

# International Admixture Standards

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## Abstract

*The term admixture is defined and European terminology is described. Then the position in ISO, which has not published any standards on admixtures, is reviewed. Next, the development and content of European Standards covering admixtures for concrete, mortar and grout is described. The first of these standards has recently been published and the status of other parts is given. European Standards covering the use of admixtures are listed. Finally, there is a brief review of American and British Standards for admixtures which are widely used around the world. © 1998 Elsevier Science Ltd. All rights reserved.*

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## INTRODUCTION

This paper describes the current position regarding standards for admixtures which are used internationally. It is not a comprehensive review of National Standards but does refer to Standards issued by ASTM and the British Standards Institution as these are widely used around the world.

## DEFINITIONS AND TERMINOLOGY

An admixture can be defined as a material added in small quantities, during the mixing process, to modify the properties of concrete, mortar or grout in the fresh and/or hardened state. Sometimes the quantity is limited to 5% by weight of cement but this limit may have to be relaxed for some materials such as sprayed concrete admixtures.

This definition excludes materials such as fly ash and granulated blast furnace slag which are sometimes known as mineral admixtures but in Europe are now included in the general term additions. Additions are defined as finely divided inorganic materials used in concrete in order to improve certain properties or to achieve special properties. This definition also encompasses silica fume.

Admixtures as defined above are sometimes described as chemical admixtures. This term is not normally used in Europe.

Additives is a term used in Europe to describe materials incorporated into cement during grinding of clinker.

## INTERNATIONAL STANDARDS

There are no International Standards (ISOs) for admixtures.

A draft document (ISO/DIS 7690 Definitions and Classification of Admixtures) was issued in 1982 but has not been progressed since then. This draft covered the following types and limited the quantity to 5% by weight of cement.

Plasticizing/water reducing	for concrete, mortar or grout
Air entraining admixtures	for concrete or mortar
Fluid repellent	for concrete, mortar or grout
Set accelerating	for concrete, mortar or grout
Hardening accelerating	for concrete, mortar or grout
Set retarding	for concrete, mortar or grout
Gas forming	for concrete or mortar
Foam forming	for concrete
Grouting	for grout
Colouring	for concrete, mortar or grout
Superplasticizing/high range	for concrete
water reducing	
Water retaining	to reduce bleeding
Bonding	for concrete or mortar
Corrosion inhibitor	for concrete or mortar

This work is the responsibility of ISO/TC71/SC1 which has recently had a change in

Secretariat to Israel Standards Institution. The sub-committee is now considering whether to adopt the European Standards (ENs) for admixtures as ISOs. Colouring materials are not normally described as admixtures; the term pigments is used in European, ASTM and British Standards.

Fluid repelling admixtures are more often known as waterproofing or water resisting admixtures.

Materials used to improve bond are typically polymer dispersions which have to be used in considerable excess of 5% by weight of cement for satisfactory results. For this reason they are not normally classified as admixtures.

## EUROPEAN STANDARDS

These are prepared by the Comité Européen de Normalisation (CEN) which currently comprises the National Standards Bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

Within CEN, admixture standards are being prepared by Sub-Committee 3 (SC3) admixtures of Technical Committee 104 (TC104) Concrete. Draft Standards are issued for an enquiry period and following action on the resulting comments a final version is prepared for the formal vote which involves weighted voting. A typical time from enquiry to formal vote is 18 months.

The texts of all draft standards (prENs) and adopted ENs are issued by CEN in English, French and German. After adoption they are published by the National Standards Bodies who may prepare translations into their national languages if these are different.

Standards completed and in preparation are as follows:

EN 934 — Admixtures for concrete, mortar and grout

Part 2: Admixtures for concrete; definitions, specifications and conformity criteria

Part 3: Admixtures for grout; definitions, specifications and conformity criteria

Part 4: Admixtures for masonry mortar; definitions, specifications and conformity criteria

Part 5: Admixtures for sprayed concrete; definitions, specifications and conformity criteria

Part 6: Sampling, quality control, marking and labelling

EN 480 — Admixtures for concrete, mortar and grout-Test methods

Part 1: Reference concrete and mortar for testing

Part 2: Determination of setting time

Part 4: Determination of bleeding of concrete

Part 5: Determination of capillary absorption

Part 6: Infrared analysis

Part 8: Determination of the conventional dry material content

Part 10: Determination of water soluble chloride content

Part 11: Determination of air void characteristics in hardened concrete

Part 12: Determination of the alkali content of admixtures

Part 13: Reference masonry mortar for testing mortar admixtures

EN 934 Part 1 and EN 480 Parts 3, 7 and 9 are missing from the above list as they have been discontinued.

The present position (October 1997) is:

EN 934-2	received positive formal vote
EN 934-3	awaiting issue for enquiry
EN 934-4	being prepared for formal vote
EN 934-5	being prepared for enquiry
EN 934-6	being prepared for formal vote
EN 480-1	received positive formal vote
EN 480-2	received positive formal vote and published
EN 480-4	received positive formal vote and published
EN 480-5	received positive formal vote and published
EN 480-6	received positive formal vote and published
EN 480-8	received positive formal vote and published
EN 480-10	received positive formal vote and published
EN 480-11	received positive formal vote
EN 480-12	received positive formal vote
EN 480-13	awaiting issue for enquiry

When adopted by formal vote the ENs are published by the National Standards Bodies. Within six months conflicting National Standards have to be withdrawn except where a package of Standards is being prepared. For concrete admixtures there is a package consisting of EN 934 Parts 2 and 6, EN 480 Parts 1–12 which will not be completed until EN 934-6 is adopted. During this period National and European Standards can co-exist.

The admixtures covered by ENs are:

## EN 934-2 — admixtures for concrete

- water reducing/plasticizing
- high range water reducing/superplasticizing
- water retaining
- air entraining
- set accelerating
- hardening accelerating
- set retarding
- water resisting

The following are to be covered by an amendment in preparation

- set retarding/water reducing/plasticizing
- set retarding/high range water reducing/superplasticizing
- set accelerating/water reducing/plasticizing

## EN 934-3 — admixtures for masonry mortar

- air entraining/plasticizing
- set retarding for long term retarded mortar

## EN 934-4 — admixtures for grout

- expanding
- non-expanding

## EN 934-5 — admixtures for sprayed concrete

- accelerating admixture
- sagging prevention admixture
- set control admixture
- bond improving admixture

A standard for pigments for use with Portland cement (EN 12878) is being prepared by CEN/TC298 Pigments, and this has just completed the enquiry stage. It includes dispersions as well as dry powders and may cover pigments mixed with admixtures.

The use of admixtures will be governed by a hierarchy of Standards as follows:

- |          |   |
|----------|---|
| EN 206   | Concrete — performance, production and conformity               |
| EN 998-2 | Specification for mortar for masonry — Part 2: masonry mortar   |
| EN 447   | Grout for prestressing tendons — specification for common grout |
| EN AAA   | Sprayed concrete  |

The status of these standards is:

- |          |                                |
|----------|--------------------------------|
| EN 206   | at enquiry                     |
| EN 998-2 | in preparation for formal vote |
| EN 447   | published 1996                 |
| EN AAA   | in preparation for enquiry     |

For all admixtures the standards include general requirements which typically include:

- effective component — by IR spectrum
- relative density
- conventional dry material content
- pH value
- effect on setting time at maximum recommend dosage
- chloride content
- sodium oxide equivalent content
- corrosion behaviour

No test for corrosion behaviour has yet been standardized and there are considerable problems on agreeing a procedure with acceptable repeatability and reproducibility.

In addition there are performance requirements specific to each type of admixture. Generally these include compressive strength and air content of reference concrete containing the admixture (test mix) compared with reference concrete without admixture (control mix) as well as requirements more specific to the action of the admixture.

For high range water reducing/superplasticizing admixtures there are also requirements for water reduction at constant consistence and increase in consistence plus retention of consistence at equal w/c ratio. For air entraining admixtures the spacing factor in hardened concrete has to be  $\leq 0.200$  mm at an air content of 4–6% by volume.

Unlike product standards EN 934-6 will impose the frequency of testing. This includes initial type testing and routine production control testing.

An outstanding issue is concrete admixtures outside the scope of EN 934-2. These include admixtures for semi-dry concrete and new technology materials such as corrosion inhibitors, underwater concrete admixtures and pumping aids. Their use will be constrained by EN 206 when it is adopted and EFCA is taking the initiative in resolving this potential problem.

It is not expected that EN 998-2 will be so restrictive towards the use of admixtures. This is partly because national practices relating to

mortar vary widely. In some countries retarded ready to use mortar predominates. In other countries dry mixed mortar to which water is added on site is the only material in use.

Pigments prepared as suspensions in water and granules, all containing surface active agents or admixtures, are referred to in prEN 12878 but the present draft does not include adequate evaluation of their effect on concrete and mortar.

## NATIONAL STANDARDS

ASTM and British Standards for admixtures are widely used internationally in the absence of ISOs.

These cover the following concrete admixtures:

Air entraining	ASTM 260	BS 5075: Part 2
Water reducing	ASTM 494	BS 5075: Part 1
High range water reducing	ASTM 494	BS 5075: Part 3
Retarding	ASTM 494	BS 5075: Part 1
Accelerating	ASTM 494	BS 5075: Part 1
Water reducing/retarding	ASTM 494	BS 5075: Part 1
Water reducing/accelerating	ASTM 494	BS 5075: Part 1
High range water reducing/retarding	ASTM 494	BS 5075: Part 3

Plasticizing for flowing concrete	ASTM 1017	BS 5075: Part 3
Plasticizing/retarding for flowing concrete	ASTM 1017	BS 5075: Part 3
Pigments	ASTM C979	BS 1014
Sprayed concrete admixture	ASTM C1141	

Generally these standards have similar performance requirements to the ENs but for air entraining admixtures they depend on freeze-thaw testing whereas EN 934-2 requires measurement of spacing factor.

## CONCLUSION

The main current development in admixture standards is the preparation of a hierarchy of European Standards. As these are new documents representing a consensus of national views some anomalies can be expected to be discovered which may necessitate amendment of the Standard. If adopted as ISO Standards they can be expected to be used widely around the world. Existing British Standards which are used extensively outside the UK will be replaced by BS ENs.