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EAST AFRICAN STANDARD

Hydraulic road binders —Specifications

EAST AFRICAN COMMUNITY

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Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to achieve this objective, the Partner States in the Community through their National Bureaux of Standards, have established an East African Standards Committee.

The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

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Introduction

Depending on the local experience and the availability of products and materials, different binders are used for road bases and sub-bases, capping layers soil stabilization and soil improvement in this country. These include cements, building limes and road hydraulic binders presently defined in the other standards.

Hydraulic road binders are finished products, produced in a factory and supplied ready for use.

It should be noted that this standard caters for the manufacture and production of hydraulic road binders, which may include cements of strength classes not greater than 32.5 N/mm².

Hydraulic road binders – Composition, specifications and conformity criteria

1 Scope

This East African Standard applies to hydraulic road binders produced in a factory and supplied ready for use in road bases, sub-bases, capping layers, and soil stabilization or soil improvement.

It specifies the mechanical, physical and chemical requirements for hydraulic road binders, together with the conformity criteria and evaluation procedures to be applied by the manufacturer.

The stabilized road bases, sub-bases, capping layers, and soil stabilization or soil improvement by application of this hydraulic road binder shall comply with the requirements of BS 1924-1 *Stabilized materials for civil engineering purposes — Part 1: General requirements, sampling, sample preparation and tests on materials before stabilization* and BS 1924 -2 *Stabilized materials for civil engineering purposes — Part 2: Methods of tests for cement-stabilized and lime-stabilized materials*.

2 Normative references

The following standards contain provisions, which, through reference in this text constitute provisions of this standard. All standards are subject to revision and, since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this standard are encouraged to take steps to ensure the use of the most recent editions of the standard indicated below.

EAS 18-1 *Cement — Part 1: Composition, specification and conformity criteria for common cements*

EAS 18-2 *Cement — Part 2: Conformity evaluation*

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

EAS 148-2 *Methods of testing cement — Part 2: Chemical analysis of cement*

EAS 148-3 *Methods of testing cement — Part 3: Determination of setting time and soundness*

EAS 148-4 *Methods of testing cement — Part 4: Determination of the chloride, carbon dioxide and alkali content of cement*

EAS 148-5 *Methods of testing cement — Part 5: Pozzolanicity test for pozzolanic cements*

EAS 148-6 *Methods of testing cement — Part 6: Determination of fineness*

EAS 148-7 *Methods of testing cement — Part 7: Methods of taking and preparing samples of cement*

EN 413-1 *Masonry cement — Part 1: Specification*

EN 459-1 *Building lime — Part 1: Definitions specification and conformity criteria*

EN 459-2 *Building lime — Part 2: Test methods*

3 Definitions

For the purpose of this East African Standard, the following definitions apply:

3.1

autocontrol testing

continuous testing by the manufacturer of hydraulic road binder samples taken at the point(s) of release from the factory/depot.

3.2

control period

period of time fixed for assessment of a set of autocontrol test results production and dispatch identified for the evaluation of the autocontrol test results.

3.3

characteristic value

value of a required mechanical, physical or chemical property having a prescribed probability P_k of not being attained in a hypothetical unlimited test series. This value generally corresponds to a specific fractile of the assumed statistical distribution of the particular property.

3.4

allowable probability P_k of acceptance CR

For a given sampling plan, the probability of acceptance of a hydraulic road binder with a percentage of results outside the characteristic value equal to the probability P_k (see 3.3).

3.5

limit value

the value of the mechanical, physical or chemical property, which is not exceeded by a single test result.

3.6

factory

facility used by a manufacturer for the production of hydraulic road binders using equipment which is suitable for continuous mass production of hydraulic road binders including, in particular, equipment for adequate grinding and homogenisation and the necessary silo capacity for the storage and despatch of each cement produced. This equipment and the production control applied allow the control of production with sufficient accuracy to ensure that the requirements of the relevant product specification standards are met.

4 Hydraulic road binder

A hydraulic road binder, when mixed with water hardens both in air and under water and remains solid, even under water.

A hydraulic road binder is a factory produced hydraulic binder, supplied ready for use, having properties specifically suitable for road and rail bases and sub-bases, capping layers, soil stabilisation and soil improvement.

A hydraulic road binder shall consist of a powder made from a blend of different constituents and statistically homogeneous in composition. A high degree of uniformity in all hydraulic road binder properties shall be obtained through continuous mass production process.

NOTE Continuous production refers to the process, the definition of the product, its composition and properties but does not imply a 24 hour production.

Qualified and skilled personnel and the facilities to test, evaluate and adjust product quality are essential for producing hydraulic road binders included in this standard.

The manufacturing process and its control shall ensure that the composition of hydraulic road binders is kept within the limits of this standard.

5 Classification

The standard strength of a hydraulic road binder is the compressive strength determined in accordance with EAS 148-1 at 28 days.

Four classes of strength are covered in this Standard: class 5, class 12,5, class 22,5 and class 32,5, the minimum standard strength being taken as the criterion of classification.

NOTE The strength classes are incorporated to enable the manufacturer to control quality and are not related to performance in bound mixes.

For strength classes 22.5 and 32.5 a subclass E is defined by a minimum content of Portland cement clinker of 20% and an additional requirements for strength at 7 days

6 Constituents

6.1 Main Constituents

The main constituents of hydraulic road binder shall be selected from the following:

Constituents which conform to EAS 18-

1. Portland cement clinker (K) ;

Granulated blastfurnace slag (S) ;

Pozzolan materials; natural pozzolanas (P) and thermally activated clays and shales (Q)

Fly ash: siliceous fly ash (V) and calcareous fly ash (W) except that when used as a constituent of hydraulic road binders of classes 5: 12.5 and 22.5 the loss on ignition of the fly ash shall be 10,0% or less.

Burnt shale (T);

Limestone (L);

Limes which conform to ENV 459-1;

Unslaked calcareous fly ash (W) containing at least 15% reactive calcium oxide (CaO) to be used only as a constituent of hydraulic road binders of class 5 and 12.5.

NOTE Cements which conform to EAS 18 and masonry cements which conform to EN 413-1:1994 may be used in hydraulic road binder production providing that their constituents comply with the above requirements.

6.2 Minor additional constituents

Minor additional constituents may be added in proportion not exceeding 5% by mass. They are specially selected, inorganic natural mineral materials, inorganic mineral materials derived from the clinker production process or constituents as specified in 6.1 unless they are indicated as main constituents in the hydraulic road binder.

Minor additional constituents, after appropriate preparation and on the account of their particle size distribution, improve the physical properties of the hydraulic road binder (such as workability or water retention). They can be inert or have slightly hydraulic, latent hydraulic or pozzolanic properties. However, no requirements are set for them in this respect.

Minor additional constituents shall be correctly prepared, i.e. selected, homogenized, dried and comminuted depending on their state of production or delivery. They shall not increase the water demand of the hydraulic road binder appreciably or impair the resistance of the bound mixture to deterioration in any way.

6.3 Calcium sulphate

Calcium sulphate, gypsum, hemihydrate or anhydrite (natural or artificial) may be added to the other constituents of the hydraulic road binder during its manufacture.

6.4 Additives

Additives, for the purpose of this East African standard, are constituents not covered in 6.1 to 6.3, which are added to improve the manufacture or the properties of the hydraulic road binder. The total

quantity of additives should not exceed 1% by mass of the binder. If it does, the quantity shall be stated on the package and/or the delivery note.

Additives shall not impair the properties of the hydraulic road binder or those of the bound mixtures.

7 Requirements

7.1 Mechanical requirements

The compressive strength of hydraulic road binders shall be determined in accordance with EAS 148-1. The cement being replaced by the hydraulic road binder.

The prism shall be produced, stored and tested as specified in EAS 148-1, unless otherwise specified below.

The prism shall be removed from the mould 24 hours after preparation and then stored, pending the test, at a relative humidity of not less than 90%.

Should it not be possible to remove the prisms from the mould after 24h, it is permitted to remove them at a later age, and this age should be stated in the test report.

When using moist air storage boxes the prisms shall not be allowed to come into contact with the water poured into the boxes up to a level of about 10mm. The lid shall close tightly and any felt seals shall be kept damp.

Hydraulic road binders shall comply with the requirements of the table 1

Table 1 — Mechanical requirements

Strength class	Compressive strength, in N/mm ²		
	At 7 days	At 28 days	
5	-	≥ 5	≤ 15
12.5	-	≥ 12.5	≤ 32.5
22.5	-	≥ 22.5	≤ 42.5
22.5 E	≥ 10.0	≥ 22.5	≤ 42.5
32.5	-	≥ 32.5	≤ 52.5
32.5 E	≥ 16.0	≥ 32.5	≤ 52.5

NOTE 1 The criterion for assessing the acceptability of an alternative method of compaction (as permitted in EAS 148-1) shall be that the difference between the averages of the two sets of 20 test batches when tested at 28 days shall not exceed 1.5 N/mm². The use of the "D" value is not valid. In the event of a dispute the reference method shall be used.

NOTE 2 A loading rate of (400 ± 40) N/s shall be used when testing specimens of classes 5 and 12.5.

7.2 Physical requirements

7.2.1 Fineness

The fineness of hydraulic road binder shall be determined by sieving.

Sieving shall be carried out in accordance with EAS 148-6. For this test the sieve residues shall not exceed the value in table 2.

7.2.2 Initial setting time

The initial setting time, determined in accordance with EAS 148-3, shall not be less than the value in table 2.

7.2.3 Soundness

For all strength classes of hydraulic road binder, the expansion, determined in accordance with EAS 148-3 shall comply with the requirements of table 2.

Hydraulic road binders containing more than 4.0 % by mass of SO₃ shall, in addition, withstand the cold water test described in EN 459 -2 Clause 5.3.2.3. It shall be regarded as unsound if, following storage in water the two specimens have warping or gaping edge cracks either on their own or in conjunction with crazing.

Table 2 — Physical requirements

Fineness % residue by mass 90 µm	Initial setting time min	Final setting time hours	Soundness mm
≤ 15	≥ 120	≤ 10	≤ 10

7.3 Chemical requirements — Sulphate content

The sulphate content, expressed as the percentage of SO₃ by mass, and determined in accordance with EAS 148-2, clause 8, shall not exceed 4.0 %.

A sulphate content of up to 7.0% by mass is permitted for the following road binders, provided that they meet the requirements in 7.2.3.

Hydraulic road binders containing burnt shale or calcareous fly ash, only if greater part of the sulphate content comes from the main constituents.

Hydraulic road binders containing more than 80% by mass of granulated blast furnace slag.

7.4 Composition

7.4.1 Declaration of composition

The constituents of a hydraulic road binder, and their average proportion in the finished product, shall be recorded. When requested by the user, the manufacturer (see clause 8) shall declare them. The constituents to be declared shall be the main constituents' (6.1) and calcium sulphate (6.3) if sulphate (SO₃) content of the hydraulic road binder exceeds 4%.

NOTE Where the greater part of the sulphate (SO₃) content of the hydraulic road binder comes from the main constituents e.g. calcareous fly ash or burnt shale, the proportion of calcium sulphate is not declared.

7.4.2 Requirements

The composition of a hydraulic road binder shall meet, for all constituents taken individually, the values documented by the manufacturer and declared if requested (see 7.4.1 and clause 8) within absolute tolerances given in table 3.

The content of Portland cement clinker of hydraulic road binders 22.5 E and 32.5 E shall not be less than 20%.

Table 3 — Recorded composition and tolerances

Recorded proportion of a constituent ¹⁾	Absolute tolerance ¹⁾
> 20 %	± 10 %
6 % to 20 %	± 5 %

¹⁾ Values in percentage by mass of the hydraulic road binder

EXAMPLE: For a recorded composition of S 55, K 30, V10, the actual composition of the hydraulic road binder would be within the following limits:

S: 45 % to 65 %

K: 20 % to 40 %

V: 5 % to 15 %

8 Standard designation

Hydraulic road binders shall be identified on accompanying documents and, where relevant, on the packaging by a figure indicating the strength class. The letter “E” shall be added to the designation of those hydraulic road binders having a minimum Portland cement clinker content of 20%.

When the constituents of the hydraulic road binder and their average proportion are to be declared on request of the user (see 7.4.1), they shall be included in the designation using the symbol of each constituent (see 6.1 and 6.3). Where cements, masonry cements and limes are used as constituents, the part of their standard designation referring to the type is used as symbol.

NOTE Particular properties relevant to the intended use are not included in the standard designation, they may be declared on the delivery documents or packaging.

EXAMPLE 1:

A hydraulic road binder conforming to this Uganda standard, of strength class 22.5 is identified by:
Hydraulic road binder CD/UK/1/2005 HRB 22.5

EXAMPLE 2:

A hydraulic road binder conforming to this standard, of strength class 32.5 and containing at least 20 % Portland cement clinker, is identified by:
Hydraulic road binder CD/UK/1/2005 HRB 32.5 E

EXAMPLE 3:

A hydraulic road binder conforming to this standard, of strength class 12.5 and declared to be constituted of 55% granulated blast furnace slag, 25% siliceous fly ash and containing 15% calcium lime, is identified by: Hydraulic road binder CD/UK/1/2005 HRB 12,

S 55, V 25, CL 15

9 Conformity criteria

9.1 Introduction

Compliance of hydraulic road binder with the requirements of this Standard shall be continuously assessed on the basis of spot samples taken at the points of release after production according to EAS 148-7, and tested according to EAS 148 Parts, 1,2,3,4 and 6 as relevant. This clause presents the necessary basic definitions, specifies the conformity criteria to be applied including the evaluation procedures and specifies the conformity requirements including the minimum sampling frequencies for each property to be tested.

NOTE This standard does not deal with acceptance inspection at delivery. It is recommended that any acceptance at delivery of HRB hydraulic road binder should be at least in accordance with the conformity criteria specified in 9.2.3.

9.2 Conformity criteria and evaluation procedure

9.2.1 General

Conformity of hydraulic road binder with this standard is assumed if the conformity criteria specified in 9.2.2 and 9.2.3 are met.

9.2.2 Statistical conformity criteria

9.2.2.1 General

Conformity on the basis of continuous sampling shall be formulated in terms of a statistical criterion based on:

The required mechanical and chemical properties defined as characteristic value, as specified in clause 7 of this standard

The probability P_k on which the definition of the characteristic value is based, as specified in table 4.

The allowable probability of acceptance CR of hydraulic road binder not conforming to the requirements, as specified in table 4.

NOTE Conformity evaluation by a procedure based on a finite number of measurements can only produce approximate value for the proportion of results outside the characteristic value in a population. The bigger the sample, the better the approximation. The selected probability of acceptance CR controls the degree of approximation by the sampling plan.

Table 4 — Required values P_k and CR

	Mechanical requirements		Physical and chemical
	7 and 28 day strength (Lower limit)	28 day strength (Upper limit)	
Probability P_k , on which the definition of the characteristic value is based	5 %		10 %
Allowable probability of acceptance CR	5 %		

Conformance with the requirements of this East African standard shall be verified either by variables or attributes as described in 9.2.2.2 and 9.2.2.3.

Table 5 — Acceptability constant k_A

Number of test results n	$k_A^{1)}$	
	for $P_k = 5\%$ (lower strength property)	for $P_k = 10\%$ (other properties)
20 to 21	2.40	1.93
22 to 23	2.35	1.89
24 to 25	2.31	1.85
26 to 27	2.27	1.82
28 to 29	2.24	1.80
30 to 34	2.22	1.78
35 to 39	2.17	1.73
40 to 44	2.13	1.70
45 to 49	2.09	1.67
50 to 59	2.07	1.65
60 to 69	2.02	1.61
70 to 79	1.99	1.58
80 to 89	1.97	1.56
90 to 99	1.94	1.54
100 to 149	1.93	1.53
150 to 199	1.87	1.48
200 to 299	1.84	1.45
300 to 399	1.80	1.42
>400	1.78	1.40

Values given in this table are valid for CR= 5 %
¹⁾Values of k_A valid for each value of n may also be used

9.2.2.2 Inspection by variables

The conformity shall be evaluated on the totality of autocontrol test results obtained on all samples taken during the control period. For this calculation the test results are assumed to be normally distributed.

The conformity is verified when the following equation(s) is (are) satisfied:

$$x - k_A s \geq L \text{ and}$$

$$x + k_A s \leq U$$

where

\bar{x} is the arithmetic mean of the totality of the autocontrol test results in the control period;

s is the standard deviation of the totality of the autocontrol test results in the control period;

k_A is the acceptability constant;

L is the specified lower limit given in tables 1 and 2 referred to in 7.1 and 7.2;

U is the specified upper limit given in tables 1 and 2 and 3 referred to in clause 6.

The acceptability constant k_A depends on the probability P_K on which the definition of the characteristic value is based, and on the number n of the test results. Values of k_A are listed in table 5. The values of k_A listed in the table are valid for 5% probability of acceptance CR of hydraulic road binder not conforming to the requirements.

9.2.2.3 Inspection by attributes

The number of test results outside the characteristic value c_D out of a totality of autocontrol test results obtained on all samples taken during the control period shall be counted and compared with an estimated number c_A , calculated from the number n of autocontrol test results and the probability P_K as specified in table 4.

Conformity is verified when the following equation is satisfied

$$c_D \leq c_A$$

Values of c_A are listed in table 7. The values are valid for 5 % probability of acceptance CR of hydraulic road binder not conforming to the requirements.

Table 7 — Values of c_A

Number of test results n	c_A for $P_K = 10 \%$
Up to 39	0
40 to 54	1
55 to 69	2
70 to 84	3
85 to 99	4
100 to 109	5
Note 1 Values given in this Table are valid for CR = 5 %.	
Note 2 If the number of test results is $n < 20$ (for $P_K = 10 \%$) a statistically based conformity criterion is not possible. In this case c_A will always be 0	

9.2.3 Single result conformity criteria

In addition to the statistical conformity criteria, compliance of test results with the requirements of this standard requires that it shall be verified that each test result of the properties shown in table 7 remains within the limit values.

9.3 Conformity requirements

9.3.1 Mechanical, physical and chemical properties

The conformity requirements for the mechanical, physical and chemical properties are given in 9.2

Sampling shall take place at the point of release of the hydraulic road binder. The minimum testing frequencies and the statistical assessment procedure are specified in table 8 for each property to be tested.

9.3.2 Composition of the hydraulic road binder

The composition of the hydraulic road binders shall meet the requirements specified in 7.4 and table 3.

Suitable procedures during production to ensure compliance with these requirements should be applied and documented. At least once per month the composition of the hydraulic road binder shall be checked by an appropriate method, using a spot sample taken at the point of release of the hydraulic road binder.

Table 7 — Limit values for single results

Property		Limit values					
		Strength class					
		5	12.5	22.5	22.5 E	32.5	32.5 E
Strength	7 day	-	-	-	8.0	-	14.0
Lower limit (N/mm ²)	28 day	3.5	10.0	20,0	20.0	30.0	30.0
Sulphate content. SO ₃ by mass)	Upper limit (%)	5.0 ¹⁾					
Fineness	90 µm	17					
Upper limit (% residue)							
Initial setting time	105						
Lower limit (min)							
Soundness	10						
Upper limit (mm)							
Clinker content (Subclasses E only)	18						
Lower limit (%)							
¹⁾ A limit value of 8.0 % by mass of SO ₃ is appropriate for hydraulic road binders containing burnt shale, calcareous fly ash or more than 80% of granulated blast furnace slag (see 7.3).							

Table 8 — Minimum testing frequencies and statistical assessment procedure

Property	Number of samples	Statistical assessment by	
		Variables ¹⁾	Attributes ²⁾
Strength	1 per week	x	
Initial setting time	1 per week	x	
Fineness	1 per week		x
Soundness	1 per week		x
Sulphate content	1 per week		x
Composition	1 per week		x
¹⁾ If the data are not normally distributed, then the method of assessment may be decided on a case by case basis.			
²⁾ If the number of samples is at least 2 per week the assessment may be made by variables			

9.3.3 Required properties of the constituents of the hydraulic road binders

The constituents of the hydraulic road binder shall meet the requirements specified in clause 6. Suitable procedures during production to ensure compliance with this requirement should be applied and documented.

10 Marking, packaging, delivery, and storage

10.1 Marking

The hydraulic road binder shall be marked on the bag and on any certificate with the following particulars:

- (i) The manufacturer's name and/or trade mark

(ii) The type of hydraulic road binder, e.g. Hydraulic road binder EAS 424 HRB 32,5 E or Hydraulic road binder EAS 424 HRB 22,5 etc depending on the particular hydraulic road binder, with clear marking to distinguish it from other types of hydraulic road binder,(refer to clause 8)

(iii) Net weight in kilograms

(iv) An indication of the date of packing preferably in figures for date, month, year, e.g. figures 02-07-2002 for the date of manufacture of second July 2002

The number and date of this standard (see inside back cover for conditions for certification marking)

10.2 Packaging

The common packaging shall be paper bags holding 50 kg, 25kg, net weight or any other appropriate weight as stipulated in the Weight and Measures Act.

10.2.1 The material shall be weather resistant and constructed to assure safe delivery of the contents.

10.2.2 The container shall be sufficiently strong so as to withstand transportation and to permit storage in tiers at least 3 metres high without damage to the container or the contents.

10.2.3 Products may be shipped in containers agreed upon between the manufacturer and the purchaser.

10.3 Delivery

The hydraulic road binder when supplied in bags shall be packed in bags of 50 kg, or 25 kg, 10 kg net weight or any other appropriate weight as stipulated in the Weight and Measures Act.

10.4 Packages

Packages varying by more than 3 % from the specified mass may be rejected; and if the average mass of packages in any shipment, as shown by weighing 50 packages taken at random, is less than that specified, the entire shipment may be rejected.

10.5 Bulk Deliveries

For hydraulic road binder in bulk, the following information shall be included in the delivery notes:

- a) The manufacturer's name
- b) The type of hydraulic road binder, Hydraulic road binder HRB 32.5 E or Hydraulic road binder HRB 22.5 etc as indicated in clause 8 (refer to clause 8).
- c) Net weight of the bulk cement in kilograms
- d) Date and time of delivery
- e) Customer, order and consignee
- f) Registration number of the delivery vehicle

10.6 Storage

The hydraulic road binder shall be stored in a dry cool place in such a manner as to permit easy access for proper inspection and identification, and in a suitable waterproof building to protect the hydraulic road binder from dampness and to minimize warehouse deterioration.

Annex A (informative) Bibliography

- [1] EAS 18-1 *Cement — Part 1: Composition, specification and conformity criteria for common cements*
- [2] EAS 18-2 *Cement — Part 2: Conformity evaluation*
- [5] EAS 148-1 *Methods of testing cement — Part 1: Determination of strength*
- [6] EAS 148-2 *Methods of testing cement — Part 2: Chemical analysis of cement*
- [7] EAS 148-3 *Methods of testing cement — Part 3: Determination of setting time and soundness*
- [8] EAS 148-5 *Methods of testing cement — Part 5: Pozzolanicity test for pozzolanic cements*
- [9] EAS 148-6 *Methods of testing cement — Part 6: Determination of fineness*
- [10] EAS 148-7 *Methods of testing cement — Part 7: Methods of taking and preparing samples of cement*
- [11] EAS 148-4 *Methods of testing cement — Part 4: Determination of the chloride, carbon dioxide and alkali content of cement*
- [12] DD ENV 13282:2000, *Hydraulic road binders — Composition, specification and conformity criteria*

