British Standard

BRITISH STANDARD

BS 4887-1: 1986

Mortar admixtures —

Part 1: Specification for air-entraining (plasticizing) admixtures

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Cement, Gypsum, Aggregates and Quarry Products Standards Committee (CAB/-) to Technical Committee CAB/3 upon which the following bodies were represented:

Brick Development Association
British Aggregate Construction Materials Industries
British Ceramic Research Association
British Precast Concrete Federation
British Ready Mixed Concrete Association
Building Employers Confederation
Cement Admixtures Association
Cement and Concrete Association
Cement Makers' Federation
Concrete Society
County Surveyor's Society
Department of the Environment (Building Research Establishment)
Department of Transport (Highways)
Electricity Supply Industry in England and Wales
Federation of Civil Engineering Contractors
Institution of Civil Engineers
Institution of Structural Engineers
Mortar Producers Association
Plasterers' Craft Guild
Society of Chemical Industry

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Contents

Foreword

This Part of BS 4887 has been prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Committee and supersedes BS 4887:1973 "*Mortar plasticizers*" which is withdrawn. It is intended to prepare, under the general title "*Mortar admixtures*", further Parts to cover other admixtures now in use in building mortars.

The admixtures specified in the 1973 edition of this standard were then called "*mortar plasticizers*" to indicate the main purpose for their use. A plasticizer of the type specified acts to improve workability by entraining air as small bubbles during mixing and so its name has been changed to "*air-entraining (plasticizing) mortar admixture*" to indicate how the admixture operates. Air-entrainment can confer other beneficial properties, such as improved frost resistance.

Mortar admixtures are used in building mortars in small quantities to improve specific properties of the mortar. They may also affect other properties so it is necessary to demonstrate that these effects are not adverse. The test methods included cover those properties of mortars likely to be important when they are used in bedding masonry units, plastering and rendering. All test methods have been taken from BS 4551; details of procedure are given in Appendix B and Appendix C.

To reduce the effects of different raw materials on test results, most test methods use a control mix and a mix containing the admixture. In this Part of BS 4887, only one mortar type and designation has been included to keep the amount of testing to a minimum. Evidence available to the committee indicates that there is no significant difference in the performance of those admixtures covered by this Part when the mortar includes lime.

It is known that the properties of different raw materials as well as the use of different mixes can change the required dosage of an admixture. It is important that the user checks the properties of the mixes to be used on site.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 6, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 4887 specifies the requirements for performance and uniformity and methods of test for air-entraining (plasticizing) mortar admixtures used to modify one or more of the properties of building mortars for use in bedding masonry units, plastering and rendering but not normally for use in screeding.

NOTE The titles of the publications referred to in this Part of BS 4887 are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 4887 the definitions given in BS 2787 and BS 4049 apply together with the following.

air-entraining (plasticizing) mortar admixture
admixture that causes a controlled and stable quantity of air in the form of small bubbles to be incorporated during the mixing of mortar to improve its plasticity

3 Performance requirements

The admixture shall enable a test mortar to comply with the performance requirements given in Table 1 when test mixes of the mortar, containing representative samples of the admixture taken as described in Appendix A, are prepared as described in Appendix B and subjected to the acceptance tests described in Appendix C.

The test mix mortar containing the admixture shall be compared with a control mix mortar made on the same day under the same conditions and the mean results obtained from two comparisons shall be used to assess compliance with the performance requirements.

One batch of the test mix mortar on which to determine the air content after extra mixing and a second batch of the test mix mortar on which to determine the other properties required shall be compared on the same day with one batch of the control mix mortar. Consequently, a total of six mortar batches shall be prepared to make two comparisons and calculate the mean values.

Batches of the admixture which have the same formulation, as described in **5.1**c) and k) need not be tested individually for acceptance if they have been shown by the uniformity tests in clause **4** to have the same composition as that of the admixture tested for acceptance and complying with the performance requirements.

4 Uniformity requirements

Any batch of admixture shall have the same composition, as given in **5.1**k), as that of the admixture tested for acceptance. To check this uniformity of composition, a sample of the batch, taken as described in Appendix A, shall be tested in accordance with Appendices D and E of BS 5075-1:1982 and shall comply with the requirements given in Table 2.

5 Information to be provided

5.1 Test information

The following test information shall be available in a certificate[1)].

a) The name, trade mark or other means of identification of the manufacturer.

b) The trade designation of the product, i.e. brand name, reference number and/or letter.

c) The description of the material, i.e. air-entraining (plasticizing) mortar admixture, its physical state (liquid or solid), its colour and the generic type of its main active constituent(s), e.g. alkali salt of wood resin, sulphated or sulphonated hydrocarbon.

d) The name and location of the test laboratory where acceptance and uniformity tests were made and the date of testing.

e) The sources of the cement and sand used in the tests.

f) The quantity of admixture, calculated on the total dry mass of mortar, used in the test mix mortar.

g) The water required to produce a mortar of standard consistence for each control and test mix mortar and the percentage water reduction for the test mix mortars.

h) The stiffening times for the control and test mix mortars.

i) The air contents of the control mix mortar after standard mixing and of the test mix mortars at each of the three test conditions.

j) The compressive strengths of the individual mortar cubes for the control and test mix mortars and the ratio of the mean compressive strength of the test mix mortar to that of the control mix mortar, expressed as a percentage, at age 7 days.

k) The composition, as follows:

1) the dry material content;

2) the ash content;

3) the relative density of liquid admixture;

[1)] Information is normally provided by the manufacturer but may be made available by a supplier after repackaging bulk material.

4) the chloride ion content, expressed as a percentage by mass of total admixture.

Table 1 — Performance requirements and acceptance tests

Characteristic	Reference		Requirement (mean of two mixes)
	Test	Mix	
Reduction in water requirement for standard consistence	**C.2**	A	Not less than 8 %
Stiffening time	**C.3**	A	Time from completion of mixing to reach resistance to penetration of 1.0 N/mm^2 for the test mix mortar to be within 1 h of the time for the control mix mortar
Air content of test mix mortar after:			
a) standard mixing	**C.4.1**	A	14 % to 20 %
b) 1 h standing	**C.4.2**	A	Not reduced by a figure of more than 3 % from the air content after standard mixing
c) extra 15 min mixing	**C.4.3**	B	Not changed by a figure of more than 5 % from the air content after standard mixing
Compressive strength at 7 days	**C.5**	A	Compressive strength of the test mix mortar to be at least 70 % relative to that of the control mix mortar

Table 2 — Uniformity requirements and tests

Characteristic	Test reference	Requirement
Dry material content	**D.1** of BS 5075-1:1982	a) For liquid admixtures: to be within 3 % (*m*/*m*) of the value stated by the manufacturer[a] b) For solid admixtures: to be within 5 % (*m*/*m*) of the value stated by the manufacturer
Ash content[b]	**D.2** of BS 5075-1:1982	To be within 1.0 % (*m*/*m*) of the value stated by the manufacturer
Relative density	**D.3** of BS 5075-1:1982	For liquid admixtures: to be within 0.02 of the value stated by the manufacturer
Chloride ion content	Appendix E of BS 5075-1:1982	To be within 5 % of the value stated by the manufacturer or within 0.2 % (*m*/*m*), whichever is the greater

[a] The term manufacturer throughout this standard includes the supplier where appropriate.
[b] Not applicable to admixtures containing more than 1 % (*m*/*m*) of chloride ion.

5.2 General information

The following general information shall be available in writing[2)].

a) The name, trade mark or other means of identification of the manufacturer.

b) The trade designation of the product, i.e. brand name, reference number and/or letter.

c) The description of the material, i.e. air-entraining (plasticizing) mortar admixture, its physical state (liquid or solid), its colour and the generic type of its main active constituent(s), e.g. alkali salt of wood resin, sulphated or sulphonated hydrocarbon.

d) Packaging, recommended storage conditions, maximum storage time before use and special precautions at extremes of temperature, including instructions regarding liquids which have become frozen. Where any special requirements on storage life apply, they shall be stated.

NOTE A certificate confirming that the storage recommendations have been followed should be provided by the manufacturer.

e) Instructions for use and any necessary safety precautions, e.g. if caustic, toxic or corrosive.

f) Any known incompatibility with other admixtures or with certain types of cements, etc.

g) The manufacturer's recommended dosage or dosages.

h) Effects of underdosage and overdosage.

6 Marking

When admixtures are supplied in containers they shall be clearly marked for the purposes of identification and indication of compliance with the following information. When the material is supplied in bulk at the point of delivery, the same information shall be provided in writing at the time of delivery.

a) The name, trade mark or other means of identification of the manufacturer.

b) The trade designation of the product, i.e. brand name, reference number and/or letter.

c) The description of the material, i.e. air-entraining (plasticizing) mortar admixture.

d) The chloride ion content, expressed as a percentage by mass of total admixture.

e) A summary of storage requirements including any special requirement on storage life, as indicated in **5.2**d), which shall be clearly marked, e.g.:

"This admixture shall not be taken to comply with the requirements of BS 4887-1:1986 after (date)."

f) Instructions for use and any necessary safety precautions, e.g. if caustic, toxic or corrosive.

g) The manufacturer's recommended dosage or dosages.

h) The number and date of this Part of this British Standard, i.e. BS 4887-1:1986[3)].

[2)] Information is normally provided by the manufacturer but may be made available by a supplier after repackaging bulk material.

[3)] Marking BS 4887-1:1986 on or in relation to a product is a claim by the manufacturer that the product has been manufactured to the requirements of the standard. The accuracy of such a claim is therefore solely the manufacturer's responsibility. Enquiries as to the availability of third party certification should be addressed to the appropriate certification body.

Appendix A Methods of sampling admixtures

A.1 General

Take samples of admixtures in accordance with the appropriate method given in **A.2** to **A.5**. In all steps of the sampling procedure, minimize the exposure of the material to the atmosphere to avoid appreciable absorption of moisture or carbon dioxide, or the evaporation of moisture.

A.2 Sampling of powdered materials from packages

Each sample shall represent not more than 1 t of solid admixture. Sample six packages or 1 % of the number of packages, whichever is the greater, or, where the total number of packages does not exceed six, all the packages. Ensure that the packages sampled are evenly distributed throughout the consignment.

Take a sub-sample from each of the selected sample packages by one or more of the following procedures, as appropriate.

a) Where packages contain 500 g or less, take the whole of the contents of a package.

b) Where packages contain more than 500 g, use either of the following methods.

NOTE The method given in 1) below is the preferred method but if a sampling tube is not available use the method given in 2).

1) Insert a sampling tube, which takes a core not less than 25 mm in diameter, into the package so that it takes a core of material substantially the entire length of the package.

2) Empty one of the packages to be sampled on to a clean dry surface and mix the material. Take at least three increments of not less than 125 g each from different parts of the heap.

Repeat the procedure with each of the other packages to be sampled and thoroughly mix the sub-samples obtained to form one bulk sample.

Reduce this bulk sample to about 1 kg, either by coning and quartering or by use of a sample splitter. Place the sample in one or more airtight labelled containers.

A.3 Sampling of liquids from containers

Each sample shall represent not more than 5 000 L of liquid admixture. Sample six containers or 1 % of the number of containers, whichever is the greater, or, where the total number of containers does not exceed six, all the containers. Ensure that the containers sampled are evenly distributed throughout the consignment.

Agitate the containers to disperse all lightly settled material. Disregard all deposits which are not readily brought into suspension by such agitation.

Without delay, take sub-samples from the selected containers by one or more of the following procedures, as appropriate.

a) Where containers hold 0.5 L or less, take the whole of the contents of a container.

b) Where containers hold more than 0.5 L, take 0.5 L of the liquid in each container, combine the sub-samples obtained in this way and mix them thoroughly to form one bulk sample.

Thoroughly mix the bulk sample and take a final sample of not less than 1 L. Place this in one or more clean bottles, labelled and tightly stoppered.

A.4 Sampling bulk materials

No requirement is specified in this Part of BS 4887 for sampling from single packages or containers whose contents exceed 1 t of solid admixture or 5 000 L of liquid admixture. The method of sampling in such cases will depend upon the circumstances, but the final sample size shall be sufficient to represent the product to be tested.

NOTE Additional guidance on sampling may be found in BS 6002.

A.5 Particulars of sample

Record the date, place and method of sampling, the identity and quantity of the material represented by the sample and the name(s) of the supervisor(s) present.

Appendix B Preparation of mortars for acceptance tests

B.1 General

To prepare the four batches of test mix mortar and two batches of control mix mortar needed for testing in accordance with Appendix C, use the constituents, mix quantities, apparatus and procedures given in **B.2** to **B.5**.

B.2 Constituents

B.2.1 *Cement*

The cement shall be an ordinary Portland cement complying with BS 12. It shall be stored in an airtight container.

B.2.2 *Aggregate*

The sand shall comply with BS 4550-5 except that the proportions and masses of the fractions given in Table 3 shall be used in each batch of mortar.

Table 3 — Grading of sand

Fraction	Size	Proportion	Mass
		%	g
A	2.36 mm to 1.18 mm	15	515
B	1.18 mm to 600 µm	15	515
C	600 µm to 300 µm	20	690
D	300 µm to 150 µm	25	860
E	150 µm to 90 µm	25	860

B.2.3 ***Admixture***

The admixture shall be added to each batch of test mix mortar in an amount to give 14 % to 20 % of air and recorded as a percentage to the nearest 0.1 % of the total dry mass of mortar.

B.3 Mix quantities

Each batch of the mortar shall contain 640 g of ordinary Portland cement (15.7 % by mass of dry mortar) and the aggregate masses given in Table 3. The water content of each batch of control and test mix mortar shall be such as to produce a standard consistence, defined as a mean dropping ball penetration of 10 ± 0.5 mm, when determined by the method given in clause **10** of BS 4551:1980. To establish the required water contents, prepare series of trial mixes, varying the water content successively and measuring the consistence of each until the correct values are reached. Reject these trial mixes.

B.4 Apparatus

B.4.1 *Type of mixer.* The mixing apparatus shall comply with **8.3** of BS 4551:1980 and be fitted with a 5 L bowl having a suitable cover of non-corrodible material clamped across the top of the bowl to prevent spillage during mixing.

B.4.2 *Dropping ball apparatus,* complying with **10.2** of BS 4551:1980.

B.4.3 *Stiffening time apparatus,* complying with **14.2** of BS 4551:1980.

B.4.4 *Air content apparatus,* complying with **13.2.1** of BS 4551:1980 for the density method.

B.4.5 *Compressive strength apparatus,* complying with **15.2** and **15.4** of BS 4551:1980.

B.5 Mixing procedures

Bring all the materials to a temperature of 20 ± 2 °C before starting the mixing of the mortar. Carry out the mixing in a room having a temperature of 20 ± 2 °C and a relative humidity of not less than 50 %.

Place all the sand and then the cement in the mixing bowl, fit the cover and mix for 30 s. Continue mixing and add about half the mixing water during the next 30 s and mix for a further 60 s. During a further 30 s of mixing add the remaining mixing water at a uniform rate. For the test mix mortars this remaining water shall contain the dissolved solid admixture or liquid admixture. Continue mixing for 60 s after all the water has been added.

Stop the mixer and clean any adhering material from the cover, paddle and sides of the bowl with a scraper, taking particular care to ensure that no unmixed materials remain at the bottom of the bowl, and complete these operations in 60 s. Cover the bowl with a damp cloth and allow the mortar to stand for 8 min after scraping the bowl. Restart the mixer and mix the mortar for a further 60 s.

Appendix C Acceptance tests on control mix and test mix mortars

C.1 General

C.1.1 ***Order of testing***

Carry out the appropriate tests on each of the six mortar mixes in the order given in **C.1.2** and **C.1.3**.

C.1.2 ***Series 1***

Prepare and test the following three mixes on the same day.

a) A control mix, to be tested for consistence (**C.2**), stiffening time (**C.3**), air content after standard mixing (**C.4.1**) and compressive strength (**C.5**).

b) A test mix A, of the same mix proportions as the control mix but containing the admixture, to be tested for consistence (**C.2**), stiffening time (**C.3**), air content after standard mixing (**C.4.1**), air content after standing (**C.4.2**) and compressive strength (**C.5**).

c) A test mix B, nominally identical to test mix A, [checked by measuring consistence (**C.2**) and air content after standard mixing (**C.4.1**)] to be tested for air content after extra mixing (**C.4.3**).

C.1.3 ***Series 2***

Prepare and test three mixes as in **C.1.2** but not necessarily on the same day as series 1.

C.2 Consistence and water requirement

Immediately after completion of mixing of each mortar, make three tests for consistence by the method described in clause **10** of BS 4551:1980. Record to the nearest 1 g the total quantity of water (including any water contributed by the admixture) required to give the standard consistence corresponding to a mean dropping ball penetration of 10 ± 0.5 mm. After testing for consistence, return the mortar to the mixing bowl using a palette knife to remove the mortar from the mould. Then remix with the palette knife for 10 s before taking samples for the following tests.

Calculate the water reduction, W, (in %) by the inclusion of the admixture from the following formula:

$$W = \frac{(C - t)}{C} \times 100$$

where

C is the water requirement of the control mix mortar (in g);

t is the water requirement of the test mix mortar (in g).

Report this water reduction to the nearest 1 %.

C.3 Stiffening time

Determine the time from completion of mixing for the mortar to reach a resistance to penetration of 1.0 N/mm^2 by the method given in clause **14** of BS 4551:1980. After completing the test, discard the mortar from the mould(s).

Report this as the stiffening time to the nearest 15 min.

C.4 Air content

C.4.1 *Air content after standard mixing*

Determine the air content by the density method given in **13.2** of BS 4551:1980. Calculate the relative density, D, of each mortar to the nearest 0.001 and then calculate the air content, A, (in %) from the following formula:

$$A = 100\,(1 - KD)$$

where

$$K = \frac{1502.6 + M}{4080 + M}$$

where

M is the mass of water (in g).

NOTE The numerical values for K are based on the mix quantities given in **B.3** with a relative density of 3.13 for the cement and of 2.65 for the sand.

After completing the test, return the mortar to the mixing bowl and remix with a palette knife for 10 s.

If the air content of a control mix mortar exceeds 7 %, repeat the mixing procedure and retest. If the air content again exceeds 7 %, change the batch or source of one or more of the constituents of the mortar and repeat the mixing and testing procedure.

If the air content of a test mix mortar is not within 14 % to 20 %, discard the mortar and repeat the tests on new batches containing a revised dosage of admixture.

Report this as the air content after standard mixing to the nearest 0.1 %.

C.4.2 *Air content after standing*

For test mix A, after taking samples to prepare the mortar cubes, cover the mixing bowl with a damp cloth to prevent loss of water by evaporation and allow to stand. After 1 h from completion of mixing, remix with a palette knife for 10 s and determine the air content using the density method given in **C.4.1**. Report the air content after 1 h standing to the nearest 0.1 %.

C.4.3 *Air content after extra mixing*

For test mix B, after completing the test in **C.4.1** and returning the mortar to the mixing bowl, start the mixer and remix for 15 min. Then determine the air content by the density method given in **C.4.1**. Report the air content after an extra 15 min mixing to the nearest 0.1 %.

C.5 Compressive strength of hardened mortar

For each batch of the control mix and test mix A, prepare three 70.7 mm cubes by the procedure given in **15.2.6** of BS 4551:1980.

Cure the specimens hydraulically (**15.2.7.1** of BS 4551:1980) at a temperature of 20 ± 2 °C. After 7 days curing, test the three cubes for compressive strength, using the procedure given in **15.4.2.2** of BS 4551:1980. Calculate the relative strength, S, (in %) with admixture from the following formula:

$$S = \frac{x}{y} \times 100$$

where

x is the mean strength of the test cubes (in N/mm^2);

y is the mean strength of the control cubes (in N/mm^2).

Report this relative strength to the nearest 1 %.

Publications referred to

BS 12, *Specification for ordinary and rapid-hardening Portland cement.*

BS 2787, *Glossary of terms for concrete and reinforced concrete.*

BS 4049, *Glossary of terms applicable to internal plastering, external rendering and floor screeding.*

BS 4550, *Methods of testing cement.*

BS 4550-5, *Standard sand for concrete cubes.*

BS 4551, *Methods of testing mortars, screeds and piasters.*

BS 5075, *Concrete admixtures.*

BS 5075-1, *Specification for accelerating admixtures, retarding admixtures and water-reducing admixtures.*

BS 6002, *Specification for sampling procedures and charts for inspection by variables for percent defective.*

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