

**BRITISH STANDARD**

# **Reinforced bitumen membranes (RBMs) for roofing – Guide to selection and specification**

ICS 91.060.20



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## Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 32, an inside back cover and a back cover.

# Foreword

## Publishing information

This British Standard is published by BSI and came into effect on 29 June 2007. It was prepared by Subcommittee B/546/1, *Reinforced bitumen membranes*. A list of organizations represented on this committee can be obtained on request to its secretary.

## Relationship with other publications

Some products included within this Standard used to be commonly referred to as roofing “felts”, and were covered by BS 747:2000. The new European product standard BS EN 13707, which will replace BS 747, refers to these as “flexible bitumen sheets for roof waterproofing”. This could be confusing to the UK construction industry. Therefore, the title of this guide reflects the current terminology used in the UK and in the Code of Practice, BS 8217.

These products are now referred to as “Reinforced Bitumen Membranes (RBMs) for Roofing”.

In flat roofing applications, these materials are almost always used with a fully supporting substrate. The exception is on a profiled metal deck, where the top flats (crowns) of the profile are used for support.

General flat roofing design is covered in BS 6229.

Specific roof design and installation of these membranes is covered in BS 8217.

BS 8747 gives guidance on the selection and use of RBMs, including those specified in BS EN 13707. Guidance in specifying RBMs equivalent to those specified in BS 747:2000 (but not covered by BS EN 13707) is included in Annexes B and C.

Publications are also available that give useful advice on construction safety (see Bibliography).

## Information about this document

This guide provides “primary advice” to the specifier with respect to the production of an effective roof, and is intended as a link document between the material product standard and the final contract specification.

This British Standard takes the form of guidance and recommendations. It cannot be quoted as a specification, and claims of compliance to it cannot be made.

*NOTE It has been assumed in the drafting of this guide that the design and construction of flat roofs is entrusted to appropriately qualified and competent people.*

*It has also been assumed that the building owner will adopt the recommendations in respect of planned inspection and maintenance of a roof during service.*

## Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

**Compliance with a British Standard cannot confer immunity from legal obligations.**

# Introduction – CEN test methods referenced in this standard

The overall aim of the Construction Products Directive (CPD) [1] is to reduce barriers to trade throughout the European Economic Area.

The CPD has, as an ideal, the concept of performance related test methods. The relationship between the results of test methods and the performance on a roof for reinforced bitumen membranes (RBMs) has not been proven, thus it should not be assumed that the results of such tests indicate accurately the in-service performance of the membrane(s) tested.

The test methods in BS EN 13707 have been developed in response to product characteristics identified from the Building Regulations [2] or their counterparts in the various Member States. Some of these are required only for installation of the product.

The CEN test methods and product standards have been developed by a committee of experts from Member States. These test methods were based on current standards such as ISOs where possible but in most cases the scope of existing standards did not coincide entirely with the scope of the CEN standards.

Roof waterproofing is an example of this. Most of the test methods are therefore new and there is no history of past values to rely upon for a given product. CEN product standards also stipulate whether the manufacturer declares a value for a given test method, together with a declared tolerance, or states a manufacturer's limiting value.

BS 747:2000 was a recipe standard. As such it was known in the roofing industry that rag-based bitumen felts did not perform as well as polyester-based products. Because of this, it was easy for a specifier to use a BS 747:2000 Type 3 for say garages or sheds, and BS 747:2000 Type 5 for roofs over offices and computer installations.

This will not be possible with BS EN 13707, because it gives no indication as to what values, as a result of carrying out tests, are required or appropriate for given end uses.

This committee has selected, through expert knowledge and a limited amount of testing, those test methods which it is believed are most suitable and relevant to performance on a roof, and has assigned threshold values which can be used to conveniently group the products into bands of performance. The worked examples are also based upon industry knowledge and experience.

Table 5 correlates end use and substrate with membrane type and choice.

## 1 Scope

This British Standard gives guidance to assist the selection and specification of a system of appropriate layer(s) of reinforced bitumen membrane (RBM) for each flat and/or sloping roofing project, tailored to the particular requirements of that project.

It provides a grouping system to assist the specifier, utilizing material properties as tested according to BS EN 13707.

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 476-3:2004, *Fire tests on building materials and structures – Part 3: Classification and method of test for external fire exposure to roofs*

BS 6100-1.3.2:1989, *Glossary of building and civil engineering terms – Part 1: General and miscellaneous – Section 1.3: Parts of construction works – Subsection 1.3.2: Roofs and roofing*

BS 6229:2003, *Flat roofs with continuously supported coverings – Code of practice*

BS 8217:2005, *Reinforced bitumen membranes for roofing – Code of practice*

BS EN 12311-1:2000, *Flexible sheets for waterproofing – Determination of tensile properties – Part 1: Bitumen sheets for roof waterproofing*

BS EN 12691: 2006, *Flexible sheets for waterproofing – Bitumen, plastic and rubber sheets for roof waterproofing – Determination of resistance to impact*

BS EN 12730:2001, *Flexible sheets for waterproofing – Bitumen, plastic and rubber sheets for roof waterproofing – Determination of resistance to static loading*

BS EN 13707:2005, *Flexible sheets for waterproofing – Reinforced bitumen sheets for roof waterproofing – Definitions and characteristics*

## 3 Terms and definitions

For the purposes of this British Standard, the definitions given in BS 6100-1.3.2:1989 and those following shall apply.

These definitions align with those used in other pertinent UK standards; they might differ slightly from those included within European Standards.

This standard introduces and confirms a new primary abbreviation/acronym as mentioned in the foreword: RBMs will henceforth be defined as “reinforced bitumen membranes”.

### 3.1 built-up reinforced bitumen membrane built-up RBM

generally, two or more layers of reinforced bitumen membrane, fastened to the substrate, bonded together with sealed joints to form a continuous waterproof covering

### 3.2 single-layer reinforced bitumen membrane single-layer RBM

specifically designed bituminous single-layer systems with sealed joints, forming a continuous waterproof covering, and installed according to the manufacturer’s specific instructions

**3.3 access roof**

roof used to provide access to plant or equipment

**3.4 base layer****preparatory layer**

layer of reinforced bitumen membrane which is laid first

**3.5 bonding bitumen**

oxidized bitumen, or other suitable bitumen compound melted and used hot as a bonding agent

**3.6 capsheet**

uppermost layer of reinforced bitumen membrane which is self-finished, i.e. incorporates a protective finish (e.g. mineral or foil-faced)

**3.7 carrier**

material incorporated into or onto the factory-made bitumen membrane to ensure its stability and/or mechanical resistance

**3.8 cold deck roof****cold roof**

roof where the principal thermal insulation is placed at or immediately above the ceiling, resulting in the roof covering and structural deck being substantially colder in winter than the interior of the building

*NOTE Generally, the cold deck flat roof is no longer recommended, due to the difficulty in providing an effective vapour control layer at ceiling level, the limitations of providing adequate ventilation above the insulation to prevent condensation, and the associated thermal losses.*

**3.9 detailing capsheet**

capsheet used on detail works and upstands, offering more flexibility for forming these

**3.10 full bonding**

use of a continuous coat of bonding bitumen (or other approved adhesive), or torch application, to fully adhere a layer of reinforced bitumen membrane

**3.11 gritting solution**

bitumen compound, formulated to bond a layer of site-applied chippings to the surface of the top layer

**3.12 intermediate layer**

any layer of reinforced bitumen membrane which is applied between the base layer, and the top layer (or capsheet)

**3.13 inverted roof****upside-down roof****protected membrane roof**

roof where the principal thermal insulation is placed above the roof covering, resulting in the roof covering, structural deck and ceiling being at a temperature close to that of the interior of the building

*NOTE Generally the principal insulation is secured by ballast, however proprietary lightweight systems are available which do not rely on separate ballast.*

**3.14 manufacturer's declared value**

**MDV**

value declared by the manufacturer accompanied by a declared tolerance

**3.15 manufacturer's limiting value**

**MLV**

value stated by the manufacturer to be met during testing, which can be a minimum or a maximum value according to statements made under product characteristics within a standard

**3.16 partial bonding**

use of a controlled and regular quantity of bonding bitumen (or other approved adhesive) or torch application, so as to provide adhesion over a proportion of the total area of the substrate

**3.17 roof deck**

part of the roof construction, which supports the waterproofing system, including as appropriate the vapour control layer and insulation board(s)

**3.18 substrate**

surface upon which a built-up reinforced bitumen membrane (RBM) is laid

**3.19 tapered insulation**

thermal insulation boards of varying thickness, designed and pre-cut or pre-formed to create or augment drainage falls when laid in a prescribed pattern

**3.20 terrace roof**

flat roof for use as an amenity area, usually having a specialist, separate, protective surface finish

**3.21 top layer**

uppermost layer of reinforced bitumen membrane, which will require the application of separate surface protection

**3.22 vapour control layer**

**VCL**

construction material (usually a reinforced bitumen membrane) that substantially reduces the transfer of water vapour through the roof build-up

*NOTE The performance of a vapour control layer is dependent upon the material, workmanship and buildability. The material chosen for a specific building should be suitable for its internal conditions.*

**3.23 warm deck roof**

**warm roof**

roof where the principal thermal insulation is placed above the deck and a vapour control layer and immediately below the roof covering, resulting in the structural deck and ceiling being at a temperature close to that of the interior of the building

## 4 Membrane selection guidelines

### 4.1 General

The primary reference for flat roof design is BS 6229, and the code of practice for RBM roofing is BS 8217, which should be consulted in conjunction with this Guide, for the selection of RBMs as the waterproofing system.

This guide assumes that the roof deck/substrate has already been selected and thermal requirements considered.

The choice of suitable membrane(s) will be dependent upon a number of factors, including:

- roof deck/substrate;
- slope/pitch;
- building and roof use;
- location and exposure;
- intended access to the building and/or roof areas (by following trades, or for maintenance, etc.);
- possible unauthorized access to the building and/or roof areas (by vandals, etc.);
- insulation type under consideration;
- the extent and complexity of detailing;
- fire performance requirements;
- surface finish; and
- durability/service-life requirements.

Any specification for overlaying of existing materials should be based upon a close condition survey, and if necessary, core sampling and non-destructive testing, to establish the exact makeup and condition of the lower layers and substrate.

In refurbishment projects, consideration should be given to correcting any inadequacy of falls, by the use of tapered insulation boards or re-decking with improved falls.

It is more than likely that such projects will need to comply with regulatory requirements for thermal insulation.

If not undergoing planned maintenance, there is also a need to establish the mode of failure of the roof, and to correct any detailing or design inadequacies.

### 4.2 Principles

In reinforced bitumen membrane roofing, it is usual to recommend systems comprising two working waterproofing layers (plus any preparatory layer, such as a Type 3G).

The underlayer provides the generic flexibility and has the capacity to absorb movements.

The second layer, either a capsheet or a top layer, provides resistance to and protection against impact damage or static loadings, and in the case of roof gardens, root protection.

*Improved durability will be achieved by using a system incorporating layers having a polyester carrier, which provides a higher tensile strength  $S$ , and/or better puncture resistance  $P$ , as categorized in Table 5.*

*SBS polymer-modified bitumen membranes (4.4.2), with greater extensibility and flexibility, especially at low temperatures, are likely to provide improved fatigue resistance, and hence a longer service life.*

To further extend the potential service life, the SP specification of the two working waterproofing layers could be increased, or an additional third working layer included.

Generally, the UK industry tends toward the former option.

The method of installation/attachment of the waterproofing system can have a bearing upon the choice of insulation, and vice versa. For further guidance, see the appendices of BS 8217.

### 4.3 Caveats

Prior to considering the roof design, the building structure and its proposed use should be confirmed and clearly stated in the project documents, as described in BS 6229.

The following factors need to be considered during the selection of the waterproofing system build-up, as described in BS 8217:

- wind loading;
- roof slope;
- overall attachment method (pour-and-roll/torch applied, full/partial bond, cold/self-adhered/mechanically fixed);
- type and thickness of thermal insulation;
- internal conditions and hence condensation risk;
- fire requirements/escape/rating;
- degree of detailing involved, e.g. for penetrations, or drainage;
- intended access to the building and/or roof areas (by following trades, for maintenance, etc.);
- intended use or access of the roof for recreational purposes; and
- roof finishes for garden or environmental purposes (e.g. root resistance).

In any refurbishment project, the thickness of insulation chosen should not be allowed to compromise the upstand height or the function of the cavity tray or damp proof course.

Refurbishment projects have been included in the flow charts (Table 7 and Table 8), by noting two additional substrates: existing asphalt, and existing RBMs.

*NOTE The existing substrate and structure are assumed to have been inspected and assessed by a competent person as suitable and safe for re-roofing and/or re-waterproofing.*

The location, purpose and expected service life of the roof all have an impact on the specification, and the relative importance of the above factors. See also the worked examples in Annex D.

Examples of variable factors (see Table 5).

- a) Location: when considering a tower block in an exposed area, e.g. Scotland, wind uplift resistance and therefore tensile strength  $S$  and attachment method should be of major concern.
- b) Purpose: with a heavily trafficked low-level roof area in a sheltered area, the puncture resistance  $P$  (both static and dynamic) will be more important.
- c) If the roof is likely to be subject to vandalism and damage, then the puncture resistance  $P$  (both static and dynamic) would again be important.
- d) Expected service life: if access to the roof is difficult, then the area may only rarely be inspected or maintained, thus requiring the use of a higher classified material (following the SP system [4.8]).

Good values for durability, elongation and pliability will also be important.

Specifiers who select their materials according to a classification listed in this standard are generally advised to require the materials to be sourced from a single manufacturer.

This is particularly important if a combined manufacturer/installer warranty is required.

It is then also advisable to select an installer who is experienced with the chosen system, and/or approved by the manufacturer.

## 4.4 Types of RBM for roofing

### 4.4.1 RBM with oxidized bitumen

Oxidized bitumen membranes are suitable for use to form waterproof coverings.

Those for RBM roofing comprise polyester or glass fibre or glass/polyester mixed base carriers, saturated and coated with oxidized bitumen.

These products are designed only for pour-and-roll application, cold adhesive application, or nail-fixing (as a preparation layer).

### 4.4.2 RBM with SBS-modified bitumen (elastomeric)

Elastomeric modified bitumen membranes are produced on polyester, glass fibre, and glass/polyester mixed base carriers. The carrier is saturated and/or coated with bitumen, modified with thermoplastic rubbers, commonly referred to in the UK as styrene butadiene styrene (SBS).

These products can be manufactured as suitable for application by pour-and-roll, by torching, by use of cold adhesive, as a self-adhesive material, or by mechanical fastening.

#### **4.4.3 RBM with APP-modified bitumen (plastomeric)**

Plastomeric modified bitumen membranes are produced on polyester, glass fibre, and glass/polyester mixed base carriers. The carrier is saturated and/or coated with bitumen, modified with polyolefin or a polyolefin copolymer, commonly referred to in the UK as atactic polypropylene (APP).

These products are primarily manufactured as suitable for torch application.

They may be used with cold adhesives, but only in strict accordance with the membrane manufacturer's instructions.

They are *not* suitable for pour-and-roll, or generally for mechanically fastened applications.

#### **4.5 Pre-filtering**

With regard to the RBM, some of the parameters encompassed by BS EN 13707 have simple pass/fail results. In order to be considered viable for specification, an RBM should pass:

- watertightness, for all applications; and
- root resistance, for green or garden roofs.

In addition, manufacturers might provide declared values or limiting values for the following parameters, which are unlikely to have a bearing on the selection of a system. For this Guide, no values have been set.

- Adhesion of granules (for mineral-finished capsheets).
- Shear resistance of joints (for single-layer systems only).
- Peel resistance of joints (for mechanically fastened single-layer systems only).

The manufacturer might also have declared a group classification (e.g. S2P1) under the classification recommended in Table 5 of this Guide.

#### **4.6 Relevant product data**

##### **4.6.1 General**

The following parameters are relevant to the selection process, and can appear in the CE mark itself, or in the product data sheet for the material.

Many parameters are primarily dependent upon the choice of carrier, while others are based on bitumen performance.

##### **4.6.2 Tensile strength (*S*)**

Tensile strength indicates the maximum force applied during testing (see Table 1).

Typical tensile strength values for membranes currently available lie between 150 N/50 mm and 900 N/50 mm, and are dependent upon the carrier. Increased tensile strength provides greater security when a lightweight or flexible deck or substrate is chosen.