

User Guide for the Portland & Blended Cement Technical Committee

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Introduction:

Hydraulic cement is a powder that, when combined with water, sand & rock, forms one of the oldest & most ubiquitous construction materials known to man: concrete. As soon as it comes in contact with water, cement undergoes a chemical reaction called hydration, transforming the material from a powder into paste that binds sand & rock together, forming concrete.

Cements are generally grouped into two main categories (Portland cements & blended cements) depending on the materials used in production of the cement. Portland cements are produced by pulverizing clinker, a material consisting mostly of hydraulic calcium silicates, and usually adding one or more of the following: water, calcium sulfate, limestone (up to 5%), and other processing additions. Blended cements are produced by intergrinding or blending Portland cement clinker with a larger percentage of one or more source of fines.

Portland cements in the United States are evaluated as one of the following ten types defined in **ASTM C150 or AASHTO M 85: *Standard Specification for Portland Cement***:

- Type I – general use
- Type IA – general use & air entrainment
- Type II – moderate sulfate resistance
- Type IIA – moderate sulfate resistance & air entrainment
- Type II(MH) – moderate sulfate resistance & moderate heat of hydration
- Type II(MH)A – moderate sulfate resistance, moderate heat of hydration & air entrainment
- Type III – high early strength
- Type IIIA – high early strength & air entrainment
- Type IV – low heat of hydration
- Type V – high sulfate resistance

Blended cements in the United States are evaluated as one of four general types defined in **ASTM C595 or AASHTO M 240: *Standard Specification for Blended Hydraulic Cement***:

- Type IS – Portland blast-furnace slag cement
- Type IP – Portland-pozzolan cement

- Type IL – Portland-limestone cement
- Type IT – ternary blended cement

Under C595/M 240, cements may also be evaluated for the following special property designations:

- (A) - Air entraining cement
- (MH) – Moderate heat of hydration
- (MS) – Moderate sulfate resistance
- (HS) – High sulfate resistance
- (LH) – Low heat of hydration

Key Aspects of the Program:

This program was developed around the various existing DOT requirements for initial & continued approval/qualification of cements. Participating producers will submit mill samples of their products to NTPEP on a quarterly basis for a full physical and chemical analysis at one of three laboratories contracted by NTPEP. Additionally, this program will serve as a clearinghouse for the producer's own quality control plan & test results.

Terminology:

- Hydraulic cement: a cement that sets and hardens by chemical interaction with water and is capable of doing so underwater.
- Portland cement: a hydraulic cement produced by pulverizing clinker, consisting essentially of hydraulic calcium silicates, and usually containing one or more of the following:
 - Water,
 - Calcium sulfate,
 - Up to 5 percent limestone, and
 - Processing additions
- Type I cement: Portland cement for when the special properties for any other type are not required.
- Type IA cement: Air-entraining Portland cement for the same uses as Type I, where air entrainment is desired.
- Type II cement: Portland cement for general use, more especially when moderate sulfate resistance is desired.
- Type IIA cement: Air-entraining cement for the same uses as Type II, where air entrainment is desired.
- Type I/II cement: Portland cement meeting the requirements for both Type I and Type II.
- Type II(MH) cement: Portland cement for general use, more especially when moderate heat of hydration and moderate sulfate resistance are desired
- Type II(MH)A cement: Air-entraining cement for the same uses as Type II(MH), where air entrainment is desired.
- Type III cement: Portland cement for use when high early strength is desired

- Type IIIA cement: Air-entraining cement for the same use as Type III, where air entrainment is desired
- Type IV cement: Portland cement for use when low heat of hydration is desired
- Type V cement: Portland cement for use when high sulfate resistance is required.
- Binary blended cement: A hydraulic cement consisting of an intimate and uniform blend produced by intergrinding and blending Portland cement clinker or Portland cement with a pozzolan, a slag, or a limestone.
- Type IS (Portland blast-furnace slag) cement: a hydraulic blended cement, in which the slag constituent is up to 95 percent slag cement.
- Type IS(A) (air entraining Portland blast-furnace slag) cement: Portland blast-furnace slag cement to which sufficient air-entraining addition has been added.
- Type IP (Portland-pozzolan) cement: a hydraulic blended cement, in which the pozzolan constituent is up to 40 percent by mass of the blended cement.
- Type IP(A) (air entraining Portland-pozzolan cement): Portland-pozzolan cement to which sufficient air-entraining addition has been added.
- Type IL (Portland-limestone cement): a hydraulic blended cement in which the limestone content is at least 5 percent but less than or equal to 15 percent by mass of the blended cement.
- Type IL(A) (air entraining Portland-limestone) cement: Portland-limestone cement to which sufficient air-entraining addition has been added.
- Type IT (ternary) cement: A hydraulic cement consisting of an intimate and uniform blend produced by intergrinding and blending Portland cement clinker or Portland cement with (1) two different pozzolans, (2) a slag and a pozzolan, (3) a pozzolan and a limestone, or (4) a slag and a limestone. Ternary blended cement Type IT($S \geq 70$) shall have a maximum limestone content of 15 percent by mass and is permitted to contain hydrated lime. All other ternary blended cements shall have a maximum pozzolan content of 40 percent by mass of the blended cement, and the total content of pozzolan, limestone, and slag shall be less than 70 percent by mass of the blended cement.
- Physical Analysis: testing for compliance with all required parameters of ASTM C150/AASHTO M 85 for Portland cement and ASTM C595/AASHTO M 240 for blended cement; and any optional parameters found in these specifications, when specified by the producer.
- Chemical Analysis: performing all the analyses found in **ASTM C114/AASHTO T 105**, *Standard Method of Test for Chemical Analysis of Hydraulic Cement*, for compliance with all required parameters of ASTM C150/AASHTO M 85 for Portland cement and ASTM C595/AASHTO M 240 for blended cement; and any optional parameters found in these specifications, when specified by the producer.

Review of Evaluations and Significance of Data Generated:

The data and information generated from this program are meant to guide DOTs in evaluating the quality of cement leaving the mills. It is not intended for results from this program to take the place of any project-level sampling and testing. In accordance with the approved work plan, all test results and documents are reviewed by the Lead State prior to publishing on Datamine.

