



ASTM Energy Standards:

Helping to Power Our Lives

As the world confronts the challenges of economic growth and environmental safety, energy will play a central role in the future of these closely related issues. Growing demands for energy are converging with shrinking natural resources and rising concerns over the consequences of climate change.

Spurred on by these challenges, research and innovation is bringing forward cleaner, safer forms of energy to fuel automobiles and airplanes, heat our homes and offices, and provide power for our daily lives. Whether it's aviation fuel, biodiesel, natural gas, nuclear and solar technology, renewable energy sources or much more, the work of ASTM technical committees has an enduring and measurable impact in this field. ASTM International standards make a valuable contribution to the development, production and distribution of energy worldwide.



ASTM COMMITTEE D02: THE GLOBAL SOURCE FOR PETROLEUM STANDARDS

Since 1904, ASTM Committee D02 on Petroleum Products and Lubricants has developed standards that have helped provide fuels for automobiles and airplanes, lubricants for machinery and heat for homes. Virtually any product that requires fuel or operates on moving parts depends on the more than 725 international standards developed by Committee D02. Today, D02 is ASTM's largest technical committee with more than 2,200 members who represent 65 countries.

LEADERSHIP IN AVIATION AND AUTOMOBILE FUELS

One of the most important contributions that D02 has made is in the area of aviation fuels. D02 standards for jet and aviation fuels help define specific types of aviation gasoline and turbine fuels for civil applications. A critical use of these standards is in describing the quality of aviation turbine fuels from the refinery to the aircraft. These technical documents, such as ASTM D7566, **Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons**, and ASTM D1655, **Specification for Aviation Turbine Fuels**, contribute to the production of fuels that are clean and contaminant free, ultimately leading to the safe and economical operation of aircraft.

Similarly, Committee D02 has been instrumental in providing specifications that provide for cleaner gasoline and better automobile performance. D02 standards such as D2699, **Test Method for Research Octane Number of Spark-Ignition Engine Fuel**, ensure consumers of the indicated octane numbers — a familiar gasoline quality that links to product performance — when filling their cars with gas. Legislators, along with engine manufacturers, petroleum refiners and marketers, use octane numbers as a primary measurement to match fuels with engines.

ADVANCING ALTERNATIVE FUELS

ASTM Committee D02 has a proud legacy in developing standards that address alternative fuels such as ethanol and biodiesel. Ethanol is widely used in the United States as a gasoline extender and octane enhancer; it also helps to reduce harmful emissions.

Committee D02 has contributed a large portfolio of standards that assist in the production of ethanol. Several of these notable standards went through their latest round of revisions in 2008, including D5798, **Specification for Fuel Ethanol (Ed75-Ed85) for Automotive Spark-Ignition Engines**. This is the key specification used in the production of E85 (85% ethanol) motor fuel for flexible fuel ground vehicles. Similarly, D4806, **Specification for Denatured Fuel Ethanol for Blending with Gasolines for Use as Automotive Spark-Ignition Engine Fuel**, is the specification for the ethanol intended to be blended with gasoline to produce E10 (10% ethanol). D4806 is used in close conjunction with D4814, **Specification for Automotive Spark-Ignition Engine Fuel** — D02's widely accepted automotive fuels specification. Future activi-

ties will address mid-level ethanol blends between E10 and E85.

In addition, Subcommittee D02.J0 on Aviation Fuels is addressing biomass-produced fuels that would help reduce such greenhouse gases as carbon dioxide. Emerging activities are aimed at 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.

Committee D02 is also the authoritative source for standards used in the development of biodiesel: an alternative fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats. Biodiesel use helps reduce such air pollutants as particulates, carbon monoxide, hydrocarbons and air toxins. D02's flagship biodiesel standard is D6751, **Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels**, a standard that refers to the pure fuel before blending with diesel fuel.

The value and impact of D6751 was underscored with the 2007 passage of the Energy Independence and Security Act, the U.S. law that promotes the use of alternative fuels and higher fuel economy standards, and mandates that all biodiesel used as fuel blend meets D6751 performance specifications.

Committee D02 broke new ground in 2008 with the release of a series of new and revised biodiesel standards. New to the biodiesel standards portfolio is D7467, **Specification for Diesel Fuel Oil, Biodiesel Blend (B6 to B20)**. D7467 covers finished fuel blends of between 6% and 20% biodiesel for on-and off-road diesel engine use. In addition, two of D02's widely used diesel and burner fuel specifications were also revised to provide allowances for up to B5 (5% biodiesel) blends. These include D975, **Specification for Diesel Fuel Oils**, which is the definitive standard for diesel fuels used today. D975 plays an important role in the production of diesel fuels used to power vehicles and equipment such as trucks, buses, tractors and snowplows. Also revised to include an allowance for up to 5% biodiesel was D396, **Specification for Fuel Oils**, which helps improve the quality of fuels used for home heating and boiler applications.

D02: A PROVEN GLOBAL REPUTATION

Committee D02 has earned a worldwide reputation for high quality, market-relevant standards. With its international membership, D02 maintains close alliances and liaison with leading energy consortia and organizations around the globe. Further evidence of D02's vast global reach can be seen in its **Interlaboratory Crosscheck Program (ILCP)** and **Technical and Professional Training (TPT)**. ILCP is a statistical quality assurance program that enables laboratories to assess their performance in conducting test methods through comparing their data against that of other participating laboratories. Of the more than 2,000 laboratories that participate in the ILCP, more than 55% are from outside the United States. The TPT courses are high quality continuing technical education programs for industry and government. More than 100 different classes on petroleum products, coal chemistry, environment and other topics are scheduled annually.

COMMITTEE D03: SUPPORTING ADVANCES IN NATURAL GAS

Another important source of energy that helps meet day-to-day needs and activities is natural gas. A vital component of the world's supply of energy, natural gas is one of the cleanest, safest and most useful of all energy sources. Serving the standardization needs of the natural gas industry is the focus of ASTM **Committee D03 on Gaseous Fuels**. Formed in 1935, Committee D03 develops standards for natural gas, reformulated natural gas, hydrogen, fuel cell gases and other miscellaneous gaseous fuels.

One of Committee D03's most recent standards is paving the way for more efficient hydrogen use. **D7265, Specification for Hydrogen Thermophysical Property Tables**, provides a valuable reference for engineers designing equipment for hydrogen generation, transport, storage and delivery to vehicles and appliances.

Alternative energy is also an important part of Committee D03's current standards development initiatives. Notable activities include those of Subcommittee D03.14 on Hydrogen and Fuel Cells, which is working on numerous standards relating to the use of hydrogen in energy generation or as feed gas to low, medium and high temperature fuel cells and other gaseous fuels. At the time of writing, D03.14 has a series of 12 standards under review in this exciting alternative energy field.

D05 AND THE FUTURE OF COAL

According to the World Coal Institute, coal provides 26% of global primary energy needs and generates 41% of the world's electricity. In addition, 68% of steel production worldwide comes from iron made in blast furnaces that use coal. The role of coal in power generation and metallurgical applications is well-entrenched and set to continue into the future.

Helping to plan for the future of this energy is ASTM **Committee D05 on Coal and Coke**. Founded in 1904, Committee D05 has worked closely with the coal, utility and steel industries to provide approximately 80 standards for classifying, sampling and analyzing coal. In recent years, Committee D05 has stepped up its efforts to develop standards that acknowledge the environmental aspects critical to the long-term utilization of coal and promote new coal technologies. This focus received a boost in 2005 when NESHAP (National Emission Standards for Hazardous Air Pollutants) for Industrial, Commercial and Institutional Boilers and Process Heaters adopted Committee D05 measurement methods for determining compliance with federal emission regulations. Among these standards are methods for gross calorific value, sulfur emissions, mercury emissions as related to chlorine content, and trace metals in coal and utility ash.

In 2008, Committee D05 continued its efforts to develop standards for measuring the carbon content of coal with the release of revised standard **D5373, Test Methods for Instrumental Determination of Carbon, Hydrogen and Nitrogen in Laboratory Samples of Coal**. D5373 provides methods to determine carbon in coal, which is essential to the reliable accounting of carbon dioxide emissions.

DETECTING NATURAL GAS IN COAL

Natural gas from unconventional sources such as coal beds has become a common target for exploration in recent years. However, there are no guides or practices available that describe procedures used to determine the gas content of coal in North America. Committee D05 is working to fill this need by developing a practice for determining the gas content of coal. The new standard will help government, industry and research laboratories to establish procedures for equipment construction, sample preparation and test methods.

ASTM COMMITTEES CONTRIBUTE TO SAFE NUCLEAR ENERGY

Helping to advance the growth of safe nuclear power and technology is the focus of the standards activities of several ASTM committees. One such committee is **C26 on Nuclear Fuel Cycle**. With a membership of more than 200 professionals and a portfolio of approximately 160 standards, Committee C26, which maintains a close relationship with the U.S. Department of Energy, 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. Committee C26 standards facilitate commerce, worker safety, public and environmental health, and regulatory compliance within the nuclear fuel cycle. On the commercialization side, C26 standards make an important contribution to the development of nuclear fuel cycle products. For example, **ASTM C996, Specification for Uranium Hexafluoride Enriched to Less Than 5% ²³⁵U**, provides the nuclear industry with a standard for enriched uranium used in fuel fabrication.

To assist industry stakeholders with nuclear waste management, Committee C26 developed standard **C1174, Practice for Prediction of the Long-Term Behavior of Materials, Including Waste Forms, Used in Engineered Barrier Systems (EBS) for Geological Disposal of High-Level Radioactive Waste**. This standard describes test methods and data analyses for models that predict the long-term behavior of materials, such as waste forms, used in the geologic disposal of spent nuclear fuel and other high level radioactive waste.

One of the newer methods in the C26 portfolio comes in response to requests from fuel producers around the world. **ASTM C1672, Test Method for Determination of Uranium or Plutonium Isotopic Composition or Concentration by the Total Evaporation Method Using a Thermal Ionization Mass Spectrometer**, outlines the use of thermal ionization mass spectrometers to determine the isotopic composition and elemental concentration of nuclear fuel components. Compared to conventional methods, the total evaporation method offers increased sample throughput, reduced sample sizes, improved precision and potentially improved accuracy, and it is generally freer from interferences. C1672 will be used for waste handling and disposition, establishing inventory values as part of a safeguard system, environmental analysis, nuclear forensics and bioassay applications.

The standards developed by **Committee E10 on Nuclear Technology and Applications** promote the advancement of nuclear science and technology and the safe application of nuclear energy in all forms. The more than 105 standards developed by E10 cover many topics important to the nuclear industry, including radiation dosimetry, structural materials and the decontamination, decommissioning and extended life operation of nuclear facilities.

E10 standards play an important role in protecting the public from potential nuclear-related hazards as well as facilitating the health and safety of nuclear facility workers. A notable example is **ASTM E1168, Guide for Radiological Protection Training for Nuclear Facility Workers**, which defines the elements of a health and safety training program for the radiological protection of workers at nuclear facilities.

HELPING DEFINE THE NEXT GENERATION OF NUCLEAR FACILITIES

Newer initiatives within Committee E10 are aimed at developing standards for new and improved nuclear plant systems and designs. A group of countries, including the United States, has agreed on a framework for cooperation in research about a new generation of safer, reliable and sustainable nuclear systems called Generation IV. Committee E10 is evaluating standards needs for addressing near-term issues related to Generation IV reactors.

One other notable ASTM technical group in the nuclear energy field is **Committee D33 on Protective Coating and Lining Work for Power Generation Facilities**. The standards developed by Committee D33 cover the evaluation, selection, application and maintenance of protective coatings used at power generation facilities. Many D33 standards focus on nuclear power, including **ASTM D5144, Guide for Use of Protective Coating Standards in Nuclear Power Plants**. This standard provides a common basis to qualify and select protective coatings for the surfaces of nuclear power generating facilities using reproducible evaluation tests. It also provides guidance for protective coatings application and maintenance.

E44, E48 PROMOTE RENEWABLE ENERGY
ASTM Committee E44 on Solar, Geothermal and Other Alternative Energy Sources develops standards for converting solar and geothermal renewable energy to directly usable energy forms. E44 standards cover many areas of renewable energy: solar heating and cooling systems and materials; photovoltaic electronic

power conversion; and geothermal utilization and materials.

Solar power continues to gain popularity as an affordable energy form that also advances the goals of environmental sustainability. Here, E44 standards such as **E424, Test Methods for Solar Energy Transmittance and Reflectance (Terrestrial) of Sheet Materials**, assist building designers in selecting and specifying glazing materials for solar energy transmittance.

Committee E44's newest subcommittee, E44.20 on Glass for Solar Applications, has begun work in five areas related to glass and glass coatings for solar purposes: photovoltaics, glass characteristics, coatings, film quality, and durability and reliability.

Also addressing renewable energy standards needs is Subcommittee E48.05 on Biomass Conversion, which is part of **ASTM Committee E48 on Biotechnology**. E48.05 has developed several standards, including **E871, Test Method for Moisture Analysis of Particulate Wood Fuels**. The group's standards cover the design and evaluation of ethanol manufacturing facilities, wood fuel characterization, anaerobic digestion systems and the cellulosic ethanol industry, from the field production to the plant where the refining process begins. Subcommittee E48.05 currently has representation from the National Renewable Energy Lab, a subsidiary of the U.S. Department of Energy, along with the U.S. Food and Drug Association.

PROTECTING THE SAFETY OF ELECTRICAL WORKERS

While this overview focuses on ASTM technical committees involved in the research, development and production of various forms of energy, the activities of one other ASTM committee is also important to note. **Committee F18 on Electrical Protective Equipment for Workers** develops critical safety standards that protect the health and well-being of electrical workers. By providing specifications for worker clothing and apparel, insulating and coverup materials, tools and related equipment, F18 standards, including **F2178, Test Method for Determining the Arc Rating and Standard Specification for Face Protective Products**, and **F2677, Specification for Electrically Insulating Aprons**, play an essential role in protecting electrical workers.

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

ASTM INTERNATIONAL TECHNICAL COMMITTEES ON ENERGY

The ASTM technical committees highlighted in this piece include:

- ▶ C26 on Nuclear Fuel Cycle
- ▶ D02 on Petroleum Products and Lubricants
- ▶ D03 on Gaseous Fuels
- ▶ D05 on Coal and Coke
- ▶ D33 on Protective Coating and Lining Work for Power Generation Facilities
- ▶ E10 on Nuclear Technology and Applications
- ▶ E44 on Solar, Geothermal and Other Alternative Energy Sources
- ▶ E48 on Biotechnology
- ▶ F18 on Electrical Protective Equipment for Workers