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Draft  
Jamaican Standard  
Specification  
for  
**Blended hydraulic cements**

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**BUREAU OF STANDARDS JAMAICA**

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Draft Jamaican Standard

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**Specification**  
**for**  
**Blended hydraulic cements**

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Jamaican Standards establish requirements in relation to commodities, processes and practices, but do not purport to include all the necessary provisions of a contract.

The attention of those using this standard specification is called to the necessity of complying with any relevant legislation.

#### Amendments

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## Foreword

This standard is a revision of and supersedes JS 301: 2013.

This standard is compulsory.

## Committee representation

## Acknowledgement

Acknowledgement is to ASTM International and International Organization for Standardization (ISO) for permission to reproduce material from the standards listed below.

## Related Documents

This standard makes reference to the following:

- a) ASTM C 109/C 109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
- b) ASTM C 114, Test Methods for Chemical Analysis of Hydraulic Cement
- c) ASTM C 150, Specification for Portland Cement
- d) ASTM C 187, Test Method for Normal Consistency of Hydraulic Cement
- e) ASTM C 191, Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
- f) ASTM C 204, Test Method for Fineness of Hydraulic Cement by Air Permeability Apparatus
- g) ASTM C 219, Terminologies Relating to Hydraulic Cement
- h) ASTM C 227, Test Method for Potential Alkali Reactivity of Cement - Aggregate Combinations (Mortar-Bar Method)
- i) ASTM C 311, Test Methods for Sampling and Testing Fly Ash or Natural Pozzolan for use in Portland-Cement Concrete
- j) ASTM C 511, Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
- k) ASTM C 595, Standard Specifications for Blended Hydraulic Cements ASTM C 1157 Performance Specification for Hydraulic Cement
- l) BS EN 197-1, Composition, Specification and Conformity Criteria for Common Cements
- m) BS EN 196-1, Methods of Testing Cement - Part 1: Determination of Strength BS EN 196- 2 Methods of Testing Cement - Part 2: Chemical Analysis of Cement
- n) BS EN 196-3, Methods of Testing Cement - Part 3: Determination of Setting Time and Soundness

- o) BS EN 196-6, Methods of Testing Cement - Part 3: Determination of Fineness
- p) BS EN 196-21, Methods of Testing Cement - Part 21: Determination of chloride, carbon dioxide and alkali content of cement.
- q) CAN3-A362-M 83, Blended Hydraulic Cements CAN3-A5-M 83 - Portland Cements
- r) ISO 679, Methods of Testing Cement - Determination of Strength
- s) ISO 9597, Cements - Test Methods - Determination of Setting Times and Soundness JS 1: Part 1 The labelling of commodities. Part 1: General principles
- t) JS 1: Part 20, The labelling of commodities. Part 20: Labelling of pre-packaged goods
- u) JS 32, Jamaican Standard Specification for Portland cement (ordinary and rapid-hardening)
- v) JS 302, Jamaican Standard Chemical test methods for hydraulic cement
- w) JS 303, Jamaican Standard Physical test methods for hydraulic cement

# Draft Jamaican Standard Specification for Blended hydraulic cements

## 1 Scope

This standard specifies two classes of blended hydraulic cements for both general and specific applications, produced by blending blast furnace slag or pozzolan with Portland cement or Portland cement clinker.

## 2 Terms and definitions

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

### 2.1

#### **addition**

a material that is inter-ground or blended in limited amounts into a hydraulic cement during manufacture either as a 'processing addition' to aid in manufacture and handling of the cement or as a 'functional addition' to modify the properties of the cement.

### 2.2

#### **air entraining hydraulic cement**

hydraulic cement containing an air entraining addition in such amounts as to cause the product to entrain air in a mortar within specified limits.

### 2.3

#### **blast-furnace slag**

the non-metallic product of the blast furnace, produced in a molten state, and consisting of silicates and aluminosilicates of calcium and other bases.

### 2.4

#### **blended hydraulic cement**

hydraulic cement consisting of two or more inorganic constituents of which at least one constituent is not Portland cement or Portland cement clinker but which contribute to the strength gaining properties of the cement.

### 2.5

#### **equivalent alkali content (Na<sub>2</sub>O eq)**

total combined sodium and potassium oxides expressed as a percentage, calculated from analysis, by the formula:  $\text{Na}_2\text{O eq} = \% \text{Na}_2\text{O} + 0.658 \times \% \text{K}_2\text{O}$ .

### 2.6

#### **granulated blast furnace slag**

the glassy granular material formed when molten blast furnace slag is rapidly chilled, such as by immersion in water.

### 2.7

#### **hydration**

the chemical reaction between hydraulic cement and water, forming new chemical compounds, most of which have strength producing properties.

**2.8****hydraulic cement**

cement that sets and hardens by chemical reaction with water and that is capable of setting and hardening under water.

**2.9****main constituent**

specially selected inorganic material in a proportion exceeding 5.0 % by mass related to the sum of all additional constituents.

**2.10****minor additional constituent**

specially selected inorganic material used in a proportion not exceeding 5.0 % by mass related to the sum of all additional constituents.

**2.11****portland blast furnace slag cement**

hydraulic cement consisting of an intimately inter-ground mixture of Portland cement or Portland cement clinker and ground granulated blast furnace slag with the proportion of the slag constituent restricted within certain specified limits.

**2.12****portland cement**

hydraulic cement made by pulverizing Portland cement clinker, and which usually contains calcium sulphate.

**2.13****portland cement clinker**

clinker consisting predominantly of crystalline hydraulic calcium silicates.

**2.14****portland pozzolan cement**

hydraulic cement consisting of an intimate and uniform blend of Portland cement or Portland blast furnace slag cement and a finely ground pozzolan in which the proportion of the pozzolan constituent is kept within specified limits.

**2.15****pozzolan**

siliceous or siliceous and aluminous material which in itself possesses little or no cementitious property but which, in a finely divided form, will react chemically with calcium hydroxide in the presence of moisture at ordinary temperatures to produce compounds possessing cementitious properties.

**2.16****reactive calcium oxide/lime (CaO)**

that fraction of the calcium oxide content which under normal hardening conditions can form calcium silicate hydrates or calcium aluminate hydrates.

**2.17****reactive silica (SiO<sub>2</sub>)**

that fraction of the silica (silicon dioxide) which is soluble after treatment with hydrochloric acid (HCl aq.) and with boiling potassium hydroxide (KOH aq.) solution.

**2.18****strength class of cement**

the classification of cement determined by the compressive strength.

## 2.19

### vendor

the seller of cement whether or not he is a manufacturer of the cement.

## 3 Cement classification

### 3.1 Cement

**3.1.1** Cement is a hydraulic binder, i.e. a finely ground inorganic material, when mixed with water, forms a paste which sets and hardens by means of hydration reactions and processes and which after hardening, retains its strength and stability even under water.

**3.1.2** Cement conforming to this standard, shall, when appropriately batched and mixed with aggregate and water, be capable of producing concrete or mortar which retains its workability for a sufficient time and shall after defined periods attain specified strengths and also possess long term volume stability.

**3.1.3** Hydraulic hardening of cement conforming to this standard is primarily due to the hydration of calcium silicates but other chemical compounds (e.g. aluminates) may also participate in the hardening process. The sum of the proportions of reactive calcium oxide and reactive silica in such cement is usually at least 50 % by mass when the proportions are determined shall be in accordance with BS EN 196-2.

### 3.2 Type classification

This standard applies to the following types of blended cement shall be generally intended for use as indicated:

#### 3.2.1 Blended hydraulic cements for general concrete construction

Type PS(X) – Portland blast furnace slag cement Type PP(X) – Portland pozzolan cement

**NOTE:** The type classification SMP (slag modified Portland cement) and PMP (pozzolan modified Portland cement) have been discontinued and the type classifications PS and PP have been extended to include all cements which have been produced as a blend of Portland cement or Portland cement clinker with granulated blast furnace slag or pozzolan. The suffix (X) indicates the percentage of the blend which comprises blast furnace slag or pozzolan.

### 3.3 Special properties

#### 3.3.1 Air entraining cement

Air entraining cement, when required, shall be specified by adding the suffix;

(A) to any of the above types; e.g. PS(20)(A) refers to Portland blast furnace slag cement with 20 % slag and air entraining addition. The air entraining option shall be specified in combination with any other special property.

#### 3.3.2 Moderate sulphate resistance (MS) or Moderate heat of hydration (MH)

Moderate sulphate resistance (MS) or Moderate heat of hydration (MH), or both, when desired by the purchaser shall be specified by adding the suffix (MS) or (MH) to the type designation.

## 4 Constituent materials and manufacture

### 4.1 Portland cement clinker

**4.1.1** Portland cement clinker is a hydraulic material which usually consists of at least two thirds by mass of calcium silicates (tricalcium silicate and dicalcium silicate), the remainder consisting of aluminium and iron containing clinker phases and other compounds. The lime/silica ratio by mass ( $\text{CaO}/\text{SiO}_2$ ) is normally not less than 2.0. The magnesium oxide ( $\text{MgO}$ ) content shall not exceed 5.0 % by mass.

### 4.2 Granulated blast furnace slag

**4.2.1** Granulated blast furnace slag shall be the glassy granulated material formed when molten blast furnace slag is rapidly chilled by immersion in water and the mineral oxide composition is normally at least two thirds by mass of the sum of calcium oxide, magnesium oxide and silicon dioxide. The remainder contains aluminium oxide together with small amounts of other compounds. The ratio by mass  $(\text{CaO} + \text{MgO})/\text{SiO}_2$  shall exceed 1.0.

### 4.3 Pozzolanic materials

**4.3.1** Pozzolanic materials are natural siliceous or silico-aluminous materials which do not harden by themselves when mixed with water, but when finely ground and in the presence of water, they react chemically at normal ambient temperature with dissolved calcium hydroxide ( $\text{Ca}(\text{OH})_2$ ) to form the strength of developing hydrated compounds. Pozzolan consists essentially of reactive silicon dioxide ( $\text{SiO}_2$ ) and aluminium oxide ( $\text{Al}_2\text{O}_3$ ). The remainder contains iron oxide ( $\text{Fe}_2\text{O}_3$ ) and other oxides. The proportion of reactive calcium oxide is negligible. The reactive silicon dioxide content is normally not less than 25.0 % by mass.

**Note:** Pozzolanic material shall be properly and correctly chosen, homogenized, dried or heat treated, and ground, depending on their required state of production or delivery.

### 4.4 Slag cements

#### 4.4.1 Portland blast furnace slag cement. [Type PS(X)]

The Portland blast furnace slag cement shall consist of an intimate and uniform blend of Portland cement and granulated blast furnace slag in which the percentage of the slag constituent is less than 70 % and is calculated as a percentage of the mass of the blended cement. Such a mixture can be produced either by inter-grinding Portland cement clinker and granulated blast furnace slag, by blending Portland cement and finely ground granulated blast furnace slag, or by a combination of both inter-grinding and blending.

### 4.5 Pozzolanic cements

#### 4.5.1 Portland pozzolan cement [Type PP(X)]

Portland pozzolan cement shall be a hydraulic cement consisting of an intimate and uniform blend of Portland cement and finely ground pozzolan in which the percentage of the pozzolan constituent is less than 40 % and is calculated as a percentage of the mass of the blended cement. Such a mixture can be produced either by inter-grinding Portland cement clinker and pozzolan, by blending Portland cement and finely ground pozzolan, or a combination of both inter-grinding and blending.

**NOTE:** Intimate and uniform blends of two or more fine materials are difficult to achieve. The manufacturer or his representative shall therefore ensure that adequate equipment and controls are

provided and that the blending process is adequate. The purchaser shall also assure himself of the adequacy of the blending operation.

#### 4.6 Air entrainment

A suitable air entraining addition may be included in the composition of any of the types of cement specified in this standard. The determining factor in the use of air entraining additions shall be an addition to the proportion that enables the resulting cement mortar or concrete to comply with specified air content requirements.

## 5 Physical properties

### 5.1 Strength

For compliance with this standard, the compressive strength of the cement shall be determined on 40 mm x 40 mm x 160 mm mortar prism specimens, or on 50 mm mortar cube specimens in accordance with JS 303. Both the mortar prism and the mortar cube test methods shall be considered as Jamaican Standard reference test methods. In the event of a dispute, either method shall be applicable as per Table 1.

The strength shall also be determined on 100 mm concrete cubes in accordance with JS 303 provided that it is understood that:

- i) it does not constitute a standard reference test method;
- ii) the purchaser agrees to the use of this method.

**Table 1 — Application of reference test methods**

Method designation	Method	Application
Reference test method 1	40 mm x 40 mm x 160 mm mortar prism test method	All cements which are produced and or labelled to comply with a standard which uses the mortar prism test method as reference.
Reference test method 2	50 mm mortar cube test method	All cements which are produced and or labelled to comply with a standard which uses the 50 mm mortar cube test method as reference.

#### 5.1.1 50 mm Mortar cube test (reference test method 1)

Cement conforming to this standard shall have the minimum compressive strengths shown in Table 2 at the specified ages when tested in accordance with Clause 6 of JS 303: 2008.

**Table 2 — Compressive strength requirements (mortar cubes)**

Age (days)	3	7	28
Required strength (MPa)	13.0	20.0	25.0

**5.1.2 Mortar prism test (reference test method 2)**

Cement conforming to this standard shall have the minimum compressive strengths shown in Table 3 at the specified ages when tested in accordance with Clause 7 of JS 303: 2008.

**Table 3 — Compressive strength requirements (mortar prisms)**

Age(days)	3	7	28
Required strength (MPa)	13.0	20.0	25.0

**5.1.3 100 mm concrete cube test (alternative test method)**

Cement conforming to this standard shall have the minimum compressive strengths shown in Table 4 at the specified ages when tested in accordance with Clause 8 of JS 303: 2008.

**Table 4 — Compressive strength requirements (concrete cubes)**

Age (days)	3	7	28
Required strength (MPa)	10.4	17.3	27.6

**5.2 Setting****5.2.1 Normal consistency**

The normal consistency shall be determined in accordance with Clause 9 of JS 303: 2008.

**5.2.2 Setting times**

The time of setting when determined in accordance with Clause 9.5 of JS 303: 2008 shall be:

Initial set	--	not less than 45 minutes
Final set	--	not greater than 420 minutes.

**5.3 Expansion****5.3.1 Autoclave expansion (standard reference procedure)**

The autoclave expansion, when determined in accordance with Clause 9.6 of JS 303: 2008 shall be a maximum of 0.80 %.



### 5.3.2 Le Chatelier expansion (alternate procedure)

The Le Chatelier expansion when measured in accordance with Clause 9.7 of JS 303: 2008 shall be not greater than 10 mm.

### 5.4 Fineness

The specific surface ( $\text{m}^2.\text{kg}^{-1}$ ) when measured in accordance with Clause 5 (Blaine Method) of JS 303: 2008 shall not be less than  $280 \text{ m}^2.\text{kg}^{-1}$  and shall be reported on all physical test reports for compliance with this standard.

## 6 Chemical properties

Cement type specified shall conform to the applicable chemical requirements as outlined in Table 5. When the manufacturer is requested to state in writing, the chemical composition of the cement supplied, the composition of the supplied cement shall conform to that shown in the statement within the tolerances depicted in Table 6.

**Table 5 — Chemical requirements**

Property	Test reference	Cement type	Requirements
Loss on ignition	JS 302	PS(X)	3.0 % max. <sup>A</sup>
		PP(X)	5.0 % max.
Insoluble residue		PS(X)	1.0 % max
		PP(X)	-----.
Sulphate content (as SO <sub>3</sub> )		PS(X)	3.0 % max.
		PP(X)	4.0 % max.
Magnesium oxide (MgO)	PS	----	
	PP(X)	6.0 % max.	
Chloride content	All	0.10 % max.	
<sup>A</sup> Up to 5.0% is allowable in a cement in which calcareous minor addition is used.			

**Table 6 — Tolerances allowed between quoted composition and that determined from sampling and testing the supplied product**

Chemical component	Tolerance %
Silicon dioxide (SiO <sub>2</sub> )	±3
Aluminium oxide (Al <sub>2</sub> O <sub>3</sub> )	±2
Calcium oxide (CaO)	±3

## 7 Inspection

Upon request, the manufacturer shall provide facilities for:

- a) the purchaser or his agent to perform careful inspection and sampling of the finished product at the manufacturer's premises or at a mutually agreed location;

- b) inspectors to check the relative quantities, and the inter-grinding or blending operation in the production of the cement.

**Note:** The facilities for inter-grinding or blending shall be adequate to ensure compliance with this standard.

## 8 Rejection

- 8.1** Cement shall be rejected if it fails to meet any of the requirements of this standard applicable to that type of cement.
- 8.2** Cement kept in bulk storage for more than six months shall be re-sampled and retested and shall be rejected if it fails to meet any of the requirements of this standard applicable to that type of cement.
- 8.3** Any cement package with a mass of cement more than 2 % below the marked mass shall be rejected.
- 8.4** Any shipment in which the average mass of the packages, determined by taking the average of 50 randomly chosen packages, is less than the mass recorded on the packages shall be rejected.

## 9 Tests and manufacturers' certificates

- 9.1** A certificate of the source and composition, which is the essential constituents used in the manufacture of the finished cement.
- 9.2** A certificate stating the nature, amount and identity of all additions used in the preparation the cement.
- 9.3** A certificate that the amount of pozzolan [for cement types PP(X)] does not vary by more than 5% by mass of the finished cement from the stated percentage.
- 9.4** A certificate of compliance of the cement with this standard and including both percentage retained on the 45µm sieve and specific surface as measured by the method described in JS 303.
- 9.5** If the purchaser or his representative requires independent test, the samples shall, at the option of the purchaser or his representative, be taken before or immediately after delivery and the tests shall be carried out in accordance with this Jamaican Standard on the written instructions of the purchaser or his representative. If the vendor so desires, he or his representative shall be present at the sampling. The manufacturer shall supply, free of charge, the cement required for testing.
- 9.6** A certificate shall state the chemical analysis and compressive strength of the cement.

## 10 Packaging and marking

### 10.1 Packaging

When cement is delivered in packages, the words "Portland blast furnace slag" or "Portland pozzolan" as appropriate, the letter type of the cement including the value of X, the name and brand of the manufacturer, the standard to which the cement complies, and the mass of the cement contained in the package shall be plainly marked on each package. This information shall be provided in the accompanying documentation when the cement is delivered in bulk.

## **10.2 Marking**

**10.2.1** When the cement contains a functional addition, the type shall be plainly marked on each package or supplied in documentation for bulk cement.

**10.2.2** In addition, the packages of cement shall be marked, to comply with all other requirements of the Jamaican Standards JS 1 Part 1 and JS 1 Part 20.

**10.2.3** Information which satisfies the general principles outlined in JS 1 Part 1 shall be provided in the documentation for all cement delivered in bulk.

**10.2.4** All packages shall be of sound integrity and legibly labelled at the time of inspection.

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## **Standards Council**

The Standards Council is the controlling body of the Bureau of Standards Jamaica and is responsible for the policy and general administration of the Bureau.

The Council is appointed by the Minister in the manner provided for in the Standards Act, 1969. Using its powers in the Standards Act, the Council appoints committees for specified purposes.

The Standards Act, 1969 sets out the duties of the Council and the steps to be followed for the formulation of a standard.

### **Preparation of standards documents**

The following is an outline of the procedure which must be followed in the preparation of documents:

1. The preparation of standards documents is undertaken upon the Standard Council's authorisation. This may arise out of representation from national organisations or existing Bureau of Standards' Committees of Bureau staff. If the project is approved it is referred to the appropriate sectional committee or if none exists a new committee is formed, or the project is allotted to the Bureau's staff.
2. If necessary, when the final draft of a standard is ready, the Council authorises an approach to the Minister in order to obtain the formal concurrence of any other Minister who may be responsible for any area which the standard may affect.
3. The draft document is made available to the general public for comments. All interested parties, by means of a notice in the Press, are invited to comment. In addition, copies are forwarded to those known, interested in the subject.
4. The Committee considers all the comments received and recommends a final document to the Standards Council
5. The Standards Council recommends the document to the Minister for publication.
6. The Minister approves the recommendation of the Standards Council.
7. The declaration of the standard is gazetted and copies placed on sale.
8. On the recommendation of the Standards Council the Minister may declare a standard compulsory.
9. Amendments to and revisions of standards normally require the same procedure as is applied to the preparation of the original standard.

### **Overseas standards documents**

The Bureau of Standards Jamaica maintains a reference library which includes the standards of many overseas standards organisations. These standards can be inspected upon request.

The Bureau can supply on demand copies of standards produced by some national standards bodies and is the agency for the sale of standards produced by the International Organization for Standardization (ISO) members.

Application to use the reference library and to purchase Jamaican and other standards documents should be addressed to:

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