appendix A7.1 to A7.3

Your Supervisor will tell you the design that you need to use.

Tasks

1. Check the base (roadbase) is to the correct tolerance. Make good any defects (excess moisture, contamination etc.)
2. Identify suitable bitumen bound surfacing material.
3. Identify suitable compaction plant.
4. Check the thickness required for the surfacing layer(s) (check with Supervisor).
5. Decide on the number and thicknesses of lifts required to complete the bitumen bound surfacing layers. For the maximum and minimum compacted lift thickness, see Table A2.2 in Annex 8 of this Guide.
6. For each lift, identify the number of compaction passes required for your compaction plant (see Table A8.3 in Annex 7 in this Guide).
7. If the bitumen bound base (roadbase) was laid more than 72 hours earlier, or trafficked, place a tack coat at a rate of 0.3 to 0.5 litres per square metre. Ensure that surface of the base (roadbase) is fully coated.
8. Paint the top 100mm of the existing surface/binder course with suitable edge sealant (not tack coat, unless the SROH permits). Ensure that the edges and corners are well coated. Take care not to splash, spill, or overpaint the existing road surface.
9. Use the temperature probe to check that the mixture is at the correct temperature (see Table A2.4 in Annex 9 of this Guide).
10. Place and level binder course material to correct uncompacted lift thickness. The surcharge for bitumen bound material is about 40%, but varies for different materials.

21. Reinstating hot-lay bituminous surfacing layers (continued)

Tasks (continued)

11. Compact with the required number of passes. Note that compaction should be stopped (regardless of the number of completed passes) if the mixture shows any signs of cracking or crushing.
12. Next to fixed street furniture (ironwork, etc.), use hand tamping or a percussive rammer (see Alternative equipment in Annex 2 of this Guide).
13. Repeat procedure for surface course material. Where required, add coated chippings to the surface before compaction.
14. Check tolerance of surface course layer thickness (the lower tolerance limit is -5mm).

It is very important to meet the tolerance required for the surface course layer, as it completes the reinstatement.

21. Reinstating hot-lay bituminous surfacing layers (continued)

Possible defects and causes

Completing hot-lay surfacing in a reinstatement is often the most difficult task to undertake. The finish of the surface layer is the only directly visible part of the reinstatement work. For this reason, a high degree of care and attention should be given to completing the surfacing operation.

You may encounter defects that are either due to problems with the hot-lay bituminous materials or non-compliance in the method used to compact the surfacing.

Common defects with hot-lay bituminous layers

Defect	Possible cause
Bleeding	• too much bitumen in the mix • too much vibration during compaction of SMASC
Roller marks	• too many fines in the mix • too much bitumen in the mix • roller too heavy for the material type and lift thickness • poor rolling operation • rolling when the material is too hot or cold
Movement of surfacing layer on the base	• too much bitumen in the mix • excessive moisture in the mix • mix too hot or cold for laying and compacting • roller too heavy • too much tack coat used
Rough surface	• too many fines in the mix • mix too hot for rolling • poor laying and rolling operations • leaving roller standing on hot surface • roller too heavy for material type and lift thickness

21. Reinstating hot-lay bituminous surfacing layers (continued)

Common defects with hot-lay bituminous layers (continued)

Defect	Possible cause
Waving	• too many fines in the mix • too much bitumen in the mix • moisture in the mix • poor rolling operation • mix too hot for rolling • roller too heavy • mixture laid too thick • opened to traffic too early
Fine cracks and/or crazing	• not enough bitumen in the mix • too many fines in the mix • over rolling • rolling when too hot • roller too heavy
Large cracks and/or crazing	• mix too hot to roll • over rolling • roller too heavy
Breakdown of aggregate during rolling operation	• mix too coarse • mix too hot or cold for rolling • poor rolling operation • roller too heavy

22. Overbanding

Overbanding is the application of a material in the joints between a road surface and the reinstatement. It is not mandatory but may be beneficial. However, you must ensure that any materials used for overbanding are BBA/HAPAS approved. The aim of using overbanding is to prevent loss of material in and around the joint and also to help prevent the ingress of water.

Overbanding can be applied as either:

- hot bitumen material (supplied in either block or tape form)
- cold bitumen material (supplied as liquid bitumen emulsions that are stored in containers)

The Specification requires that the overbanding should not be more than 3mm thick or 40mm wide. Overbanding that exceeds the width requirement can pose a skid resistance risk to two wheeled vehicles and for this reason must be carefully controlled. A screed shoe should be used to help control the thickness and width of overbanding. As it is very difficult to meet the skid resistance required in the Specification, coarse grit is usually added to the bitumen by the supplier.

Equipment and materials for hot overbanding

Hot-applied overbanding materials need a safe method of heating to the required working temperature. The method will depend upon the type of material being used and the scale of the reinstatement work being carried out. Standard equipment and materials for completing hot overbanding may include:

- a portable gas ring and metal container
- a vehicle-mounted temperature-controlled bitumen heater
- a portable gas torch and propane bottle for tape materials

Applying hot overbanding using a screed shoe

22. Overbanding (continued)

Tasks for applying hot overbanding

1. Ensure that the road surface and reinstatement are clean and excess moisture removed.
2. Heat the overbanding material using the most suitable method:
   - For blocks:
     a) once the block has melted, carefully transfer the material to a metal container.
     b) pour the molten material into a screed shoe held by another operative. The screed shoe can then be dragged along the joint.
     c) as the material in the screed shoe is used up, refill with more material from the container.
   - For tapes:
     a) cut and place the tape in position over the joint.
     b) apply heat using a portable gas torch until the tape just melts. Be careful not to overheat the tape as it may catch fire.

Equipment and materials for cold overbanding

Standard equipment and materials for completing cold overbanding include:

- liquid bitumen material
- coarse grit (where required)
- metal container, stiff brush or a screed shoe

Tasks for applying cold overbanding

1. Ensure that the road surface and reinstatement are clean and dry.
2. Application of the cold materials may be carried out using either a sturdy brush or a screed shoe. The screed shoe is recommended as it is easier to comply with the Specification requirements.
3. Pour the material into a screed shoe held by another operative. The screed shoe can then be dragged along the joint.
4. As the material in the screed shoe is used up, refill with more material from the container.
5. Where improved skid resistance is required, sprinkle coarse grit (typically 4 to 6mm) by hand on the cold bitumen material. The use of fine grit is not recommended.

22. Overbanding (continued)

Common problems with overbanding

Common problems encountered when undertaking overbanding include:

1. Effects of weather conditions

   Overbanding should not be applied in the following situations:

   - wet road surface conditions (although some products can be used on damp surfaces – check with Supervisor)
   - low temperatures (overbanding should not be applied below a minimum air temperature of +5°C)
   - high temperature (overbanding should not be applied above a maximum air temperature of +30°C)

2. Working with PCSMs

   The application of hot overband materials on reinstatements recently completed with PCSMs may result in poor bonding. This is due to water evaporation or a chemical reaction between two different bitumen materials.

3. Contamination

   The overbanding material and the surface of the reinstatement joint must not become contaminated with foreign materials (e.g. paint, vegetation or chemicals).

4. Storage

   Manufacturers provide guidance notes on the storage life of their products and these should be followed. Cold applied overbanding products deteriorate if stored in an excessively hot or cold environment.

Safeguards

When working with overbanding materials, you must take the following precautions:

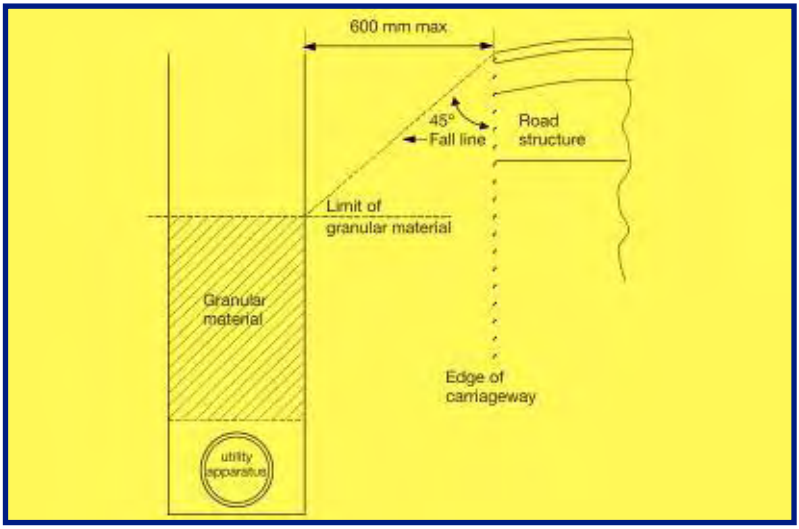
- wear thick industrial gloves, safety boots and eye protection (when you are working with both hot and cold materials)
- do not inhale fumes produced by molten bitumen (if used in the open air, the risk is very low)
- further details regarding Health and Safety and hot bituminous materials are found in Section 22 of this Guide
- you must refer to your Company's risk assessments, method statements and Health and Safety Plans

23. Verges and unmade ground

Tasks

1. The method of backfilling you use depends on the following:
   - where the road structure (layers, foundations, kerbs and edge support) extend into the verge or unmade ground, the reinstatement must match the existing design with similar materials and thickness
   - where the road structure does not extend into the verge or unmade ground, and there is no kerb, any reinstatement within 600mm of the road must include sub-base material, placed as shown here:

SROH Figure S9.1



2. Check that the surround to apparatus is to the correct tolerance. Make good any defects (excess moisture, contamination etc.).
3. Identify suitable backfill material.
4. Identify suitable compaction plant.
5. Check the thickness required for the backfill and sub-base (check with Supervisor).
6. Decide on the number and thickness of lifts required to complete the backfill and the sub-base. For the maximum and minimum compacted lift thickness, see Table A2.3 in Annex 8 of this Guide.

23. Verges and unmade ground (continued)

Tasks (continued)

7. For each lift, find the number of compaction passes required for your compaction plant (see Table A8.1 in Annex 6 of this Guide).
8. Place and level backfill material to the correct uncompacted lift thickness.
9. Compact with the number of passes stated in Table A8.1.
10. Repeat for further lifts as required.
11. Check the tolerance of the completed backfill and sub-base (check with Supervisor).
12. To complete the reinstatement, place and rake topsoil to required level:
    - in cultivated areas – shrubs, plants or bulbs should be reinstated using the same or similar species
    - in grassed areas – original, or replacement turf, or seed, may be used
    - in areas that have been previously mown, at the time of completing the reinstatement, the surface must be free from stones greater than 20mm in size
13. Restore verges, ditches and drainage courses to their original condition.

24. Leaving the finished site

Tasks:

1. For a **permanent reinstatement**, before it is left, the site must be returned to the condition it was in before the reinstatement took place. Steps to take include:
   - removal of excess materials
   - restoration of all permanent signs (some additional signs may be required)
   - reinstate all road markings, coloured surfacings and other surface treatments correctly
   - reinstate any specialised footways, footpaths, and cycle track features (e.g. tactile paving)
   - restore street furniture to original position
   - ensure that the surface is in a clean and serviceable condition
   - pack away equipment and tools
   - check that all signs, cones, barriers and lamps have been removed

2. For an **unattended site**, the site must be left in a safe and secure condition. Steps to take include:
   - stockpile excess material safely
   - check the condition of all temporary signs, barriers and lamps
   - ensure that the road, footway, footpath or cycle track is in a clean, safe and serviceable condition
   - visit the site on a regular basis, to ensure that the site remains in a safe condition

Annex 1 Backfill materials General information

Backfill categories

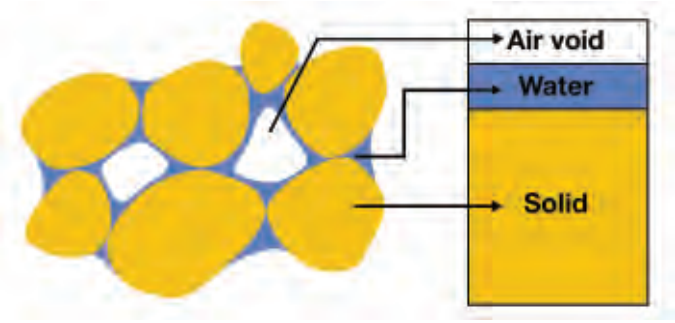
All excavated materials that meet the Specification requirements can be reused as backfill in trenches. Backfill materials are classified into five categories:

- Class A Graded granular materials
- Class B Granular materials
- Class C Cohesive/granular materials
- Class D Cohesive materials
- Class E Unacceptable materials

Ideally, the Class of backfill material should have been established before back-filling starts. Even if a material does not meet the Specification requirements, simple methods can be used to produce a material condition that is acceptable. These include removal of large lumps or foreign material, and increasing or reducing the moisture content.

Composition of backfills

All backfills are made up of three parts:



Solids – the natural soil or rock particles. The solid component of the material cannot be made much denser by compaction.

Water – coating the solid particles and filling voids. The water or moisture content of a material cannot be made denser by compacting.

Air voids – up to 20% of a loose backfill is made up of air. Compaction removes air from the loose soil, and reduces the air content to between 5 and 10%.

Annex 1 Backfill materials General information (continued)

Moisture content

Moisture content is very important because moisture acts as a lubricant and helps compaction of backfill materials. If there is **not enough moisture**, the material:

- will not compact well
- will have a high air content
- may have high settlements

If the **moisture is correct**, the material will:

- compact well
- have high strength
- have minimum settlement

If there is too **much moisture**, the material:

- will be too wet to compact well
- will have low strength
- may not support traffic loads

Moisture content can be checked on site using the most appropriate of the simple tests. For each Class of backfill, the tests are described in the following pages.

Annex 1 Backfill materials Identification

Identifying materials

The following pages include basic descriptions of the backfill classes in the Specification. For full details, you must refer to NG5 in the Specification.

Class A: Graded Granular

Full identification of Class A on site is difficult (not possible without the help of laboratory backup). For this reason, material excavated from a trench which looks like Class A should be treated as Class B. Granular sub-base (GSB 1) or Type 1 will normally meet the Class A requirements.

Class B: Granular materials

Materials:	Can be crushed rock, sand and gravel or mixtures of these materials.
Sampling:	Select representative samples from beneath the outer surface of the stockpile or from the excavated material.
Size:	Size should generally range from fine sand up to coarse lumps of 50mm. Some 75mm lumps are allowed, but this size should be avoided if possible.
Moisture content:	**Too dry:** No sheen, and fines will be dry and dusty.
	Target moisture: Material has a dull (wet) sheen, fines stick to larger material, and no surplus water runs off the larger aggregate.
	Too wet: Fines will be saturated and water will run off the larger aggregate.
Compaction:	Treat as Granular Material in Table A8.1 (see Annex 6 of this Guide).

Too dry

Target moisture

Too wet

Annex 1 Backfill materials Identification (continued)

Class C: Cohesive/granular materials

Materials:	Can be mixtures of fine and coarse aggregates, gravel, sand, silt and clay, or mixtures of these materials.
Sampling:	Select representative samples of the excavated material.
Size:	The granular content should range from less than 5mm up to 50mm. Some 75mm lumps are allowed, but this size should be avoided if possible
Moisture content:	If the granular content of the material is more than half, check for moisture content as though it was Class B material. If the clay content of the material is more than half, check for moisture content as though it was Class D material.
Compaction:	If the granular content of the material is **less than 20% (a fifth)**, treat as Cohesive Material in Table A8.1 (see Annex 6 of this Guide). If the granular content of the material is **20% or more**, treat as Granular Material in Table A8.1 (see Annex 6 of this Guide).

Cohesive granular

Annex 1 Backfill materials Identification (continued)

Class D: Cohesive materials

Materials:	Clay, silt or mixed fine grained material.
Sampling:	Select representative samples of excavated material.
Size:	The clay must be broken into lumps of 75mm or less and particles should not all be the same size.
Moisture content:	**Too dry:** Take a sample and squeeze together in one hand. If the material crumbles and fails to stay together, it is too dry.
	Target moisture: If you can roll the material between your hands (or on the back of a shovel) to the diameter of a pencil before it starts to break up, the moisture content is in the target range.
	Too wet: When forming a ball of the material in your hand, if the material squeezes easily between your fingers, it is too wet.
	Compaction: Treat as Cohesive Material in Table A8.1 (see Annex 6 of this Guide).

Too dry

Target

Too wet

Annex 1 Backfill materials Identification (continued)

Class E: Unacceptable material

Class E materials **shall not be used** in the reinstatement.

Examples of Class E materials include:

- peat and materials from swamps, marshes or bogs
- logs, stumps or perishable materials (organic matter)
- frozen materials
- materials liable to frost heave (when placed at a depth within 450mm of the pavement surface)
- materials liable to spontaneous combustion
- materials with hazardous chemical or physical properties
- materials which do not meet the requirements for Classes A to D. Some of the materials which fail to meet the requirements of Classes A to D may be suitable for use as Alternative Reinstatement Materials (ARMs), and may be used in the reinstatement after treatment (see Appendix A9 of the Specification)

Class E materials should be stockpiled safely and separate from acceptable materials (to avoid contamination), and removed from site as soon as convenient.

Annex 2 Compaction equipment – Standard

There are many different types of compactors available on the market. Each type is able to compact materials with different amounts of energy, and is more effective on certain materials. A brief description of the characteristics and the calculations required for the different compactors is presented in this Annex.

Vibrotamper

Typical use:

- mainly used for trench reinstatement (often called a trench rammer)
- qually capable of compacting cohesive and granular materials
- not preferred for applications involving a layer thickness of 50mm or less

Specification weight category:

- Mass (in kilograms, kg) **[see Calculation 1]**

Comments:

- often supplied with different shoe sizes
- for best compaction, the shoe must hit the ground flat, not on its toe or heel
- for cohesive materials, may be operated at reduced speed for the first pass only

Vibrating plate

Typical use:

- mainly used for trench compaction
- equally capable of compacting cohesive and granular materials

Specification weight category:

- Mass per square metre (in kilograms per square metre, kg/m^2) **[see Calculation 2]**

Comments:

- often supplied with different plate sizes
- largest plates may be too wide for narrow reinstatements
- vibrating plates should be operated in the lowest available gear/speed (except for the first pass, which should be at maximum forward speed)

Annex 2 Compaction equipment - Standard (continued)

Vibrating roller – single drum

Typical use:

- mainly used for compaction of bituminous surfacing
- capable of compacting cohesive and granular materials (better for granular)
- often supplied with breaker attachment

Specification weight category:

- Mass per metre width (in kilograms per metre, kg/m) **[see Calculation 3]**

Comments:

- vibrating rollers should be operated in the lowest available gear and:
  - with NO vibration for the first pass (in order to prevent uneven displacement of material within the layer)
  - with FULL vibration for following passes

Vibrating roller – twin drum

Typical use:

- mainly used for compaction of bituminous surfacings
- capable of compacting cohesive and granular materials (better for granular)

Specification weight category:

- Mass per metre width (in kilograms per metre, kg/m) **[see Calculation 4]**

Comments:

- see lowest gear comment above
- a twin drum compactor is more effective than single drum (requires fewer compactor passes), but is more difficult to control in small working areas

To ensure acceptable compaction, always follow the manufacturers' operating instructions.

Annex 2 Compaction equipment – Alternatives

Alternative compaction plant for areas of restricted access

Vibrotamper

Typical use:

- see previous section on vibrotampers

Specification weight category:

- mass (in kilograms, kg)
- minimum mass 25kg

Hand tampers

Typical use:

- used for manual compaction in areas larger compactors cannot access
- hand rammers may be used for initial tamping of fine fill material

Specification weight category:

- no minimum mass specified

Percussive rammer (pole tamper)

Typical use:

- minimum mass 10kg
- capable of hundreds of blows per minute
- requires a separate compressor

Specification weight category:

- mass (in kilograms, kg)

Comments:

- In general, lightweight vibrotampers and pole tampers are capable of achieving the same degree of compaction as larger items of compaction plant. However, alternative compaction plant are usually not self-advancing and therefore can be more difficult to operate effectively
- Hand tampers may also be used immediately adjacent to street furniture, around standpipes and other isolated fixed features, and at reinstatement edges

Annex 2 Compaction equipment Calculating weight categories

Calculation	Method
1	**To find the operating mass of vibrotamper (in kg):** • no calculation is necessary • the model name often gives the mass e.g. the Wacker BS65Y has a mass of 65kg (but the operating mass, including fuel, may be slightly higher) • for information on mass, check the ID plate on the vibrotamper and on the foot As an alternative, look up the machine specification in the manual
2	**To calculate mass per square metre of a vibrating plate (in kg/m²).** • measure the width of the plate which is in contact with the ground in metres = A • measure the length of the plate which is in contact with the ground in metres = B • multiply A times B to get the plate area in square metres = C • check the ID plate on the plate for the mass in kg = D • divide D by C to get the mass per square metre As an alternative, look up the machine specification in the manual. The value required is often called the static load (must be in kg/m²).
3	**To calculate the mass per metre width of a vibrating single drum compactor (in kg/m):** • measure the width of the drum in metres = A • check the ID plate on the compactor for the total mass in kg = B • divide B by A to get the mass per metre width As an alternative, look up the machine specification in the manual. The value required is often called the static linear load (must be in kg/m).
4	**To calculate the mass per metre width of a vibrating twin drum compactor (in kg/m):** • measure the width of one of the drums in metres = A • check the ID plate on the compactor for the total mass in kg = B • divide B by 2 to get the mass resting on one drum in kg = C • divide C by A to get the mass per metre width As an alternative, look up the machine specification in the manual. The value required is often called the static linear load (must be in kg/m).

Annex 2 Compaction equipment Guidance on use

General advice

Once acceptable backfill has been identified, a suitable compactor has to be selected for the work. When compacting, you must think of four important factors:

1. The type and size of the compactor to suit the work.
2. The thickness of each compacted layer.
3. The number of passes required to achieve the required compaction of each layer.
4. The tolerances of the compacted layers.

Compactor selection

In general, the heavier a vibrating compactor is, the more compaction energy it puts into a soil when operating. If the compactor is too small, then the amount of compaction energy is too low and the soil will not be compacted to the correct density. This will result in:

- high air voids
- long term settlement
- need to redo the reinstatement at a later date

If the compactor is **too large**, then the amount of compaction energy is too high. This will result in:

- crushing of soil particles in granular soils,
- less stable backfill
- risk of damage to buried apparatus

Operation of compactors

To ensure acceptable compaction:

- always follow the manufacturers' operating instructions

It is important to select the correct compactor for the job.

Annex 3 Alternative Reinstatement Materials (ARMs)

Alternative Reinstatement Materials (ARMs) permit rapid reinstatements to be carried out. ARMs are also environmentally friendly, as they:

- often use recycled material
- can make use of poor quality materials
- are produced using less energy
- can be self levelling

The most commonly used ARM is foamed concrete. Details of this and other types of ARMs can be found in Appendix A9 of the Specification.

Foamed concrete is:

- very easy to place (is poured directly into the reinstatement)
- self levelling and requires no compaction
- made up of sand and cement (often called a foamed mortar), and sometimes aggregate is also added to the mixture (a foamed lean concrete)
- a lightweight material due to the formation of air bubbles in the mixture. The air bubbles can be introduced into the foamed concrete by adding a pre-formed foam or an air-entraining agent. This can be carried out at the batching plant or on site
- a material that takes between 12 and 15 hours to cure. Curing can be speeded up by the addition of an accelerator

Annex 3 Alternative Reinstatement Materials (ARMs) (continued)

When working with foamed concrete, you must take the following precautions:

- Always place protective sleeves around other utilities apparatus in the trench
- In the first 3–6 hours, all types of foamed concrete could present a hazard in terms of drowning. The use of temporary covering or an accelerated setting material would minimise this danger. Use secure guarding to prevent anyone from falling into a reinstatement that has recently been backfilled with foamed concrete. Those at risk include site workers, the general public and animals
- Always wear the correct personal protection. Cement and air-entraining agents can be harmful to the skin and eyes. If the eyes are affected, they should be immediately washed with clean water and medical attention sought
- You must refer to your Company's risk assessments, method statements and Health and Safety Plans

Notes on foamed concrete

1. Can be used:
   - at any position within the surround to apparatus and/or backfill as the entire layer or combined with any other backfill materials, in any proportion, within any reinstatement
   - as sub-base within any reinstatement
   - as a combined sub-base and base (roadbase) layer in Road Types 1, 2, 3, and 4
   - as a combined sub-base and binder course, within any reinstatement in footways, footpaths and cycle tracks
2. Must not be used as a substitute for permanent surface course materials and **must never** be used within 100mm of the finished reinstatement surface for carriageways. Foamed concrete is suitable for backfilling narrow openings. (e.g. around plastic chambers).
3. Can be excavated using a wide-bladed chisel and breaker (lower strength materials tend to break down into powder, while the higher strength materials break down into small lumps).
4. Should not come into contact with plastic utility pipes.

Annex 3 Alternative Reinstatement Materials (ARMs) (continued)

Checks for foamed concrete

1. On delivery, check the batch note/delivery ticket to make sure the material is what has been ordered. Check the following:
   - Has the quantity ordered been delivered?
   - Is it the required strength?
   - Does it have the correct water/cement ratio?
   - Does it have the correct cement and aggregate content?
   - If an additive has been specified, has it been added?
2. Inspect the material:
   - if the mix looks very grey, it may contain too much cement
   - if the mix looks very yellow, it may have too little cement
3. Checks:
   - Density – fill a container of known volume (e.g. a bucket) and weigh it. You must weigh the container first, and subtract this weight from your final result. To work out the density divide the measured mass of the foamed concrete (i.e. total weight minus weight of bucket) by the volume of the container. (Check with Supervisor for calculation)
   - Quality – If any doubt exists on the quality of the material, three samples should be taken, placed in standard 150mm^3 polystyrene boxes and sent to the laboratory for testing

Equipment and materials for foam concrete reinstatements

There are two methods for producing foamed concrete:

- using a ready mix supplier
- using your own materials equipment and plant

Other standard items may include:

- an air-entraining agent
- screed board for levelling
- protective sleeves for other utility apparatus
- container and scales for measuring density
- materials to prevent uncontrolled flow of foamed concrete
- additional guarding equipment

Annex 3 Alternative Reinstatement Materials (ARMs) (continued)

Tasks:

1. Check for signs of broken highway drainage channels and/or ducting for other services (foamed concrete acts like a liquid and can flow into openings and cavities and lead to serious blockages).
2. Any openings should be properly sealed before any backfilling begins.
3. Pour foamed concrete into the reinstatement. Contact with the edge of the existing surface should be avoided. This will help you to achieve a good vertical edge bond when finishing the reinstatement at a later stage.
4. Use a screed board to obtain the correct level within a trench. Careful use of a shovel may also be effective.

Supervisor

There are no restrictions in the Specification on the composition of foamed concretes. The only requirement is that the materials should be:

- approved
- C2 (a compressive strength of between 2 and 10N/mm^2 at 90 days) for all Road Types 0 to 4 sub-base and all layers below binder course in Type 3 and 4 roads
- C4 (a compressive strength of between 4 and 10N/mm^2 at 90 days) for base (roadbase) and sub-base in Road Types 1 and 2

Annex 4 Reinstating cold-lay surfacing materials

The Specification divides cold-lay surfacing materials into two groups:

- Permanent Cold-lay Materials (PCSMs)
- Deferred Set Mixtures (DSMs)

A checklist for using cold-lay surfacing materials is presented on the following page.

Permanent Cold-lay Surfacing Materials (PCSMs)

Permanent Cold-lay Surfacing Materials (PCSMs) may be used as alternatives to hot-lay bituminous surfacing materials. PCSMs are a mixture of bitumen and aggregate and must have a HAPAS certification from BBA before they can be used.

PCSMs are specialised materials and training is required to ensure that they are used correctly.

The Specification permits PCSMs to be used in the following:

- all footways, footpaths and cycle tracks
- as a permanent binder course in Road Types 3 and 4
- as a Permanent Cold-lay Surface Course in Road Types 2, 3 and 4

PCSMs must **NOT** be used in Road Types 0 and 1.

Deferred Set Mixtures (DSMs)

Deferred Set coated Mixtures (DSMs) may also be used as alternatives to hot-lay surfacing materials. DSMs are surface or binder course materials that are used in interim reinstatements, and are a mixture of bitumen and aggregate to BS 4987. The Specification permits the following DSMs:

- 6mm surface course
- 10mm surface course
- 20mm dense binder course

DSMs must **NOT** be used in permanent reinstatements. Refer to the Specification for further details (Sections A2.4.2, A10.2).

Annex 4 Reinstating cold-lay surfacing materials (continued)

Checklist for cold-lay surfacing materials

You must check that the material is suitable for use in the reinstatement. The main checks are as follows:

1. The material must be suitable for use in the reinstatement. Where PCSMs are used, they must be HAPAS approved.
2. On delivery, check the batch note/delivery ticket to make sure that the material meets the requirements.
3. Inspect the material prior to tipping:

Question	Answer
a) Does the material look acceptable? b) Is the aggregate size correct? c) Is the aggregate fully coated with bitumen?	If yes to all, material is acceptable.
d) Has separation of the mix occurred during transportation and caused a black slurry to appear? e) Is there any contamination? f) Has the storage date expired?	If any are evident, the material should be rejected

4. Once the material has been tipped, check condition and suitability. After tipping, the material should look like the material in Picture A (below left) and not as Picture B (below right). If any doubts exist, a sample should be taken for laboratory analysis.

Picture A: Acceptable condition

Picture B: Unacceptable condition

Annex 4 Reinstating cold-lay surfacing materials (continued)

Checklist for cold-lay surfacing materials (continued)

5. If cold-lay surfacing materials are not going to be used immediately, they should be covered with a plastic sheet (to maintain moisture content).
6. After storing the material, the workability of the stockpile should be checked prior to laying.
7. When compacting cold-lay surfacing materials, it is important to use the correct surcharge, compaction equipment and number of passes (see Section 11 of this Guide).
8. On completion of compaction, the surface should be examined for any defects (e.g. cracking, crazing or incorrect tolerance).

Annex 5 NJUG guidance on the colour coding of utilities' apparatus

Utility	Duct	Pipe	Cable	Marker tape
Gas	Yellow	Yellow Orange Yellow + brown stripe	–	Yellow
Water	Blue	Blue	–	Blue
Sewerage	–	Black	–	–
Electricity	Black	–	Black Red for HV	Yellow
Telecommunications	White	–	Light grey, black	Yellow
Communications	Grey, green	–	Light grey, black	White, green and/or yellow
Highway Authority	**Duct**	**Pipe**	**Cable**	**Marker tape**
Street lighting (England)	Orange	–	Black	Yellow
Street lighting (Scotland)	Purple	–	Purple	Yellow
Traffic control	Orange	–	Orange	Yellow
Motorways/trunk roads (England/Wales)	**Duct**	**Pipe**	**Cable**	**Marker tape**
Communications	Purple	–	Grey	Yellow
Communications power	Purple	–	Black	Yellow
Road lighting	Orange	–	Black	Yellow
Motorways/trunk roads (Scotland)	**Duct**	**Pipe**	**Cable**	**Marker tape**
Communications	Black or grey	–	Black	Yellow
Road lighting	Purple	–	Purple	Yellow

This NJUG guidance reflects utility practice but operators must not assume that any mains or services encountered will conform to these recommendations. This guidance is updated from time to time.

Annex 6 Table A8.1 Compaction (non-bituminous)

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Table A8.1 Compaction requirements for granular, cohesive and cement bound materials

Compaction Plant and Weight Category	Cohesive Material (less than 20% granular content)			Granular Material (20% or more granular content including cement bound material)		
	Minimum Passes/Lift for compacted lift thickness up to			Minimum Passes/Lift for compacted lift thickness up to		
	100 mm	150 mm	200 mm	100 mm	150 mm	200 mm
Vibrotamper						
50 kg minimum	4	8 #	NP	4	8	NP
Vibrating Roller						
Single Drum						
1000-2000 kg/m	8	NP	NP	6	NP	NP
2000-3500 kg/m	3	6	NP	3	5	7
Over 3500 kg/m	3	4	6 #	3	4	6
Twin Drum						
600-1000 kg/m	NP	NP	NP	6	NP	NP
1000-2000 kg/m	4	8	NP	3	6	NP
Over 2000 kg/m	2	3	5 #	2	3	4
Vibrating Plate						
1400-1800 kg/m²	NP	NP	NP	5	NP	NP
Over 1800 kg/m²	3	6	NP	3	5	7
All Above Plant	For Maximum and Minimum compacted lift thickness See Appendix A2.6, Table A2.3					
Alternative Compaction Plant for Areas of Restricted Access (including small excavations and trenches less than 200 mm width)						
Vibrotamper 25 kg minimum **Percussive Rammer** 10 kg minimum	Minimum of 6 compaction passes Maximum of 100 mm compacted lift thickness					

Notes

1. NP = Not permitted
2. # = Not permitted on wholly cohesive material i.e. clay and/or silt with no particles > 75 microns (μm)
3. Single drum vibrating rollers are vibrating rollers providing vibration on only one drum
4. Twin drum vibrating rollers are vibrating rollers providing vibration on two separate drums

Annex 7 Table A8.3
Compaction (bituminous)

Table A8.3 Compaction requirements for bituminous mixtures

Compaction Plant and Weight Category	Bituminous Mixtures — Minimum Passes/Lift for compacted lift thickness up to			
	40 mm	60 mm	80 mm	100 mm
Vibrotamper				
50 kg minimum	5	7	NP	NP
Vibrating Roller				
Single Drum				
600–1000 kg/m	10	12	NP	NP
1000–2000 kg/m	6	NP	NP	NP
2000–3500 kg/m	5	7	8	NP
Over 3500 kg/m	4	6	7	NP
Twin Drum				
600–1000 kg/m	5	7	NP	NP
1000–2000 kg/m	4	5	6	8
Over 2000 kg/m	3	4	4	6
Vibrating Plate				
1400–1800 kg/m²	6	NP	NP	NP
Over 1800 kg/m	3	5	6	8
All Above Plant	For Maximum and Minimum compacted lift thickness See Appendix A2.5, Table A2.2			
Alternative Compaction Plant for Areas of Restricted Access (including small excavations and trenches less than 200 mm width)				
Vibrotamper 25 kg minimum **Percussive Rammer** 10 kg minimum	Minimum of 5 compaction passes Maximum of 75 mm compacted lift thickness			

Notes

1 NP – Not Permitted

2 [illegible]

3 [illegible]

4 [illegible]

5 [illegible]

Revision to Table A8.3 (dated August 2002)

The 600–1000kg per metre category single drum vibrating roller is **inserted** above the 1000–2000 category with the requisite minimum passes of 10 and 12 respectively for 40mm and 60mm compacted lift thicknesses. The 80mm and 100mm thicknesses are NP (Not Permitted) for this category.

Annex 8 Table A2.2 and Table A2.3 Compacted lift thickness

Table A2.2 Compacted lift thickness (mm) bituminous mixtures

Material	Compacted Lift Thickness (mm)		
	Minimum at any point	Nominal Lift Thickness	Maximum at any point
6[illegible] DSC	15	20 to 30	40
10mm DGSC	25	30 to 40	50
15/10 HRA SC	25	30 to 40	50
30/14 HRA SC	25	35 to 40	50
10mm SMA SC	20	25 to 35	40
14mm SMA SC	30	35 to 45	50
10mm Porous Asphalt	25	30 to 35	40
20mm Porous Asphalt	40	45 to 60	65
60/20 HRA BC	40	45 to 80	100
14mm SMA BC	30	35 to 45	50
20mm SMA BC	40	45 to 55	60
20 mm DBM	40	50 to 100	110

Table A2.3 Compacted lift thickness (mm) non bituminous mixtures

Material	Compacted Lift Thickness (mm)		
	Minimum at any point	Nominal Lift Thickness	Maximum at any point
CBM 2	70	100 to 150	200
C30 Concrete	100	As required	As existing
C40 Concrete	100	As required	As existing
Granular	75	100 to 150	200
Cohesive	75	100 to 150	200
Clay Lumps	25	40 to 50	75

Annex 9 Table A2.4
Laying temperatures (bituminous)

Table A2.4 Laying temperatures – bituminous materials

Material	Binder Grade	Maximum Temperature at any stage (C)	Minimum Temperatures (C)	
			Arrival ↓	Minimum Rolling
OGSC	125	160	120	95
DSC	190	150	110	85
DRC	50	185	150	130
	125	170	120	90
	190	150	110	80
HRA SC	50	190	130	100
	100	175	120	85
HRA BC	50	170	130	100
	100	165	120	90
SMA SC	50	200	N/A	150
SMA BC	100	190		140
Porous Asphalt	125	135	110	85
	190	145		

Annex 10 Table S10.1 Air void contents

Table S10.1 In-situ air void content requirements

Bituminous Materials	Permitted Air Voids			
	Carriageways		Footways	
	Max %	Min %	Max %	Min %
6mm Dense Bitumen Surface Course	NF	NF	15	2
10mm Close Graded Surface Course	*C	2	NF*	NF*
HRA Surface Course	6	2	10	2
SMA Surface Course	6	2	10	2
HRA / Material to BS 4987 Base /Roadbase	*C	2	12	2
HRA / Material to BS 4987 Binder Course	*C	2	12	2
PCSM Materials	*C	2	13	2

Note: See page [illegible]

Annex 11 Performance requirements As laid profile

The reinstatement of any surface should be completed so that;

- it is flat and as flush as possible with the surrounding surface
- there is no significant crowning or depression of the surface
- the difference in level (construction tolerance) at the edge of the reinstatement should not exceed +/- 6mm

Once the reinstatement is completed and opened to traffic, the intervention limits specified in Sections S2.2.2 to S2.2.5 of the Specification will apply.

For reference, the intervention limits for edge depression, surface depression, surface crowning and combined defects are reproduced here.

Edge depression – intervention

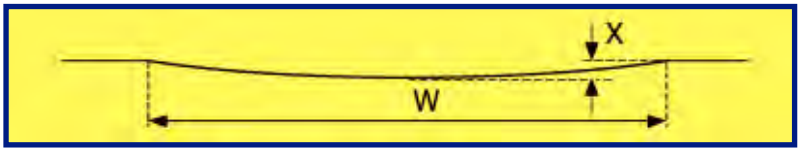
An edge depression is a vertical step or trip at the interface of the reinstatement and the existing surface. Intervention is required where the depth of any edge depression exceeds 10mm over a continuous length of more than 100mm in any direction, as shown below.

SROH Figure S2.2

Surface depression – intervention

A surface depression is a depressed area within the reinstatement having generally smooth edges and gently sloping sides, forming a shallow dish, as shown below.

SROH Figure S2.3



Intervention will be required where the depth of any area of surface depression spanning more than 100mm in any plan dimension exceeds the intervention limit X shown in Table S2.1 of the Specification.

Annex 11 Performance requirements As laid profile (continued)

Surface depression – intervention continued

S

Table S2.1 Intervention limits – surface depression

Reinstatement Width W (mm)	Intervention Limit X (mm)	Combined Defect Intervention Limit (mm)
Up to 400	10	10
Over 400 to 500	12	12
Over 500 to 600	14	12
Over 600 to 700	17	14
Over 700 to 800	19	16
Over 800 to 900	22	18
Over 900	25	20

Surface crowning – intervention

Surface crowning is where the reinstatement is above the main level of the adjacent surface as shown below.

SROH Figure S2.4

Intervention shall be required where the height of any area of surface crowning spanning more than 100mm in any plan dimension exceeds the intervention limits Z shown in Table S2.2 of the Specification.

S

Table S2.2 Intervention limits – surface crowning

Reinstatement Width W (mm)	Intervention Limit Z (mm)	Combined Defect Intervention Limit (mm)
Up to 400	10	10
Over 400 to 500	12	10
Over 500 to 600	14	12
Over 600 to 700	17	14
Over 700 to 800	19	16
Over 800 to 900	22	18
Over 900	25	20

Annex 11 Performance requirements As laid profile (continued)

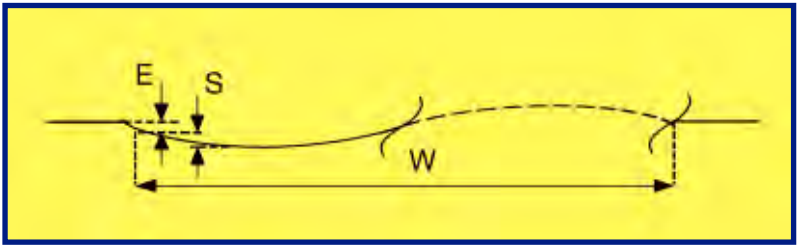
Combined defect – intervention

The intervention limits specified for surface depressions and surface crowning include a reduction in the intervention limit for combined defects. This is 80% of the tabulated value, subject to a minimum of 10mm, where surface depressions, crowning or edge depressions coincide. For detailed advice refer to the Notes for Guidance (NG2.2.5) in the Specification.

The method of measurement for combination depressions and crowning are illustrated below.

Combination depression:

SROH Figure NG2.2

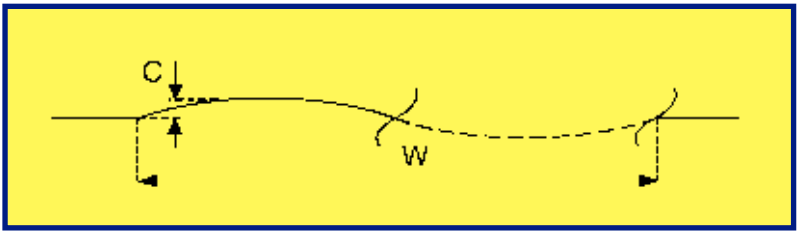


E = edge depression contribution = 10mm

S = surface depression contribution = 10mm or 80% of tabulated value (whichever is greater)

Combination crowning:

SROH Figure NG2.3



C = surface crowning contribution = 10mm or 80% of tabulated value (whichever is greater).

Annex 11 Performance requirements As laid profile (continued)

Fixed features

SROH Section S2.3.1

All fixed features, such as edgings, channel blocks, drainage fixtures, surface boxes and ironware etc., should be level and flush as possible with the adjacent surfaces and shall be installed to meet the following criteria:

- fixed features shall be laid to coincide with the mean level of immediately adjacent surfaces
- the difference in level between a fixed feature and the adjacent surface shall not exceed +/- 6mm
- drainage features shall be set flush with the adjacent surface, and should not be more than 6mm below this level

Fixed features – intervention

Intervention is required where the mean level of the fixed feature (excluding drainage) does not coincide with the mean level of the immediately adjacent surface, within a tolerance of +/- 10mm.

In the case of drainage features, intervention is required where the mean level does not coincide with the mean level of the immediately adjacent surface, within a tolerance of + 6mm to -15mm.

Annex 11 Performance requirements Skid resistance

The Specification requires that an adequate skid resistance of the reinstated running surface be maintained. This is achieved by selection of the polished stone value (PSV), aggregate abrasion value (AAV) and texture depth of the aggregate exposed at the road surface.

The exposed aggregate may be:

- precoated chippings rolled into the surface (HRA)
- coarse aggregate within the surface course
- coated material to BS4987
- chippings or other aggregate applied as surface dressing or slurry sealing treatment

The measurement of skid resistance, texture depth and surface regularity becomes more difficult as the reinstatement width reduces. However, material requirements and laying conditions remain unchanged.

It is worth noting that there is no requirement to provide a texture depth, PSV or AAV that is better than that existing at the running surface adjacent to the reinstatement. In addition for rigid roads, where the running surface has been randomly grooved, a brushed surface finish to the requirements of Table S2.5 is acceptable for small excavations, narrow trenches and openings less than 1m wide.

Texture depth

In general, for all bituminous surface course materials permitted in Appendix A2 of the Specification and for rigid roads where the surface of the concrete slab is the running surface of the road, the texture depth shall comply with the requirements of Table S 2.5 below.

Table S2.5 Texture depth (sand patch method)

	Texture Depth (mm)		
Reinstatement Location	HRA, SMA Surface Treatments & Thin Surface Course Systems	All other Bituminous Surfaces	Concrete Roadslab
Roads where speed limit	[illegible] average	[illegible] minimum	[illegible] minimum
- 56 mph (90 kph)	[illegible] minimum		
All other roads	[illegible] minimum	[illegible] minimum	[illegible] minimum

Texture depth shall be measured in accordance with BS 598: Part 105. For further guidance and information refer to Section S2.6.2 of the Specification.

Annex 11 Performance requirements Skid resistance (continued)

Polished Stone Value (PSV)

SROH Section S2.6.3

For the purposes of determining PSV requirements, reinstatements in roads are classified into two site categories, according to the apparent degree of risk associated with the site location, as follows:

Site A – potentially high risk

This includes:

- traffic signals, pedestrian crossings, railway level crossings – including 50m approaches
- roundabouts and their exits – including 50m approaches
- bends < 100m radius where the speed limit > 40mph (65 kph) – including 50m approaches
- downhill gradients > 10% for more than 50m (single or dual carriageway)
- uphill gradients > 10% for more than 50m (single carriageway only)

Site B – average or low risk

All other situations on single and dual carriageways, including the following:

- generally straight sections of carriageway
- approaches to and across major/minor road junctions
- bends of 100m radius or greater, at any speed limit
- downhill/Uphill sections of 10% gradient or less

In most cases, all bituminous surface course materials permitted in Appendix A2 of the Specification, the PSV of all precoated chippings and the coarse aggregate in all mixes without precoated chippings at the running surface shall comply with the requirements of Table S2.7. as shown below. The coarse aggregate in all mixes used with precoated chippings at the running surface shall have a minimum PSV of 45.

Table S2.7 Bituminous roads – polished stone value

Road Type	Reinstatement Minimum PSV Site A Potentially High Risk	Site B Average or Low Risk
0	68	62
1	68	62
2	65	62
3	65	62
4	65	62

Annex 11 Performance requirements Skid resistance (continued)

SROH Section S2.6.3

Polished Stone Value (PSV) – continued

The PSV of the materials shall be tested in accordance with SHW Clause 915.3.

In certain cases the PSV of a material may vary from the values given in Table S2.7 of the Specification. The exceptions are:

- where an interim surface course contains an aggregate that may not comply with the requirements of Table S2.7, a surface treatment may become necessary before the reinstatement is made permanent. In this event, the requirements of Table S2.7 are applicable only to the coarse aggregate contained within the surface treatment and not to the underlying aggregate within the interim surface course
- where a high friction coating is to be applied to a reinstatement to match an existing coating, an alternative PSV may be specified by agreement, in place of the requirements of Table S2.7, depending upon the nature of the site and the period over which the friction coating will be absent
- where a Highway authority has evidence that a different PSV has proved satisfactory, an alternative PSV may be specified by agreement in place of the requirements of Table S2.7
- where a permanent surface course contains more than one type of aggregate or aggregates from more than one source, all coarse aggregates within the mixture shall comply with the PSV requirements of Table S2.7

Annex 11 Performance requirements Skid resistance (continued)

Aggregate Abrasion Value (AAV)

SROH Section S2.6.4

In general, for all bituminous surface course materials permitted in Appendix A2 of the Specification:

the AAV of all precoated chippings and the course aggregate in all mixes used without precoated chippings at the running surface shall comply with the requirements of Table S2.7.

Table S2.8 Bituminous roads – aggregate abrasion value

Road Type	All Pre-coated Chippings	Reinstatement Maximum AAV SMA, un-chipped HRA, Material to BS 4987 Surface Courses & Thin Surface Course Systems
0	10	12
1	12	14
2	12	14

In certain cases, the AAV of a material may vary from the values given in Table S2.7. These exceptions are:

The AAV shall be measured in accordance with BS 812: Part 113.

Where an interim surface course material contains an aggregate that may not comply with the requirements of Table S2.8, a surface treatment may become necessary before the reinstatement is made permanent. In this event, the requirements of Table S2.8 are applicable only to the coarse aggregate contained within the surface treatment and not to the underlying aggregate within the interim surface course.

This guide provides practical advice to assist good workmanship and promote the highest standards of reinstatement by site operatives and supervisors under the New Roads and Street Works Act 1991. It is NOT a replacement or abbreviated version of the Code of Practice, Specification for the Reinstatement of Openings in Highways (Second Edition [England], June 2002).

Information is presented in the order that a reinstatement is undertaken, from signing, excavating, reinstating and then leaving a completed job. Each section is typically broken down to cover:

- Specification details
- checks, with hints and tips of what to look out for
- a list of tasks to be completed
- health and safety issues to be aware of.

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