

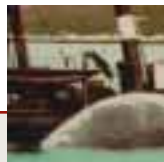
in context

A TIMELINE OF HIGHLIGHTS FROM THE HISTORIES OF ASTM COMMITTEE D02 AND THE PETROLEUM INDUSTRY

BY GEORGE E. TOTTEN, Ph.D.

This abridged timeline highlights the history of Committee D02 on Petroleum Products and Lubricants and key moments in the history of the petroleum and related industries. For the unabridged version, see the D02 homepage at www.astm.org/COMMIT/D02.htm.

- 1849** Canadian Abraham Gesner develops a process to distill kerosine (coal oil) from cannel coal and bituminous shale; he will become known as the “father of the petroleum industry.” Kerosine is easy to produce, cheap, smells better than animal-based fuels when burned, and does not spoil on the shelf as does whale oil.
- 1854** The Pennsylvania Rock Oil Company, the first oil company in the United States, is formed.
- 1859** Edwin L. Drake opens the first commercially successful oil well in the United States drilled for the sole purpose of finding oil. Oil is shipped in 42-gallon [159 L] barrels. The 42-gallon barrel was established in 1482 by King Edward IV as the standard for the packing of fish. The drilling of the Drake Well begins an international search for petroleum.
- 1862** Early problems disposing of the gasoline fraction lead to the contamination of kerosine resulting in subsequent fires, and this leads to the development and standardization of flash-point methods. The United Kingdom enacts the Petroleum Act, which defines a “flammable liquid” as one having a flash point below 100°F [38°C].
- 1876** Nicolaus Otto invents the first four-stroke internal combustion engine, the Otto Cycle Engine, which he uses to build a motorcycle.
- 1885** Karl Benz builds a gasoline-engine powered “motorized tricycle.” The following year, he will patent the first “carriage with a gasoline engine.” Until now, gasoline has been an unwanted fraction of petroleum, causing many house fires because of its tendency to explode when used in kerosine lamps (see 1862).
- 1898** ASTM International, originally known as the American Section of the Interna-





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tional Association for Testing Materials, and later as the American Society of Testing and Materials, is formed.

1900 The advent of the automobile is welcomed as a relief from pollution. New York City, with its 120,000 horses, scrapes up 2.4 million pounds [1.1 x 10⁶ kg] of manure every day.



ASTM Founder
Charles B. Dudley

1901 Henry Ford forms the Henry Ford Company but



will later quit in a dispute. The company will become known as Cadillac automobile manufactured in 1902. In 1903, Henry Ford will form the Ford Motor Co. in Michigan. (During this time, steering wheels replaced tillers.) In 1908, the first Model T will roll off the Ford assembly line.



1908 The General Motors Company is formed from Oldsmobile (1896), Cadillac (1902) and Buick (1903).

1918 Committee N issues its first standard, D 56, Method for Flash Point by Tag Closed Tester.

1919 The American Petroleum Institute is established.

1920 Committee N is renamed D02 on Petroleum Products and Lubricants; its scope is broadened to be consistent with its new title.

1921 ASTM D 86, Method for Distillation of Petroleum Products at Atmospheric Pressure, is approved. This will become one of the most-used ASTM standards and will become a joint ASTM/Institute of Petroleum standard in 1964. D 86 will be one of the three building blocks of petroleum standardization with the publication of ASTM D 445, Method for Kinematic Viscosity of Transparent and Opaque Liquids (the Calculation of Dynamic Viscosity) (see 1937), and D 1655, Specification for Aviation Turbine Fuels (see 1959).

1921 ASTM D 90, Sulfur in Petroleum Products by the Lamp-Gravimetric Method, is issued and will be active as a tentative standard until 1955. It will become a test method in 1970 as D 1266, Method for Sulfur in Petroleum Products (Lamp Method).

1922 ASTM D 128, Methods for Analysis of Lubricating Grease, is approved and published. This test method outlines methods of chemical analysis of lubricating greases, including those based on synthetic lubricating fluids and non-soap thickeners.

1903 At Kitty Hawk, N.C., the Wright brothers achieve the first powered, manned, heavier-than-air, controlled flight.

1904 ASTM Committee N on Standard Tests for Lubricants is formed when the Society's Executive Committee discusses the need for standards in the petroleum industry during their meeting at the Engineers Club in Philadelphia, Pa., on Oct. 22. Committee N will go on to hold its first meeting in May 1905 in Pittsburgh, Pa. Its membership will consist of 10 people.



1923 As technical director at Daimler in Stuttgart, Germany, Ferdinand Porsche develops the legendary supercharged Mercedes Benz SS and SSK sports cars, among others.

1924 ASTM D 187, Method for Burning Quality of Kerosine, is issued and will become a full standard in 1927. This standard covers kerosine used for illuminating purposes (kerosine or "coal oil" lamps as they were initially called).

1880



D 187 will be followed in 1925 by ASTM D 219, Method for Burning Quality of Long-Time Burning Oil for Railway Use, a tentative standard that will become a full standard in 1927, covering railway semaphore signal lamps. In 1978, a kerosine

specification (D 3699, Specification for Kerosine) will be issued.

1925 The Chrysler Corporation is organized.

1925 ASTM D 217, Methods for Cone Penetration of Lubricating Grease, is issued. This test method covers tests for performing full scale, prolonged worked, and block penetrations on lubricating grease. ASTM D 1403, Methods for Cone Penetration of Lubricating Grease Using One-Quarter and One-Half Scale Cone Equipment, will be added in 1956 to allow for penetration measurements on smaller grease samples.



1928 The first edition of Special Technical Publication *STP 7, Significance of Tests for Petroleum Products*, is issued, which is now known as *Manual 1*. 2003 will see the publication of the 7th edition.

1930 ASTM D 323, Method for Vapor Pressure of Petroleum Products (Reid Method), is published. Until now, a test method developed by the Interstate Commerce Commission and prescribed by the Bureau of Explosives in 1912 has been used.

1930 As the market grows, petroleum distribution continues to be an important issue in order to serve the world market. The advent of new technologies, such as Jersey Standard's process for boosting fuel octane through the use of additives and blending technology (e.g., "Blue Sonoco"), also facilitates both

market growth and improved performance.

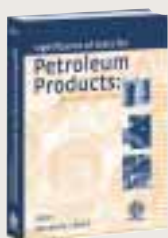
1933 The National Exchange Group is formed within Committee D02. The primary missions of the NEG are the measurement of engine test standards' precision, evaluation of factors affecting ratings, and assisting participating laboratories in maintaining interlaboratory testing reproducibility. By 2004, the NEG will operate an X-check program whereby laboratories periodically test gasolines comparatively for octane number and diesel fuels for cetane number.

1933 ASTM D 357, Method of Test for Knock Characteristics of Motor Fuels, is issued. The phrase "by the Motor Method" will be added to the title in 1947 when D 908, Method of Test for Knock Characteristics of Motor Fuels by the Research Method, is issued, to differentiate the two standards. D 357 will be withdrawn in 1969 and replaced by D 2700, Test Method for Motor Octane Number of Spark-Ignition Engine Fuel.

1933 Toyota Industries Corporation establishes an automobile department, which will separate from the parent company in 1937 to become Toyota Motor Corporation.

1934 ASTM D 381, Method for Gum Content of Gasoline, is published. The increased ownership of automobiles leads to increased demand for gasoline, which in turn leads to the development of improved cracking operations. This leads to more olefins in fuel, hence a greater tendency to form gums and sediment, thus requiring gum test methods and specification requirements.

1934 The first of four fuel standards issued by Subcommittee E on Burner, Diesel, Non-Aviation Gas Turbine, and Marine Fuels — D 396, Specification for Burner Fuels — is issued, covering fuels for fuel-oil burning equipment such as home heating oils. Next will be ASTM D 975, Specification for Diesel Fuel Oils, which will cover diesel fuels starting with its publication in 1948. Prior to this, there has been no widely used specification for diesel engine fuel. The third, ASTM D 2880, Specification for Gas





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Turbine Fuel Oils, covering non-aviation gas turbine fuels, will be issued in 1970. Lastly, ASTM D 2069, Specification for Marine Fuels, will be issued in 1991.

1935 The first successful passenger airliner, the DC-3, makes its maiden flight.



1935 The first KdF Wagens (to be renamed Volkswagen in 1945) are produced.

1937 ASTM D 445, Method for Kinematic Viscosity of Transparent and Opaque Liquids (the Calculation of Dynamic Viscosity), is the second of three building blocks of petroleum standardization along with ASTM D 86 (see 1921) and ASTM D 1655 (see 1959). The enormous list of products covered by ASTM D 445 includes jet fuels, aircraft turbine lubricants, marine and domestic fuel oils, diesel fuels, industrial fluid lubricants, automotive and heavy-duty engine oils, heat transfer fluids, hydraulic oils and many more. ASTM D 445 will also become ISO Standard 3104.

1937 Competition among automobile manufacturers leads to engines with higher and higher compression ratios, requiring higher-octane gasolines. This leads to process development in the industry, e.g., cracking, reforming, isomerization, etc. In D02, this leads to changes in the gasoline specification and the first appearance of ASTM D 439, Specification for Gasoline, showing three types of gasoline based on volatility and further breakdown according to antiknock characteristics. The U.S. Federal Trade Commission will later require the posting of the Antiknock Index in 1979. ASTM D 439 will be discontinued in 1991 and replaced with D 4814, Specification for Automotive Spark-Ignition Engine Fuel.



1940 ASTM D 566, Method for Dropping Point of Lubricating Grease, is published. It is the basic test method for determining the temperature at which the thickener in grease melts. This method, along with D 217, Method for Cone Penetration of Lubricating Grease, and D 128, Methods for Analysis of Grease, forms the core of tests performed routinely on greases by all producers and users around the world.

1941 ASTM D 613, Method for Ignition Quality of Diesel Fuels by the Cetane Method, is issued to provide a better measure of fuel ignition properties. Subsequently, methods will be developed for estimating cetane numbers using a calculated "cetane index" when engine test data are not available, including: D 976, Methods for Calculated Cetane Index of Distillate Fuels (1966), and D 4737, Method for Calculated Cetane Index by Four Variable Equation (1987).

1942 Twenty-four-inch [610 mm] and 20-inch [508 mm] diameter pipelines, respectively known as the "Big Inch" and the "Little Big Inch," are built to transfer petroleum crude oil from the oil fields of east Texas and refined petroleum products from the Gulf Coast to refining and distribution areas near New York, N.Y., and Philadelphia, Pa. The lines are a major part of the U.S. war effort and represent a significant achievement in pipeline technology in terms of sheer size and scope.



1942 First publication of the acid and base number method for petroleum products, ASTM D 664, Test Method for Acid Number of Petroleum Products by Potentiometric Titration, which provides information on the quality or oxidative state of the oil.

1946 ASTM D02 Subcommittee J on Aviation Fuels is formed to develop an aviation gasoline specification. This results in the issuance of ASTM D 910, Specification for Aviation Gasolines, which specifies five grades of aviation gasoline differing in lead content, color and octane numbers.

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- 1947** “The Research Method,” D 908, Method of Test for Knock Characteristics of Motor Fuels by the Research Method (see 1933), is issued. It will be replaced in 1968 by D 2699, Test Method for Research Octane Number of Spark-Ignition Engine Fuel.
- 1947** Committee D02 Subcommittee 1 on Combustion Characteristics is formed, which merges all activities of the National Exchange Group (see 1933) and the relevant ASTM standards development activities.
- 1947** The International Organization for Standardization and its Technical Committee (ISO/TC) 28 on petroleum products and lubricants are organized. Many ASTM D02 test methods will be used as the basis for test methods developed by ISO/TC 28.
- 1947** The first off-shore oil well is drilled.
- 1954** ASTM D 1322 is issued as the Smoke Point of Jet Fuels. It will undergo several title changes and, in 1997, D 1322 will become a joint standard with the Institute of Petroleum’s IP 57/95, Smoke Point.
- 1958** More than a million passengers fly over the Atlantic Ocean, surpassing the total of Atlantic steamship passengers for the first time.
- 1958** The first sequence tests for engine oils are published as ASTM Special Technical Publication *STP 315, Multi-Cylinder Test Sequences for Evaluating Automotive Engine Oils*. *STP 509, Single-Cylinder Engine Tests for Evaluating the Performance of Crankcase Lubricants* will be published in 1972.
- 1959** First International Organization for Standardization Technical Committee (ISO/TC) 28 recommendation (standard) is published (ISO/R91-1959 Petroleum measurement tables); this eventually will become ISO 91-1. R91 is based, in part, on IP 200/ASTM D1250, Guide for Petroleum Measurement Tables.
- 1959** The third building block of petroleum standardization, ASTM D 1655, Specification for Aviation Turbine Fuels, is issued (see 1921 and 1937). This will be



the exclusive specification for aviation turbine fuel in the United States (about 35 to 40 percent of the world’s aviation fuel), used with other international standards for the “Joint Checklist,” which is used for guidance (except in Russia), representing 75 to 90 percent of the world’s jet fuel.



- 1960** ASTM D 1660, Method for Thermal Stability of Aviation Turbine Fuels, is published. It is one of the first tests to simulate performance rather than fuel chemistry to define a satisfactory fuel. ASTM D 1660 will be replaced in 1973 by ASTM D 3241, Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels (JFTOT Procedure), which helps make ASTM D 1655, Specification for Aviation Turbine Fuels, a performance specification and not simply a specification for composition.
- 1960** The Organization of Petroleum Exporting Countries (OPEC) is formed by Iran, Iraq, Kuwait, Saudi Arabia, and Venezuela.
- 1964** Since the 1950s, the four-ball test machine has been used to assess lubrication and wear performance on petroleum and synthetic fluids. The first ASTM four-ball wear test, D 2266, Method for Wear Preventive Characteristics of Lubricating Grease (Four-Ball Method), is issued this year. A fluid lubricant version, D 4172, Method for Wear Preventive Characteristics of Lubricating Fluid (Four-Ball Method), will appear in 1982. D 5183, Method for Determination of the Coefficient of Friction of Lubricants Using the Four-Ball Wear Test Machine, will later be developed for determining coefficients of friction to assess performance differences due to friction modifiers used in energy conserving motor oils and fluid lubricants.
- 1965** Hearings on leaded gasoline begin in the U.S. Senate.
- 1966** The Timken extreme pressure test machine, developed in the 1930s for evaluating the load carrying properties of greases, is used in the new ASTM D 2509, Method for Measurement of Load-Carrying Capacity of Lubricating Grease (Timken Method). The method for fluids, D 2782, Method for Measurement of Extreme-Pressure Properties of Lubricating Fluids (Timken Method), will issue in 1969.



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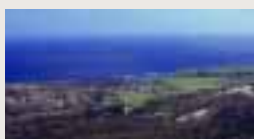


These methods will be used in almost every industrial application where extreme pressure is required.

1967 ASTM D 2602, Test Method for Apparent Viscosity of Engine Oils at Low Temperature Using the Cold-Cranking Simulator, is issued. Earlier in this decade, a cold cranking simulator laboratory test was developed. An ASTM round robin study shows that an excellent correlation is obtained between actual engine cranking data and laboratory test data obtained with 18 reference oils.

1967 ASTM D 2625, Method for Endurance (Wear) Life and Load Carrying Capacity of Solid Film Lubricants (Falex Pin and Vee Method), is issued and is the first standardized ASTM test using the pin and vee block for the measurement of anti-wear and endurance (life) of bonded solid film lubricants. The pin and vee block test machine, more commonly known as the Falex tester or Faville tester, named after its inventor, was developed in 1927 as a salesman's demonstration tool for fluid lubricants containing anti-wear and extreme pressure additives.

1967 The U.S. Congress passes the Clean Air Act, which authorizes planning grants to state air pollution control agencies.



1967 The ASTM X-ray fluorescence instrumental method, D 2622, Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-Ray Fluorescence Spectrometry, for the determination of sulfur in fuels, becomes widely popular, replacing earlier old-fashioned, time-consuming, and labor-intensive wet chemistry methods. D 2622 can detect parts per million quantities of sulfur as opposed to only higher levels of sulfur. This standard will become a mandatory U.S. Environmental Protection Agency method for sulfur regulations for both gasoline and diesel.

1970 The president of General Motors urges the elimination of lead additives from gasoline in order to allow the use of catalytic converters.

1970 The U.S. Environmental Protection Agency (EPA) is formed.

1970 The Society of Automotive Engineers requests Subcommittee D02.07 on Flow Properties to develop a

test method to determine the ability of an oil to flow to the engine oil pump and to critical engine parts under actual engine-use conditions. The result of this work will be the issuance of ASTM D 3829, Test Method for Predicting the Borderline Pumping Temperature of Engine Oil, in 1979, which will later be modified to incorporate a proper cooling cycle, and ASTM D 4684, Method for Determination of Yield Stress and Apparent Viscosity of Engine Oils at Low Temperature.



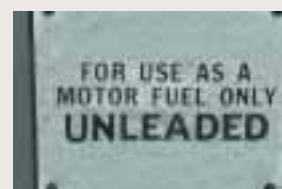
1970 ASTM D 2882, Method for Indicating the Wear Characteristics of Petroleum and Non-Petroleum Hydraulic Fluids in a Constant Volume Vane Pump, is issued and will become the standard for wear testing both in North America and Europe (see 2003).

1972 The U.S. Congress passes the Clean Water Act.

1972 Landmark publication of Research Report (RR) D2:1004, a standardized statistical protocol for estimating repeatability and reproducibility for petroleum test methods.

1972 The U.S. Environmental Protection Agency (EPA) announces all gasoline stations must carry "nonleaded" gasoline, but will delay setting standards until 1973.

1973 A worldwide energy crisis created by the Arab Oil Embargo begins on Oct. 17 and will continue until March 1974. The crisis leads to greater interest in renewable energy and greater pressure to discover and develop new North American oil resources. It will also result in a revolution in automobile manufacture by replacing the large energy-consuming vehicles of the 1950s and '60s with more compact and energy-efficient cars. The embargo will also lead to the creation of the U.S.



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- Strategic Petroleum Reserve. By the early '80s, oil will be in surplus and prices will fall.
- 1974** ASTM D 3244, Practice for Utilization of Test Data to Determine Conformance with Specifications, is issued. This standard will become indispensable when applying precision data to test methods.
 - 1975** "Mobil 1" is introduced as the first fully synthetic motor oil nationally marketed in the United States.
 - 1975** Catalytic converters are introduced in many automobiles to meet emissions standards established by the U.S. government.
 - 1976** The ASTM Test Monitoring Center is established at Carnegie Mellon University to monitor the test methods of Subcommittee B on Automotive Lubricants.
 - 1976** ASTM D 3520, Method for Quenching Time of Heat-Treating Fluids (Magnetic Quenchometer Method), is issued. This method will go on to be one of the most important methods in the heat-treating industry for classifying cooling characteristics of quench oils.
 - 1978** The U.S. government begins limiting the amount of lead permitted in gasoline. The purpose of this regulation is to prevent deterioration of the platinum catalysts in catalytic converters. By June 1979 nearly half of all U.S. gasoline will be unleaded.
 - 1980** ASTM D 3764, Practice for Validation of Process Stream Analyzer Systems, is issued and is the first D02 practice dealing with the validation of process analyzers.
 - 1982** Subcommittee D02.07 begins work on a laboratory test method to evaluate low-temperature pumpability, that will result in the issuance of D 5133, Method for Low Temperature, Low Shear Rate, Viscosity/Temperature Dependence of Lubricating Oils Using a Temperature-Scanning Technique, in 1991. D 5133 will go on to be used as a required OEM specification by the International Lubricant and Standardization Approval Committee (ILSAC) in their ILSAC GF-2 specification.
 - 1985** The first standard specification for engine oils, ASTM D 4485, Specification for Performance of Engine Oils, is issued.
 - 1986** The primary phase-out of leaded gasoline in the United States is completed.
 - 1986** ASTM Subcommittee J on Aviation Fuels organizes

- the first technical training course on aviation fuels. By 2004, this course will have been taught more than 56 times to more than 1,600 students in 13 countries and 20 cities. This is the first of the ASTM Technical and Professional Training Program courses.
- 1987** Subcommittee B on Automotive Lubricants is the first to implement facilitation of its monitored standards by forming a section and paying facilitators out of funds derived from reference oil sales for monitored test methods.
- 1988** To address the need for specifications relating to gasoline-ethanol blends, D02 issues D 4806, Specification for Denatured Fuel Ethanol for Blending with Gasolines for Use as Automotive Spark-Ignition Engine Fuel. To further address the need to cover other oxygenates and properties such as cetane number, metal corrosion, water tolerance, drivability, and federal regulations, ASTM D 4814, Specification for Automotive Spark-Ignition Engine Fuel, is also issued this year. For the first time, D02 recognizes an engine fuel standard not based solely on a straight hydrocarbon product (gasoline). These methods will be followed by others that address automotive spark-ignition engine fuel performance.
- 1989** ASTM D 4953, Method for Vapor Pressure of Gasoline and Gasoline-Oxygenate Blends (Dry Method), is issued in response to problems with water interacting with gasoline-oxygenate blends when testing in accordance with D 323 (see 1930).
- 1989** Although used for 30 years for the development of industrial and automotive fluid lubricants, the first standardized FZG gear test is ASTM D 4998, Test Method for Evaluating Wear Characteristics of Tractor Hydraulic Fluids, issued this year, which evaluates gear wear applicable to tractor hydraulic fluids. The FZG gear test machine is the only ASTM test machine that uses an actual gear set as the consumable test piece. In 1991, ASTM D 5182, Test Method for Evaluating the Scuffing (Scoring) Load Capacity of Oils, which evaluates gear oils, will be published.





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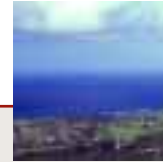
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By 2004, this test will be under consideration by the military as a replacement for its Ryder gear test.

1989 ASTM D02.92, the Coordinating Subcommittee on Interlaboratory Crosscheck Programs (ILCP), is established to address laboratories' desire and need to participate in certification programs that evaluate laboratory proficiency, also called interlaboratory crosschecks (see 1993).

1989 ASTM D 4950, Classification and Specification for Automotive Service Greases, is approved and published. The approval of this method culminates approximately 20 years of joint effort by ASTM, the National Lubricating Grease Institute, and the Society of Automotive Engineers to develop a standard that will be analogous to the American Petroleum Institute engine-oil classification. Several additional test methods are developed and standardized as part of the effort to develop D 4950.

1990 The first standard engine test for engine oils, ASTM D 5119, Method for Evaluation of Automotive Engine Oils in the CRC L-38 Spark-Ignition Engine, is published.

1990 The D02.93 Coordinating Subcommittee on International Standards and Related Activities is formed.

1990 ASTM Committees D02 and E13 on Molecular Spectroscopy and Chromatography kick off a collaboration on multivariate infrared analyzers.

1990 A worldwide round robin is conducted to develop a cold-cranking simulator test very close to the same temperatures actually used for the engine-cranking test. This work results in the issuance of ASTM D 5293, Method for Apparent Viscosity of Engine Oils between 5° and -30°C Using the Cold-Cranking Simulator. This helps the Society of Automotive Engineers (SAE) to establish meaningful low-temperature cranking limits for SAE W grade oils.

1992 Hydraulic fluids are often used in environments where flammability of the fluid is a safety concern,

therefore, ASTM D 5306, Method for Linear Flame Propagation Rate of Lubricating Oils and Hydraulic Fluids, is approved. This standard measures the propagation rate of a flame and is an indication of the relative ignitability of the fluid.



1993 D2PP Software for calculating statistical precision obtained in the interlaboratory studies conducted in D02 committees is published. Virtually all D02 crosschecks use this software for data analysis. This is one of the most important milestones in the committee's history.

1993 The Interlaboratory Crosscheck Program (see 1989) is launched, and a major milestone is achieved as evidenced by the wide popularity of this program around the world. It is truly an international program with 45 percent of the participating laboratories from outside the United States. By 2004, more than 700 laboratories, many of which are from outside of North America, will have participated in 18 programs.



1994 The first standardized test for evaluating metalworking fluids using actual metalworking tools, ASTM D 5619, Method for Comparing Metal Removal Fluids Using the Tapping Torque Test Machine, is issued.

1994 The Data Communications Committee is formed within the D02 Subcommittee B Test Monitoring Board to standardize industry protocols for electronic data transfer.

1994 E 1655, Practice for Calibration of Multivariate IR Analyzers, is the first fruit of the D02/E13 collaboration (see 1990).

1994 Committee D02 begins to add mandatory quality-control sections to numerous standards to improve the data reliability in routine petroleum products testing.

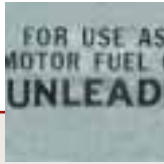
1994 ASTM D02.04 on Hydrocarbon Analysis plays a key role in developing new and/or improved test methods to meet the gasoline regulatory requirements of the U.S. Environmental Protection Agency (EPA) and California Air Resources Board (CARB). The ASTM endeavor includes writing new and revising existing test methods and conducting large, multi-method round robins to study test methods. Close attention





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- is paid to improving the precision of test methods.
- 1996** Eco-evaluated fluids have become a major topic in the fluid power industry and by this year two very complex standards are approved: ASTM D 6006, Guide for Assessing Biodegradability of Hydraulic Fluids, and D 6046, Classification of Hydraulic Fluids for Environmental Impact.
 - 1997** The first standard test for the direct measurement of the effect of engine oils on fuel economy, ASTM D 6202, Method for Automotive Engine Oils on the Fuel Economy of Passenger Cars and Light-Duty Trucks in the Sequence VIA Spark Ignition Engine, is issued.
 - 1997** Coordinating Subcommittees 94 and 95 are created out of CS 91, the General Coordinating Committee. CS 94 is the Coordinating Subcommittee on Quality Assurance and Statistics, which serves as the central resource on statistics and quality assurance practices for D02. The principle function of CS 95 Subcommittee on Terminology is the maintenance of the terminology compendium ASTM D 4175, Terminology Relating to Petroleum, Petroleum Products, and Lubricants.
 - 1997** ASTM D 6158, Specification for Mineral Hydraulic Oils, is issued and defines the physical, chemical, and performance requirements of the four more common mineral base hydraulic fluids (HH (non-inhibited refined mineral oil), HL (refined mineral oil with improved rust protection and oxidation stability), HM (improved antiwear properties), and HV (improved viscosity-temperature properties)). This specification was developed over several years and is a significant accomplishment. ASTM D 6158 provides an overview of both the requirements and testing results to be reported.
 - 1997** ASTM D 6200, Method for Determination of Cooling Characteristics of Quench Oils by Cooling Curve Analysis, is issued for cooling curve characterization of petroleum-based quench oils. This method will be followed by ASTM D 6482, Method for Determination of Cooling Characteristics of Aqueous Polymer Quenchants by Cooling Curve Analysis with Agitation (Tensi Method), and D 6549, Method for Determination of Cooling Characteristics of Quenchants by Cooling Curve Analysis with Agitation (Drayton Unit), which are used for cooling curve characterization of both petroleum and aqueous-polymer quen-

chants. The latter two standards are the only methods of this kind in the world and are global standards. These methods were developed in collaboration with the Quenching and Cooling Committees of ASM International and International Federation for Heat Treatment and Surface Engineering.



- 1997** High VI improved hydraulic fluids often contain high viscosity index improvers, which may shear down with use and reduce the in-service viscosity of the fluid. ASTM D 6080, Practice for Defining the Viscosity Characteristics of Hydraulic Fluids, is developed to address this situation. New fluids are subjected to controlled testing to determine the degraded viscosity and are then reclassified according to viscosities at both low and high temperatures. The advantage of such a system is that users can ascertain if a fluid is sufficiently shear-stable for their application.
- 1998** The publication of ASTM D 6299, Practice for Applying Statistical Quality Assurance Techniques to Evaluate Analytical Measurement System Performance, provides a standardized approach and control chart techniques for D02 test methods for quality analysis.
- 1998** Publication of ASTM D 6300, Practice for Determination of Precision and Bias Data for Use in Test Methods for Petroleum Products and Lubricants, which is a conversion of Research Report (RR) D02:1007 methodology into ASTM standard practice format; this standard is technically harmonized with ISO 4259.
- 1999** ASTM D 6377, Method for Determination of Vapor Pressure of Crude Oil: VPCR_x (Expansion Method), and D 6378, Method for Determination of Vapor Pressure (VP_x) of Petroleum Products, Hydrocarbons, and Hydrocarbon-Oxygenate Mixtures (Triple Expansion Method), are issued. ASTM D 6450, Test Method for Flash Point by Continuously Closed Cup (CCCFP) Tester, is also issued, which does not rely on the use of the human eye to detect the flash point and instead, utilizes the pressure increase when a flash occurs.
- 2000** The European Union bans leaded gasoline.
- 2000** A new interlaboratory cross-check program for crude oils is launched. Analysis of crude oils is more challenging than most refined products, and their addition to the program represents a major step in improving the precision of test methods.





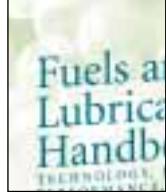
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2000 The first D02 test method that uses intermediate precision rather than repeatability in its precision statement is approved and published: ASTM D 6593, Test Method for Evaluation of Automotive Engine Oils for Inhibition of Deposit Formation in a Spark-Ignition Internal Combustion Engine Fueled with Gasoline and Operated Under Low-Temperature, Light-Duty Conditions.

2001 One of the largest interlaboratory studies ever undertaken in D02 is conducted to determine low levels of sulfur in gasolines and in diesels. It involves four test methods, 70 laboratories and 32 samples. More than 6,000 data points are collected. The new precision data obtained is expected to define the regulatory compliance for low levels of sulfur of fuels in the future.

2001 ASTM D 6666, Guide for Evaluation of Aqueous Polymer Quenchants and D 6710, Guide for Evaluation of Hydrocarbon-Based Quench Oil, are issued; they are the only standards of this kind available covering both petroleum and aqueous-polymer quenchants.

2002 Publication of D 6792, Guide for a Quality System in Petroleum Products and Lubricants Testing Laboratories, the first total quality management standard for petroleum labs. This is the first standard of its kind issued by D02 for benchmarking a laboratory's performance with respect to quality management. It sets a performance standard and provides a road map on how to achieve it.

2002 ASTM D 6546, Test Methods and Suggested Limits for Determining the Compatibility of Elastomer Seals for Industrial Hydraulic Fluid Applications, is approved. This guide relates to the compatibility of hydraulic fluids with O-ring elastomers, which are used extensively for sealing in hydraulic components. The information from these tests can be used to anticipate expected service quality.

2002 To help fluid users and developers understand the suitability of a fluid for its intended use, ASTM D 6813, Guide for Performance Evaluation of Hydraulic Fluids for Piston Pumps, is published. This is a very thorough and useful guide for selecting test methods that are available to deter-

mine specific performance characteristics.

2003 ASTM D 6973, Method for Indicating Wear Characteristics of Petroleum Hydraulic Fluids in a High Pressure Constant Volume Vane Pump - 35 VQ, is approved, which uses a larger and higher-pressure vane pump relative to the vane pump used in ASTM D 2882 (see 1970).

2003 Publication of the *Fuels and Lubricants Handbook: Technology, Properties, Performance, and Testing*. This near-encyclopedia provides in-depth discussion of a large range of fuels and lubricants and the test methods used in determining their properties and performance characteristics. It is the most comprehensive treatise on the subject to have been published in more than 40 years.

2004 D2PP software is issued as an adjunct to D 6300 (see 1998), as standardized controlled software to execute the D 6300 statistical algorithms.

2004 A new interlaboratory cross-check program for sulfur determination of ultra-low sulfur in diesel fuels is launched. It will use four methods designated by the U.S. Environmental Protection Agency (EPA) for regulatory compliance, and will use samples with 15 parts per million or less of sulfur. As ultra-low sulfur fuels become mandatory on the roadways, the importance of this new initiative is sure to grow.



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