

KENYA STANDARD

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1st Edition

Admixtures for sprayed concrete

Part 5:

Definitions, requirements, conformity, marking and labelling.



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Admixtures for sprayed concrete

Part 5:

Definitions, requirements, conformity, marking and labelling

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Foreword

This Kenya Standard was prepared by the Concrete and concrete products Technical Committee under the guidance of the Standards Projects Committee, and it is in accordance with the procedures of the Kenya Bureau of Standards.

The KS 2770 consist of the following parts, under the general title *Admixtures for concrete, mortar and grout*

- *Part 1: Admixtures for concrete, mortar and grout — Common requirements*
- *Part 2: Concrete admixtures — Definitions, requirements, conformity, marking and labelling*
- *Part 3: Admixtures for masonry mortar — Definitions, requirements, conformity, marking and labelling*
- *Part 4: Admixtures for grout for prestressing tendons - Definitions, requirements, conformity, marking and labelling*
- *Part 6: Sampling, conformity control and evaluation of conformity.*

During the preparation of this standard, reference was made to the following document (s):

BS EN 934-5:2007 Admixtures for concrete, mortar and grout. Admixtures for sprayed concrete. Definitions, requirements, conformity, marking and labelling

Acknowledgement is hereby made for the assistance derived from this (these) source (s) |

This draft Standard is used with the standards of the KS 2769: 2017 series which comprises the test methods for admixtures. []

Admixtures for sprayed concrete

Part 5:

Definitions, requirements, conformity, marking and labelling.

1. Scope

This Standard defines and specifies requirements and conformity for admixtures specifically intended for use in sprayed concrete.

The types of admixtures covered are:

- set accelerating and non-alkaline set accelerating admixtures;
- consistence control admixtures;
- bond improving admixtures.

Provisions governing the practical application of these admixtures in the production of sprayed concrete are not part of this Standard.

2. Normative references

The following referenced documents referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies

KS EAS 148-1, Methods of testing cement — Part 1: Determination of strength

KS EAS 148-3, Methods of testing cement — Part 3: Determination of setting times and soundness

KS EAS 18-1, Cement Part 1: Composition, specifications and conformity criteria for common cements

KS 2769-1, Admixtures for concrete, mortar and grout — Test methods Part 1: Reference concrete and reference mortar for testing

KS 2769-2, Admixtures for concrete, mortar and grout Test methods — Part 2: Determination of setting time

KS 2769-6, Admixtures for concrete, mortar and grout Test methods — Part 6: Infrared analysis

KS 2769-8, Admixtures for concrete, mortar and grout Test methods — Part 8: Determination of the conventional dry material content

KS 2769-10, Admixtures for concrete, mortar and grout — Test methods — Part 10: Determination of water soluble chloride content

KS 2769-12, Admixtures for concrete, mortar and grout — Test methods — Part 12: Determination of the alkali content of admixtures

KS 2770-6:2001, Admixtures for concrete, mortar and grout Part 6: Sampling, conformity control and evaluation of conformity

EN 1542:1999, Products and systems for the protection and repair of concrete structures — Test methods — Measurement of bond strength by pull-off

KS ISO 1920-2:2016 Testing of concrete — Part 2: Properties of fresh concrete

KS ISO 1920-4:2005 Testing of concrete-Part 4:Strength of hardened concrete.

KS ISO 1158, Plastics Vinyl chloride homopolymers and copolymers — Determination of chlorine content (KS ISO 1158:1998)

KS ISO 758, Liquid chemical products for industrial use — Determination of density at 20 degrees C

KS ISO 4316, Surface active agents — Determination of pH of aqueous solutions — Potentiometric method

3. Terms and definitions

For the purposes of this Standard, the following terms and definitions apply

3.1. General definitions

3.1.1.

performance

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

3.1.2.

compliance dosage

dosage of an admixture, expressed in % by mass of cement, stated by the manufacturer, which will meet the requirements of this Standard

NOTE The compliance dosage should be within the recommended range of dosage.

3.1.3.

recommended range of dosage

dosages between limits expressed in % by mass of cement that the manufacturer recommends for the product based on experience on site

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 result.

3.1.4.

maximum recommended dosage

upper limit of the recommended range of dosage

3.1.5.

control mix

prescribed mix without admixture

3.1.6.

test mix

prescribed mix incorporating an admixture

3.2. Specific definitions

3.2.1.

sprayed concrete admixture

material added to the concrete mix before or during the spraying process, in a quantity not exceeding 5 % by mass of cement, except for sprayed concrete set accelerating admixture, where the dosage should not exceed 12 %, to modify the properties of the mix in the fresh and/or hardened state

3.2.2.

sprayed concrete set accelerating admixture

admixture to develop very early setting of the sprayed concrete differing from set accelerating admixtures as defined and specified in KS 2770-2

3.2.3.

non-alkaline sprayed concrete set accelerating admixture

sprayed concrete set accelerating admixture according to 3.2.2 with an alkali content (given as Na₂O⁻ equivalent) not exceeding 1.0 % by mass of the admixture

3.2.4.

consistence control admixture

admixture that retains consistency for a long period

NOTE This type of admixture is normally used in combination with a compatible sprayed concrete set accelerating admixture.

3.2.5.

bond improving admixture

admixture added to the concrete mix before or during the process of spraying and which improves the bond between the sprayed concrete layers and/or the substrate surface

4. Requirements

4.1. General requirements

All the admixtures defined in this Standard shall conform to the general requirements given in Table 1.

4.2. Specific requirements

Additional to the general requirements in 4.1, the admixtures defined in 3.2.1 to 3.2.5 shall conform to the following specific requirements:

Sprayed concrete set accelerating admixture Table 2

Non-alkaline sprayed concrete set accelerating admixture Table 2

Consistence control admixture Table 3

Bond improving admixture Table 4

These requirements shall be satisfied within the recommended range of dosage.

Table 1 — General requirements

	Property	Test method	Requirements
1	Homogeneity ^a	Visual	Homogeneous when used. Segregation shall not exceed the limit stated by the manufacturer.
2	Colours	Visual	Uniform and similar to the description declared by the manufacturer.
3	Effective component ^a	KS 2667-6 ^b	Infrared spectra to show no significant change with respect to the effective component when compared to reference spectrum provided by the manufacturer.

4	Relative density ^a	KS ISO 758	D ± 0.03 if D > 1.10 D ± 0.02 if D ≤ 1.10 Where D is the manufacturer's stated value of density.
5	Conventional dry material content ^a	KS 2667-8 ^c	0.95 T ≤ X < 1.05 T, if T ≥ 20 % 0.90 T ≤ 5 X < 1.10 T, if T < 20 % T is manufacturer's stated value % m/m.; X is test result % by mass on dry material content.
6	pH-Value ^a (only for liquid admixtures)	KS ISO 4316	Manufacturer's stated value ±1 or within manufacturer's stated range.
7	Total chlorine ^{a d}	KS ISO 1158 ^e	Either ≤ 0.10 % by mass and not above the manufacturer's stated range.
8	Water soluble chloride ^a	KS 2669-10	Either ≤ 0.10 % by mass ^h or not above the manufacturer's stated range.
9	Alkali content (Na ₂ O-equivalent) ^a	KS 2669-12	Not above the manufacturer's stated maximum. ≤ 1.0% by mass for non-alkaline sprayed concrete set accelerating admixture.
10	Corrosion behaviour	^{f g}	No corrosion promotion effects on steel embedded in concrete.

^a Manufacturer's stated value shall be provided in writing, to the user, on request.

^b If the method in KS 2669-6 is not suitable, the manufacturer shall recommend an alternative test method.

^c If the method in KS 2669-8 is not suitable, the manufacturer shall recommend an alternative test method.

^d If there is no significant difference between total chlorine content and water soluble chloride content, only the water soluble chloride content shall be determined in subsequent tests on the admixture involved.

^e The procedure in KS ISO 1158 shall be modified as follows:

- increase the sample size to 0.1 g of dry admixture;
- use silver nitrate and ammonium thiocyanate solutions 0.01 N.

^f For testing, cement CEM I with C₃A content less than 5 % by mass shall be used.

^g If admixtures are tested for corrosion behaviour, tests should be performed in accordance with KS 2669-14

^h Where the chloride content is ≤ 0.10 % by mass, the admixture may be described as "chloride free".

Table 2 — Specific requirements for sprayed concrete set acceleration and non-alkaline set acceleration admixtures at equal w/c ratio

	Property	Reference mortar	Test method	Requirements
1	Setting time	Reference mortar KS 2669-1 ^{a b}	KS 2669-2 ^c	Initial setting time ≤ 10 min Final setting time ≤ 60 min (average of three tests)
2	Compressive strength	Reference mortar KS 2669-1 ^{a de}	KS EAS 148-1	At 28 days: Compressive strength of test mix ≥ 75 % compressive strength of control mix or ≥ 90 % for non-alkaline accelerators. At 90 days: Compressive strength of test mix compressive ≥ strength of test mix at 28 days.

^a The w/c ratio shall be ≤ 0.50 and such that the test mix shall have the standard consistence defined in KS EAS 148-3 immediately prior to addition of the admixture.

^b In difference to KS 2669-1, the set accelerating admixture is added to a cement mortar of standard consistence, just before the end of the mixing time. Adding the admixture, mixing and filling the mould, without undue segregation or vibration, shall be completed in a time not exceeding 30 s.

^c The difference to KS 2669-2, the total mass of the moving parts of the Vicat shall be (300 ± 2) g.

^d All components of the mortar shall be conditioned to a temperature of (5 ± 1) °C. The test specimen shall be stored at (20 + 2) °C.

^e The set accelerating admixture is added to the mortar just before the end of the mixing time. The filling and compacting of the mould with the mortar shall then be completed as soon as possible.

Table 3 — Specific requirements for consistence control admixtures at equal consistence

	Property	Reference concrete	Test method	Requirements
1	Retention of consistence	Annex A	KS ISO 1920-2 (slump) or KS ISO 1920-2 (flow)	Control mix: Initial slump: 180 mm to 230 mm, or initial flow: 480 mm to 550 mm. 6 h after addition of the admixture, the consistence of the test mix shall be ≥ 80 % of the initial consistence of the test mix.
2	Compressive strength	Annex A	KS ISO 1920-4	At 28 days: Compressive strength of test mix ≥ strength of control mix

Table 4 — Specific requirements for bond improving admixtures at equal consistence

	Property	Reference concrete	Test method	Requirements
	Tensile bond strength	Annex B	Annex B	Tensile bond strength between layers at 28 days: test mix ≥ 125 % of control mix

2	Compressive Strength	Annex C	KS ISO 1920-4	At 28 days: Compressive strength of test mix \geq 80 % of compressive strength of control
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5. Sampling

Requirements for sampling are given in KS 2770-6.

6. Conformity control

Requirements for conformity control are given in KS 2770-6, 5.3 and 5.4. The frequency of testing in connection with the factory production control is given in Table 5.

Table 5 — Minimum frequency of test for factory production control

Tests	Set accelerating and non-alkaline set accelerating admixtures	Consistence control admixtures	Bond improving admixtures
Homogeneity, colour	B	B	B
Relative density (for liquids only)	B	B	B
Conventional dry material content	B	B	B
pH value (for liquids only)	B	B	B
Chloride content (Cl ⁻) ^a	4	4	4
Alkali content	2	2	2
Compressive strength at 28 days	1	1	1
Setting time	A	-	-
Retention of consistence	-	A	-
Tensile bond strength	-	-	A
Numbers in this table denote minimum frequency of test per year, spread according to production; if the Production is less frequent every batch has to be tested. A: means test for every 1 000 t but not more than 3 times a year B: means test each batch NOTE The effective component (infrared analysis) need not be included in the programme of factory production control. It has been included in initial type testing.			
^a Total chlorine content also has to be tested at this frequency if it is significantly different from the water soluble chloride content.			

7. Evaluation of conformity

Requirements for evaluation of conformity are given in KS 2770-6:2001, Clause 5.

8. Marking and labelling

8.1. General

When admixtures for sprayed concrete are supplied in containers they shall be clearly marked with the relevant information listed in 8.2 and 8.3. 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.

8.2. Designation of admixtures

Admixtures for sprayed concrete shall be designated by:

- name of type of admixture in English
- number of this Standard: KS 2770-5;
- code, to identify the type of admixture, consisting of the number of this Standard and the number of the table which gives the additional performance requirements for the particular type of admixture.

EXAMPLE Set accelerating admixture for sprayed concrete; KS 2770-5; T.2.

8.3. Additional information

- batch number and production plant;
- summary of storage requirements including any special requirements on storage life which shall be clearly marked, e.g.: This admixture shall not be taken to comply with KS 2770-5 after "date";
- instructions for use and any necessary safety precautions, e.g. if caustic, toxic or corrosive;
- manufacturer's recommended range of dosage;
- actions to be taken before use if segregation has occurred.

Annex A

(normative)

Reference concrete for testing consistence control admixture

A.1 General

The constituent materials and the preparation of the reference concrete shall be in accordance with the requirements of KS 2669-1 except as given in this annex below. The requirements for the consistence are given in Table 3. All tests shall be carried out at the same consistence.

A.2 Cement content

The cement content shall be 450 kg/m³.

A.3 Aggregates

The sieve curve for the aggregate is given in Table A.1.

Table A.1 — Aggregate for reference concrete

Sieve size mm	Percentage by mass passing the test sieve a ^b
8.0	100
4.0	73 to 100
2.0	55 to 90
1.0	37 to 72
0.5	22 to 50
0.25	11 to 26
0.125	4 to 12
0.063	<2

^a The range is selected to accommodate both crushed and uncrushed aggregate.
^b The variation in the quantity passing each sieve of the chosen grading for both mixes (control and test mix) shall not exceed ± 2.0 % by mass.

A.4 Consistence

Testing shall be carried out under standard laboratory conditions of (20 + 2) °C. The concrete shall be covered with a plastic sheet to prevent evaporation during the standing period. The initial consistence of the reference concrete shall be slump (180 mm to 230 mm) or flow (480 mm to 550 mm). This shall apply to both the test

and control mixes. The test mix only, shall be re-tested 6 h after mixing and shall have a consistence $\geq 80\%$ of the initial consistence of the test mix.

A.5 Compressive strength

Following the test for consistence, 6 h after adding the consistence control admixture, the test mix is returned to the mixer. After 60 s mixing the mixer is stopped and the concrete is placed in the compressive strength moulds. The concrete is cured in the moulds under standard laboratory conditions according to EN 12390-2 until it has fully set. It is then de-moulded and curing continued under standard laboratory conditions until the age when it is to be tested for compressive strength.

A control mix at equal consistence (see BA) is prepared at the same time as the test mix and placed in the compressive strength moulds immediately after mixing. The concrete is cured under normal laboratory conditions and tested for compressive strength at 28 days.

A.6 Test report

The test report shall include at least the following information:

- Cement:
 - a. manufacturer and factory;
 - b. type;
 - c. class of strength in accordance with KS EAS 18-1;

- Sprayed concrete bond improving admixture
 - d. Manufacturer:
 - e. type;
 - f. dosage;

- Tensile bond strength results rounded to 0.05 N/mm²
 - g. Individual by specimen type;
 - h. Average by specimen type;
 - i. Average test specimen failure as percentage of average control specimen failure strength.

Annex B (normative) Measurement of tensile bond strength

B.1 General

This test is intended for laboratory use only. Test and control concrete mixes are prepared and used to make the following test specimens each consisting of two layers:

- a) control concrete to control concrete;
- b) test concrete to test concrete.

The test procedure shall follow EN 1542 with the deviations shown in B.3.

B.2 Preparation of the control and test mix

The constituent materials and the preparation of the reference and test concrete shall be in accordance with the requirements of KS 2669-1 with deviations as follows:

- a) cement content 450 kg/m³;
- b) aggregates in accordance with Table A.1;
- c) consistence (60 to 80) mm slump or (380 to 420) mm flow.

B.3 Applying the concrete and storage of specimens

All components of the concrete, together with the moulds and tools used for preparing the mix and its application shall be located in the standard laboratory climate (EN 1542) for at least 24 h before use.

The base of the moulds can be of any suitable material but a concrete slab has been found most suitable. Mould sides to contain a uniform 40 mm thickness of concrete are attached to the base.

One mould shall be filled with control concrete and one with test concrete. The concrete shall be compacted by hand tamping, levelled and then finished with a single pass of a steel float. The specimens are then left, uncovered, in the standard laboratory climate.

After 24 h the mould is removed and the surfaces given just sufficient wire brushing to remove any laitance. Double height mould sides are then fitted so that a further layer of (30 to 40) mm of concrete can be added.

The control concrete mould shall be filled with a further batch of control concrete. The test concrete mould shall be filled with a further batch of test concrete. The concrete in both moulds shall be compacted by hand tamping, levelled and then finished with a steel float. The specimens are then left, uncovered, in the standard laboratory climate for 24 h before de-moulding. After de-moulding, the specimens are then left, uncovered, in the standard laboratory climate for a further 27 days.

B.4 Testing

The tests shall be carried out in accordance with EN 1542:1999, Clause 7, except that the drill shall pass through the top layer of concrete and approximately 20 mm into the first layer of concrete.

Five bond tests are performed on each test specimen.

B.5 Test report

The test report shall include the following information:

- Cement:
 - a. manufacturer and factory;
 - b. type;
 - c. class of strength (in accordance with KS EAS 18-1).

- Sprayed concrete bond improving admixture:
 - e. Manufacturer;
 - f. Type;
 - g. Dosage.

- Tensile bond strength results rounded to 0.05 N/mm²:
 - h. Individual by specimen type;
 - i. average by specimen type;
 - j. average test specimen failure as percentage of average control specimen failure strength.