

B5 – Transport, Laying & Compaction

The methods of transporting, laying and compacting bituminous mixtures are defined in British (BS) Standards. The BS EN Standards for bituminous mixtures only apply to the mixture 'in the delivery vehicle'. They do not specify how the mixtures are to be used.

This Topic page gives details of:

- Transport and delivery
- Tack coat and bond coat
- Laying in adverse conditions
- Hand laying
- Joints
- Compaction
- Layer thickness
- Delivery and rolling temperatures
- Rates of spread.

The BS requirements and guidance can be considered as 'best practice' for all road surfacing work, including pedestrian areas and car parks. The Specification for Highway Works (SHW) uses the BS requirements as the basis of its clauses.

Full details are given in:

Standard: BS 594987, Asphalt for roads and other paved areas.
 Specification for transport, laying and compaction and design protocols

BS 594987 replaced: BS 594-2, Hot rolled asphalt for roads and other paved areas. Specification for transport, laying and compaction of hot rolled asphalt and BS 4987-2, Coated macadam (asphalt concrete) for roads and other paved areas. Specification for transport, laying and compaction.

Transport and delivery

Bituminous mixtures are transported in insulated and sheeted vehicles to prevent an excessive drop in temperature and protect against adverse weather. The vehicles must be loaded in a way that minimises segregation.

Diesel oil, kerosene and other substances that can soften the mixture must not be used on the floor of the vehicle to aid discharge. A minimum amount of sealing grit, vegetable oils, sand, soap solution or proprietary release agent is generally permitted.

The mixture should be delivered at a temperature that allows sufficient time for it to be properly laid and compacted before the layer cools.

Tack coat and bond coat

Tack coats and bond coats are used to promote adhesion between layers in new construction and to bond a new layer to the existing surface in resurfacing works. It is now understood that tack coat and bond coat make a very important contribution to the long-life of a road structure.

The Standard requires that a tack coat or bond coat must be applied before a new surface course is laid. Other specifications, including SHW, often require a tack or bond coat to be used between the other layers in the road structure.

A tack coat is a simple sprayed layer of bitumen emulsion complying with:

BS EN 13808, Bitumen and bituminous binders.

Framework for specifying cationic bituminous emulsions

Class C40 B4 or

Class C40 B3

Bond coats are specialist proprietary emulsion materials, usually made with polymer modified bitumen. Bond coats are often used as part of a thin surface course system, because they can help to resist the higher stress imposed by heavy traffic.

The Standard contains five tables that specify the amount of (residual) bitumen that must remain on the surface once the emulsion has broken. The amount depends upon the binder content of the new mixture and the condition of the layer it is to be laid on.

Bitumen emulsion used as tack coat and bond coat must be applied at a uniform rate. It should be allowed to break (turn from brown to black) and not be allowed to collect in hollows.

Cold, wet weather and standing water can slow down or prevent the break of the tack coat or bond coat.

Laying in adverse conditions

Bituminous mixtures must not be laid if standing water, ice or snow is present on the surface to be covered.

Cold weather will reduce the amount of time available for proper compaction, but layer thickness and wind speed are also important.

Thick layers loose heat more slowly than thin layers. Layers less than 40 mm thick require particular care.

Hand laying

Hand laying is often used when small quantities have to be laid in private drives and pedestrian areas, in inaccessible areas where machines cannot enter or if there are cost implications.

It is important to protect the delivered mixture from heat loss and adverse weather. Mixtures tipped into a heap must be sheeted.

The Standard requires that the mixture is spread in a layer of uniform thickness with an even texture. It must be thoroughly compacted immediately.

Joints

Well-made joints make a very important contribution to the long-life of a road structure. Badly sealed joints allow water to enter and break the bond between the layers.

The standard requires all joints to be made in a way that ensures adequate compaction and bonding to adjacent surfaces.

For surface course layers, all joints must be made by cutting back the edges to a vertical face that exposes the full thickness of the layer. The loosened material is discarded and the vertical face is painted with a thin and uniform coating of hot bitumen (or specified alternative).

The requirement to 'cut and paint' joints applies to transverse joints, joints abutting the existing surface and any longitudinal joints. It also applies to transverse joints in lower layers.

The vertical face of chamber covers, gully tops, kerbs, channels and other projections must also be coated with hot bitumen (or specified alternative).

The position of longitudinal joints should be planned so as ensure that they are offset at least 300mm from any parallel joints in the layer below.

The practice of applying bitumen to the upper surface of a finished joint is discouraged. There is a risk of skidding and slipping, particularly in wet weather.

Compaction

The Standard covers a wide range of bituminous mixtures used in a variety of ways. It also covers sampling and testing to assess the proportion of air voids in the compacted layer. Full details are given in the Standard.

Laying operations should not commence until the rollers are ready to start compaction. Compaction should start as soon as the rollers can travel without causing undue displacement of the laid mixture or surface cracking.

When complete, there should be no distinct roller marks on the surface. Rollers should not stand on the compacted layer if it is still warm.

Layer thickness

The Standard specifies the nominal and minimum compacted layer thickness for bituminous mixtures.

The specified thickness for routinely used mixtures is:

Mixture	Size, mm	Nominal layer thickness, mm	Minimum thickness, mm
Asphalt concrete (AC)			
Dense surface course	6	20 to 30	15
Close-graded surface course	10	30 to 40	25
Dense binder course	20	50 to 100	40
Dense base	32	70 to 150	55
Hot rolled asphalt (HRA)			
Surface course (sand carpet)	0/2	25	20
Regulating course	15/10	30	25
Surface course	30/14	40	35
Stone mastic asphalt (SMA)			
Surface course	6	20 to 40	15
	10	25 to 50	20
	14	35 to 50	30

Delivery and rolling temperatures

The Standard gives guidance on the minimum temperature on arrival. The temperatures are intended to allow sufficient time for laying and compaction. However, delivery temperatures are often difficult to measure in a safe way.

Guidance on minimum rolling temperatures is also given. The temperatures are related to the visco-elastic properties of the grade of bitumen used in the mixture. They ensure that the mixture is still sufficiently workable to be properly compacted. Considerations such as wind/rain etc should also be taken into account.

Simplified guidance is:

Bitumen grade, pen	Minimum arrival temperature, °C	Minimum rolling temperature, °C
40/60	130	100
100/150	120	95
160/220	110	85

The actual guide temperatures for some mixtures may be slightly different to this table. Refer to the Standard for full details.

Rates of spread

The actual rate of spread that can be achieved using a particular bituminous mixture at the specified thickness depends upon the density and grading of the aggregate, the condition of the layer (substrate) below and the degree of compaction.

The guidance in Annex B of the Standard can be simplified as:

Average compacted thickness, mm	Approximate rate of spread, m ² /tonne
25	16 (15 to 18)
30	13 (12 to 15)
35	11 (10 to 13)
40	10 (9 to 11)
50	8 (7 to 9)
60	7 (6 to 8)
80	5 (4 to 6)
100	4.5 (4 to 5)

The Standard gives slightly different values for different types of mixture. See the Standard for further details.

Quality management

The SHW requires road surfacing works on trunk roads including motorways to be carried out in accordance with:

Quality Management in Highway Works, Sector Scheme 16
Sector Scheme Document for the Laying of Asphalt Mixes.

The sector scheme details how a quality management system (QMS) complying with BS EN 9001 can developed and maintained with by a road surfacing contractor. The sector scheme includes specific requirements about the training and competence of the contractor's employees.

Sector scheme documents are published by UKAS. Copies can be downloaded from: www.ukas.com. Click on the UKAS Publications (M4) list under Information Centre. Then scroll down to the list of Sector Schemes in the section about publications related to certification body accreditation.