



Designation: C1709 – 22

Standard Guide for Evaluation of Alternative Supplementary Cementitious Materials (ASCM) for Use in Concrete¹

This standard is issued under the fixed designation C1709; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This guide is intended to provide a technical approach to the evaluation of alternative supplementary cementitious materials such as pozzolans and hydraulic materials that fall outside the scope of Specifications C618, C989/C989M, C1240, and C1866/C1866M. This guide provides the initial steps for a comprehensive evaluation of an ASCM that provides due diligence for its specific intended uses in concrete; however, it does not evaluate conformance to all possible performance criteria for all types of concrete mixtures.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 Performing the tests or meeting the test limits in this guide should not imply that the material tested meets the requirements of Specifications C618, C989/C989M, C1240, and C1866/C1866M. These materials should not be represented as such and each specific source is to be evaluated separately.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C78/C78M Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
- C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens)
- C114 Test Methods for Chemical Analysis of Hydraulic Cement
- C125 Terminology Relating to Concrete and Concrete Aggregates
- C138/C138M Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
- C143/C143M Test Method for Slump of Hydraulic-Cement Concrete
- C157/C157M Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
- C186 Test Method for Heat of Hydration of Hydraulic Cement (Withdrawn 2019)³
- C204 Test Methods for Fineness of Hydraulic Cement by Air-Permeability Apparatus
- C231/C231M Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- C232/C232M Test Method for Bleeding of Concrete
- C311/C311M Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
- C403/C403M Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

¹ This guide is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.24 on Supplementary Cementitious Materials.

Current edition approved Oct. 1, 2022. Published February 2023. Originally approved in 2011. Last previous edition approved in 2018 as C1709–18. DOI: 10.1520/C1709-22.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.

*A Summary of Changes section appears at the end of this standard

- C430** Test Method for Fineness of Hydraulic Cement by the 45- μ m (No. 325) Sieve
- C457/C457M** Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete
- C469/C469M** Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression
- C618** Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- C666/C666M** Test Method for Resistance of Concrete to Rapid Freezing and Thawing
- C672/C672M** Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals (Withdrawn 2021)³
- C989/C989M** Specification for Slag Cement for Use in Concrete and Mortars
- C1012/C1012M** Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution
- C1064/C1064M** Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
- C1202** Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
- C1218/C1218M** Test Method for Water-Soluble Chloride in Mortar and Concrete
- C1240** Specification for Silica Fume Used in Cementitious Mixtures
- C1293** Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
- C1543** Test Method for Determining the Penetration of Chloride Ion into Concrete by Ponding (Withdrawn 2019)³
- C1556** Test Method for Determining the Apparent Chloride Diffusion Coefficient of Cementitious Mixtures by Bulk Diffusion
- C1567** Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
- C1585** Test Method for Measurement of Rate of Absorption of Water by Hydraulic-Cement Concretes
- C1679** Practice for Measuring Hydration Kinetics of Hydraulic Cementitious Mixtures Using Isothermal Calorimetry
- C1702** Test Method for Measurement of Heat of Hydration of Hydraulic Cementitious Materials Using Isothermal Conduction Calorimetry
- C1866/C1866M** Specification for Ground-Glass Pozzolan for Use in Concrete
- D3987** Practice for Shake Extraction of Solid Waste with Water
- D4326** Test Method for Major and Minor Elements in Coal Ash By X-Ray Fluorescence

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this guide, refer to Terminology **C125**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *alternative supplementary cementitious materials (ASCM)*, *n*—inorganic materials that react pozzolanically or hydraulically, and beneficially contribute to the strength, durability, workability, or other characteristics of concrete, and does not meet Specifications **C618**, **C989/C989M**, **C1240**, and **C1866/C1866M**.

4. Significance and Use

4.1 Supplementary cementitious materials (SCM) covered under existing ASTM specifications are fly ash, slag cement, raw and calcined natural pozzolans including calcined clays, silica fume, and ground-glass pozzolan. The use of these materials, and limits established in existing specifications, are based on data obtained from research programs, field testing, and long term performance monitoring. Performance of SCM in specific concrete mixtures is commonly verified through preconstruction testing. This guide provides an approach to assessing the properties of materials that are not covered under existing specifications, and for assessing the performance of those materials in concrete.

4.2 If an ASCM does not yet have a significant record of performance in concrete, a comprehensive evaluation based on this Guide should be undertaken, and it should be recognized that this ASCM might be introduced for a specific project or into a limited marketplace to initially demonstrate its performance. The user should bear in mind the intended end use of the ASCM and use appropriate test methods to establish its suitability. An ASCM that demonstrates good performance through a comprehensive evaluation as outlined in this guide could then be considered to have access to broader markets and could be considered for inclusion in an ASTM standard for SCM. For this reason, the test program to demonstrate acceptable performance should include concrete mixtures with a range of characteristics specific to the ASCM's intended use.

4.3 In the absence of long-term durability or acceptable field performance, prospective users are advised to apply appropriate risk management and engineering practice in the use of an ASCM.

5. Evaluation Program

5.1 *Classification of Materials*—The performance of the evaluated ASCM should be compared to that of one of the existing types of SCM as listed in **1.1**. The ASCM should not be classified as being a variant of, or equivalent to, an existing type of SCM. The material should be described as an “alternative supplementary cementitious material (ASCM).” The process that is responsible for generating the ASCM should be indicated on any reports such that any significant variations in that process would be noted when it occurs.

5.2 Evaluation of the Material:

5.2.1 *General*—Evaluate the ASCM in a comprehensive laboratory test program followed by field trials. A sample of the ASCM used for this evaluation should be representative of its source. A phased program suitable for many types of ASCMs is as follows:

Stage I—Characterization of the Material

Stage II—Determination of Suitable Fineness