

Australian Standard™

**Chemical admixtures for concrete,
mortar and grout**

Part 1: Admixtures for concrete



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This Australian Standard was prepared by Committee BD/33, Chemical Admixture for Concrete. It was approved on behalf of the Council of Standards Australia on 28 June 2000 and published on 4 October 2000.

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The Association of Consulting Engineers Australia
Australian Chamber of Commerce and Industry
Australian Concrete Repair Association
Australian Pre-mixed Concrete Association
AUSTROADS
Cement and Concrete Association of Australia
Concrete Institute of Australia
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STANDARDS AUSTRALIA

RECONFIRMATION

OF

AS 1478.1–2000

**Chemical admixtures for concrete, mortar and grout
Part 1: Admixtures for concrete**

RECONFIRMATION NOTICE

Major stakeholders of this publication have reviewed the content of this publication and in accordance with Standards Australia procedures for reconfirmation, it has been determined that the publication is still valid and does not require change.

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Approved for reconfirmation in accordance with Standards Australia procedures for reconfirmation on 29 August 2018.

NOTES

Australian Standard™

Chemical admixtures for concrete, mortar and grout

Part 1: Admixtures for concrete

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PREFACE

This Standard was prepared by the Standards Australia Committee BD/33, Chemical Admixtures for Concrete, to supersede AS 1478—1992, MP 20.1—1971, Permeability-reducing admixtures, MP 20.2—1975, *Thickening admixtures for use in concrete and mortar*, and MP 20.3—1977, *Expanding admixtures for use in concrete, mortar and grout*.

The objective of this Standard is to provide users and specifiers of chemical admixtures with the requirements for chemical admixtures to be added to concrete mixes incorporating portland and blended cements.

This Revision includes the following changes:

- (a) Requirements for compression testing at 1 year have been removed.
- (b) Provision has been made for a mid-range water-reducing admixture, having performance intermediate between normal and high-range water-reducing admixtures.
- (c) Provision has been made for special admixtures having claimed attributes that cannot be verified by current standard tests, with the objective of demonstrating the influence of such admixtures on normal concrete properties.
- (d) The three miscellaneous publications MP 20.1, MP 20.2 and MP 20.3 have been revised and added to this document as informative appendices.

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STANDARDS AUSTRALIA

Australian Standard

Chemical admixtures for concrete, mortar and grout

Part 1: Admixtures for concrete

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for chemical admixtures to be added to concrete mixes incorporating portland and blended cements.

NOTES:

- 1 Sampling procedures are given in Appendix A.
- 2 Information on admixtures for use in concrete is given in Appendix B.
- 3 Guide to determine the chloride ion content in admixtures is given in Appendix C.
- 4 Information on thickening admixtures is given in Appendix D.
- 5 Information on shrinkage-reducing and shrinkage-compensating admixtures is given in Appendix E.
- 6 Information on permeability-reducing admixtures is given in Appendix F.
- 7 Admixtures that have been acceptance tested and approved to AS 1478—1992 and that meet the requirements of this Standard do not require re-assessment.

1.2 APPLICATION

This Standard shall not be interpreted as preventing the use of cementitious material other than portland and blended cements, such as ground-granulated iron blast furnace slag or pozzolana such as fly ash or silica fume.

1.3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

- | | |
|----------|---|
| 1012 | Methods of testing concrete |
| 1012.2 | Method 2: Preparation of concrete mixes in the laboratory |
| 1012.3.1 | Method 3.1: Determination of properties related to the consistency of concrete—Slump test |
| 1012.4 | Method 4: Determination of air content of freshly mixed concrete (all methods) |
| 1012.5 | Method 5: Determination of mass per unit volume of freshly mixed concrete |
| 1012.6 | Method 6: Method for the determination of bleeding of concrete |
| 1012.8.1 | Method 8.1: Method of making and curing concrete—Compression and indirect tensile test specimens |
| 1012.9 | Method 9: Determination of the compressive strength of concrete specimens |
| 1012.13 | Method 13: Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory |
| 1012.18 | Method 18: Determination of setting time of fresh concrete, mortar and grout by penetration resistance |
| 1152 | Specification for test sieves |

AS

- 1379 Specification and supply of concrete
- 2162 Verification and use of volumetric apparatus
- 2162.1 General—Volumetric glassware
- 2350 Methods of testing portland and blended cements
- 2350.2 Method 2: Chemical composition of portland cement
- 2758 Aggregates and rock for engineering purposes
- 2758.1 Concrete aggregates
- 3799 Liquid membrane-forming curing compounds for concrete
- 3972 Portland and blended cements

AS/NZS

- 2350.8 Method 8: Fineness index of portland and blended cement by air permeability

ACI

- 211.1 Standard practice for selecting proportions for normal, heavyweight, and mass concrete

ASTM

- C457 Standard Test Method for Microscopical Determination of Air-Void System in Hardened Concrete

1.4 DEFINITIONS

For the purpose of this Standard, the definitions below apply.

1.4.1 Acceptance testing**1.4.1.1 General acceptance testing**

Testing carried out to assess the performance of the admixture in accordance with this Standard.

1.4.1.2 Specific acceptance testing

Testing carried out to assess the performance of admixtures and mixes for specific work.

1.4.2 Admixture

A material other than water, aggregates, and cementitious materials, used as an ingredient in concrete, and added to the batch in controlled amounts immediately before or during its mixing to produce some desired modification to the properties of the concrete.

NOTE: For more information, see Paragraph B5.3, Appendix B.

1.4.3 Composite sample

A sample obtained by combining three or more grab samples from one lot.

1.4.4 Control mix

A batch of concrete mixed without the admixture under test.

1.4.5 Grab sample

A sample obtained in a single operation.

1.4.6 Lot

Quantity of admixture produced under essentially uniform conditions, usually a unit shipment or a single production quantity.

1.4.7 Test mix

A batch of concrete mix incorporating an admixture under test.

1.4.8 Uniformity testing

Testing carried out by the manufacturer to assess the chemical and physical uniformity of the admixture supplied.

1.5 TYPES AND SYMBOLS

The following admixtures, together with their type symbol, are provided for in this Standard:

<i>Admixture</i>	<i>Type symbol</i>
Air-entraining	AEA
Water-reducing	WR
Set-retarding	Re
Set-accelerating	Ac
Water-reducing and set-retarding	WRRe
Water-reducing and set-accelerating	WRAc
High range water-reducing	HWR
High range water-reducing and set-retarding	HWRRe
Medium-range WR, normal setting	MWR
Special purpose, normal setting	SN
Special purpose accelerating	SAC
Special purpose retarding	SRe

NOTES:

- 1 The various types of admixtures are described in detail in Appendix B.
- 2 Special purpose admixtures are admixtures having claimed performance attributes outside the range of this Standard. Such attributes include but are not restricted to anti-washout, air de-training and corrosion inhibiting. Compliance with the provisions of this Standard gives some assurance that the admixture does not have a detrimental effect on the concrete.

1.6 PACKAGING

An admixture shall be delivered in impermeable, clean, closed containers, which can not be attacked by the admixture.

1.7 INFORMATION TO BE SUPPLIED

The following shall be made available to the purchaser:

- (a) Name and type of admixture.
- (b) Compliance dose rate; i.e., the dose rate at which the material has been found to comply with the acceptance tests of this Standard, for the type of admixture indicated.
- (c) Recommended dose range.
- (d) The chemical composition, in the following forms:
 - (i) The chemical class of the principal active ingredient.
NOTE: A list of common classes is given in Appendix B.
 - (ii) Whether the admixture contains significant chloride ion and, if so, the chloride ion content of the admixture as supplied.

For the purpose of this Clause, an admixture shall be considered not to contain significant chlorides if the chloride ion content is not greater than 1.5 g chloride ion per litre of admixture, provided the admixture is used at a rate not greater than 2 L/m³ of concrete.

NOTE: Methods of determining chloride ion content in admixtures are given in Appendix C.

- (iii) Whether the admixture contains triethanolamine (TEA).

If the admixture contains TEA, it shall be stated that if the admixture is used at the compliance dose rate, then the proportion of TEA (expressed as percent TEA by mass of binder) shall not exceed one of the following levels:

(A) 0.025%.

(B) 0.050%.

NOTE: These are two levels that have been found to have an influence on the drying shrinkage of concrete.

- (e) A warning against using the admixture in conjunction with other admixtures except where specific test information is available.
- (f) The sequence of addition recommended by the manufacturer for use with the admixture.
- (g) Use-by date of the admixture.

1.8 MARKING

The following shall appear on the container in which an admixture is supplied, or shall accompany bulk supplies of an admixture:

- (a) Name and type of admixture (see Clause 1.5).
- (b) Recommended dose rate.
- (c) Use-by date of the admixture.
- (d) Manufacturer's reference number enabling the manufacturer to identify the material within the company's quality control records.

NOTE: Manufacturers making a statement of compliance with this Australian Standard on a product, packaging, or promotional material related to that product are advised to ensure that such compliance is capable of being verified.

SECTION 2 PROPERTIES OF ADMIXTURES

2.1 ADMIXTURES OTHER THAN AIR-ENTRAINING ADMIXTURES

2.1.1 General acceptance testing

General acceptance testing shall be carried out at the time of market introduction to assess the performance of admixtures in accordance with this Standard.

2.1.2 Requirements

After being tested in accordance with Section 4 by comparing a concrete mix containing the admixture with a control mix, concrete containing an admixture shall comply with the requirements of Table 2.1, and the following:

- (a) *Water content* The water content (in kilograms per cubic metre of fresh concrete) shall be calculated to the nearest 1 kg/m^3 . The net water content of the batch of concrete shall be determined as the mass of water in the batch in excess of that present as absorbed water in the aggregates and shall include the water content of the admixture. The mass per unit volume (in kilograms per cubic metre) and the volume of concrete (in cubic metres) in the batch shall be determined in accordance with Section 4.
- (b) *Strength* Concrete containing an admixture shall be tested for compressive strength at the ages of 3 days, 7 days, 28 days and 90 days.
Concrete containing admixture of Type HWR shall, in addition, be tested at the age of 1 day.
- (c) *Drying shrinkage* Drying shrinkage shall be determined for Type SN, SRe and SAc admixtures.
- (d) *Air content* Air content shall be determined and reported for both the control and test mixes.

2.1.3 Uniformity testing

In addition to the tests required in Clause 2.1.2, the manufacturer shall carry out appropriate tests on the lot of material that has been tested for acceptance. This testing shall be carried out in conjunction with the initial acceptance testing and for all subsequent batches of admixture. The manufacturer shall report the results of these tests and the test procedure used.

Uniformity tests shall include the following:

- (a) *Determination of pH value* Maximum variation at time of manufacture shall be ± 1.0 from the current value stated by the manufacturer.
NOTE: With admixtures manufactured at high pH (e.g. pH 9 to 11), the pH value tends to drift downwards with time. This change in pH does not affect the admixture performance.
- (b) *Determination of relative density* Maximum variation shall be ± 0.02 from the value stated by the manufacturer.
- (c) *Determination of non-volatile content* The acceptable range about the value declared by the manufacturer, (X%) shall be $(X \pm 2)\%$ for liquid admixtures and $(X \pm 3)\%$ for solid admixtures.
- (d) *Determination of chloride ion content* For admixtures containing purposeful addition of chloride, the acceptable range about the value declared by the manufacturer (Y%) shall be $\pm 10\%$ of Y. For other admixtures, values should be determined on composite samples at intervals of six months and reported.

2.2 AIR-ENTRAINING ADMIXTURES

2.2.1 General acceptance testing

General acceptance testing shall be carried out initially at the time of market introduction to assess the performance of air-entraining admixtures in accordance with this Standard.

2.2.2 Requirements

When tested in accordance with Section 4 by comparing a concrete mix containing the admixture with a control mix containing the reference admixture (see Clause 3.2.4), Type AEA admixture shall comply with the following:

- (a) *Bleeding* The bleeding of the concrete shall be computed as a percentage of the net mass of the mixing water in the concrete, the net mixing water being the water in excess of that present as absorbed water in the aggregates. The bleeding of concrete containing the admixture under test shall not exceed that of the control mix by more than 2% of the net mass of the mixing water.
- (b) *Time of setting* The initial and final times of setting of concrete containing the admixture under test shall not deviate from those of the control mix by more than 1 h.
- (c) *Compressive strength* Specimens for compressive strength testing shall be tested at 7 days, 28 days and 90 days.

The compressive strength, at any test age, of concrete containing the admixture under test shall not be less than 90% of that of the control mix at the same test age.

2.2.3 Uniformity testing

In addition to the tests required in Clause 2.2.2, the manufacturer shall carry out appropriate tests on the lot of air-entraining admixture that has been tested for acceptance. This testing shall be carried out in conjunction with the initial acceptance testing and for all subsequent batches of admixture. The manufacturer shall report the results of these tests.

Uniformity tests shall include the following:

- (a) *Determination of pH value* Maximum variation at time of manufacture shall be 1.0 from the current value stated by the manufacturer.
NOTE: With admixtures manufactured at high pH (e.g. pH 9 to 11), the pH value tends to drift downwards with time. This change in pH does not affect the admixture performance.
- (b) *Determination of relative density* Maximum variation shall be ± 0.01 from the value stated by the manufacturer.
- (c) *Determination of non-volatile content* The acceptable range about the value declared by the manufacturer (Z%) shall be $(Z \pm 1)\%$ for liquid admixtures.

TABLE 2.1
PHYSICAL REQUIREMENTS FOR CONCRETE CONTAINING ADMIXTURES

Physical requirements	WR	MWR	HWR	Re	WRR	HWR	Ac	WR	AEA	SN	SRe	S
Water content (max) as % of control	95	90	85	105	95	85	105	95	See Note 1	Report	Report	Report
Time of setting, allowable deviation from control, h (initial and final set)	±1	±1	±1	1 to 3 later	1 to 3 later	1 to 3 later	1 to 3 earlier	1 to 3 earlier	±1	±1	1 to 3 later	1 to 3 earlier
Compressive strength (min) as % of control at age:												
1 day	—	—	130	—	—	—	—	—	—	—	—	—
3 days	110	115	125	100	110	125	100	115	—	90	90	90
7 days	110	115	120	100	110	120	100	110	90	90	90	90
28 days	110	110	115	100	100	115	100	110	90	90	90	90
90 days	100	105	110	100	100	110	90	95	90	90	90	90
Drying shrinkage	See Note 4									Test and report		

NOTES:

- 1 Bleeding shall not exceed that of the control mix by more than 2% (Clause 2.2(a)).
- 2 Setting time shall be reported to the nearest 10 min in accordance with AS 1012.18.
- 3 Experience has shown that indirect tensile strengths of the order of 8% to 12% of compressive strengths may be expected.
- 4 Where required, drying shrinkage shall be tested and reported.

SECTION 3 GENERAL TEST REQUIREMENTS

3.1 SCOPE OF SECTION

This Section sets out the general test requirements for the laboratory testing of samples of materials proposed for use as chemical admixtures in concrete, both for general acceptance and for use in specific work.

NOTE: The performance of an admixture in concrete is influenced by the properties of the other materials used. It is recommended that trials for specific projects be conducted using these materials.

3.2 GENERAL ACCEPTANCE TESTS

3.2.1 General

For general acceptance tests, cement and aggregates selected for use in concrete shall be commercially available and commercially used materials. If any material is rejected for use in plain concrete, it shall be rejected for use in the evaluation tests of admixtures. Any material that interferes with the normal performance of an admixture shall also be rejected for evaluation tests.

3.2.2 Cement

Cement shall be Type GP in accordance with AS 3972. Cement used in any series of acceptance tests shall be taken from a single delivery.

In addition, the following shall be determined:

- (a) Sulfuric anhydride (SO_3), by the method in AS 2350.2.
- (b) Fineness, by the method in AS 2350.8.
- (c) Sodium oxide (Na_2O) and potassium oxide (K_2O).
- (d) Type and quantity of mineral additions.

3.2.3 Aggregates

3.2.3.1 General

Aggregates shall comply with AS 2758.1.

Fine and coarse aggregates used in any series of acceptance tests shall be taken from single lots of uniform materials. Where tests are made for specific work (in accordance with Clause 3.3), aggregates shall comply with Clauses 3.2.3.2 and 3.2.3.3, as appropriate.

3.2.3.2 Coarse aggregates

The coarse aggregate shall be produced from rock or gravel. The grading shall be that specified for graded coarse aggregate of 20 mm nominal size.

3.2.3.3 Fine aggregates

In tests for air-entraining admixtures only, the grading of the fine aggregate shall comply with Table 3.1.

3.2.4 Reference air-entraining admixture

Where an air-entraining admixture is required in a control mix, the reference admixture shall be a neutralized resin as an aqueous solution containing 12.5% solids.

NOTE: 'Neutralized Vinsol' resin, manufactured by Hercules Inc Wilmington, Delaware, USA, has been found to be suitable. No other suitable resins are known to exist or are readily available.

TABLE 3.1
GRADING REQUIREMENTS OF FINE
AGGREGATES
(For air-entraining admixtures only)

AS sieve*	% passing
4.75 mm	100
1.18 mm	65–75
300 µm	12–20
150 µm	2–5

* See AS 1152

3.3 SPECIFIC ACCEPTANCE TESTS FOR ADMIXTURES

When testing an admixture for use in specific work, the cement and aggregate shall be representative of those proposed for use in the work. The admixture shall be added in the same manner, at the same dose rate, and at the same time during the batching and mixing operations as on the job. The concrete shall be designed to have the same cement content and slump as that specified for the work.

NOTE: It is preferable to use the largest size aggregate and largest test specimens appropriate to the work in question. Wet screening should be avoided.

3.4 CONCRETE MIXES FOR GENERAL ACCEPTANCE TESTS

3.4.1 Number of batches and specimens

At least two separate batches of concrete containing the admixture under test and the same number of batches of the control mix shall be mixed. On any one day the number of controls prepared shall be the same as the number of test batches prepared with any one admixture.

Notwithstanding the above, a common control mix may be used when testing more than one admixture on the same day, provided that all admixtures are air-entraining admixtures or all admixtures are other than air entraining admixtures.

Specimens of the type and the numbers listed in Table 3.2 shall be made for each batch. For compressive strength, at least one specimen from each of two different batches shall be tested at each specified age.

TABLE 3.2
TYPES AND MINIMUM NUMBERS OF TESTS AND SPECIMENS

Test	Type of admixture (see Clause 1.5)	Minimum No. of specimens	
		Per batch	Total (control & test)
Slump	All	1	4
Air content	All	1	4
Bleeding	AEA	1	4
Time of setting	All	1	4
Water content	All except AEA	1	4
Compressive strength	AEA	4	16
	HWR	6	24
	Other	5	20
Drying shrinkage	Optional	3	12

3.4.2 Proportioning of concrete mixes

3.4.2.1 Method

Concrete for tests for general acceptance shall be proportioned on the basis of saturated surface-dry aggregates, using a recognized method of mix design such as ACI 211.1.

NOTE: When calculating proportions for the first trial control mix using the method given in ACI 211.1, the air content should be assumed as 1.5% for non-air-entrained concrete and 5.5% for air-entrained concrete.

3.4.2.2 Cement content

The cement content of the concrete shall be $300 \pm 15 \text{ kg/m}^3$. The cement content for the test mix shall not differ by more than 5 kg/m^3 from that of the control mix, after correction for yield.

3.4.2.3 Water content and slump

A concrete mix, whether used as a control or to contain the admixture under test, shall be suitable for consolidation by hand rodding, and shall not be prone to segregation.

The slump of all mixes shall be within the limit of $80 \pm 10 \text{ mm}$ and the difference between the average slump for control mix and average slump for test mix shall not exceed 10 mm. The specimen shall not shear during the slump test, and when the side of the specimen is tapped gently with the tamping rod after the slump measurement has been completed, the concrete shall gradually slump further and not fall apart.

The water content of the concrete shall be the minimum consistent with the slump requirements of this Standard.

For concrete containing the admixture under test, the proportion of fine aggregate to coarse aggregate shall be the same as for the control concrete. The minimum water content shall be achieved by adjustments in the amount of total aggregate only, while maintaining the yield and slump in the required ranges.

NOTE: Previous tests done to AS 1478—1992 are still valid.

3.4.2.4 Addition of admixture

The admixture under test shall be added to the test mix in the manner recommended by the manufacturer. The reference air-entraining admixture shall be added with the first increment of mixing water that is added to the mixer after the addition of cement. The order of addition shall not be altered within any test series and shall be reported.

3.4.3 Dose rate of admixture

Concrete mixes shall be prepared both with and without the admixture under test. The concrete without the admixture under test shall be referred to as the control mix. The dose rate shall be constant for each test mix and shall be as follows:

- (a) Admixtures to be tested for compliance with Clause 2.1 shall be applied at a dose rate necessary to comply with the requirements for water content, or time of setting as appropriate to the admixture type. For Special Purpose admixtures the dose rate shall be that claimed to provide concrete having the special property. The control mix shall be prepared without the addition of an admixture.
- (b) Admixtures to be tested for compliance with Clause 2.2 shall be applied at the dose rate necessary to produce an air content of $5.5 \pm 0.5\%$ in the test mix. The control mix shall contain sufficient of the reference air-entraining admixture to produce an air content of $5.5 \pm 0.5\%$.

SECTION 4 TEST METHODS

4.1 SCOPE OF SECTION

This Section sets out the methods for laboratory testing of the samples of materials proposed for use as chemical admixtures in concrete. The methods are both for general acceptance testing and for use in specific work. The tests are based on arbitrary stipulations, which makes possible highly standardized testing. They are not intended to simulate actual job conditions.

4.2 PREPARATION OF TEST SPECIMENS

Concrete containing the admixture under test and control concrete shall be machine-mixed in accordance with AS 1012.2.

4.3 TEST METHODS

4.3.1 Tests on freshly mixed concrete

Specimens of freshly mixed concrete shall be tested in accordance with the following methods:

- (a) *Slump* Slump shall be measured in accordance with AS 1012.3.1.
- (b) *Air content* Air content shall be determined in accordance with AS 1012.4 (all methods).
- (c) *Bleeding* The bleeding test shall be carried out in accordance with AS 1012.6.
- (d) *Time of setting* Time of setting shall be determined in accordance with AS 1012.18.
- (e) *Water content* The water content shall be calculated to the nearest 1 kg/m³ as follows:
 - (i) The net water content of the batch of concrete shall be determined as the mass of water in the batch in excess of the saturated surface dried condition in the aggregates and shall include the water content of the admixture.
 - (ii) The mass per unit volume (kilograms per cubic metre) and the volume of concrete (cubic metres) in the batch shall be determined in accordance with AS 1012.5.

4.3.2 Tests on hardened concrete

For tests on hardened concrete, specimens shall be made and tested in accordance with the following methods:

- (a) *Compressive strength* Specimens for compressive strength testing shall be made and cured in accordance with the methods specified for concrete sampled in a laboratory in accordance with AS 1012.8.1, and shall be tested in accordance with AS 1012.9.
- (b) *Drying shrinkage* When requested, specimens for drying shrinkage testing shall be made and tested in accordance with AS 1012.13.

4.4 TEST REPORT

The test report relating to a sample of admixture shall include the following:

- (a) *Admixture* —
 - (i) name of manufacturer, product name, lot number and type of admixture (see Clause 1.5);