

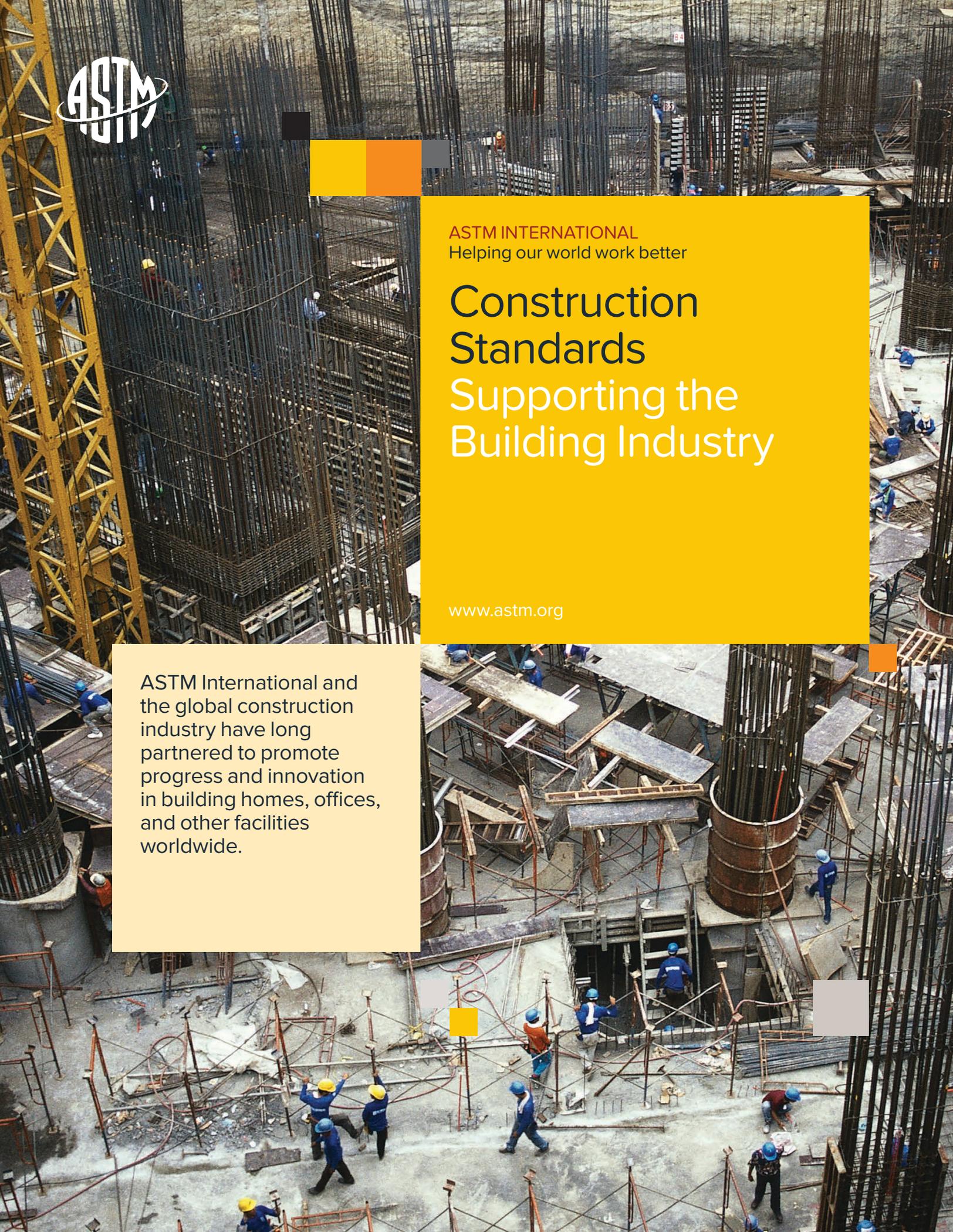


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# Construction Standards Supporting the Building Industry

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ASTM International and the global construction industry have long partnered to promote progress and innovation in building homes, offices, and other facilities worldwide.



# ASTM Construction Standards: Supporting the Building Industry

Today, more than 2,000 ASTM International standards support the construction of buildings that will stand the test of time. These standards are the work of numerous technical committees. The collective expertise of these committees is reflected in ASTM Standards in Building Codes (available online), which includes standards to help design buildings that meet international code requirements.

## Laying the Foundation: C01 and C09

Standards from the committees on cement (C01) and concrete and concrete aggregates (C09) have long played a significant role in the worldwide construction industry.

Committee C01 (formed 1902) organized to address the need for uniform test methods. A number of government and industry organizations, including the Portland Cement Association, were involved in the emerging cement industry at that time. To them, ASTM offered the opportunity for balanced participation in creating standards.

Committee C01 issued its first standard in 1904: the Standard Specification for Cement. Stakeholders, including manufacturers, engineers, architects, and

government agencies, embraced the standard, which was a watershed event for the young U.S. construction industry. With a single specification to cover all general construction cement, shipments and use nearly tripled in the next 10 years, driving dramatic growth.

## C150: The Global Cement Standard

That early cement specification paved the way for what is now the specification for portland cement (C150/C150M). C150 covers the physical and chemical requirements of eight types of portland cement. Cement manufacturers and purchasers as well as concrete producers, specifiers, and users have adopted the standard.

Over the years, C150 has been revised to address changing industry needs, ensuring the standard's ongoing support for building quality and performance. Recent revisions have focused on base cement technology improvements to achieve environmental benefits and to support sustainable construction.

For example, C150 has been revised to include the inter-grinding of limestone, which helps reduce the energy-intensive process of grinding clinker to create cement. In addition, C150 supports the inclusion of slag (a steel processing byproduct) and fly ash (a coal processing byproduct) in cement, which allows for productive re-use of these waste materials.

## More Cement Standards

Additional key C01 standards support the material's quality and performance. For example, C1157/C1157M specifies hydraulic cements for general and specific applications. Another standard describes how to measure the compressive strength of hydraulic cement mortars (C109/C109M). Other standards support the measurement of the yield stress and plastic viscosity of hydraulic cementitious paste (C1749) and the high shear mixing of hydraulic cement pastes (C1738). The committee is also beginning to work on standards for non-hydraulic cement.

## C09: Authoritative Source for Concrete Standards

A dozen years after Committee C01 began work, Committee C09 formed in 1914 to address standards for concrete. Today, C09 has more than 1,400 members responsible for 180+ standards that cover concrete and related materials. Like the cement standards, those from C09 are woven into the day-to-day workings of the construction industry. For example, the specification for ready-mixed concrete (C94/C94M) covers fresh, unhardened ready-mixed concrete. Another standard addresses the use of returned fresh concrete in a new batch of the material (C1798). Others support the use

ASTM International  
and the construction  
industry enjoy a fruitful  
partnership.

## Performance Standards: Advancing Cement Durability

Committee C01 is continually enhancing cement performance standards. Standards such as the specification for portland cement (C150) and the specification for blended hydraulic cements (C595) address prescriptive and performance requirements. Others such as the performance specification for hydraulic cement (C1157) mainly focus on durability and performance. C1157 specifies cements based on requirements for general use, high early strength, resistance to sulfate attack, and heat of hydration.



of ground calcium carbonate and aggregate mineral filler in concrete mixtures (C1797) and evaluating the hydration of hydraulic cementitious mixtures (C1753/C1753M), which can help indicate setting characteristics, strength development, and compatibility.

#### Addressing New Technologies

Recent Committee C09 work includes standards to support the use of pervious concrete, an environmentally friendly technology that aids stormwater management. Pervious concrete captures stormwater and allows it to seep into the ground, reducing runoff and helping to meet regulations. Because of its porosity, pervious concrete cannot be tested using traditional concrete standards.

One standard from the pervious concrete subcommittee (C09.49) covers density and void content of freshly mixed pervious concrete (C1688/C1688M). The test helps verify that the pervious concrete delivered to a project corresponds to the producer's mix proportions.

Committee C09 is also working on standards for self-consolidating concrete, which can flow easily into tight and constricted spaces without segregating or requiring vibration. One test in this area covers the passing ability of self-consolidating concrete by J-ring (C1621/C1621M), which is used to ensure a proper mix.

Another C09.49 standard uses a column technique for static segregation (C1610/C1610M), which helps users understand cohesion. This is especially important for uses such as walls or columns. The C1610 measurement helps indicate how well a concrete mixture will serve this purpose.

Additional C09 standards work includes a proposed standard that will cover how to fabricate and test ultra-high performance concrete specimens in the lab and in the field. Other standards under way address making consistent fiber-reinforced concrete test specimens; measuring electrical resistance of fresh concrete; identifying whether an aggregate is reactive and might lead to a loss of concrete strength; and specifying colloidal silica.

#### C01 and C09: Collaboration for Progress

Committees C01 and C09 work closely together on common goals. One area is a joint subcommittee on the performance of cementitious materials and admixture combinations (C09.48/C01.48). The group is developing standards to investigate and evaluate material and admixture properties. The subcommittee has developed a standard for measuring hydration kinetics of hydraulic cementitious mixtures using isothermal calorimetry (C1679), which helps producers understand the compatibility of various concrete materials with each other.

The committees have also collaborated to organize a subcommittee on risk management for alkali-aggregate reactions (C09.50), which is developing standards to mitigate these reactions in concrete.

In addition, the C01 and C09 committees sponsor the Cement and Concrete Reference Laboratory (CCRL), which helps laboratories ensure quality assurance. CCRL, a division of ASTM International, has laboratory inspection and proficiency sample programs that help labs monitor procedures and maintain testing excellence. Program materials include portland, blended, and masonry cements; portland cement concrete, pozzolans, masonry mortar, and concrete masonry units. Over 1,100 laboratories in Canada, Mexico, and the United States participate in these programs.

#### D08: Keeping Buildings Safe and Dry

Another ASTM committee with a major impact on building construction is the committee on roofing and waterproofing (D08). The committee (formed 1905) has grown to more than 600 members responsible for close to 200 standards covering materials, products, and systems that use asphalt, coal-tar, polymer modifiers, and rubbers.

Today, D08 work includes standards that help define the expected reliability of finished products. For example, a method for wind resistance of asphalt shingles (D7158/D7158M) helps firms meet performance and safety expectations. Another standard covers how to select and install systems that promote drainage around the foundations of buildings and on plazas (D7492/D7492M).

Committee D08 continues to support innovations and changes to traditional technologies. For example, one test method determines the capability of roofing and waterproofing materials to seal around fasteners (D7349/D7349M). This standard describes how to measure water migration resistance at the point of penetration. Meanwhile, one roofing standard (D7379) tests the strength of modified bitumen sheet material laps using cold process adhesive. Another outlines how to evaluate and prepare a roof membrane for coating (D7120/D7120M).

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Committee  
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D08 also works on sustainable roofing. One standard in this area guides users in establishing a recycling program for roofing membranes and shingles (D8013). Other standards support the use of green roof systems. A standard for vegetative roof systems (E2777) helps those working in this field with concepts, construction requirements, and types of green roofs. Other related standards include one that supports expanded shale, clay and slate in the growing media, and drainage layer for green roofs (E2788).

### Helping Owners and Occupants

While several ASTM International committees support the construction industry through product-related standards, another committee helps to ensure better building performance and management: the committee on performance of buildings (E06), formed in 1946 during the post-World War II building boom. The committee's global membership of 1,300+ experts develop and maintain standards that help building developers, owners, and occupants with health and safety issues.

For example, E06 manages standards related to lead contamination and radon testing. The subcommittee on lead hazards associated with buildings (E06.23) has several standards in this area, including a practice for selecting lead hazard reduction methods for identified risks (E2252). Additional standards address composite wipe sample preparation for analysis following lead abatement (E2913 and E2914). Radon testing is addressed by the subcommittee on air leakage and ventilation performance (E06.41). Standards such as the practice for installing radon mitigation systems in existing low-rise residential buildings (E2121) help contractors ensure a high degree of safety and success in retrofitting projects.

In related work, the committee on air quality (D22) works on standards to help building owners better manage asbestos. One standard in this area is a practice to inspect asbestos abatement projects (E1368).

Notably, E06 has developed a series of standards for testing windows, doors, skylights, and curtain walls under environmental conditions such as wind and airborne debris. One standard covers the performance of exterior windows, curtain walls, doors, and impact protective systems impacted by windborne debris in hurricanes (E1996). Another helps stakeholders to determine water penetration of these components (E1105), and a third tests for air leakage (E283). A related standard guides the use of hygrothermal modeling for building envelope moisture control design (E3054/E3054M). The guide, part of a planned series, helps with predicting and evaluating design considerations.

In another area, the subcommittee on high-rise building external evacuation devices (E06.77) has developed two standards for emergency equipment to use when the primary safety routes are not accessible:

## Standards help protect buildings from water and fire while also keeping people safe.

specifications for multi-story building external evacuation controlled descent devices (E2484) and platform rescue systems (E2513).

Committee E06 has also developed standards for products to protect buildings in case of fire. The practice for intumescent coatings (E2924), which safeguard steel structural integrity during a fire, covers the specification, application, and inspection of fire-resistant materials. Another supports the inspection of installed firestops (E2174), which seal openings in building assemblies. A related standard guides inspection of fire-resistive joint systems and perimeter fire barriers (E2393).

Building officials use the specification for flat wall insulating concrete form systems (E2634) as an enforcement tool, and architects use it to ensure that products conform to standards.

### E06: Performance, Resilience, and Building Economics

In addition to components and systems, the E06 committee considers overall approaches to construction. Building enclosure commissioning (BECx) and building resilience standards are being worked on by the subcommittee on performance of building enclosures (E06.55).

Two standards for BECx (E2813 and E2947) address how to ensure that a structure meets project requirements before the design begins and then from design to construction, occupancy, and operations. E2813 also covers how to establish requirements for BECx providers.

The subcommittee is also actively working on building resiliency, which supports a structure's ability to withstand disasters.

Another subcommittee on building economics (E06.81) has developed standards to help evaluate building projects and reduce costs throughout the life cycle. One standard provides the means to compare life cycle costs of different building designs (E917); another covers value engineering and analysis of projects, products, and processes so that the best value may be obtained (E1699).

### More Building Blocks

Many other committees actively support the building construction industry.

The committee on building seals and sealants (C24) develops standards for aerosol foam sealants, caulking compounds, elastomeric sealants, glazing compounds, preformed sealing tapes, and preformed gaskets.



More than 200 industry experts are responsible for about 100 standards. Notably, C24 is responsible for a specification for elastomeric joint sealants (C920), which covers the properties of a cured single- or multi-component cold-applied sealing, caulking, or glazing material used on buildings, plazas, and decks. C920 is widely cited in building codes and is also used by U.S. government agencies. Another C24 standard helps screen sealant joint performance by measuring its time-dependent modulus (C1735).

The committee on wood (D07) is responsible for 90 standards for timber, wood, modified wood, veneer, wood-based structural panels, and other wood-based building products.

Today, D07 works in areas such as natural fiber-polymer composites and structural wood adhesives. One example is a standard that recognizes the latest glued laminated (glulam) timber technology (D7199) by establishing characteristic values for reinforced glulam beams using mechanics-based models.

The committee has also developed a standard fire resistance test for evaluating floor-ceiling assemblies (D7746). In addition, D07 is working on standards for structural insulated panels, which comprise a foam core sandwiched between two wood facings.

Construction building masonry and natural stone are the focus of committees such as those on mortars and grouts for unit masonry (C12), manufactured masonry units (C15), and dimension stone (C18).

One C12 standard covers the use of mortars in the construction of nonreinforced and reinforced unit masonry structures (C270). Similar to C270, a specification for facing brick (solid masonry units made from clay or shale) is focused on concrete brick and similar solid units used in structural masonry or facing for buildings (C216). Another specification supports the use of mortars to repair historic masonry (C1713).

In Committee C18, standards such as a guide for choosing and installing dimension stone anchoring systems (C1242) help architects, engineers, contractors, and suppliers to design, select, specify, and install natural stone products. Another standard covers stone specimen sampling and preparation so that testing will accurately reflect material properties.

The committee on gypsum and related building materials and systems (C11) works on standards for gypsum board, or wallboard, and other related products. The main specification for gypsum board (C1396/C1396M) covers materials and manufacture of gypsum board for walls, ceilings, and partitions. Other C11 standards support wallboard, including the specification for nonstructural steel framing pieces that can back wallboard (C645) and its application and finishing (C840). The committee has also developed standards for the lathing and furring to be covered by stucco (C1063) and its application (C926), both of which are cited in residential building codes.

C11 and the committee on fiber-reinforced cement products (C17) have cooperated on standards such as the classification for abuse-resistant nondecorated interior gypsum panel products and fiber-reinforced cement panels (C1629/C1629M). Specifiers can use the standard to compare specific product properties.

Both C11 and E06 are responsible for standards for exterior insulation and finish systems (EIFS) used to clad the outside of buildings. The standards provide methods to evaluate EIFS strength, drainage efficiency, and freeze-thaw resistance as well as well as guidance for applying EIFS,

The glass and glass products committee (C14) oversees standards in this area, including three standards used extensively in building construction. The specification for flat glass (C1036) addresses the quality requirements of flat, transparent, clear, and tinted glass. The specification for heat-strengthened and fully tempered flat glass (C1048) covers requirements for coated and uncoated flat glass used in general building construction. And the specification for laminated architectural flat glass (C1172) covers the quality requirements of glass consisting of two or more glass lites bonded together.

## A Sustainable Future

As sustainable construction has become more widely practiced, standards for this industry have become part of the committee on sustainability (E60). E60 (formed 2008) grew from a pre-existing group that developed standards such as a guide for general principles of sustainability relative to buildings (E2432).

ASTM International supports environmentally friendly buildings and facilities with more than 40 standards from several committees that have been adopted by the International Green Construction Code (IgCC), which focuses on safe and sustainable construction.

Committee E60 is working on new standards that address marketing and product claims related to sustainable buildings, water stewardship, and other issues. The committee has also organized a subcommittee on sustainable manufacturing (E60.13) (which includes building products in its scope) and the subcommittee on water use and conservation (E60.07), which is responsible for standards such as a practice for building water conservation through reclamation (E2635) and water stewardship in building design, construction, and operation (E2728).

Other standards efforts for sustainable construction focus on vegetative and cool roofs, solar energy, plastic and composite lumber, and more.

## Sustainability and Environmental Product Declarations

Along with the global growth in sustainable building construction has come a rise in “green” product claims from manufacturers and industry suppliers. Understanding the meaning and validity of these claims, whether based on certification programs or individual company assertions, is becoming increasingly difficult.

To best determine product sustainability, and to make more informed choices, building designers, contractors, consumers, and code officials need credible information on environmental impact. Manufacturers also benefit by tapping into the growing market for green building materials and through greater awareness of how their products and practices affect the environment. A key tool available to help manufacturers assess the true greenness of their products is the environmental product declaration (EPD) — a detailed report outlining a product’s effect on the environment over the course of its lifetime.

In 2012, ASTM International became a Program Operator for developing product category rules (PCRs) and verifying EPDs in response to the growing need to understand the real environmental impact of products from raw material extraction to disposal and recycling ([www.astm.org/EPDs](http://www.astm.org/EPDs)). PCRs detail the rules and guidelines for developing environmental declarations for products that can fill equivalent functions. EPDs are verified in accordance with the International Organization for Standardization (ISO) 14025 standard and to ensure that life cycle assessment data accurately describes the environmental aspects of a product.

ASTM International is also part of the Program Operator Consortium launched to provide more useful environmental product transparency solutions and to reduce complexity. The consortium serves as a resource and advocate for creating PCRs, reviewing life cycle assessment reports, and verifying and publishing EPDs.

Consortium members also include CSA Group, ICC-Evaluation Service, NSF Sustainability, SCS Global Services, and Sustainable Minds. Affiliate members include the National Ready Mixed Concrete Association and Sustainable Solutions Corp.

ASTM has helped many industries in developing PCRs and verifying new EPDs, making sure that all proper procedures are followed. Industry-specific efforts have led to published PCR with the following organizations:

- Asphalt Roofing Manufacturers Association
- Canadian Precast/Prestressed Concrete Institute
- Expanded Shale, Clay, and Slate Institute
- Gypsum Association
- Interlocking Concrete Pavement Institute
- National Concrete Masonry Association
- National Precast Concrete Association
- Portland Cement Association
- Precast/Prestressed Concrete Institute
- Single Ply Roofing Industry
- Slag Cement Association
- Window and Door Manufacturers Association

## Furthering Construction with Training

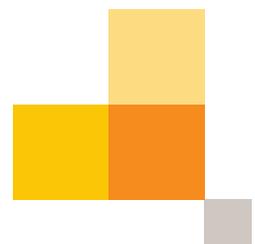
Accredited by the International Association for Continuing Education and Training for its program, ASTM International offers several training series for construction technicians.

The online construction courses include the Construction Materials Technician Series, which is registered with the American Institute of Architects Continuing Education Systems. The program helps quality assurance and quality control technicians to advance their skills and prepare for certification exams. Self-paced modules focus on aggregate, concrete field, concrete strength, aggregate base, cement, and self-consolidating concrete testing.

## In Conclusion

Standards and programs in this piece represent some of the ASTM International work in this industry sector. Additional ASTM committees also develop standards that help ensure quality in the building envelope and its man-made and natural foundation.

As buildings are constructed or enhanced and improved, ASTM International will continue to be a dedicated partner in meeting the needs of construction industry stakeholders around the world.





## ASTM International technical committees highlighted in this piece include:

- Air Quality (D22)
- Building Seals and Sealants (C24)
- Cement (C01)
- Concrete and Concrete Aggregates (C09)
- Dimension Stone (C18)
- Fiber-Reinforced Cement Products (C17)
- Glass and Glass Products (C14)
- Gypsum and Related Building Materials and Systems (C11)
- Manufactured Masonry Units (C15)
- Mortars and Grouts for Unit Masonry (C12)
- Performance of Buildings (E06)
- Roofing and Waterproofing (D08)
- Sustainability (E60)
- Wood (D07)



### ASTM INTERNATIONAL

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Committed to serving global societal needs, ASTM International positively impacts public health and safety, consumer confidence, and overall quality of life. We integrate consensus standards, developed with our international membership of volunteer technical experts, and innovative services to improve lives — Helping our world work better.

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