

Significant Recent Revisions to Cement and Concrete Standards

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Within the United States, ASTM International and the American Association of State Highway Transportation Officials (AASHTO) are the primary standards development organizations (SDOs) that publish cement and concrete material specifications, test methods, practices, and guides. These standards are invoked by reference in ACI standards, such as ACI CODE-318¹ and ACI SPEC-301.² They are also discussed in important guides such as ACI PRC-201.2, “Durable Concrete—Guide,”³ and they establish the basis for ACI and other certification programs for testing technicians. Material specifications play an important role in facilitating commerce. Development of these standards enables purchasers and manufacturers (as well as suppliers) to establish consensus-based requirements for products.

As the concrete industry evolves and innovates, standards must keep pace. Recent innovation supporting sustainability targets and a push towards performance-oriented specification and design practices have been key drivers for standards changes. There are also substantial benefits to manufacturers, users, and suppliers when standards for materials developed by different SDOs have consistent requirements. This article presents a summary of significant changes that have been incorporated in relevant standards, and it summarizes the reasons for these changes. Given that blended cements accounted for about 65% of total cement shipments in the United States in 2025,⁴ attention is given to updates to ASTM C595/C595M, “Standard Specification for Blended Hydraulic Cements,”⁵ and its AASHTO equivalent, M 240M/M 240, “Standard Specification for Blended Hydraulic Cement.”⁶

The authors are actively involved in ASTM Committees C01, Cement, and C09, Concrete and Concrete Aggregates, and they are (nonvoting) participants of the AASHTO Committee on Materials and Pavements. Further, they participate in the AASHTO-ASTM Joint Task Group on Harmonization of Cement Specifications, a group established in the early 2000s to minimize differences and harmonize requirements across companion specifications for cements. The

Task Group evaluates, revises, and endorses proposed changes before moving these proposals forward to the respective ASTM and AASHTO subcommittees for formal balloting. Since its inception, this process has facilitated approval of most proposed revisions that it has endorsed. Another task group is working on harmonizing specifications for supplementary cementitious materials (SCMs) across ASTM and AASHTO.

Manufacturers and suppliers of cementitious materials must publish a document demonstrating compliance with compositional and testing requirements provided in each relevant specification. While this document is often referred to as a mill test report, several different terms are currently used for it (for example, “manufacturer’s certification,” “manufacturer’s report,” and “manufacturer’s statement”), even within the same standard. A broader effort is underway to standardize on the term “Supplier’s Certification” for all ASTM cementitious material specifications.

Blended Cement Specifications

Blended cements include constituents of portland cement clinker, pozzolan such as coal ash, granulated blast-furnace slag or slag cement, and limestone, which are interground or blended to produce a uniform finished product. ASTM C595/C595M and AASHTO M 240M/M 240 specifications impose limits on the quantity of the blending constituents. Blended cement type designations are followed by “(X)...” indicating the target percentage of the blended material. For example, Type IL(10) has a target quantity of 10% limestone. Cements with more than one constituent have “(AX)(BY)” in their designation, with “A” and “B” denoting the blend constituent (“P” for pozzolan, “S” for slag cement, and “L” for limestone) and “Y” denoting the target quantity of the second constituent. The 2026 editions of ASTM C595/C595M and AASHTO M 240M/M 240 include significant revisions of these limits.

Compositional limits

Previously, limestone was not a permitted constituent of Type IP (portland-pozzolan) and Type IS (portland-blast-

furnace slag) cements. Type IT (ternary blended) cement, however, was permitted to contain up to 15% limestone and one SCM, or two SCMs and no limestone. Types IP and IS cements are now permitted to contain up to 15% limestone in addition to a pozzolan or slag, respectively. In the context of blended cement standards, “slag” is a pre-ground slag cement or granulated blast-furnace slag that is interground with the other constituents. Type IT (ternary blended cement) is permitted to contain up to 15% limestone and is now required to contain two SCMs, which may be two pozzolans or one pozzolan and one slag. The target limestone content in excess of 5% of all blended cement types must be reported in the Type designation. Performance requirements for Types IP, IS, and IT cements are unaffected by these changes.

The primary impact of these changes to compositional limits will be in the Type designation of many previously designated Type IT cements. Blended cements containing one SCM and limestone, which were previously designated as Type IT, would now be designated as Type IP or Type IS. An example would be such as a Type IT(P25)(L10) cement being redesignated as Type IP(P25)(L10). Note that the target composition of this example cement is the same, but the type designation is changed from Type IT to Type IP.

The current limits on blended constituents restrict the manufacture and use of emerging low-carbon cement products under ASTM C595/C595M and AASHTO M 240M/M 240, such as limestone calcined-clay cements (LC³) and high-filler low-water (HFLW) cements. To address this deficiency, ASTM C595/C595M added a new Type IC (composite cement) in 2026. Type IC is not currently included in AASHTO M 240M/M 240. Type IC cements are permitted to contain any number (one or more) of pozzolan, slag, and limestone constituents, provided they do not exceed in total 70% by mass of the blended cement (effectively requiring a minimum 30% of portland cement). Type IC cement may contain up to 30% limestone, while target limestone amount cannot exceed 15% in the other blended cement types. A variety of innovative blends of constituents not otherwise covered by other blended cement types could be developed and specified under the ASTM C595/C595M Type IC designation. The physical and performance requirements for Type IC cement are identical to those for other blended cements with the same pozzolan and/or slag cement contents, although there are minor differences in chemical requirements. State agencies that reference AASHTO M 240M/M 240 for cement in their concrete specifications can permit the use of Type IC cement by referencing ASTM C595/C595M. The same is true for permitting a performance-based hydraulic cement covered by ASTM C1157/C1157M-25, “Standard Performance Specification for Hydraulic Cement,”⁷ which does not have an equivalent AASHTO specification. The requirements for all other blended cements remain harmonized across ASTM C595/C595M and AASHTO M 240M/M 240.

The naming convention for Type IC cements is the same as

for other blended cements. Type IC cements may include:

- An LC³ cement with 30% calcined clay and 20% limestone—Type IC(P30)(L20);
- A portland-limestone cement (PLC) with 20% limestone (similar to what has been under evaluation at MnRoad since 2023⁸)—Type IC(L20); or
- A quaternary blended cement with 20% slag cement, 18% natural pozzolan, and 12% coal ash—Type IC(S20)(P18)(P12).

Table 1 summarizes the compositional limits in the 2026 editions of ASTM C595/C595M and AASHTO M 240M/M 240. Highlighted cells represent limits that were revised in 2026.

Sulfate resistance of Type IL cement

For portland cement conforming to ASTM C150/C150M, “Standard Specification for Portland Cement,”⁹ and AASHTO M 85, “Standard Specification for Portland Cement,”¹⁰ sulfate resistance is defined by maximum limits on the tricalcium aluminate (C₃A): 8% for moderate sulfate resistance (Type II), and 5% for high sulfate resistance (Type V). Cement phase composition estimated for portland cement cannot be determined for blended cements in the same manner as for portland cement, and so these limits on chemical phases are not specified in ASTM C595/C595M and AASHTO M 240M/M 240. For blended cements (and for combinations of cementitious materials in concrete), sulfate resistance has been determined by meeting expansion criteria at 6 or 12 months (or 18 months for cementitious combinations in very severe sulfate exposures) when tested in accordance with the ASTM C1012/C1012M, “Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution,”¹¹ mortar bar expansion test. ASTM C1012/C1012M was developed to evaluate combinations of cementitious materials that include SCMs, and the test was not intended to establish the sulfate resistance of portland cements or PLCs. ASTM C1012/C1012M immerses test mortar bars in a high-concentration sodium sulfate solution. ASTM C452/C452M, “Standard Test Method for Potential Expansion of Portland-Cement Mortars Exposed to Sulfate,”¹² is a 14-day mortar bar expansion test first published in 1960, wherein additional sulfate (gypsum) is added when mixing the mortar. This method has been referenced in ASTM C150/C150M and AASHTO M 85, with an optional requirement for Type V cements (high sulfate resistant) with a 0.040% maximum expansion limit in ASTM C452/C452M. This requirement is invoked in ACI CODE-318 when Type V cements are used without SCMs in severe (S3) sulfate exposure conditions. Recent studies comparing the two test methods confirm that ASTM C1012/C1012M is a more severe test, to the point that some Type V portland cements could not meet the expansion limit for the high sulfate resistance designation in ASTM C595/C595M and AASHTO M 240M/M 240.¹³ By evaluating comparative tests on several cement sources, it has been established that ASTM C452/C452M is appropriate for evaluating the sulfate resistance of Type IL

Table 1: Compositional Requirements for Blended Cements in ASTM C595/C595M-26 and AASHTO M 240M/M 240-26

Constituent	Type IL	Type IP	Type IS	Type IT	Type IT(S≥70)	Type IC*
Limestone (L)	>5%, and ≤15%	≤15%	≤15%	≤15%	≤15%	≤30%†
Pozzolan (P)	0	≤40%	0	≤40%	†	†
Slag (S)	0	0	≤95%‡	†	†,‡	†
Sum (L + P + S)	n/a	n/a	n/a	<70%	≤95%	≤70%
Number of pozzolan and slag constituents	0	1	1	2	2	No requirement

Revised limits are highlighted in yellow.

*Type IC cement is only included in ASTM C595. †There is no stated maximum content for these constituents, but the cement must satisfy the maximum limit for the total limestone, pozzolan, and slag cement. ‡Type IS and Type IT cements with 70% or more slag cement may also contain hydrated lime.

cements.¹⁴ ASTM C595/C595M and AASHTO M 240M/M 240 were revised to establish sulfate resistance for Type IL cements to be primarily based upon ASTM C452/C452M testing. A similar change was made to CSA A3001¹⁵ in 2023, and a supporting revision to ASTM C452/C452M in 2026 clarified that Type IL cements may be tested by this method.

Type IL cements are now designated as moderate (MS) and high (HS) sulfate-resistant based on the following ASTM C452/C452M expansion criteria:

- Moderate sulfate-resistant, Type IL(MS)—14-day expansion ≤ 0.050%; and
- High sulfate-resistant, Type IL(HS)—14-day expansion ≤ 0.035%.

If the cement does not meet ASTM C452/C452M expansion limits, the cement may still be qualified based on ASTM C1012/C1012M test results at 6 to 12 months. When evaluating other blended cements that contain pozzolans or slag cement (Types IP, IS, IT, and IC) and cementitious combinations in concrete, expansion criteria based on ASTM C1012/C1012M still apply.

Chemical requirements

Unsoundness of cement can result from unreacted calcium oxide or periclase, a crystalline form of magnesium oxide (MgO), which can cause early- or later-age expansion in concrete when these phases react with water. ASTM C151/C151M, “Standard Test Method for Autoclave Expansion of Hydraulic Cement”¹⁶—the autoclave expansion test—has been historically used to test unsoundness potential of cements. However, the test did not reliably predict cement performance. In 2023, the requirement for the autoclave expansion test (ASTM C151/C151M) was removed from ASTM C595/C595M and AASHTO M 240M/M 240, following a similar change to ASTM C150/C150M and AASHTO M 85 in 2022. While ASTM C150/C150M and AASHTO M 85 for portland cements have a maximum 6.0% limit on MgO, a similar limit was not in place for blended cements, except for Type IP cements and some Type IT cements. An MgO limit on finished blended cements was considered impractical given that many limestone and slag cement constituents can contain substantial amounts of MgO, but not in the form of periclase

that would present a risk of unsoundness.

For Types IL, IP, IS, and IT cements, a limit of 6.0% MgO in the portland cement constituent was introduced in 2026. This replaced a 6.0% MgO limit on finished Type IP and IT cements that contained a pozzolan as the largest blending constituent. It also ensures that portland cements meeting the requirements of ASTM C150/C150M and AASHTO M 85 can be used to manufacture blended cements. Currently, Type IC has a 6.0% MgO limit on the finished cement if the pozzolan content exceeds the limestone or slag cement content. ASTM Subcommittee C01.10, Hydraulic Cements for General Concrete Construction, is working on a future revision to align the MgO limit for Type IC with other blended cement types.

Loss on ignition (LOI) limits were primarily established for coal ash to reduce the potential for unburned coal and activated carbon to absorb chemical admixtures, particularly air-entraining admixtures, to more reliably achieve consistent entrained air in concrete (ACI PRC-232.2¹⁷). Measurement of LOI also captures the carbon dioxide content of calcium carbonate and increases with higher limestone content in cement. ASTM C595/C595M and AASHTO M 240M/M 240 contain maximum LOI limits both on finished cements (with higher limits on cements containing more than 5% limestone) and on the individual coal ash, silica fume, and (until 2026) natural pozzolan constituents.

For natural pozzolans, LOI is more closely related to the bound water content of the material than to forms of carbon that affect the efficacy of admixtures (ACI PRC-232.1¹⁸). The LOI limits on Type IP and IT cements in earlier editions of ASTM C595/C595M and AASHTO M 240M/M 240 also restricted some natural pozzolans from use at levels up to the 40% limit because of the LOI limit on the finished cement.

The resulting revisions to LOI requirements in 2026 are:

- The 10.0% LOI limit on natural pozzolan constituents of blended cements was eliminated. This aligns with Canadian (CSA A3001) and European (EN 197-1¹⁹) standards;
- The LOI limit on finished Type IP and IT blended cements (except the new Type IC cement) containing natural pozzolans was increased to 8.0%, or 13.0% if the limestone content is greater than 5%. Previously, these limits were 5.0% and 10.0%; and

- Type IC cement was introduced with an LOI limit of 5.0%, or 16.0% if the limestone content of the cement is greater than 5%.

Other Cement and SCM Standards

Several new standards have been published, and existing standards have been updated in recent years for SCMs:

- ASTM C1866/C1886M, “Standard Specification for Ground-Glass Pozzolan for Use in Concrete,”²⁰ was published in 2020. This standard provides an avenue for recycled container, plate, and E-glass to be used as an SCM. Two Types, GS and GE, are defined to cover soda-lime-silica glass and glass from waste glass fiber reinforcement, respectively. Type GS has a high alkali content compared to Type GE;
- ASTM C1912/C1912M, “Standard Specification for Supplementary Cementitious Material for Use in Concrete,”²¹ was published in 2025. This is a performance-oriented specification to accommodate emerging and innovative SCMs that do not meet the traditional specifications for SCMs. This specification can also be used to qualify coal ash, slag cement, and natural pozzolans that do not meet the traditional specifications applicable to these materials. The strength activity index requirement is 80% of the control mixture’s strength at 7 and 28 days, slightly higher than the 75% requirement in ASTM C618, “Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.”²² To accommodate slower-reacting SCMs, an option to meet a strength activity index of 80% at 56 days is included. An additional reactivity test for bound water content, in accordance with method B of ASTM C1897, “Standard Test Methods for Measuring the Reactivity of Supplementary Cementitious Materials by Isothermal Calorimetry and Bound Water Measurements,”²³ is included in this specification. This specification includes an optional requirement to report the foam index, determined in accordance with ASTM C1827, “Standard Test Method for Determination of the Air-Entraining Admixture Demand of a Cementitious Mixture,”²⁴ to evaluate if the SCM has an adverse impact on entraining air in concrete. An optional requirement was added in 2026 to report a “resistivity index” measured on mortar cubes in accordance with ASTM C1952, “Standard Test Method for Determination of Bulk Resistivity Index of Mortar Cubes using Bulk Electrical Resistivity Measurements.”²⁵ The resistivity index is the ratio of the resistivity measured on the test mortar with the SCM to that of the control mixture with portland cement or PLC. Resistivity can be measured on the same cubes before these are tested for compressive strength. The resistivity index is thereby reported at same ages as for the strength activity index and additional later ages, although there is no minimum value established for compliance. The inclusion of these additional methods is intended to prevent the qualification of inert materials as

SCMs based solely on strength activity index. AASHTO M 363M/M 363, “Standard Specification for Supplementary Cementitious Material for Use in Concrete”²⁶ is an equivalent specification to ASTM C1912/C1912M published in 2026;

- ASTM C1945, “Standard Specification for Natural Pozzolan for Use in Concrete,”²⁷ was initially published in 2024 with the same requirements as for Class N natural pozzolans specified by ASTM C618, and it was most recently revised in 2026. The descriptors “raw and calcined” were removed from the title along with the reference to Class N. Revisions have also introduced optional requirements on pozzolanic reactivity in accordance with ASTM C1897. These include an optional limit on bound water content, and an optional requirement to report the 7-day heat of hydration. Limits on LOI are removed as the constituents contributing to LOI do not impact the ability to entrain air in concrete, like in coal ash. Many natural pozzolans increase the water demand to achieve target slump in concrete. For this purpose, a water requirement limit of 115% of control from ASTM C618 is retained in this specification. The intent is to eventually delete Class N natural pozzolans from ASTM C618 and AASHTO M 295, “Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete,”²⁸ making this the sole relevant specification for natural pozzolans. AASHTO M 359, “Standard Specification for Raw or Calcined Natural Pozzolan for Use in Concrete”²⁹ is the equivalent specification to ASTM C1945 published in 2026; and
- ASTM C1697, “Specification for Blended Supplementary Cementitious Materials,”³⁰ permits blending pozzolans and slag cement that comply with the respective specifications to be sold as a blended product. A revision approved in 2026 and pending publication will permit limestone as a blended constituent provided it is not the major constituent by mass in the blending. There is no equivalent AASHTO specification for blended SCMs.

Concrete Standards

ASTM C94/C94M, “Standard Specification for Ready-Mixed Concrete,”³¹ added references to new specifications for concrete materials to permit the use of traditional and emerging materials. The inclusion of ASTM C1797, “Standard Specification for Ground Calcium Carbonate and Aggregate Mineral Fillers for use in Hydraulic Cement Concrete,”³² impacted the process of batching, and it is clarified that these can be measured cumulatively on the scale for cementitious materials as the last weighed material.

Details reported on the delivery ticket have been revised. A few years ago the numeric limits for time and revolutions to the point of discharge of concrete were removed. The specification now requires that these limits should be established as project- and mixture- specific requirements between the producer and purchaser during the ordering

process. These established limits need to be documented on the delivery ticket for awareness by the purchaser and testing agency personnel. As in the past, these limits can be waived if workability is adequate without the need to add water in excess of that of the approved mixture proportions. The delivery ticket can include the quantity of water that can be added to a load (water held back at the time of batching) at the purchaser's request—several producers include this information on delivery tickets as standard practice.

There were several updates to the production process: requirements for load cells were established; batching accuracy requirements for cementitious materials and aggregates were clarified; and the batch water should be accurate to $\pm 1.5\%$ of the target batch water (which is defined in the specification), while the total mixing water, as established by the mixture design, should be accurate to $\pm 3\%$.

New terms have been defined for “preliminary sample” that determines if adjustments are needed to achieve target slump and air content; and for “acceptance sample” obtained in accordance with ASTM C172/C172M, “Standard Practice for Sampling Freshly Mixed Concrete.”³³ The complete process of sampling and testing was updated in Section 17. If slump and air content measured on an acceptance sample do not comply with the requirements of the order, there is a requirement to conduct a check test on a new sample. Additionally, for strength acceptance, it is emphasized that test specimens should be standard-cured in accordance with ASTM C31/C31M, “Standard Practice for Making and Curing Concrete Test Specimens in the Field.”³⁴

ASTM C94/C94M previously included three options for ordering concrete: “performance” option (A) where the producer is responsible to proportion the mixture; “prescriptive” option (B) where the purchaser includes details on mixture composition and is responsible for performance; and a “mixed” option (C) where the purchaser specifies the required strength in addition to a minimum cementitious material content. The mixed option C has now been removed.

Other changes to ASTM C94/C94M were to consistently use the terms “cementitious materials” to replace “cement” and “producer” to replace “manufacturer.”

ASTM C1778, “Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete,”³⁵ was revised to better describe the multistep approach to alkali-aggregate reaction (AAR) risk reduction illustrated in the standard's flowchart, and to update guidance for evaluating aggregate sources for alkali-carbonate reactions, in accordance with compositional limits or testing in accordance with ASTM C1105, “Standard Test Method for Length Change of Concrete Due to Alkali-Carbonate Rock Reaction.”³⁶ Because ASTM C1778 is a guide that is written in non-mandatory language, it cannot be directly referenced in codes or specifications. AASHTO R 80, “Standard Practice for Determining the Reactivity of Concrete Aggregates and Selecting Appropriate Measures for Preventing Deleterious Expansion in New Concrete Construction,”³⁷ is a comparable,

but not equivalent, standard practice that now contains recommended criteria for using AASHTO T 380, “Standard Method of Test for Potential Alkali Reactivity of Aggregates and Effectiveness of ASR Mitigation Measures (Miniature Concrete Prism Test, MCPT),”³⁸ for determining the reactivity of aggregates and evaluating the efficacy of cementitious combinations with aggregates. Guidance to the prescriptive methods of mitigating alkali-silica reaction (ASR) has been updated based on recent research.³⁹

ASTM C1876, “Standard Test Method for Bulk Electrical Resistivity or Bulk Conductivity of Concrete,”⁴⁰ is invoked in some specifications and is being considered by ACI Committees 332, Residential Concrete Work, and 321, Concrete Durability Code, for inclusion as an indicator of the permeability of concrete in codes for residential concrete and durability, respectively. The method previously required curing and conditioning concrete cylindrical test specimens in a prepared solution designed to simulate that of concrete pore solution. This process required accurate measurement and dissolution of three salts in water, resulting in a solution that is difficult to dispose on completion of the test. A new Method B was added to the standard in 2025 that permits conditioning specimens in saturated lime water. Both methods now also require determining the bulk electrical resistivity of concrete as the average of at least three, instead of two, specimens.

ASTM C125/C125M, “Standard Terminology Relating to Concrete and Concrete Aggregates,”⁴¹ added a definition for “low-carbon concrete,” which is aligned with the definition used in ACI CODE-323-24.⁴²

Three new test methods for concrete were published by ASTM earlier this year:

- ASTM C1953/C1953M-26, “Standard Test Method for Water Content in Fresh Cementitious Mixtures by Rapid Evaporation,”⁴³ is intended to determine if the water content of concrete delivered is consistent with that intended by the mixture design. A high-power oven, powered by a generator at the jobsite, is used to dry a sample of concrete at around 815°C (1500°F) to constant mass, typically within 15 to 25 minutes;
- ASTM C1959/C1959M-26, “Standard Test Method for Non-Contact Measurement of Resonant Frequencies of Concrete Cylinders,”⁴⁴ is a noncontact method for measuring the longitudinal and transverse resonant frequencies of cylinders. Microphones are used to detect the specimen's vibration, rather than contact sensors used in ASTM C215, “Standard Test Method for Fundamental Transverse, Longitudinal, and Torsional Resonant Frequencies of Concrete Specimens.”⁴⁵ Systems based on this standard may accomplish signal acquisition and processing using applications on mobile phones and tablet computers. A non-mandatory appendix discusses the use of the results to determine the dynamic elastic modulus and estimate the compressive strength of test specimens
- ASTM C1963-26, “Standard Test Method for Air-

Permeability Coefficient of Hardened Concrete by the Double-Chamber Vacuum Cell Method,”⁴⁶ is a test method to determine the air-permeability coefficient of hardened concrete. This method can obtain measurements of in-place concrete on the permeability characteristics of cover concrete. The measured air permeability is affected by the saturation level that the device attempts to normalize; however, it is unaffected by the conductivity of the pore solution in concrete.

Closing

ACI's motto is “Always advancing,” and the same holds true to cement and concrete standards. Many of the changes described in this article will have an impact on the work of an engineers, material producers, contractors, students, or professors. This article is only a small selection of significant activity to revise and develop new standards. The consensus process in standards development welcomes broad participation, debate, and consideration of the impacts of proposed changes and new standards. This brings strength and legitimacy to the final product and is one reason these standards are so widely used in ACI documents. The authors encourage ACI members to consider participating in the development of these standards that impact their work and the cement and concrete industry.

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Selected for reader interest by the editors.



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