



ASTM INTERNATIONAL
Helping our world work better

Safe and Sustainable Highways with ASTM Standards

www.astm.org

As billions of dollars are invested to improve and maintain highway infrastructure, ASTM International standards contribute to the success of these public works projects. By supporting the science and technology of highway construction, safety, maintenance and sustainability, ASTM standards ensure that our roadways are reliable, safe and built to last. Moreover, ASTM standards offer the quality and performance that can give good returns on infrastructure investments.

Committee D04: More than a Century of Infrastructure Building

For more than 100 years, ASTM International Committee D04 on Road and Paving Materials has played a major role in helping to guide highway construction across the United States. D04 has made significant contributions to our infrastructure through developing test methods and specifications used for roadway construction and maintenance.

D04 standards contribute to the quality of road paving and construction materials across several areas, including bituminous mixtures; asphalt; aggregates; sealants used in the joints of road pavements and bridges; bridges and structures, including bridge deck protection systems; and highway traffic marking materials, lighting and signal materials.

- Today, Committee D04 has a diverse membership of more than 700 stakeholders who participate on 25+ technical subcommittees and manage over 200 standards. Many of these standards have been adopted in regulations by the U.S. Federal Highway Administration, the U.S. Department of Transportation and state departments of transportation.

- Among D04's significant standards is a test for bituminous materials penetration (D5), which gives guidance for measuring the consistency of semi-solid and solid bituminous materials. Pavement design and analysis engineers, asphalt concrete mix designers and laboratory technicians also rely on a method for indirect tensile (IDT) strength of bituminous mixtures (D6931) to help predict asphalt concrete performance and evaluate reasons for fatigue cracking, rutting and moisture susceptibility.
- Subcommittee D04.51 on Aggregate Tests has developed a test method that shortens the often time-consuming testing of bulk aggregate materials used in asphalt and concrete mixtures. A test to determine the relative density and absorption of fine, coarse and blended aggregate using combined vacuum saturation and rapid submersion (D7370) enables an entire blend to be tested in less than 30 minutes, making it ideally suited for quality control at asphalt and concrete plants.

Supporting Innovation through Superpave Standards

- Committee D04 is also developing standards used in the Superpave (Superior Performing Asphalt Pavements) system. Superpave, an outcome of the U.S. federally funded Strategic Highway Research Program, is a system for designing asphalt mixtures so that highway engineers and contractors can ensure that the right asphalt binder and aggregate structure are used based on the intended roadway's traffic and climate. Supporting these efforts are D04 standards such as a test method for determining the permanent shear strain and complex shear modulus of asphalt mixtures using the Superpave shear tester (D7312), a laboratory testing protocol used at the five U.S. Superpave centers.

Navigating a Safe Trip

Another important focus for Committee D04 is developing standards for materials used in highway signs and pavement markings. Road safety depends upon the availability of readable information both day and night, regardless of the overhead lighting, under a variety of weather conditions and against backgrounds of varying complexity. Subcommittee D04.38 on Highway Traffic Control Materials helps to achieve these safety goals through such standards as a specification for retroreflective sheeting for traffic control (D4956).

Guiding motorists is also part of efforts in ASTM Committee E12 on Color and Appearance. Subcommittee E12.10 on Retroreflection focuses on standards for measuring pavement marker performance because visibility is affected by wear. Assisting in this process are E12.10 standards for measuring retroreflective pavement marking materials and for measuring the daytime chromaticity of pavement marking materials, both using portable devices.

In addition, nighttime driving is aided by an ASTM practice for measuring photometric characteristics of retroreflectors (E809). E809 focuses on the relationship between the vehicle headlamp, retroreflector and the driver's eye geometry. Also used to aid nighttime driving is a practice for measuring colorimetric characteristics of retroreflectors under nighttime conditions (E811), which helps ensure that drivers receive the same message day or night.



C01 and C09

Building Highways that Last

The work of ASTM Committees C01 on Cement and C09 on Concrete and Concrete Aggregates has also played an important role in building highways. C01 and C09 are known for their diverse range of members and extensive partnerships with industry and government organizations.



In the transportation field, Committees C01 and C09 cooperate closely with the American Association of State Highway and Transportation Officials (AASHTO). The group's mission is to advocate for multimodal and intermodal transportation and to serve the U.S. Department of Transportation and the U.S. Congress. The AASHTO Standing Committee on Highways develops all major engineering standards, guides and policies for the highway program, either as a unit or through its subcommittees. It also investigates, studies and reports on all engineering activities and developments, including all phases of road and bridge design, construction, maintenance, traffic requirements, roadside development, aesthetics, tests and investigations of materials, and protection of the environment. To help achieve its goals, AASHTO adopts and references numerous cement and concrete standards from C01 and C09.

- The cooperative efforts of Committee C01 and AASHTO are evident in C01's flagship cement standard, the specification for portland cement (C150). The specification covers the physical and chemical requirements for manufacturing eight types of portland cement, the basic ingredient of concrete. C150 is used by manufacturers and purchasers of cement as well as concrete producers, specifiers and users, and is harmonized with the AASHTO specification for portland cement.
- As federal, state and local transportation agencies maintain the nation's infrastructure, Committee C09 performance standards have a valuable role in making the most of the investments in our highways. Many C09 standards contribute to the quality and extended service life of roads and highways. Notable among these is a test for electrical indication of concrete's ability to resist chloride ion penetration (C1202), which helps to ensure that roadways resist salt penetration and related degradation and hazards such as potholes.
- Winter driving can be perilous at times, particularly on snow covered and icy roads. To help better gauge the performance of highways in cold weather conditions, Subcommittee C09.67 on Resistance to the Environment offers a test method for resistance of concrete to rapid freezing and thawing (C666/C666M) and a test method for scaling resistance of concrete surfaces exposed to deicing chemicals (C672/C672M).

- Similarly, the standards developed by Subcommittee C09.26 on Chemical Reactions provide guidelines to test reactions that can cause damage to road surfaces. Many of these standards are focused on alkali-silica reactivity that can cause serious expansion and cracking in concrete, resulting in major structural problems and sometimes necessitating demolition. Among these are the test method for potential alkali-silica reactivity of aggregates (chemical method) (C289); the test method for length change of concrete due to alkali-carbonate rock reaction (C1105); and the test method for determining the potential alkali-silica reactivity of combinations of cementitious materials and aggregate (accelerated mortar-bar method) (C1567).

Supporting Highway Design and Construction

ASTM Committee D18 on Soil and Rock, which is responsible for more than 350 standards related to the physical and chemical properties and behavior of soil, rock and the fluids contained in them. For highway applications, a number of standards are relevant to their design and construction.

- D18 standards guide materials characterization with a test method for particle-size soil analysis (D422), a soils classification system (D2487) and methods for the liquid and plastic limits and plasticity index of soils (D4318), which are used to characterize soils and correlate their behavior. Other D18 standards relevant to materials performance include methods for soil laboratory compaction characteristics (D698 and D1557) and a test for California bearing ratio of laboratory compacted soils (D1883). These standards are used in maintenance and evaluation along with such standards as a method for density and weight of soil in place (D1556), a specification for soil-aggregate subbases and bases, and a test for in-place density and water content (D6938).

Extending Highway Life through Geosynthetics

The use of geosynthetic technologies in highway systems is also a focus of ASTM efforts. Geosynthetics, a range of polymeric materials and products that provide durability in civil engineering applications, improve the lifespan of roads and other structures by stabilizing foundations, promoting drainage and preventing erosion, generally at a lower cost than other products.

- ASTM Committee D35 on Geosynthetics has developed more than 140 standards that facilitate the design and selection of geosynthetic materials in the construction and environmental industries. Such D35 standards as tests for deterioration of geotextiles by exposure to light, moisture and heat in a xenon arc type apparatus (D4355) and for water permeability of geotextiles by permittivity (D4491) help measure the endurance of geotextiles for drainage and erosion control in highway construction projects.

Supporting Advances in Stormwater Management

Also playing a role in managing our nation's highways are the standards of ASTM Committee F17 on Plastic Piping Systems.

- Within F17's portfolio of standards are specifications that advance the usage of high density polyethylene pipe in municipal stormwater applications, such as culverts for highway drainage. Among the notable F17 standards in this area is a specification for 12 to 60 in. [300 to 1500 mm] annular corrugated profile-wall polyethylene (PE) pipe and fittings for gravity-flow storm sewer and subsurface drainage applications (F2306/F2306M).

Stronger Bridges and Infrastructure with Standards

Fortifying the United States' bridges is just one of the focus areas of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys. A01, ASTM International's founding committee, has helped specify the steel used in bridge construction for more than 100 years.

- Subcommittee A01.02 on Structural Steel for Bridges, Buildings, Rolling Stock and Ships coordinates today's standards work in these areas. Among the group's standards is a specification for structural steel for bridges (A709/A709M), which covers carbon and high strength low alloy steel structural shapes, plates and bars, and quenched and tempered alloy steel for structural plates intended for use in bridges.
- A standard from Subcommittee A01.05 on Steel Reinforcement offers a tool for promoting the long-term strength of bridges and supports the production of high performance, corrosion-resistant steel; the specification covers zinc and epoxy dual-coated steel reinforcing bars (A1055/A1055M). The standard is beneficial to state departments of transportation that require high performance corrosion protection of reinforcing steel bars in coastal environments and that use deicing salts on roads, bridges and decks.

“Fortifying the United States’ bridges is just one of the focus areas of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys.”

A01

ASTM International’s founding committee has helped to specify the steel used in bridge construction for more than 100 years.

A standard from Subcommittee A01.05 on Steel Reinforcement offers a tool for promoting the long-term strength of bridges and supports the production of high performance, corrosion-resistant steel; the specification covers zinc and epoxy dual-coated steel reinforcing bars (A1055/A1055M).

- Many standards from ASTM Committee F16 on Fasteners are used in infrastructure construction as well. F16 provides more than 75 standards for bolts, screws, nails and other fasteners for a wide range of industrial applications. Subcommittee F16.02 on Steel Bolts, Nuts, Rivets and Washers offers standards that specify products and components used in bridge construction. These include a specification for structural bolts, steel, heat treated, 120/105 ksi minimum tensile strength (A325), which covers the requirements for two types of heavy hex structural bolts made of quenched and tempered steel, and for hardened steel washers (F436), covering washers for mechanical and structural use with bolts, nuts, studs and other internally and externally threaded fasteners.

Committee E17: Enhancing Road Safety and Traffic Management

The standards of ASTM Committee E17 on Vehicle-Pavement Systems help to ensure safe journeys on roads and highways. Committee E17 maintains more than 70 standards related to pavement management technologies, vehicle pavement interactions and intelligent transportation systems.


- One important aspect of E17 activities is measuring pavement friction and skid resistance. Its test method for skid resistance of paved surfaces using a full-scale tire (E274) offers transportation industry stakeholders a valuable testing tool. An important standard from Subcommittee E17.21 on Field Methods for Measuring Tire Pavement Friction is a method for measuring the skid resistance of pavements and other trafficked surfaces using a continuous reading, fixed-slip technique (E2340). Regulatory agencies and state highway departments can use E2340 to reduce the potential of skidding accidents by identifying pavements that have become too slippery to be safe.
- Traffic management agencies and traffic monitoring device manufacturers benefit from such E17 standards as the specification for highway traffic monitoring devices (E2300) and the test methods for evaluating the performance of highway traffic monitoring devices (E2532). Both of these standards provide methods for specifying and conducting acceptance tests for devices used to monitor and measure traffic flow parameters such as vehicle count, speed, lane occupancy and vehicle presence.
- Profilograph simulation programs, such as those currently in use by the U.S. Federal Aviation Administration and the U.S. Federal Highway Administration, are used for quality control in pavement construction. A standard practice for simulating profilograph response to longitudinal profiles of traveled surfaces (E2955) enables a practical way to evaluate smoothness and rideability issues.
- Many state departments of transportation also collect traffic data to better manage traffic or provide travel information as part of intelligent transportation systems (ITS). Some agencies save and archive this data after its initial real-time use and make it available to other data users, who may know little about the data or how it was collected. To make this historical data more useful in improving the overall efficiency of transportation systems, Committee E17 offers the ASTM specification for archiving ITS-generated traffic monitoring data (E2665), which covers a consistent way to document such data.

Facilitating the Development of Green Highways

With the increased focus on our planet's long-term environmental health, work to rebuild our nation's infrastructure must be pursued in a manner that considers natural resources. Promoting sustainability in highway construction is the focus of standards development activities in numerous ASTM technical committees.

- Subcommittee D04.99 on Sustainable Asphalt Pavement Materials and Construction is developing standards involving sustainable bituminous materials and construction that consider and improve environmental impact. This includes asphalt materials that utilize recycled materials and industrial byproducts, such as reclaimed asphalt pavement and roofing shingles, and ground tire rubber. The group is moving forward to develop new standard guides for using recycled asphalt pavement and recycled asphalt shingles, among others.
- The use of recycled materials in highway construction is also the focus of Subcommittee D18.14 on Geotechnics of Sustainable Construction. The group is working on standards related to using industrial byproducts together with earth materials for sustainable infrastructure construction.
- The activities of these two groups complement other ASTM activities for sustainable highway construction materials. In addition to those mentioned, Subcommittee C09.24 on Supplementary Cementitious Materials offers standards that enable the reuse of industrial materials in concrete, including test methods for sampling and testing fly ash or natural pozzolans for use in portland cement concrete (C311) and the specification for coal fly ash and raw or calcined natural pozzolan for use in concrete (C618). Several new standards are also in development by C09.24. Similar goals are being achieved by Subcommittee C09.27 on Ground Slag, which develops standards for reusing ground granulated blast-furnace slag.

The ongoing reliability and safety of roads and highways are essential to the quality of our everyday lives and the long-term economic vitality of our nation. As we set out to strengthen highway infrastructure for the future, ASTM standards are prepared to help guide the way.



ASTM International technical committees highlighted in this piece include:

- A01 on Steel, Stainless Steel and Related Alloys
- C01 on Cement
- C09 on Concrete and Concrete Aggregates
- D04 on Road and Paving Materials
- D18 on Soil and Rock
- D35 on Geosynthetics
- E12 on Color and Appearance
- E17 on Vehicle-Pavement Systems
- F16 on Fasteners
- F17 on Plastic Piping Systems

ASTM INTERNATIONAL

Helping our world work better

Over 12,000 ASTM standards operate globally. Defined and set by us, they improve the lives of millions every day.

Combined with our innovative business services, they enhance performance and help everyone have confidence in the things they buy and use – from the toy in a child's hand to the aircraft overhead.

Working across borders, disciplines and industries we harness the expertise of over 30,000 members to create consensus and improve performance in manufacturing and materials, products and processes, systems and services.

Understanding commercial needs and consumer priorities, we touch every part of everyday life: helping our world work better.

ASTM International

100 Barr Harbor Drive
P.O. Box C700
West Conshohocken, PA
19428-2959
USA
tel +1.610.832.9500
fax +1.610.832.9555
service@astm.org
www.astm.org