

# A guide to BS EN 998 - 1 and BS EN 998 - 2

## Introduction

BS mortar and associated test method standards were withdrawn and replaced by harmonized European Product Standards and common test methods. In addition a revised British Standard covering those mortar test methods that were not part of the new European Standards, but was desired to be retained, has been published.

### Standards/documents withdrawn

BS 4721:1981	Specification for ready-mixed building mortars
BS 5838-2:1980	Specification for dry packaged cementitious mixes - Pre-packed mortar mixes
BS 4551:	Methods of testing mortars screeds and plasters which is currently published in two parts is being republished as a single part Standard with the same Standard number. A multi part Standard on mortar testing has been published as BS EN 1015
PD 6472	Guide to specifying the quality of building mortars

### Standards/documents adopted

A new two part harmonized product Standard for mortar was published in 2003.

BS EN 998-1	Specification for mortar for masonry - Part 1: Rendering and plastering mortar
BS EN 998-2	Specification for mortar for masonry - Part 2: Masonry mortar
PD 6678	Guide to the selection and specification of masonry mortar

These documents are applicable to all mortars. However when applied to site mixed mortars they must be used in conjunction with the existing published document PB 6697. It should be noted that the Standards are not applicable when calcium sulfate is used as the principal binding agent.

BS EN 998-2 has been written using the performance concept, this is a departure from the traditional UK practice, which has been based primarily on a prescription (recipe) approach. The recipe approach is based on the producer of the mortar batching prescribed proportions of materials, the performance concept requires the producer of the mortar to achieve a stated performance and allows the producer freedom to select the mix proportions to achieve this.

Historically recipes for screed materials have been listed in section 4 of BS 4721 and screed material testing covered by BS 4551. Screed materials are no longer within the scope of the mortar Standards and a separate series of Standards cover these products:

BS EN 13318:	Screed material and floor screeds - Definitions
BS EN 13813:	Screed material and floor screeds - Screed material - Properties and requirements

Screed material testing is covered by BS EN 13892, which is published in eight parts. This data sheet does not discuss the new screed Standards.

## Terminology

The introduction of the new Standards will result in the use of a number of new terms these include:

- **Attestation system** - this is the term used to describe the degree of involvement of third parties or the producer in assessing the conformity of the product in accordance with the technical specification.
  - **CE marking** - this mark signifies that a product conforms to a harmonized European technical specification (European Standard or European Technical approval). Annex ZA of the relevant Standard lists the technical requirements for CE marking, for a product for a designated end use. Since the introduction of the Construction Products Regulation, CE marking is now mandatory in the UK.
  - **Declared value** - a value that the manufacturer is confident in achieving, bearing in mind the precision of the test and variability of the process.
  - **Evaluation of conformity** - a systematic examination of the extent to which a product fulfils specified requirements.
  - **Harmonized Standard** - a European Standard (EN) prepared under the mandate of the European Commission with the purpose of supporting a directive. A directive defines generic safety requirements.
  - **Initial type test** - prior to placing a product on the market and when changes occur either in the constituent materials or production process which could affect the characteristics of the product, initial type testing, must be undertaken.
- The initial type tests that are necessary for each product are listed within the individual Standards.
- **Mandate** - a formal request from the European commission to CEN (European Standards Organisation) to prepare a Standard.

## Classification of Mortars

Both parts of BS EN 998 classify mortar in three different ways, the classification system is shown in Table 1.

Table 1: Classification of mortar

	BS EN 998-1 Rendering/plastering	BS EN 998-2 Masonry mortar
According to location of finished manufacture	(i) Factory made (ii) Semi-finished (iii) Site made	(i) Factory made (ii) Semi-finished (iii) Pre-batched (iv) Premixed lime sand (v) Site made
According to concept	(i) Designed (ii) Prescribed	(i) Designed (ii) Prescribed
According to properties and uses	(i) General purpose (GP) (ii) Lightweight* (LW) (iii) Coloured (CR) (iv) One coat for external use (OC) (v) Renovation <sup>#</sup> (R) (vi) Thermal insulating (T)	(i) General purpose (G) (ii) Thin layer <sup>†</sup> (T) (iii) Coloured (CR)

\* A lightweight mortar is required to have a dry hardened density of less than 1300kg/m<sup>3</sup>

† A thin layer masonry mortar is required to have a maximum aggregate particle size of 2mm

# A renovation rendering mortar is designed for use on moist masonry walls containing soluble salts

### Materials

The European Standards for both rendering mortars and masonry mortars require that constituent raw materials shall have characteristics which permit the finished product to conform to the requirements of the Standard. The European Standards require that constituent materials of established suitability be used.

### Rendering Mortar (BS EN 998-1)

The manufacturer of the mortar is required to declare the workable life when the mortar contains an admixture to control the setting, testing should be undertaken in accordance with BS EN 1015-9. It is a requirement of the Standard that the air content be tested and declared when relevant to the end use of the mortar.

The requirements for hardened rendering and plastering mortar are set out in Table 2.

Table 2: Classification for hardened rendering and plastering mortars

Property	Type	Mean values
Compressive strength at 28 days	CS.i CS.ii CS.iii CS.iv	0, 4 - 2, 5N/mm <sup>2</sup> 1, 5 - 5, 0N/mm <sup>2</sup> 3, 5 - 7, 5N/mm <sup>2</sup> > 6N/mm <sup>2</sup>
Capillary water absorption	W 0 W 1 W 2	Not specified c ≤ 0, 40kg/m <sup>2</sup> min 0, 5 c ≤ 0, 20kg/m <sup>2</sup> min 0, 5
Thermal conductivity	T 1 T 2	≤ 0, 1W/m.K ≤ 0, 2W/m.K

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Table 3 lists the requirements for each of the classifications for rendering and plastering mortar.

Manufacturers may declare density values for hardened plastering and rendering mortar

when appropriate. Testing shall be carried out in accordance with BS EN 1015-10.

A manufacturer may if he wishes declare a value where a dash is indicated in a box.

There is a durability requirement for the determination of water penetration after completion of the capillary water absorption test, this is required to be undertaken in accordance with BS EN 1015-18 for One Coat rendering mortar (OC).

Table 3: Requirements for hardened plastering and rendering mortar

Test Parameter	Method of test	GP	LW	CR	OC	R	T
Dry bulk density (kg/m <sup>3</sup> )	BS EN 1015-10	Declared range of values 1300 Kg/m <sup>3</sup>	Declared range of values	Declared range of values	Declared range of values	Declared range of values	Declared range of values
Compressive strength (categories)	BS EN 1015-11	CS I - IV	CS I - III	CS I - IV	CS I - IV	c	CS I - II
Adhesion (N/mm <sup>2</sup> and fracture pattern (FP) A, B or C)	BS EN 1015-12	≥ Declared value and fracture pattern	≥ Declared value and fracture pattern	≥ Declared value and fracture pattern	-	≥ Declared value and fracture pattern	≥ Declared value and fracture pattern
Adhesion after weathering cycles (N/mm <sup>2</sup> and fracture pattern (FP) A, B or C)	BS EN 1015-21	-	-	-	Declared value and fracture pattern	-	-
Capillary water absorption (kg/(m <sup>2</sup> .h. <sup>0.5</sup> )). For mortars intended to be used in external elements	BS EN 1015-18	W0 - W2	W0 - W2	W0 - W2	W1 - W2	≥0.3kg/m <sup>2</sup> after 24 hours	W1
Water penetration after capillary water absorption test (in mm)	BS EN 1015-18	-	-	-	-	≤5mm	-
Water permeability on relevant substrates after weathering cycles (ml/cm <sup>2</sup> after 48 hours)	BS EN 1015-21	-	-	-	≤1ml/cm <sup>2</sup> after 48 hours	-	-
Water vapour permeability coefficient (μ) for mortars intended to be used in external elements	BS EN 1015-19	≤ Declared value	≤ Declared value	≤ Declared value	≤ Declared value	≤15	≤15
Thermal conductivity (W/m.k)	BS EN 174:2002 Table A12	-	-	-	-	-	-
For mortars intended to be used in elements subject to thermal requirements	BS EN 174:2002 4.2.2	-	-	-	-	-	T1≤0.10

Table 3 continued

Test Parameter	Method of test	GP	LW	CR	OC	R	T
Reactions to fire (class)	BS EN 13501-1	The Standard states that where the mass or volume fraction (whichever is the most onerous) of organic material is less than 1.0% the mortar may be classified as reaction to fire Class A1 without the need for test, this provision is also applicable to masonry conforming to BS EN 998-2. Where the volume or mass of organic matter is greater than 1.0% testing in accordance with BS EN 13501-1 shall be undertaken.					
Durability		No requirements for durability are prescribed except for one coat rendering mortars where adhesion and water permeability after weathering cycles has to be assessed					

## Masonry mortar (BS EN 998-2)

- a** The requirements for the properties of fresh masonry mortar are set out in Table 4. The mortar should be sampled in accordance with BS EN 1015-2.
- b** For thin layer mortars the correction time determined in accordance with BS EN 1015-9 shall be declared.
- c** For designed Masonry mortars, the compressive strength classes illustrated are:

M1, M2, 5, M5, M10, M15, M20. It is possible to have further strength classes where the manufacturer may declare other values in class Md. The compressive strength shall be determined on samples taken in accordance with BS EN 1015-2 and tested in accordance with BS EN 1015-11. It should be noted that the compressive strength classes are different to those adopted for traditional mortar designations as shown in the National Annex to BS EN 998-2.

- d** Other hardened properties of masonry mortar may have to be declared depending on the proposed end use of the mortar. Table 5 summarises these:

Table 4: Requirements for fresh properties of masonry mortar

Property	Test	Requirement
Workable life	BS EN 1015-9	≥ Declared value
Chloride content (i)	BS EN 1015-17	≤ Declared value
Air content (ii)	BS EN 1015-7	Within declared range

### Note

- (i) The chloride content shall not exceed 0,1% Cl of the mortar by dry mass, the chloride content may also be calculated based on the chloride ion content of the individual constituent materials.
- (ii) The Standard does not prescribe limits for the air content

Table 5: Requirements for properties of hardened masonry mortar

Property	Performance level	Test method	Requirement to provide data
Bond strength	Declared value	BS EN 1052-3, alternatively a tabulated value in accordance with Annex C of BS EN 998-2 may be declared	Only applicable to designed masonry mortar subjected to structural requirements
Water absorption	Declared value	BS EN 1015-18	Only applicable to masonry mortar used in external situations
Water vapour permeability	Declared value	Calculation of tabulated values in accordance with BS EN 1745, Annex A, Table 12	Only applicable to masonry mortar used in external situations
Dry density of hardened mortar	Declared value	BS EN 1015-10	When relevant to the use for which the mortar is placed on the market
Thermal conductivity	Declared value	BS EN 1745, Table A12 alternatively measured values in accordance with BS EN 1745 Clause 4.2.2 may be declared	Only applicable to masonry mortars subject to thermal requirements

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e For prescribed masonry mortars the proportions shall be declared. Additionally the relationship between the compressive strength and the mix proportions shall be declared using publicly available references, establishing the relationship between mix proportions and compressive strength. The informative National Annex NA of BS EN 998-2 incorporates a Table showing the traditional BS 4721 Designations and the comparative mortar class. This is reproduced as Table 6.

Table 6: Traditional designations of the new mortar classes

BS 4721 - Traditional mix designations	BS EN 998-2 - Mortar class*
i	12
ii	6
iii	4
iv	2

\*It should be noted that the new mortar classes relate to prism lengths

## Attestation of conformity

European legislation prescribes different levels of attestation of conformity which relate to product end use and relevant design and safety criteria. There are six levels, each one defines the tasks that must be undertaken by the manufacturer/Notified Body (generally a third party certification body). The applicable levels for mortar products are:

Rendering mortar and prescribed masonry mortar - Level 4  
 Designed masonry mortar - Level 2+

Table 7 shows the requirements for these levels.

Table 7: Attestation of conformity classes

Conformity numbering system	2+	4
<b>Tasks for the manufacturer</b>		
Factory production control	✓	✓
Extra testing of samples taken from the production unit (factory) in accordance with a prescribed test plan	✓	-
Initial type testing	✓	✓
<b>Tasks for the notified body</b>		
Initial type testing	-	-
Initial certification of factory production control (FPC)	✓	-
Continuous surveillance of factory production control (FPC)	✓	-
Audit testing of samples taken from the factory or the market place or site	-	-

✓ = test required

## Testing

It was stated in the introduction that mortar testing is covered by the BS EN 1015 series of test methods, these are listed in Table 8 below. The revised version of BS 4551 will cover the procedures for undertaking two physical tests where no conflicting European Standard has been published:

- Determination of consistence by dropping ball
- Determination of consistence retentivity and water retentivity

In addition it will contain the methods of chemical analysis, this subject area has not yet been addressed with the European Standardization work programme.

Table 8: BS EN 1015 - Methods of test for mortar for masonry

<b>Part 1</b>	Determination of particle size distribution (by sieve analysis)
<b>Part 2</b>	Bulk sampling of mortars and preparation of test mortars
<b>Part 3</b>	Determination of consistence of fresh mortar (by flow table)
<b>Part 4</b>	Determination of consistence of fresh mortar (by plunger penetration)
<b>Part 6</b>	Determination of bulk density of fresh mortar
<b>Part 7</b>	Determination of air content of fresh mortar(i)
<b>Part 9</b>	Determination of workable life and correction time of fresh mortar
<b>Part 10</b>	Determination of dry bulk density of hardened mortar
<b>Part 11</b>	Determination of flexural and compressive strength of hardened mortar
<b>Part 12</b>	Determination of adhesive strength of hardened rendering and plastering mortar on substrates
<b>Part 17</b>	Determination of water-soluble chloride content of fresh mortar
<b>Part 18</b>	Determination of water absorption due to capillary action of hardened mortar
<b>Part 19</b>	Determination of water vapour permeability of hardened rendering and plastering mortar
<b>Part 21</b>	Determination of the compatibility of one-coat rendering mortar with backgrounds (through assessment of adhesive strength and water permeability after conditioning)

(i) For rendering and masonry mortars made with porous aggregates the air content may be determined according to BS EN 1015-6 (fresh mortar density). There are some gaps in the sequence of the part numbers, this has arisen because a number of work items that had been allocated part numbers have either been dropped from the work programme or work on them has been suspended for the present. It should be noted that not all the test methods are called up by the Product Standards.



MPA Mortar is part of the Mineral Products Association, the trade association for the aggregates, asphalt, cement, concrete, dimension stone, lime, mortar and silica sand industries.

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