

Concrete admixtures —

Part 3: Specification for superplasticizing admixtures

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 British Ready Mixed Concrete Association
 Building Employers' Confederation
 Cement Admixtures Association
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Foreword

This Part of BS 5075 has been prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Committee and is based on an initial draft provided by the Cement Admixtures Association. This Part of this standard incorporates such recommendations of other organizations as the Technical Committee felt were appropriate, and is based on the results of cooperative tests carried out in accordance with earlier drafts of this Part.

This Part of this standard is concerned only with retarding superplasticizing admixtures.

The requirements for non-retarding superplasticizers which were previously covered by this part of BS 5075 have been superseded by the issue of BS EN 934-2 and BS EN 934-6.

Where existing British Standards and specifications call up non-retarding superplasticizers meeting the requirements of BS 5075-3, products with an existing certificate showing compliance with that standard can still be accepted. Products which have been tested to the requirements of BS EN 934-2 should also be accepted as showing technically equivalent performance.

Where standards and specifications call up BS EN 934, it is recommended that for an interim period, BS 5075 certification should be continued to be accepted as technically equivalent.

Accelerating and retarding water-reducing admixtures are covered by BS 5075-1 and admixtures for mortar are covered by BS 4887. All other types of admixture for concrete are now covered by BS EN 934-2.

Admixtures for mortars are covered by BS 4887. Major changes are made to this part of this British Standard by Amendment No. 1 subsequent to the publication of BS EN 934-2.

This Part of BS 5075 specifies acceptance tests which demonstrate the ability of a particular formulation to meet stipulated performance requirements, and admixture uniformity tests which demonstrate that a particular consignment is similar to material which has previously been submitted to the acceptance tests. Either may be carried out by the vendor or at an independent laboratory at the request of the purchaser.

In the acceptance tests, provision has been made for the diverse applications of retarding superplasticizing admixtures in practice and the differing chemical nature of those available. Some of the tests are therefore relevant to the use of retarding superplasticizing admixtures to produce very high workability, whilst the remainder are relevant to obtaining very large reductions in water content.

In the first of these applications, it is usually the intention to produce flowing concrete without drastic alteration of the mix designs employed for normal concrete. Excessive bleeding, segregation, retardation or air-entrainment are undesirable, however, and should not be promoted by the use of superplasticizing admixtures in this type of concrete.

In the second application, a large reduction in water content is required without loss of workability. An extension of initial stiffening time is required within limits and the requirement for early but not later age strength development is relaxed.

The principle has been followed of having one test mix concrete at the same water/cement ratio as a control mix to establish the effect of the admixture on workability and strength. In a second test mix, a fixed water reduction is made and the concrete is tested against specified requirements for workability, stiffening time and strength. An upper limit is placed on the air content of the concrete in both test mixes.

Workability can change rapidly immediately after mixing. However, tests have shown that a relatively stable state is attained within 10 min to 15 min from the completion of mixing and this time has been selected for establishing initial workability. In the case of flowing concrete, there is usually a tendency for the effect of the superplasticizing admixture on workability to diminish steadily with time and, in order to ensure adequate retention of the initial high workability, a requirement for loss of workability on standing has been introduced.

The stiffening time test, which is carried out on mortar sieved from the concrete, is used to determine the times required for a standard needle to indicate a resistance to penetration of 0.5 N/mm^2 and 3.5 N/mm^2 . Work has shown that the time to reach a resistance of 0.5 N/mm^2 corresponds approximately to the extreme limit for placing and compacting concrete, and the time to reach a resistance of 3.5 N/mm^2 gives a guide to the time available for the avoidance of cold joints.

No requirements for tests on hardened concrete have been introduced, apart from those relating to compressive strength. Drying shrinkage, creep, and long term durability are still under investigation, and the effect of superplasticizing admixtures on these properties should be the subject of advice from the admixture manufacturer.

The admixture uniformity tests include determination of dry material content, ash content and chloride ion content. The standard requires that the chloride content of the admixture shall be declared so that the user will be fully aware of the amount of chloride that will be introduced into the concrete, and if necessary will be able to take appropriate precautions.

When a purchaser requires a certificate stating that an admixture complies with this Part of BS 5075, the manufacturer should provide the information given in 6.1. Additional information relating to the correct use of the admixture as given in 6.2 should also be made available on request.

The performance of retarding superplasticizing admixtures should be assessed in the particular concrete to be used because the performance may be affected by changes in concrete composition.

Certification. Attention is drawn to the certification facilities described on the inside back cover of this standard.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

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1 Scope

This Part of BS 5075 specifies the performance requirements and methods of test for retarding superplasticizing admixtures, which may be used to modify one or more properties of hydraulic binder concrete: the workability, the rate of stiffening and hardening, and the strength.

NOTE The titles of the publications referred to in this standard are listed in the Bibliography.

2 Definitions

For the purposes of this Part of BS 5075, the definitions given in BS 6100 apply together with the following.

2.1

text deleted

2.2

retarding superplasticizing admixture

superplasticizing admixture that imparts prolonged workability retention and retards setting

3 Sampling

An admixture to be tested in accordance with this Part of BS 5075 shall be sampled by the appropriate method described in Appendix A of BS 5075-1:1982.

4 Performance requirements

Admixtures shall comply with the performance requirements, appropriate to the type of admixture, detailed in Table 1 and Table 2.

For the purpose of acceptance testing, a representative sample of admixture, as defined in the appropriate subclause in Appendix A of BS 5075-1:1982 shall be subjected to the tests detailed in Table 1 and Table 2 and shall comply with the relevant requirements specified therein.

Concrete mixes for these tests shall be prepared and tested in accordance with Appendices A and B.

Each of the test mixes A and B containing the admixture shall be compared with a control mix made on the same day under the same conditions and the mean result obtained from two such comparisons shall be taken to assess compliance with the specified test requirements.

Consignments of the admixture which have the same description, as given in 6.1 l), 6.2 a) and b), need not be tested individually for acceptance. If any characteristic of the admixture given in 6.1 l), 6.2 a) and b) is changed new acceptance tests shall be carried out and the designation as given in 6.1 b) shall be changed.

NOTE 1 Although the purpose of the tests is to verify compliance with the specified requirements, the results will also serve to demonstrate the effect of the admixture on certain properties of the concrete; it will be seen that, for some types of admixture, certain tests are not applicable.

NOTE 2 For the purposes of acceptance testing, the manufacturer¹⁾ or his agent may be required by the purchaser to demonstrate compliance with the test requirements. The manufacturer is responsible thereafter for ensuring; by his control of production, that consignments of admixture maintain, on delivery, the performance of the sample originally tested for acceptance.

Table 1 — Performance tests and requirements for high workability test mix concrete A

Property	Test reference	Type of admixture
		Retarding superplasticizing
Flow	B.3	510 mm to 620 mm
Loss of workability on standing	B.2 B.5	At 4 h the slump shall be not less than that of the control mix concrete at 10 min to 15 min.
Minimum compressive strength as % of control mix concrete: at 7 days at 28 days	B.7	90 90
NOTE The strength requirements take into account the usual variation in cube testing and the limited increase in air content allowed with the test mix concretes.		

¹⁾ The term “manufacturer” throughout this standard includes the supplier where appropriate.

Table 2 — Performance tests and requirements for water reduced test mix concrete B

Property	Test reference	Type of admixture
		Retarding superplasticizing admixture
Slump	B.2	Not more than 15 mm below that of the control mix concrete
Stiffening time relative to control mix concrete: for 0.5 N/mm ² for 3.5 N/mm ²	B.4	1 h to 4 h longer —
Minimum compressive strength as % of control mix concrete: at 24 h at 7 days at 28 days	B.7	— 125 115

NOTE The strength requirements take into account the usual variation in cube testing and the limited increase in air content allowed with the test mix concretes.

Table 3 — Uniformity tests and requirements

Property	Test reference	Requirement
Dry material content	D.1 of BS 5075-1:1982	a) For liquid admixtures: to be within 3 % (<i>m/m</i>) of the value stated by the manufacturer b) For solid admixtures: to be within 5 % (<i>m/m</i>) of the value stated by the manufacturer
Ash content ^a	D.2 of BS 5075-1:1982	To be within 1.0 % (<i>m/m</i>) 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 % (<i>m/m</i>), whichever is the greater

^a Not applicable to admixtures containing more than 1.0 % (*m/m*) of chloride ion.

5 Uniformity tests and requirements

Any batch of admixture shall have the same physical state and composition, given as in 6.1 l) and 6.2 b), as that of the admixture tested for acceptance. To check this uniformity of composition, a representative sample of the batch taken in accordance with Appendix A of BS 5075-1:1982 shall be tested in accordance with Appendices D and E of BS 5075-1:1982 and shall satisfy the requirements given in Table 3.

6 Provision of information

6.1 Test information

The following information shall be available from the manufacturer in a test certificate:

- the name, trade mark or other means of identification of the manufacturer;
- the trade designation of the product, i.e. brand name, reference number and/or letter;
- the description of the material, i.e. retarding superplasticizing admixture;
- 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 aggregates used in the tests;
- f) the dosages of admixture used in each of the test mixes;
- g) the values, where applicable, for each control and test mix, of slump, flow, air content and water/cement ratio as well as the cement content of the control mix;
- h) the loss of workability for test mix A, as measured by slump, after standing for specified periods;
- i) the percentage water reduction for test mix B;
- j) the stiffening times for the control mix and for test mix B;
- k) the ratio of the mean compressive strength of the cubes at the appropriate ages from each of test mixes A and B to the mean compressive strength of the control mix cubes;
- l) the composition as follows:
 - 1) the dry material content;
 - 2) the ash content;
 - 3) the relative density of liquid admixtures;
 - 4) the chloride ion content, expressed as a percentage by mass of total admixture.

6.2 General information

The following information shall be available²⁾ in writing:

- a) the physical state (i.e. liquid or solid) and colour;
- b) the generic type of main active constituents, e.g. sulfonated melamine formaldehyde condensate, sulfonated naphthalene formaldehyde condensate or lignosulfonate;
- c) the chloride content relative to the cement mass contributed by the recommended dosage or dosages, expressed as a percentage by mass of chloride ion;

d) the 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, e.g.:

“This admixture shall not be taken to comply with BS 5075-3:1985 after (date)”

- 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 cement, etc.;
- g) the manufacturer’s recommended dosage or dosages;
- h) the effects of underdosage and overdosage.

7 Marking

When admixtures are supplied in containers they shall be clearly marked with the following information. When the material is supplied into a bulk container at the point of delivery, the same information shall be provided in writing at the time of delivery as follows:

- 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. retarding superplasticizing admixture;
- d) the chloride ion content, expressed as a percentage by mass of total admixture;
- e) a summary of storage requirements including any special requirements on storage life, as indicated in 6.2 d), which shall be clearly marked, e.g.:
 - “This admixture shall not be taken to comply with BS 5075-3:1985 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 5075-3:1985³⁾.

²⁾ Information is normally provided by the manufacturer in a data sheet but may be made available by a supplier after re-packaging bulk material.

³⁾ Marking BS 5075-3:1985 on or in relation to a product is a claim by the manufacturer that the product has been manufactured in accordance with 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 to support such claims should be addressed to the Director, Quality Assurance Division, BSI, Linford Wood, Milton Keynes MK14 6LO in the case of certification marks administered by BSI or to the appropriate authority for other certification marks.

Appendix A Preparation of concrete for acceptance tests

A.1 General

Prepare the concrete for the acceptance tests using the constituents, mix proportions and procedure given in **A.2** to **A.5**. Use identical cement and aggregates for all mixes in a series being compared.

To compare the properties of concrete with and without the addition of the admixture, make duplicate batches of test mix concrete A, and of test mix concrete B, and duplicate batches of control mix concrete.

A.2 Constituents

A.2.1 Cement

The cement⁴⁾ shall be a reference Portland cement which is an ordinary Portland cement that has been specially selected for the purpose of admixture acceptance tests and shall comply with BS 12. It shall be identified as "CAA/BS 5075-1 Reference Portland Cement" and shall be stored in a sealed container.

A.2.2 Aggregates

The aggregates shall be in an oven-dry condition. The coarse aggregate shall be an uncrushed gravel complying with BS 882. It shall consist of 20 mm and 10 mm single-sized materials. Neither of the sizes shall have a flakiness index higher than 35 % when tested in accordance with BS 812-105.1 nor a 10 % fines value less than 50 kN when tested in accordance with BS 812-111.

The fine aggregate shall be an uncrushed sand complying with BS 882 except that the grading of the sand as used shall comply with that given in Table 4. The sand shall be obtained from a source that is known to be free from organic matter and it shall have a content of acid-soluble matter of less than 5 % when tested in accordance with clause 7 of BS 4550-6:1978.

Table 4 — Fine aggregate grading limits

BS 410 sieve size		Percentage mass passing BS sieve
mm	µm	%
10		100
5		90 to 100
2.36		85 to 100
1.18		75 to 100
	600	60 to 79
	300	12 to 40
	150	0 to 10

A.2.3 Admixture

The admixture shall be in the appropriate condition recommended by the manufacturer for general use in practice.

A.3 Mix proportions

NOTE It is advisable to prepare trial mixes to ensure that the control mix concrete complies with **A.3.1** for slump, cement content and air content.

A.3.1 Control mix concrete

The proportions, by mass, of the oven-dry aggregate shall be: 40 parts of 20 mm coarse aggregate: 20 parts of 10 mm coarse aggregate: 40 parts of fine aggregate. The cement content of the fully compacted concrete shall be $300 \pm 5 \text{ kg/m}^3$ when determined in accordance with BS 1881-107, except that the container described in **3.2** therein may be replaced by the container described in **5.2.2** of BS 1881-106:1983 or by the cylinder C described in **3.1** and Table 1 of BS 1881-103:1983. The water content of each batch shall be such as to produce a concrete having a slump value of 65 mm to 85 mm inclusive, when determined in accordance with **B.2**.

The air content shall be not more than 2.0 % when tested in accordance with **B.6**. Where this value is exceeded, repeat the test procedure using aggregates from different sources.

⁴⁾ Information on the supply of the reference cement can be obtained from the Cement Admixtures Association, 38A Tilehouse Green Lane, Knowle, West Midlands B93 9EY.

A.3.2 Test mix concrete A

Test mix concrete A shall contain the admixture at the manufacturer's recommended dosage rate. It shall be of the same composition as the control mix and the water content shall include the quantity of water contributed by the admixture. The air content, determined in accordance with **B.6**, shall be not more than 2.0 % higher than that of the corresponding control mix concrete and in any case not more than a total of 3.0 %.

A.3.3 Test mix concrete B

Test mix concrete B shall contain the admixture at the manufacturer's recommended dosage rate. It shall be of the same composition as the control mix except that the total water/cement ratio (including the quantity of water contributed by the admixture) shall be adjusted to give a water reduction of 16 % (unless otherwise specified by the manufacturer) relative to the control mix concrete.

The air content, determined in accordance with **B.6**, shall be not more than 2.0 % higher than that of the corresponding control mix concrete and in any case not more than a total of 3.0 %.

The relation between the percentage water reduction and the total water/cement ratio (w/c), is given by:

$$w/c \text{ of test mix concrete B} = w/c \text{ of control mix} \times \frac{(100 - \text{percentage water reduction})}{100}$$

$$= w/c \text{ of control mix} \times 0.84 \text{ (unless otherwise specified by the manufacturer)}$$

A.4 Type of mixer

The concrete shall be mixed in a pan mixer filled to between 50 % and 90 % of its nominal full capacity.

NOTE Each batch of control or test mix concrete will require approximately 100 kg or 40 L of concrete for the full range of tests. A pan mixer with a nominal capacity of 50 L will generally be most suitable.

A.5 Mixing procedure**A.5.1 General**

Prepare identical batches of control mix concrete and identical batches of test mix concretes A and B in the same mixer using the same procedure. Arrange the mixing so that a set of batches of a control mix and associated test mix concrete A and/or B is produced on the same day. Weigh the cement, aggregates and water. Carry out the required tests on duplicate batches of each concrete.

A.5.2 Mixing control mix concrete

Place the aggregates in the mixer, add approximately half the mixing water and mix the material for 2 min. After standing for 8 min, with the pan covered to minimize evaporation, spread the cement evenly over the surface of the mixed aggregates, restart the mixer and mix for 30 s. Add the remainder of the mixing water during the next 30 s and continue mixing the concrete for a further 3 min.

A.5.3 Mixing test mix concretes A and B

Adopt the mixing procedure described above but disperse the admixture in the second addition of water.

Appendix B Tests on control mix and test mix concretes

B.1 General

Use the appropriate test procedure for each of the concrete mixes produced. Where compaction of the concrete is required it shall be accomplished by mechanical vibration using an identical method and procedure each time on concretes of similar workability. The operator should be aware that, in the case of test mix A, only a short period of vibration will be necessary due to the very high workability of the concrete. Take samples of concrete for testing by the method given in BS 1881-1:1970⁵⁾. Carry out duplicate tests as indicated in clause 4 of this standard.

B.2 Slump

Determine the slump of the control mix and test mix concrete B by the method given in BS 1881-102. Make duplicate determinations between 10 min and 15 min after the completion of mixing. Calculate and report the mean slumps to the nearest 5 mm.

B.3 Flow

Determine the flow of duplicate samples of test mix concrete A between 10 min and 15 min after the completion of mixing by the method given in BS 1881-105. Calculate and report the mean flow in millimetres to the nearest 5 mm.

B.4 Stiffening times

Determine the times from completion of mixing for the control mix and test mix concrete B to reach resistances to penetration of 0.5 N/mm² and 3.5 N/mm² according to the method given in C.4 of BS 5075-1:1982.

B.5 Loss of workability on standing

Determine the slump of test mix concrete A at 4 h, when testing retarding superplasticizing admixtures, using the method given in BS 1881-102 after the following operations.

After mixing, cover the concrete for the test to prevent loss of water by evaporation and keep it at a temperature of 20 ± 2 °C. At 45 min after completion of mixing, re-mix the concrete by hand using a shovel just enough to counteract any bleeding or segregation, and make duplicate determinations of the slump. Discard this concrete and keep the remaining concrete covered and then, at 4 h after completion of mixing, repeat the re-mixing by hand and make duplicate determinations of the slump. Calculate and report the mean slumps to the nearest 5 mm.

B.6 Air content

Determine the air content of each batch of the control and test concretes A and B to the nearest 0.1 %, in accordance with the procedure described in BS 1881-106 with the following modification. Compact each layer of concrete in the air meter by mechanical vibration of minimum duration to give a relatively smooth concrete surface with a glazed appearance (e.g. 5 s per layer on a Vebe table). Carry out the tests between 30 min and 45 min after the completion of mixing for each of the mixes. Cover the concrete to prevent evaporation of water between the completion of mixing and start of the test. Discard the concrete used for this test.

B.7 Compressive strength

Cast sufficient 100 mm test cubes, within 60 min of completion of mixing for the control and test mix concretes A and B, to provide three test cubes for each of the ages specified in Table 1 and Table 2. Cast, cure and test the cubes in accordance with BS 1881-108, BS 1881-111 and BS 1881-116, but take care to avoid excessive vibration of test mix concrete A that may still be in a flowing condition. If one result within the set of three obtained on specimens tested at the same age varies by more than ± 5 % from the mean, discard the result and recalculate the mean of the two remaining results. If more than one result varies by more than ± 5 % from the mean, discard the set of results and repeat the tests on the concrete. Calculate the ratio of the mean compressive strength of the test mix concretes A and B to that of the control mix concretes as a percentage, to the nearest 1 %, at the appropriate ages.

⁵⁾ BS 1881-1:1970 is under revision and will be superseded by BS 1881-125 "Methods of mixing and sampling fresh concrete in the laboratory".

Bibliography

- BS 12, *Specification for ordinary and rapid-hardening Portland cement.*
- BS 410, *Specification for test sieves.*
- BS 812, *Testing aggregates.*
- BS 812-105.1, *Methods for determination of particle shape — Flakiness index.*
- BS 812-111, *Methods for determination of ten percent fines value (TFV)*
- BS 882, *Specification for aggregates from natural sources for concrete.*
- BS 1881, *Testing concrete.*
- BS 1881-1:1970, *Method of mixing and sampling fresh concrete in the laboratory*⁶⁾.
- BS 1881-102, *Method for determination of slump.*
- BS 1881-103:1983, *Method for determination of compacting factor.*
- BS 1881-105, *Method for determination of flow.*
- BS 1881-106:1983, *Method for determination of air content of fresh concrete.*
- BS 1881-107, *Method for determination of density of compacted fresh concrete.*
- BS 1881-108, *Method for making test cubes from fresh concrete.*
- BS 1881-111, *Method of normal curing of test specimens (20 °C method).*
- BS 1881-116, *Method for determination of compressive strength of concrete cubes.*
- BS 4550, *Methods of testing cement.*
- BS 4550-6:1978, *Standard sand for mortar cubes.*
- BS 4887, *Mortar plasticizers*⁷⁾.
- BS 5075, *Concrete admixtures.*
- BS 5075-1:1982, *Specification for accelerating admixtures, retarding admixtures and water-reducing admixtures.*
- BS 6100, *Glossary of building and civil engineering terms.*
- BS EN 934-2, *Admixtures for concrete, mortar and grout — Part 2: Concrete admixtures — Definitions and requirements*⁷⁾.
- BS EN 934-6, *Admixtures for concrete, mortar and grout — Part 6: Sampling, conformity control, evaluation of conformity, marking and labelling*⁷⁾.

⁶⁾ BS 1881-1:1970 is under revision and will be superseded by BS 1881-125 “Methods of mixing and sampling fresh concrete in the laboratory”.

⁷⁾ Referred to in the foreword only.

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