

CAA Guidelines
For establishing the suitability of
Viscosity Modifying Admixtures
for Self-Compacting concrete



**The sign of
Quality and
Established Suitability**



Foreword

These Guidelines have been prepared by the Technical Committee of the UK Cement Admixture Association (CAA).

The Guidelines are intended to establish the suitability of special purpose concrete admixtures used in the United Kingdom and that are not covered by BS EN 934-2 Admixtures for concrete, mortar and grout: Part 2 Concrete admixtures – Definitions, requirements, conformity, marking and labelling.

Introduction

This document only covers the requirements for viscosity modifying (Segregation reducing) admixtures for self-compacting concrete. The full guidelines can be found on www.admixtures.org.uk.

The full Guidelines cover seven categories of special purpose concrete admixtures that are in widespread use in the United Kingdom but are not covered by BS EN 934-2.

The requirements follow the format established by BS EN 934-2. However, for some of the admixtures there is no agreed laboratory test available to measure their effectiveness in relation to the primary function. In these cases the effectiveness is required to be agreed between the manufacturer and purchaser.

1 Scope

This document specifies definitions and requirements for viscosity modifying (Segregation reducing) admixtures in order to establish suitability for use in concrete complying with BS EN 206-1.

This document only covers viscosity modifying (Segregation reducing) admixtures for self-compacting concrete.

Provisions governing the practical application of admixtures in the production of concrete, i.e. requirements concerning composition, mixing, placing, curing etc. of concrete containing admixtures are not part of these guidelines.

2 Normative references

These Guidelines incorporate by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to these Guidelines only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

BS EN 206-1 *Concrete - Part 1: Specification, performance, production and conformity.*

BS EN 480-1 *Admixtures for concrete, mortar and grout - Test methods - Part 1: Reference concrete and reference mortar for testing.*

BS EN 480-2 *Admixtures for concrete, mortar and grout - Test methods - Part 2: Determination of setting time.*

BS EN 480-6 *Admixtures for concrete, mortar and grout - Test methods - Part 6: Infrared analysis.*

BS EN 480-8 *Admixtures for concrete, mortar and grout - Test methods - Part 8: Determination of the conventional dry material content.*

BS EN 480-10 *Admixtures for concrete, mortar and grout - Test methods - Part 10: Determination of the water soluble chloride content.*

BS EN 480-12 *Admixtures for concrete, mortar and grout - Test methods - Part 12: Determination of the alkali content of admixtures.*

BS EN 934-2: *Admixtures for concrete mortar and grout – Part 2: Concrete admixtures – Definitions, requirements, conformity, marking and labelling.*

BS EN 934-6: *Admixtures for concrete, mortar and grout - Part 6: Sampling, conformity control and evaluation of conformity.*

BS EN 12350-2 *Testing fresh concrete - Part 2: Slump test*

BS EN 12350-5 *Testing fresh concrete – Part 5: Flow table test*

BS EN 12350-6 *Testing fresh concrete – Part 6: Density*

BS EN 12350-7 *Testing fresh concrete - Part 7: Air content - Pressure method.*

BS EN 12390-1:2002 *Testing hardened concrete - Part 1: Shape, dimensions and other requirements for specimens and moulds.*

BS EN 12390-3:2002 *Testing hardened concrete - Part 3: Compressive strength of test specimens.*

BS EN 12620: 2002 *Aggregates for concrete.*

ISO 649-2 *Laboratory glassware - Density hydrometers for general purposes – Part 2: Test methods and use.*

ISO 4316 *Surface active agents - Determination of pH of aqueous solutions - Potentiometric method.*

3 Definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

3.1.1 General definitions

3.1.1.1

performance

ability of an admixture to be effective in its intended use without detrimental effects

3.1.1.2

compliance dosage

the dosage of an admixture, expressed as percent by mass of cement, stated by the manufacturer, which will meet the requirements of this standard. The compliance dosage is within the recommended range of dosage

3.1.1.3

recommended range of dosage

dosages between limits expressed as percent by mass of cement, which the manufacturer recommends for the product, based on experience in use.

NOTE The use of the recommended dosage does not imply that compliance with this standard will be met over the whole range. Trial tests should be carried out with the materials to be used on site to find the dosage necessary to achieve the required performance.

3.1.1.4

maximum recommended dosage

upper limit of the recommended range of dosage

3.1.1.5

reference concrete and mortar

concrete and mortar composition specified for testing admixtures for conformity with this standard.

3.1.1.6

primary function

a single function of a multifunction admixture designated by the manufacturer.

3.1.1.7

general requirements

characterise the admixture by physical and chemical measurements.

3.1.1.8

specific requirements

characterise the performance of the admixture in a cementitious mix .

3.1.2 Specific definitions

3.1.2.1

admixtures for concrete

materials added during the mixing process of concrete, in a quantity not normally exceeding 5% by mass of the cement content of the concrete to modify the properties of the mix in the fresh and / or hardened state.

3.1.2.2

segregation reducing admixture

admixture that modifies the mix viscosity to reduce segregation of concrete.

NOTE segregation reducing admixtures are often called viscosity modifying admixtures (VMA).

3.2 Symbols and abbreviations

FPC Factory production control

ITT Initial type testing

4 Requirements

4.1 General requirements

All the admixtures defined in these Guidelines shall conform to the general requirements in Table 1.

NOTE The requirements in these Guidelines assume that admixtures are uniformly dispersed in concrete; special attention should be given to the dispersion of powder admixtures.

Table 1 - General Requirements

No	Property	Test method	Requirements
1	Homogeneity	Visual	Homogeneous when used. Segregation shall not exceed the limit stated by the manufacturer
2	Colour	Visual	Uniform and similar to the description provided by the manufacturer
3	Effective component	BS EN 480-6 ^{a)}	IR spectra to show no significant change with respect to the effective components when compared to reference spectrum provided by the manufacturer
4	Relative density (for liquids only)	ISO 649-2 ^{a)}	$D \pm 0,03$ if $D > 1,10$ $D \pm 0,02$ if $D < 1,10$ where D is manufacturer's stated value
5	Conventional dry material content	BS EN 480-8 ^{a)}	$0,95 T \leq X < 1,05 T$ for $T \geq 20 \%$ $0,90T \leq X < 1,10T$ for $T < 20 \%$ T is manufacturer's stated value % by mass X is test result % by mass
6	pH value ^{c)}	ISO 4316 ^{a)}	Manufacturer's stated value ± 1 or within manufacturer's stated range
7	Effect on setting	BS EN 480-2	Report results at the compliance dosage in reference mortar with CEM 1 cement
8	Water soluble chloride (Cl ⁻)	BS EN 480-10	Either $\leq 0,10 \%$ by mass ^{b)} or not above the manufacturer's stated value
9	Alkali content (Na ₂ O equivalent)	BS EN 480-12	Not above the manufacturer's stated maximum
NOTES ^{a)} The manufacturer may recommend an alternative test method for both ITT and FPC. ^{b)} Where the chloride content is $\leq 0,10 \%$ by mass the admixture may be described as "chloride free". ^{c)} Liquid admixtures only.			

4.2 Information to be provided by the manufacturer

The following information shall be documented and provided on request by the manufacturer.

- Recommended range of dosage;
- limit of segregation for homogeneity;
- description of colour;
- relative density – liquids only;
- conventional dry material content;
- pH value;
- Report the setting time at the compliance dosage;
- maximum water soluble chloride content;
- maximum alkali content.

4.3 Requirements for specific types of admixture

The specific requirements of these guidelines cover performance in a cementitious mix where suitable laboratory tests are available.

Segregation reducing admixtures shall conform to the following specific requirements:

Table 2 – Specific requirements for segregation reducing admixtures
(at equal consistence)

No	Property	Reference concrete	Test method	Requirement
1	Segregation	reference concrete C.2	Annex C	Slump flow segregation width \leq 20 mm
2	Compressive strength	reference concrete C.2	BS EN 12390-3	At 7 and 28 days test mix \geq 90% of reference mix

5 Sampling

Sampling shall be in accordance with BS EN 934-6.

6 Conformity control

6.1 Initial type testing

Requirements for when ITT shall be performed are given in BS EN 934-6

The results of ITT shall be documented by the manufacturer and shall include the following:

- a) Manufacturers stated values for general requirements;
- b) actual general requirement test values obtained;
- c) any variation from the test method detailed in table 1;
- d) source and type of cement and aggregates for specific admixture tests;
- e) dosage of admixture used (compliance dosage);
- f) the control and test mix values for each test, (individual and average if applicable);
- g) the test result along side the requirement with a statement on compliance;
- h) date of testing.
- i) Any other information required by this and supporting standards.

6.2 Factory production control

Factory production control shall be in accordance with table 9 and BS EN 934-6.

7 Evaluation of conformity

Evaluation of conformity shall be in accordance with BS EN 934-6.

8 Marking and labelling

8.1 General

When admixtures for concrete are supplied in containers, they shall be clearly marked with the information listed in **8.2** and **8.3** of this standard. When the material is supplied into a bulk container at the point of delivery, the information in **8.2** shall be provided in writing at the time of delivery but can give reference to a separate sheet detailing the information required by **8.3**.

8.2 Designation and traceability

The following information shall be provided on the label or in writing at the point of delivery:

- a) The manufacturer's trade name for the admixture;
- b) the type of admixture, e.g. pumping aid;
- c) a code traceable to the admixture batch, production control records and retained sample.

8.3 Additional information

The following information shall be provided on the label or in writing.

- a) A summary of storage requirements;
- b) storage life including the words; this admixture shall not be taken to comply with this standard after DD MM YYYY;
- c) instructions for homogenisation before use, when necessary;
- d) the manufacturer's recommended range of dosage;
- e) the maximum water soluble chloride ion content;
- f) any special instructions for use;
- g) health and safety data.

Table 9 – Minimum frequency of test for FPC

Tests	Segregation reducing admixtures		
Homogeneity/colour	B		Numbers in this table indicate frequency of test per year spread according to production. If production is less frequent every batch has to be tested.
Relative density	B		
Conventional dry material content	B		
pH value	B		A means a test every 1000 t produced with a maximum of 3 tests per year and a minimum of once per year provided at least one batch of the product is produced.
Water soluble chloride	1		
Alkali content	1		
Washout			
Compressive strength	1		B means test every batch.
Shrinkage reduction			
Air content of fresh concrete	1		
Segregation	A	pH value is for liquid admixtures only.	
		NOTE Effective component (infra red analysis) and effect on setting time at compliance dosage only have to be included in ITT.	

Annex C: Determination of segregation in a concrete mix (Normative)

C.1 Principle

A reference concrete detailed in clause C.2 is produced at a slump of (120 ± 20) mm.

A control concrete is made at the same W/C ratio as the reference mix. The consistence of the control concrete is increased by the addition of a superplasticiser to a level where segregation of the coarse aggregate occurs.

A test concrete is made to the same mix as the control concrete and to which is added the segregation reducing admixture, followed if necessary by further superplasticiser to achieve a consistence equal or greater than that of the control mix.

C.2 Materials and Apparatus

Reference concrete mix to C.2.1
Superplasticiser complying with EN 934-2 T3.2
Slump test apparatus to BS EN 12350-2.
Slump Flow test apparatus to clause C5
Compressive strength moulds to BS EN 12390-1

C.2.1 Reference concrete mix

CEM 1 Cement	215 Kg/m ³
GGBS	215 kg/m ³
Sand	920 Kg/m ³
20 mm Crushed Aggregate	590 Kg/m ³
10 mm Crushed Aggregate	250 Kg/m ³

C.3 Test Procedure

Make a Reference concrete mix as detailed in clause C.2.1 with sufficient water to give a slump of (120 ± 20) mm. Record the slump and W/C ratio. Make 6 specimens for compressive strength testing, 3 at 7 and 3 at 28 days.

The control concrete is made at the same W/C ratio as the reference concrete. By the addition of a superplasticiser the consistence is increased to a level where segregation occurs. The slump flow and segregation width shall be measured in accordance with clause C.5. If the slump flow segregation width is less than 50 mm, the test shall be repeated, using additional superplasticiser to increased consistence*. Record the W/C ratio, slump flow and the slump flow segregation width.

*NOTE: if the slump flow segregation width is still less than 50 mm it may be necessary to repeat the reference mix, increasing the W/C ratio.

For the test concrete use the same mix as the control concrete but add the segregation reducing admixture. If necessary, add sufficient additional superplasticiser to give a slump flow equal to or greater than that of the control mix. The slump flow and segregation width shall be measured in accordance with clause C.5.

Record the W/C ratio, slump flow and the slump flow segregation width. Make 6 specimens for compressive strength testing, 3 at 7 and 3 at 28 days.

C.4 Test report

This shall include the following:

- a) Trade name, description and dosage of the segregation reducing admixture;
- b) Trade name, description and dosages of the superplasticising admixture;
- c) Reference mix: slump, water:cement ratio, hardened density and compressive strength;
- d) Control mix: slump flow, water:cement ratio, slump flow ring segregation width;
- e) Test mix: slump flow, water:cement ratio, slump flow segregation width, hardened density and compressive strength;

C.5 Segregation Measurement

C.5.1 Equipment

- slump cone conforming to EN 12350-2
- base plate of a flat, stiff non absorbing material, at least 800mm square,

C.5.2 Procedure for slump flow and segregation width

Moisten the base plate and inside of the slump cone.

Place the base plate on level stable ground and the slump cone centrally on the base plate. Hold down firmly.

Fill the cone with the concrete in one layer. Do not tamp, simply strike off the concrete level with the top of the cone.

Remove any surplus concrete from around the base of the cone.

Raise the cone smoothly and vertically, allowing the concrete to flow out freely.

Measure the final diameter of the concrete in two perpendicular directions.

Calculate the average of the two measured diameters. (This is the slump flow in mm SF_T).

Also record the diameter to the outer limit of coarse aggregate in two perpendicular directions.

Calculate the average of the two measured diameters. (This is the aggregate slump flow in mm SF_A).

The difference between the aggregate slump flow and the total slump flow average diameters is divided by two and recorded as the slump flow segregation width.

$$\text{Slump Flow Segregation Width} = \frac{SF_T - SF_A}{2}$$

