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ASTM Energy Standards Helping to Power Our Lives

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D02

The global leader in standards that fuel our world

ASTM Energy Standards: Powering Our Lives

As the world confronts the linked issues of economic growth and environmental sustainability, energy will play a central role. Growing demands for energy are converging with shrinking natural resources and rising concerns over climate change.

Spurred on by these challenges, research and innovation are bringing forward cleaner, safer, and renewable forms of energy to fuel cars and airplanes, heat homes and offices, and provide other kinds of power. Whether it's aviation fuel, biodiesel, natural gas, nuclear energy, solar panels, or something else, the work of ASTM International committees continues to advance the energy sector. ASTM standards help drive the development, production, distribution, and commerce of energy worldwide.

D02: Global Leader in Petroleum Standards
Committee D02 has earned a worldwide reputation for high quality, market-relevant standards. D02 maintains close alliances with leading energy consortia and organizations around the globe. Hundreds of its standards are used globally by more than 90 countries.

Since 1904, Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants has developed the world's most respected standards, including fuels for automobiles and airplanes, lubricants for machinery, and heat for homes. Virtually every product that requires fuel or operates on moving parts depends on the more than 825 international standards from D02. Today, D02 is ASTM's largest committee with more than 2,400 members from about 70 countries.

Leadership in Aviation and Automobile Fuels
D02 makes the world-renowned standards for aviation fuels. The standards define specific types of jet and piston aircraft fuels for civil applications; they describe the requirements for fuel quality at every step of the process, from the refinery to the aircraft.

For example, the standard for aviation turbine fuel containing synthesized hydrocarbons (D7566) and the standard for aviation turbine fuels (D1655) ensure fuels are clean and contaminant free, helping planes fly safety and efficiently.

The committee also develops specifications that provide for cleaner gasoline and better automobile performance. Globally recognized D02 standards such as D2699 and D2700 assure consumers of the indicated octane numbers — a familiar gasoline quality linked to product performance — when filling their cars with gas. Regulators, engine manufacturers, gasoline refiners, and marketers use octane numbers as a primary measurement to match fuels with engines.

Advancing Alternative Fuels
Committee D02 also develops standards for alternative and renewable fuels such as ethanol and biodiesel.

Ethanol is used as a gasoline extender and octane enhancer. D02 standards assist in its production and use:

- Standard D5798 (the specification for fuel ethanol in automotive spark-ignition engines) helps with producing E85 (51 to 83 volume % ethanol) fuel, also known as "Ethanol Flex-Fuel," for ground vehicles.
- Similarly, D4806 (the specification for denatured fuel ethanol for blending with gasoline) covers ethanol intended to be blended with gasoline to produce E10 (15% ethanol). This standard is used in conjunction with D02's widely accepted automotive fuels specification (D4814).

D02 is also responsible for standards for biodiesel, an alternative fuel derived from vegetable oils or animal fats. Biodiesel use helps reduce the use of petroleum. D02's flagship biodiesel standard is D6751 for biodiesel fuel blend stock, a specification that refers to the pure fuel before blending with diesel fuel.

Notably, the U.S. law that promotes alternative fuels and higher fuel economy standards mandates that all biodiesel used as fuel blend meet D6751 performance requirements.

Additional biodiesel standards include:
- D7467 covers finished fuel blends between 6% and 20% biodiesel for on- and off-road diesel engines;
- D975, the definitive standard for diesel fuel oils, plays an important role in powering trucks, buses, tractors, snowplows, and more; and
- D396 helps improve the quality of fuel oils used for home heating and boiler applications.

Committee D02 also supports the use of renewable aviation fuels. For example, D7566 incorporates synthesized iso-paraffinic (SIP) fuel produced from hydro-processed fermented sugars. The standard helps support the safe use of this carbon aviation fuel by airlines.

Standards help drive innovation in areas such as fuel cells, which use hydrogen and produce almost no pollution.

Supporting Advances in Gaseous Fuels

Hydrogen and Fuel Cells

Subcommittee D03.14 develops standards that support hydrogen in energy generation or as feed gas for fuel cells and other gaseous fuels.

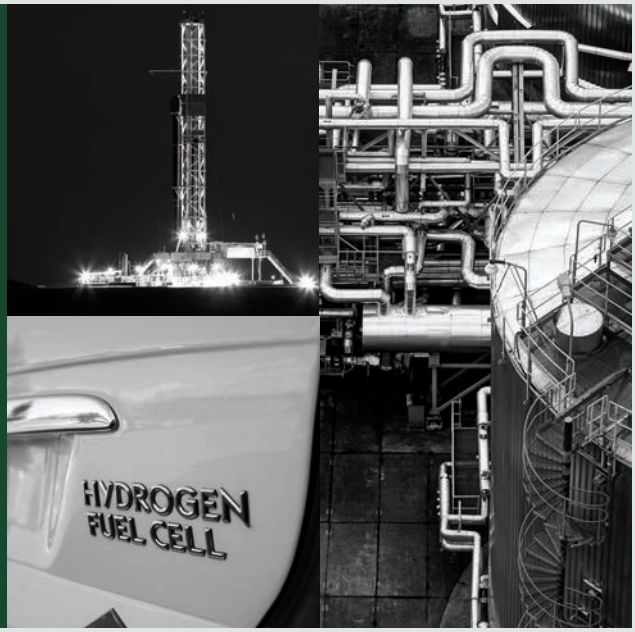
Hydrogen Thermophysical Property Tables

A standard specification (D7265) provides a valuable reference for engineers designing equipment for hydrogen generation, transport, storage, and delivery to vehicles and appliances.

Hydraulic Fracturing

Subcommittee D18.26 is working to guide operations in hydraulic fracturing and protect downstream air, land, and water resources.

ASTM standards development activities support hydrogen in energy generation and in hydraulic fracturing.



Subcommittee D02.J0 on Aviation Fuels is addressing biomass-produced fuels that would help reduce such greenhouse gases as carbon dioxide. The group aims to develop standards for synthesized hydrocarbon turbine fuels, alternative fuels derived from coal via synthesis processes (such as Fischer-Tropsch), and paraffinic kerosene blend stocks synthesized from natural gas.

D02: A Proven Global Reputation

D02's global reach can also be seen in ASTM's Proficiency Testing Programs (PTP), which help ensure statistical quality assurance. PTP help laboratories to assess how well they conduct test methods through comparing their data with that of other laboratories. Of the more than 4,500 laboratories that participate, more than 50 percent are from outside the United States. Related training courses provide high quality continuing education for industry and government. More than 50 classes on petroleum products, coal chemistry, the environment, and other topics are scheduled annually, and an online training series is geared toward petroleum laboratory technicians.

Committee D03: Supporting Advances in Natural Gas

Another important energy source that helps meet day-to-day needs is natural gas. A vital component of the world's energy supply, natural gas is one of the cleanest, safest, and most useful of all energy sources. Committee D03 on Gaseous Fuels develops standards for natural gas, biogas sourced natural gas, hydrogen fuel cell gases, and other gaseous fuels as well as analytical methods to confirm gaseous fuel quality.

For example, one standard has paved the way for more efficient hydrogen use. D7265 (hydrogen thermophysical property tables) provides a valuable reference for engineers designing equipment for hydrogen generation, transport, storage, and delivery to vehicles and equipment.

Alternative and renewable energy is another important focus of D03 standards development. Hydrogen is a clean energy source that offers great potential as an environmentally friendly solution to power automobiles, heat buildings, and more. Engines that use pure hydrogen produce almost no pollution. Fuel cells are the technology that converts hydrogen into usable energy for a variety of transportation and building-related equipment. Often compared to batteries, fuel cells combine hydrogen and oxygen to produce electricity.

Subcommittee D03.14 on Hydrogen and Fuel Cells works on numerous standards for using and analyzing hydrogen in energy generation or as feed gas for fuel cells and other gaseous fuels. D03.14 has developed more than 10 standards to assist in gas sampling, analysis, and composition; thermophysical properties; on line/at line testing; and other critical areas related to hydrogen and fuel cells. These standards include:

- D7550 (determination of ammonium, alkali, and alkaline earth metals in hydrogen) details a procedure to determine cations in fuel cell feed gases, which are necessary to ensure a feed gas is of sufficient purity for fuel cell systems; and
- D7941 covers hydrogen purity analysis in a method to measure contaminants in fuel-cell-grade hydrogen.

Promoting Safer Natural Gas Production

With the ongoing global interest in new energy sources, hydraulic fracturing holds great promise in driving continued energy growth. The oil and gas industry increasingly turns to this technology to tap into vast reserves of oil, natural gas, and even geothermal energy located in shale formations thousands of feet below the earth's surface. Hydraulic fracturing maximizes the extraction of these previously inaccessible resources.

Subcommmittee D18.26 on Hydraulic Fracturing aims to further best practices for this technology. A part of Committee D18 on Soil and Rock, the group is pursuing standards to better guide operations in the field and protect downstream air, land, and water resources. Several new standards currently under development address critical aspects of hydraulic fracturing operations, including groundwater monitoring, engineering, and drilling techniques as well as data management and reporting. The group's first standard, on monitoring water wells (D8006), guides how to gather samples and obtain representative data about the well water.

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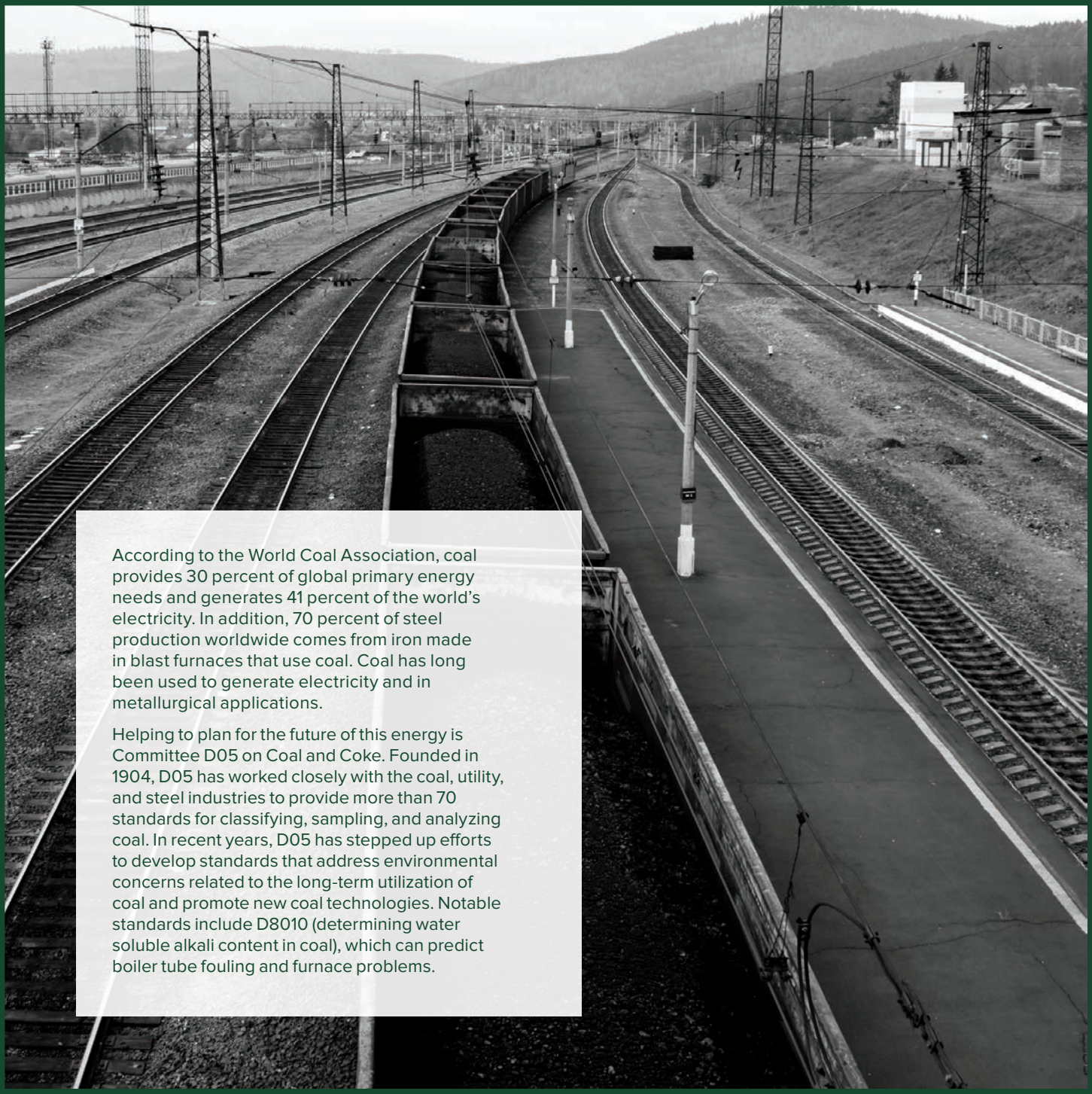
D05 and the Future of Coal



According to the World Coal Association, coal provides 30 percent of global primary energy needs and generates 41 percent of the world's electricity. In addition, 70 percent of steel production worldwide comes from iron made in blast furnaces that use coal. Coal has long been used to generate electricity and in metallurgical applications.

Helping to plan for the future of this energy is Committee D05 on Coal and Coke. Founded in 1904, D05 has worked closely with the coal, utility, and steel industries to provide more than 70 standards for classifying, sampling, and analyzing coal. In recent years, D05 has stepped up efforts to develop standards that address environmental concerns related to the long-term utilization of coal and promote new coal technologies. Notable standards include D8010 (determining water soluble alkali content in coal), which can predict boiler tube fouling and furnace problems.

50+ renewable energy standards address the conversion of energy from the sun and the earth.

Leading Global Standards for Renewable Energy
Committee E44 on Solar, Geothermal, and Other Alternative Energy Sources develops standards focused on converting solar and geothermal renewable energy to directly usable energy forms. E44's 50+ standards address such areas as the heating of domestic hot water; active and passive space heating and cooling; process heating; thermal conversion power generation; photovoltaic (PV) generation of electricity; and advanced energy conversion, including wind energy.

A major committee focus is solar energy technologies that take advantage of the sun to provide heat, light, hot water, and electricity for homes and businesses. A primary example is PV (solar cell) systems that convert sunlight directly into electricity — an interconnected assembly of solar panels — and are installed on rooftops to supplement power used in homes and offices.

E44 supports PV technology through Subcommittee E44.09 on Photovoltaic Electric Power Conversion, which is responsible for more than 20 standards. Many ASTM standards form the foundation of qualification standards from other standards developers such as the Institute of Electrical and Electronics Engineers and the International Electrotechnical Commission.

- E2527 (performance of photovoltaic systems under natural sunlight) offers a recognized procedure for testing and reporting the electrical performance of a photovoltaic concentrator module or system.
- E1171 (photovoltaic modules in cyclic temperature and humidity environments) provides industry with useful guidelines to assess performance in varying conditions.
- E3006 helps screen out PV module materials that would degrade quickly when exposed to ultraviolet radiation from sunlight.

With new system installers entering the market, there has been a growing need for best installation practices for both residential and commercial PV use. E2766 addresses the installation of roof mounted PV arrays. The standard includes requirements such as proper water-shedding integration with the existing roof system, water sealing of roof penetrations, and sufficient anchoring per regional pressure load requirements. Also included are safety and hazard considerations such as worker fall protection on high pitched roofs, electrical exposure, accessibility of modules, and roof clearance around the array perimeter.

Another standard details the minimum requirements for the installation, commissioning, operations, and maintenance process during the expected life of a PV power plant (E3010). This responds to the needs of industry stakeholders, specifically investors and insurers, to support large-scale commercial photovoltaic installations and to help ensure safe and reliable power generation.

Quality and Safety in Solar Power Systems
Complementing the activities of E44.09 are those of Subcommittee E44.05 on Solar Heating and Cooling Systems and Materials. E44.05 develops a wide range of practices for safe and reliable design, installation, and operation of solar heating and cooling systems. These standards are used by designers, manufacturers, distributors, installers, contractors, regulatory officials, and building owners:

- E424 (solar energy transmittance and reflectance) helps building designers select and specify glazing materials for solar energy transmittance;
- E683 (installation and service of solar space heating systems) helps ensure adequate performance, safety, and customer satisfaction; and
- E1056 helps with installing and servicing solar domestic water heating systems.

Looking to the Future
Committee E44 is taking aim at other standardization needs to further propel the commercialization and adoption of solar energy technologies. The committee is currently working on a proposed specification for heat metering equipment requirements and durability tests for renewable energy materials and components.

Tapping the Power of the Earth's Core

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countries use E1675 to sample gas thermal fluid.

Geothermal energy — the energy contained in the rocks and fluids of the earth — offers great potential as an abundant source of renewable power. This energy can be found in shallow ground and in the hot water and hot rock located a few miles beneath the earth's surface. Geothermal energy is clean, sustainable, and available 24 hours a day. Tapping into this resource to heat and cool buildings requires geothermal systems, which include a heat pump, an air delivery system, and a heat exchanger, which is a system of pipes buried in shallow ground.

Geothermal energy science and application are the focus of the standards development efforts of Subcommittee E44.15 on Geothermal Field Development, Utilization, and Materials. E44.15 standards improve communications by providing consistent terminology and offering practices and test methods to evaluate the quality of geothermal resources, determine material compatibility for geothermal hardware, and define the performance of power conversion technologies.

The most widely accepted E44.15 standard is E1675 for sampling geothermal fluid for chemical analysis. E1675 is used in 17 countries to guide the collection of representative samples of the steam and liquid phases as they exist in the pipeline. To help further advance geothermal energy technologies, E44.15 has begun developing a new practice aimed at defining requirements for the installation, testing, commissioning, and maintenance of closed loop geothermal heat exchangers.

Committees Contribute to Safe Nuclear Energy

ASTM committees help advance safe nuclear power and technology.

One such committee is C26 on Nuclear Fuel Cycle, which has more than 180 professionals, is responsible for more than 170+ standards, and plays a critical role in all aspects important to the nuclear fuel cycle, including spent nuclear fuel, waste materials, and repository waste packaging and storage. The standards support commerce, worker safety, public and environmental health, and regulatory compliance within the nuclear fuel cycle. On the commercialization side, the committee's standards contribute to the development of nuclear fuel cycle products. C26 maintains a close relationship with the U.S. Nuclear Regulatory Commission.

- C996 (the specification for uranium hexafluoride) provides the nuclear industry with a standard for enriched uranium used in fuel fabrication.
- C1751 (how to sample radioactive tank waste) provides guidance on techniques and devices used to obtain grab samples from tanks containing high level radioactive waste created during the reprocessing of spent nuclear fuels. (Because of the high level of radiation exposure, access is limited to these tanks.)
- C1672, developed in response to fuel producer requests worldwide, determines uranium or plutonium isotopic composition. The test method is used for waste handling and disposition, establishing inventory values as part of a safeguard system, environmental analysis, nuclear forensics, and bioassay applications.

Standards from Committee E10 on Nuclear Technology and Applications promote nuclear science and the safe application of nuclear energy. These standards cover many topics, including radiation dosimetry, structural materials, and the decontamination, decommissioning, and extended life operation of nuclear facilities. E10 standards also help protect the public from potential nuclear-related hazards and contribute to the health and safety of nuclear facility workers.

- E1168 (radiological protection training for nuclear facility workers) defines the elements of a health and safety training program for workers at nuclear energy plants.
- E2956 (how to monitor the neutron exposure of light water reactor pressure vessels) establishes the means and frequency of monitoring the neutron exposure of pressure vessels throughout the reactor's operating life. (This standard addresses a U.S. Nuclear Regulatory Commission requirement for light water reactor materials surveillance.)
- A practice for light-water moderated nuclear power reactors (E185) helps in designing a surveillance program to monitor radiation-induced changes.

Defining the Next Generation of Nuclear Plants
Current Committee E10 efforts aim to support new and improved nuclear plant systems and designs. A group of countries has agreed on a framework for cooperation in research about a new generation of safer, more reliable, and more sustainable nuclear systems called Generation IV. E10 is evaluating standards needs for addressing near-term issues related to Generation IV reactors.

ASTM Nuclear Road Map: Comprehensive Knowledge for Industry Stakeholders
To document the work and approach for nuclear-related standards over the coming years, stakeholders have developed a road map that details upcoming plans. To learn more, visit the home pages of either Committee C26 (www.astm.org/COMMITTEE/C26.htm) or E10 (www.astm.org/COMMITTEE/E10.htm).

In the ever-changing field of energy, ASTM International will continue to remain a constant source of high quality standards that meet the needs of industry stakeholders and consumers around the world.

Empowering Innovation in Biomass Energy

Biomass is another dynamic renewable energy form that is on the agenda of ASTM technical committees. Biomass comes from biological material (particularly wood or plants); agriculture residue (corn, wheat, and sugar cane); forest remains (dead trees, branches, and tree stumps); and organic components of municipal and industrial wastes. Biomass can be converted directly into liquid biofuels such as ethanol and biodiesel.

Subcommittee E48.05 on Biomass Conversion is addressing standardization needs of biomass through a wide range of specifications and test methods. Committee members include representatives from the National Renewable Energy Lab, the U.S. Food and Drug Administration, and others from around the world. E48.05 standards also support research, testing, and production of biofuels. Its most recent standard, E3050, supports ethanol as a cooking fuel.

E871

(moisture analysis of particulate wood fuels) supports the testing of fuels derived from wood sources such as sander dust, sawdust, pellets, green tree chips, and mill refuse.

E1758

(determining carbohydrates in biomass) is a test method for biomass materials, including hard and soft woods, herbaceous materials (switch grass and sericea); agricultural residues (corn stover, wheat straw, and bagasse); waste paper (office waste, boxboard, and newsprint); and others.

Committee D34 on Waste Management also develops standards for renewable energy in Subcommittee D34.03 on Treatment, Recovery, and Reuse. D34.03 standards are used to research and produce refuse-derived fuels (RDF), which consist of organic components of municipal wastes such as plastics and biodegradable waste. RDF producers and users benefit from standards such as E953 for fusibility of refuse-derived fuel ash and E791 for calculating refuse-derived fuel analysis data.

ASTM International technical committees highlighted in this piece include:

- C26 on Nuclear Fuel Cycle
- D02 on Petroleum Products, Liquid Fuels, and Lubricants
- D03 on Gaseous Fuels
- D05 on Coal and Coke
- D18 on Soil and Rock
- D34 on Waste Management
- E10 on Nuclear Technology and Applications
- E44 on Solar, Geothermal, and Other Alternative Energy Sources
- E48 on Bioenergy and Industrial Chemicals from Biomass

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.

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