B4 – Bitumen & Road Emulsion

Bitumen is the visco-elastic binder that gives bituminous mixtures their flexibility and durability. It is produced by distilling crude oil.

Bitumen is visco-elastic. Its properties are affected by temperature and the length of time a force is applied to it. Different grades of bitumen have differing visco-elastic resistance to deformation.

Bitumen can be dispersed in water to form a bitumen emulsion. The bitumen is distributed throughout the emulsion as very small particles that are held in suspension by electrostatic charges created by the addition of an emulsifier.

Full details are given in:

Standards	BS EN 12591, Bitumen and bituminous binders. Specification for paving grade bitumen
	BS EN 13808, Bitumen and bituminous binders. Framework for specifying cationic bituminous emulsions
BS Guidance	PD6691, for bitumen in mixtures
	PD6690, for general guidance
	BS 594987, for tack and bond coats

BS EN 12591 replaced most of: BS 3690-1, Bitumens for building and civil engineering

BS EN 13808 replaced most of: BS 434-1, Bitumen road emulsions (anionic and cationic). Specification for bitumen road emulsions

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Paving-grade bitumen

Paving-grade bitumen is specified using a system based on the results of the penetration value test. The penetration value is used with the softening point value to specify the required visco-elastic properties.

In the UK, the required visco-elastic properties for the principle grades are:

Grade	Penetration value at 25°C	Softening point temperature, °C
40/60	50 ± 10	50 to 58
100/150	125 ± 25	39 to 47
160/220	190 ± 30	35 to 43

In rural parts of Scotland and Northern Ireland, a slightly softer grade is sometimes used instead of 40/60 grade:

Grade	Penetration value at 25°C	Softening point temperature, °C
70/100	85 ± 15	43 to 51

70/100 pen replaced the bitumen previously known as 70 pen grade.

Two ‘stiff’ grades have been used for heavily trafficked pavements:

Grade	Penetration value at 25°C	Softening point temperature, °C
10/20	15 ± 5	63 to 76
30/45	37.5 ± 7.5	52 to 60

30/45 pen is traditionally known as 35 pen grade.

Mixtures made using 'stiff' bitumen require carefully mixture design and a range of additional controls. They are not intended for routine use.

Test methods for bitumen

In the UK, test methods for bitumen are published by the Institute of Petroleum (IP) as documents in the IP/BS 2000 series. Most of the test methods are also published as EN Standards, giving a 'triple number'.

The routinely used test methods are:

BS EN 1426	Methods of tests for petroleum and its products.
BS 2000-49	Bitumen and bituminous binders.
IP 49	Determination of needle penetration
BS EN 1427	Methods of test for petroleum and its products.
BS 2000-58	Bitumen and bituminous binders.
IP 58	Determination of softening point. Ring and ball method

The trade association for bitumen is the Refined Bitumen Association (RBA). The Association publish a series of Technical Data Sheets and other supporting information. Further details can be found on: www.bitumenuk.com

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Bitumen emulsion

Bitumen emulsion is often used as a binder for surface dressing and as the tack or bond coat for road surfacing.

The emulsion allows a relatively stiff grade of bitumen to be sprayed onto the road surface at relatively low temperatures. When the sprayed liquid hits the road surface, chemical changes occur that 'break' the emulsion. Most of the water phase of the bitumen emulsion evaporates and the rest is absorbed by the surface. This leaves a thin film of bitumen.

In the UK, most emulsions are cationic – the emulsifier gives the bitumen particles a positive charge that is attracted to the negatively charged surface of most aggregates.

BS EN 13808 uses a fixed set of codes to identify different grades of bitumen emulsion, for example: C 40 BF4

In this case:

Code	Explanation
C	Cationic (positively charged) emulsion
40	Nominal bitumen content, % by mass
B	Made with paving grade bitumen
F	Contains more than 2% flux oil (by mass)
4	Moderate speed of 'break' (scale is 1 to 7)

A code that is often used instead of B is:

P	Made with polymer modified bitumen

Bitumen emulsion made with polymer modified bitumen is often used in surface dressing at high-stress locations, and as a bond coat in thin asphalt surface course systems.

Bitumen emulsions were specified using BS 434-1. This standard also used a coding system. The approximate equivalent grades are:

BS 434-1	BS 13808
K1-40	C40 B 4 or C40 BF 4
K1-60	C60 B 3 or C60 BF 3
K1-70	C69 B 3 or C69 BF 3

The trade association for bitumen emulsion is the Road Emulsion Association (REAL). The Association publish a series of Technical Data Sheets. Further information can be found on: www.rea.org.uk