



TEXAS OILTECH LABORATORIES



SCHEDULE OF PRICES AND SERVICES

30TH
EDITION



TEXAS OILTECH
LABORATORIES



SINCE 1985

Quality Controlled Through Analysis

10630 FALLSTONE RD. HOUSTON, TEXAS 77066
P.O. BOX 741802 HOUSTON, TEXAS 77274

TEL: (281) 495-2400
FAX: (281) 495-2410



I would like to extend my thanks to our wonderful clients for an extraordinary growth during the past 30 years.

My goal and the goal of our professional staff is to provide you with the most accurate and precise services that is possible.

Your support and confidence in our abilities has enabled us to reach milestones that we did not anticipate achieving. We are grateful for your role in helping us reach them.

We try to anticipate future quality requirements continuously invest in our personnel training, so that we can continue to provide testing services that are of the highest quality, precise, timely, relevant, and personalized to our client's needs. Our future is as bright as our past has been thanks to you, our domestic and international clients for putting your trust in us.

We look forward to being of service to you for the next 30 years and beyond.

Sincerely,

Fereshteh Sorurbakhsh

President



SINCE 1985

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10630 FALLSTONE RD. HOUSTON, TEXAS 77066
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Welcome to Texas OilTech Laboratories.



We are pleased to present to you our 30th Anniversary Edition of our Catalog of Testing Services. In addition to our main laboratory in Houston, Texas, we are providing services from our other laboratories in Bogota, and Cartagena Colombia; and Campinas S.P. Brazil. Additionally, we have developed strategic partnerships with first-rate partner laboratories around the globe. Our on-site testing teams can rapidly mobilize to any location, domestic or international to provide first class in-situ sampling and testing.

As ISO 9001:2008 and ISO 17025 certified laboratories, our analytical testing services include over 800 different test procedures for a wide array of products ranging from liquid and gaseous fuels, new and in-service lubricants, crude oils, solvents, petrochemicals, waste oils, soils, water and wastewater.

Our new upstream division routinely conducts studies in EOR/IOR, flow assurance and fluid Compatibility experiments.

Throughout all of our operations, we maintain our strictest adherence to the principle of international quality control, by maintaining a cadre of well-qualified and well-trained quality assurance, quality control personnel. This process uniquely qualifies us to conduct in-depth training for our own staff and personnel from other organizations.

Quality control of our process will always be our guiding light.

Sincerely,

A. Phillip Sorurbakhsh
Chief Executive Officer



30 Years of Service Excellence
Cert. No. 0005085
Quality Management System Certified to ISO 9001:2008
Visit our Website at <http://www.tol-lp.com>



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We Are Proud of Our History

30 Years of Success

Texas OilTech Laboratories on a Glance

Back in 1985, two engineers envisioned the need for a testing laboratory in Houston to provide rapid turnaround time for a variety of testing services required by the crude oil gatherers, toll blenders, and others in the local petroleum industry. Since its founding in 1985, Texas OilTech Laboratories has been serving companies and entities ranging

from U.S. Military to large multinational companies in the oil industry, not only providing state-of-the-art test analysis, but solutions to our clients' needs. As a result, we have been serving a worldwide community for over 3 decades.

It didn't take long for the personnel of Texas OilTech Laboratories to become known as "the problem solvers" due to their ability to understand the clients' needs and provide them with proper solutions by interpreting data.

Through the Decades

Growing in Quality Standards faster than in Size

Offering over 800 different test procedures for the entire range of gaseous and liquid fuels, natural and synthetic lubricants, and all types of specialty petroleum products, TOL covers its clients' needs from A to Z. No matter where your business or project is located, whether onshore or offshore, TOL is able to

provide your company with solutions from our headquarters in Texas, United States, or from our high-tech laboratories in France, Brazil, and Colombia. Each laboratory is staffed with highly educated and trained personnel.

Accreditations

ISO/IEC 17025, ISO 9001.

Quality Controlled Through Analysis is not only our slogan, but the basis for our daily operation since our inception.

Our laboratories are accredited with ISO/IEC 17025 which is the standard that acknowledges our competence for testing and calibration. The two main sections in ISO/IEC 17025 are Management Requirements and Technical Requirements.

Management requirements are primarily related to the operation and effectiveness of the quality management system within the laboratory.

Technical requirements include factors which determines the correctness and reliability of the tests and calibrations performed in laboratory.

Introduction

Texas OilTech Laboratories is a privately held corporation since 1985. Our offices and laboratories are conveniently located in Southwest Houston, just off the Sam Houston Tollway (Beltway 8) at U.S. Highway 59. Our physical location is at:

Office and Laboratory

Texas OilTech Laboratories
10630 Fallstone Road
Houston, TX 77099, USA
Phone: +1-281 495-2400
Fax: +1-281 495 2410
Email: sales@tol-lp.com
Website: www.tol-lp.com

Billing & Invoices

Texas OilTech Laboratories
P.O. Box 741909
Houston, TX 77274-1909

Other Offices

Brazil
Colombia
UAE

A Word About Petroleum Testing

Petroleum hydrocarbons can range from crude oil and natural gas to refined products such as fuels, lubricants, and petrochemicals.

We endeavor to maintain a capability for testing this wide range of products using test procedures from various sources. Our analytical services are performed according to methods authorized and approved by the following technical agencies:

ASTM American Society for Testing and Materials
ISO International Standards Organization
EPA U.S. Environmental Protection Agency
AOAC Association of Official Analytical Chemists

Analytical testing technology is constantly changing and so we regularly upgrade our test procedures and laboratory equipment to provide the best available technology for our customers. Often, there may be several alternate procedures that can be utilized and we try to identify the most cost-effective procedure consistent with the requirements for test precision and limit of detection.

Our experienced staff has developed and validated analytical methods and procedures that can have become standards in the industry. We have even developed testing protocols and unique instrumentation to modify methodologies in order to meet compliance requirements in special customer projects. We try to keep Texas OilTech Laboratories at the leading edge of the technology for petroleum testing.

Today, on-site testing is a major part of our activity as we visit new power plant sites all over the globe. We can simultaneously support three crews for performance testing or plant commissioning or when fuel problems develop in the field.

TOL has also developed a reputation as problem solvers. By combining a number of analytical techniques, we can perform investigative studies on problems related to lubricants, petrochemicals, and fuel streams for gas turbines and diesel engines.

We thank you, our clients, for your loyal support over these years and we look forward to continuing a good working relationship in the years ahead. Your analytical testing needs will continue to drive our business plan.

We acknowledge the memory of three of our technical people who have since passed: These include our founder, Mr. Nader Sorurbakhsh, who initiated the laboratory culture that we continue to follow, and three chemists, Wilbert M. Burbank, Gregory Dimataris, and Dr. Reza Oskui, who were responsible for the development of many special test procedures for our clients.

Today we also employ people who were not yet born in 1985, but they give the same spirit of attention to detail, strong technical understanding, and good laboratory practice that is still paramount at TOL. And they do this with modern laboratory instrumentation and levels of precision that were not available twenty-five years ago.



TERMS AND CONDITIONS

Unless otherwise agreed in a formal contract, services provided by Texas OilTech Laboratories are expressly limited to the terms and conditions stated herein

Business Hours:

Our business hours are 8:00 AM to 5:00 PM local Central Time, Monday through Friday. Testing services performed at other hours and on weekends or holidays are subject to overtime charges. Additionally, weekend service requires prior arrangement and a special laboratory opening fee. Discount prices are not applicable for rush samples

Payment Terms:

Payment in advance is required for all clients except those whose credit has been established with our company. For clients with approved credit, terms are net 10 days. For your convenience we also accept American Express, VISA, and MasterCard credit cards.

Confidentiality:

Strict confidentiality is maintained in all of our dealings with clients. Confidentiality agreements, therefore, are signed willingly. In any instance where information is subpoenaed by and must be released to a regulatory or legal body, the client is promptly notified. Likewise, the client agrees to respect all such relationships of trust. Client agrees it will not use Texas OilTech Laboratories' name and/or data in any manner, which might cause harm to the company's reputation and/or business. Under no circumstances is the name of Texas OilTech Laboratories to be published either alone or in association with that of any other party, without its approval in writing.

Billing:

All fees are charged or billed directly to the client. The billing of a third party will not be accepted without a statement, signed by the third party, which acknowledges and accepts payment responsibility.

Turnaround Time:

48-hour turnaround is available on routine procedures. Samples received after 3:00 pm are logged in on the following business day

Warranty and Limits of Liability:

The total liability of Texas OilTech Laboratories, its officers, employees, agents, or sub-contractors for any loss or damage arising out of Texas OilTech Laboratories' performance, whether by way of negligence, or breach of contract, or otherwise shall not exceed the amount paid or payable by client for the work leading to the claim. We warrant the accuracy of test results for the sample as submitted. The foregoing express warranty is exclusive and is given in lieu of all other warranties, expressed or implied. We disclaim any other warranties, expressed or implied, including a Warranty of fitness for Particular Purpose and Warranty of Merchantability.

Certificate of Analysis:

We issue a hard copy Certificate of Analysis for you product. Certificate of Analysis may not be reproduced, except in full, without prior written approval by Texas OilTech Laboratories. After analytical results have been reported to our clients, we shall retain copies of Certificates of Analyses for a period of 2 years, after which such Certificates of Analyses will be destroyed. If client requests additional copies of such Certificates of Analyses during the retention period, no additional charges will apply for preparation and printing of such reports.

Sample Retention:

Samples are retained for 30 days after testing unless otherwise notified by the client. There is no charge for sample storage or disposal. Samples will be packaged and returned to client when requested.

Contracts:

All contracts are subject to review and approval by Texas OilTech Laboratories' legal department, and must be signed by a corporate officer.

Prices:

Prices are subject to change without notice.

Containers and Sample Pick-up

Local sample pick-up is provided at no charge. Containers, mailers, labels and shipping instruction for domestic and international shipment of your samples are provided at no cost.

Texas OilTech Laboratories
10630 Fallstone Road
Houston, TX 77099 USA

Texas OilTech Laboratories is an Equal Opportunity/ Affirmative Action Employer



Alphabetical List of Tests

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
The test codes used to identify a Method are for identification and are generally related to the ASTM or other protocol. We use suffix letters with the Method test codes to identify different practices within the same ASTM procedure, e.g., different test temperatures or different test times.	
A	
A-C Loss Characteristics, Permittivity, and Dielectric Constant	ASTM D 150
Acetaldehyde Content of Vinyl Acetate	ASTM D 2191
Acetone in Methanol	ASTM D 1612
Acid Acceptance of Halogenated Organic Solvents	ASTM D 2942
Acid Number	DuPont FPL-3
Acid Number and Naphthenic Acids by Coulometric Titration	UOP 587
Acid Number and Naphthenic Acids by Titration	UOP 565
Acid Number of Naval Stores Products	ASTM D 465
Acid Number of Petroleum Products, Potentiometric Titration	ASTM D 664
Acid Number of Petroleum Products, Semi-Micro Color Indicator Titration	ASTM D 3339
Acid Number of Used Lubricating Oils by Semi-Quantitative Micro Determination	ASTM D 5770
Acid Number, Color-Indicator Titration (TAN)	ASTM D 974.a
Acid Wash Color of Industrial Aromatic Hydrocarbons	ASTM D 848
Acidity in Aviation Turbine Fuel, Acid Number	ASTM D 3242
Acidity in Vinyl Acetate and Acetaldehyde	ASTM D 2086
Acidity in Volatile Solvents and Chemical Intermediates	ASTM D 1613
Acidity of Benzene, Toluene, Xylene, Solvent Naphtha, and Industrial Aromatics	ASTM D 847
Acidity of Halogenated Organic Solvents	ASTM D 2989.a
Acidity of Hydrocarbon Liquids and their Distillation Residues	ASTM D 1093
Acidity or Alkalinity of Water	ASTM D 1067
Active Sulfur in Cutting Fluid	ASTM D 1662
Additive Elements in Lubricating Oils by ICP-AES	ASTM D 4951.a
Additive Elements, Wear Metals, and Contaminants in Used Lubricating Oils, ICP-AES	ASTM D 5185
Adhesion of Solid Film Lubricants	ASTM D 2510
Air and Other Non-condensables, Including Refrigerants	BB-F-1421 B.f
Aldehydes in Styrene Monomer	ASTM D 2119
Alkalinity in Acetone	ASTM D 1614
Alkalinity of Caustic Soda	ASTM E 291
Alkalinity of Halogenated Organic Solvents	ASTM D 2989.b
Alkalinity, Titrimetric, Phenolphthalein	Std M 2320
Alkyl Nitrate in Diesel Fuel by Spectrophotometry	ASTM D 4046
Aluminum and Silicon in Fuel by Ashing, Fusion and ICP-AES	ASTM D 5184
Amine Purity by Gas Chromatography, (Rich and Lean)	ASTM D 2083.b
Amines, Total, by Gas Chromatography	ASTM D 2083.a
Ammonium Bisulfide	UOP 683
Amyl Nitrate in Diesel Fuels	ASTM D 1839
Aniline Point of Petroleum Products	ASTM D 611.a
Aniline Point, Mixed, of Petroleum Products	ASTM D 611.b
Aniline Point, Thin Film, of Petroleum Products	ASTM D 611.c
Anions Content by Ion Chromatography	EPA 300.1
Anions in Sodium Hydroxide and Potassium Hydroxide	ASTM E 1787
Anions in Water by Chemically Suppressed Ion Chromatography	ASTM D 4327.a
Anti-Icing Inhibitors (Ether) in Aviation Fuel	ASTM D 5006
Antimicrobial Agents as Preservatives for Invert Emulsion Hydraulic Fluids	ASTM E 979

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Antimony in Paint by AA Spectroscopy	ASTM D 3717
Antioxidant Concentration in HL Turbine Oils	ASTM D 6810
Antioxidant Content, Primary, in New or In-service Oils	ASTM D 7590
API Gravity, Hydrometer Method	ASTM D 287.a
Apparent Density, Bulk Factor and Pourability	ASTM D 1895
Apparent Viscosity of Engine Oils, Cold Crank Simulator	ASTM D 5293
Appearance of Admixtures Containing Halogenated Organic Solvents	ASTM D 3741
Appearance of Clear, Transparent Liquids (Visual Inspection)	ASTM E 2680
Aromatic Carbon Content of Hydrocarbon Oil by NMR	ASTM D 5292
Aromatic Content	EN 12916
Aromatic Content and Polynuclear Aromatic Content of Diesel Fuels and Aviation Turbine Fuels by Supercritical Fluid Chromatography	ASTM D 5186
Aromatic Content of Mineral Spirits by GC	ASTM D 3257
Aromatic Hydrocarbon Types in Aviation Fuel and Petroleum Distillates	IP 391
Aromatic Hydrocarbon Types in Aviation Fuels and Petroleum Distillates	ASTM D 6379
Aromatic Hydrocarbon Types in Middle Distillates, High Performance Liquid Chromatography (HPLC) Method with Refractive Index Detection	ASTM D 6591
Aromatic Types in Gas Oil Fractions by GC-MS	ASTM D 3239
Aromatics and Non-aromatics Fractions by Elution Chromatography	ASTM D 2549
Aromatics, Paraffins, and Olefins Content in Fuel Gas by GC-MS	ASTM D 6420.b
Arsenic and Selenium in Coal by AA/Hydride Generation	ASTM D 4606
Arsenic by AA, Furnace Technique. LOD = 0.05 ppm	EPA 7060A
Arsenic in Paint	ASTM D 2348
Arsenic in Petroleum Stocks and Catalysts by Spectrophotometry	UOP 387
Arsenic in Water	ASTM D 2972
Ash Content of Adhesives	ASTM D 5040
Ash Content of Bituminous Products	AASHTO T111
Ash Content of Engine Coolants and Anti-Rusts	ASTM D 1119
Ash Content of Petroleum Coke	ASTM D 4422
Ash Content of Petroleum Products	ASTM D 482
Ash in the Analysis Sample of Coal and Coke, wt%	ASTM D 3174.a
Ash in Wood	ASTM D 1102
Ash, Sulfated Residue, Lube Oils and Additives	ASTM D 874
Ash, Sulfated Residue, Organic Materials by Thermogravimetry	ASTM E 2403
Asphalt Residue of Specified Penetration	ASTM D 243
Asphaltenes	IP 143
Asphaltenes (Heptane Insolubles) in Crude Petroleum and Petroleum Products	ASTM D 6560
Autoignition Temperature	DIN 51 794
Autoignition Temperature of Liquid Chemicals	ASTM E 659
B	
Barium in Water, Atomic Absorption Spectrophotometry, Graphite Furnace	ASTM D 4382
Barium, Calcium, Magnesium and Zinc in Lube Oil by Atomic Absorption	ASTM D 4628
Base Number by Potentiometric Titration	ASTM D 4739
Base Number in New and Used Lubricants by Color Indicator Titration	ASTM D 5984
Base Number, Potentiometric Perchloric Acid Titration	ASTM D 2896
Benzene and Toluene in Finished Gasoline by GC	ASTM D 3606
Benzene by Gas Chromatography	ASTM D 4492
Benzene in Gasoline by Infrared Spectroscopy	ASTM D 4053

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Benzene in Hydrocarbon Solvents by Gas Chromatography	ASTM D 4367
Benzene in Spark-Ignition fuels by Using Mid Infrared Spectroscopy	ASTM D 6277
Benzene, Toluene, and Total Aromatics in Finished Gasolines by Gas Chromatography-Mass Spectrometry (GC-MS)	ASTM D 5769
Benzene, Toluene, Ethyl Benzene, Heavier Aromatics and Total Aromatics by GC	ASTM D 5580
Beryllium in Water, LOD = 0.05 ppm	ASTM D 3645
Biodegradability Test, OECD, by CO ₂ Evolution Test, DOC Analysis Measurement	OECD 301 B
Bitumen Content	ASTM D 4
Bitumen Content in Paving Materials	ASTM D 2172
Boiling Point	BB-F-1421 B.b
Boiling Point and Boiling Point Range by GC	DuPont F3205.b
Boiling Point Distribution of Crude Oils and Vacuum Residues by Gas Chromatography	ASTM D 7169
Boiling Point Distribution of Hydrocarbon Solvents by GC	ASTM D 5399
Boiling Point of Engine Coolants	ASTM D 1120
Boiling Point of Petroleum Products at Atmospheric Pressure	ASTM D 86.a
Boiling Point Range	BB-F-1421 B.g
Boiling Range Distribution of Crude Petroleum, by GC	ASTM D 5307
Boiling Range Distribution of Gasoline by Wide-Bore Capillary Gas Chromatography	ASTM D 7096
Boiling Range Distribution of Petroleum Distillates from 100° to 615°C by GC	ASTM D 7213
Boiling Range Distribution of Petroleum Distillates in Boiling Range from 174 to 720°C by Gas Chromatography, C ₁₀ to C ₁₀₀	ASTM D 6352
Boiling Range Distribution of Petroleum Fraction by Gas Chromatography	ASTM D 2887.a
Boiling Range Distribution, Gasoline, by GC	ASTM D 3710
Borderline Pumping Temperature of Engine Oil	ASTM D 3829
Bromide Ion in Water, Ground Water, and Drinking Water.	ASTM D 1246
Bromine Index of Aromatic Hydrocarbons	ASTM D 1492
Bromine Index of Petroleum Hydrocarbons	ASTM D 2710
Bromine Number by Electrometric Titration Method	ASTM D 1159
Bromine Number of Unsaturated Aliphatic Compounds	ASTM E 234
Bulk Density, Vibrated, Calcined Petroleum Coke	ASTM D 4292
Burning Quality of Kerosene, 16 hr and 48 hr	ASTM D 187
Burning Quality of Kerosene, 16 hr and 48 hr	IP 10
Butadiene Dimer and Styrene in Butadiene Concentrates by GC	ASTM D 2426
C	
C, H, N in Laboratory Samples of Coal and Coke, Instrumental Determination	ASTM D 5373
Cadmium in Water	ASTM D 3557
Calcium and Magnesium in Water	ASTM D 511
Calcium, Magnesium Content	EN 14538.a
Calcium, Magnesium, Potassium, and Sodium by Flame AA Spectrometry	ASTM D 5086
Calorific Value and Specific Gravity of Gaseous Fuels	ASTM D 3588.a
Calorific Value, Gross, of Coal and Coke	ASTM D 5865
Carbohydrates in Biomass by Gas Chromatography	ASTM E 1821
Carbon and Hydrogen in the Analysis Sample of Coal and Coke	ASTM D 3178
Carbon Distribution and Structural Group Analysis of Petroleum Oils by the n-d-M	ASTM D 3238
Carbon Number Distribution of Paraffins, Naphthenes and Aromatics by GC	UOP 870
Carbon Residue (Micro Method)	ASTM D 4530
Carbon Residue, Conradson	ASTM D 189.a
Carbon Residue, Conradson on 10% Residue	ASTM D 189.b

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Carbon Residue, Ramsbottom	ASTM D 524.a
Carbon Residue, Ramsbottom on 10% Residue	ASTM D 524.b
Carbon, Hydrogen, and Nitrogen in Petroleum Products, Instrumental	ASTM D 5291.a
Carbonizable Substances in White Mineral Oil	ASTM D 565
Carbonized Matter	ASTM E 346
Carbonyl by HPLC	EPA 554
Carbonyl Compound Trace, with 2,4-Dinitrophenylhydrazene	ASTM E 411
Carbonyl Compounds by HPLC	EPA 8315
Carbonyl Content	UOP 624
Carbonyls in C ₄ Hydrocarbons	ASTM D 4423
Cation Exchange Capacity, CEC	EPA 9080
Cavitation Corrosion and Erosion Characteristics of New Aluminum Pumps With Engine Coolants	ASTM D 2809
Cetane Index, Calculated by Four Variable Equation	ASTM D 4737
Cetane Index, Calculated, Includes API Gravity and Distillation	ASTM D 976
Cetane Number, Ignition Quality of Diesel Fuels	ASTM D 613
Characterization of Fluorocarbon Refrigerants, GC	DuPont F3205.a
Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate and Sodium Ions	ASTM C 871
Chloramines by Standard Method	Std M 4500-Cl-G
Chloride and Other Ions in Engine Coolants by Ion Chromatography	ASTM D 5827
Chloride in Aqueous Sample	EPA 9212
Chloride in Coal	ASTM D 2361
Chloride in Refinery Waters	UOP 456
Chloride in Refrigerants	BB-F-1421 B.e
Chloride Ion in Engine Coolants	ASTM D 3634
Chloride Ions by Ion Chromatography	ASTM D 5542.a
Chloride Ions in Brackish Water, Seawater & Brine	ASTM D 4458
Chloride Organic and Inorganic, in Hydrocarbons	UOP 588
Chloride, Inorganic, and Sulfate in Insulating Oil	ASTM D 878
Chloride, Inorganic, in Water and Wastewater	ASTM D 512
Chloride, Total, in Coal by Oxygen Bomb Combustion	ASTM D 4200
Chlorides, Organic, in Crude Oil (Naphtha Cut)	ASTM D 4929
Chlorinated Organic Acid Compounds in Water by Gas Chromatography with an Electron Capture Detector (GC-ECD)	ASTM D 5317
Chlorine (Total Halogens) in New and Used Oils, Bomb Method	ASTM D 808
Chlorine in New and Used Lubricants	ASTM D 1317
Chlorine, Forms of, in Refuse in Refuse-Derived Fuel	ASTM E 776
Chlorine, in New and Used Petroleum Products Total, by Microcoulometry	EPA 9076
Chromium Hexavalent Chelation	EPA 7197
Chromium in Paint by AA Spectroscopy	ASTM D 3718
Chromium, Hexavalent, Dissolved (AA, Furnace)	EPA 218.5
Clay-Gel Separation Test, Chromatographic Method for Characterizing Process Oils	ASTM D 2007
Cleanliness and Compatibility of Residual Fuels by Spot Test	ASTM D 4740
Cleanliness of Aviation Turbine Fuel - Laboratory Automatic Particle Counter Method	IP 564
Cleanliness of Aviation Turbine Fuels - Portable Automatic Particle Counter	IP 565
Cleanliness Test, Automated Particle Count	SAE 749-D
Cleanliness Test, Microscope Examinations	SAE 42067
Cleanliness Test, Millipore Examinations	MIL 565

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Cloud Point of Petroleum Products	ASTM D 2500
Cloud Point of Petroleum Products (Constant Cooling Rate Method)	ASTM D 5773
Cloud Point of Petroleum Products (Linear Cooling Rate Method)	ASTM D 5772
Cloud Point of Petroleum Products, Stepped Cooling Method	ASTM D 5771
Cobalt in Water	ASTM D 3558
Coefficient of Friction of Lubricants, Four-Ball	ASTM D 5183
Cold Filter Plugging Point of Diesel and Heating Fuels, CFPP	ASTM D 6371
Cold Filter Plugging Point, CFPP	IP 309
Coliform, Total (72 hour)	EPA 9131
Collection and Microscopical Sizing, Counting of Particulates in Gas	TOL SC 6028.a
Color and Appearance, Visual	ASTM E 1478
Color of Dyed Aviation Gasolines	ASTM D 2392
Color of Halogenated Organic Solvents, Platinum-Cobalt Scale	ASTM D 2108
Color of Petroleum Products by Tristimulus Method	ASTM D 6045
Color of Transparent Liquids, Gardner Color Scale	ASTM D 1544
Color, APHA, Platinum-Cobalt Scale	ASTM D 1209
Color, ASTM Color Scale	ASTM D 1500
Color, Saybolt Chromometer Method	ASTM D 156
Comparison of Waterborne Petroleum Oils by Infrared Spectroscopy	ASTM D 3414
Compatibility of Additives with Aviation Fuels	ASTM D 4054
Compatibility of Mixtures of Turbine Lubricating Oils	ASTM D 7155
Component Analysis of Spark Ignition Fuels by Gas Chromatography	ASTM D 6733
Composition Breakdown (C1 to C40) by GC, Sludge	ASTM D 2887.b
Composition Breakdown, Gas Chromatography	EN 14105
Composition of Gases by Mass Spectrometry	ASTM D 2650
Composition of Insulating Oils, Carbon Type	ASTM D 2140
Composition of Natural Gas by Gas Chromatography	ASTM D 1945.a
Composition of Natural Gas by Gas Chromatography (TCD/FID)	GPA 2261
Composition of Natural Gas by Gas Chromatography, extended	ASTM D 1945.b
Composition of Natural Gas by Gas Chromatography, extended to C ₁₄	GPA 2286
Composition of Reformed Gas by Gas Chromatography	ASTM D 1946
Composition of Waterborne Oils	ASTM D 3415
Congealing Point of Petroleum Waxes	ASTM D 938
Cooling Characteristics of Aqueous Polymer Quenchants by Cooling Curve Analysis with Agitation (Tensi Method)	ASTM D 6482
Cooling Characteristics of Quench Oils	ASTM D 6200
Cooling Characteristics of Quenchants by Cooling Curve Analysis, (Drayton Unit)	ASTM D 6549
Copper Content by Atomic Absorption or GFAA	ASTM D 1688
Copper in Jet Fuels by Graphite Furnace Atomic Absorption Spectrometry	ASTM D 6732
Corrosion from Industrial Aromatic Hydrocarbons, Copper Strip Tarnish Test	ASTM D 849
Corrosion from Petroleum Products, Copper Strip Tarnish Test, 2 hours @ 100°C	ASTM D 130
Corrosion from Petroleum Products, Disposable Copper Foil Strip	ASTM D 7095
Corrosion per NACE Standard TM-01-72	NACE TM-01-72
Corrosion Preventive Properties, Greases	ASTM D 1743
Corrosion Test for Engine Coolants	ASTM D 1384
Corrosion Testing of Engine Coolants, Simulated Service Test	ASTM D 2570
Corrosion Testing of Metals	ASTM G 31
Corrosion, Copper Strip, Liquefied Petroleum Gas	ASTM D 1838
Corrosion, Copper Strip, Lubricating Greases	ASTM D 4048

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Corrosion, Test Metal Specimens	ASTM G 4
Corrosive Silver in Electrical Insulating Oil	DIN 51353
Corrosive Sulfur in Electrical Insulating Oil	ASTM D 1275
Corrosive Sulfur in Electrical Insulating Oil - Part A	ASTM D 1275.a
Corrosive Sulfur in Electrical Insulating Oil - Part B (48 hrs)	ASTM D 1275.b
Corrosiveness and Oxidation Stability of Hydraulic Oils, Aircraft Turbine Engine Lubricants, and Other Highly Refined Oils	ASTM D 4636
Corrosiveness of Diesel Engine Oil at 135°C	ASTM D 6594
Corrosivity Toward Steel, Coupon	EPA 1110
Corrosivity, NACE Standard TM-01-69	NACE TM-01-69
Corrosivity, pH by Glass Electrode	EPA 9045C
Crude Oil Classification, Bureau of Mines Index	BMCi
Crude Oil Classification, Paraffinic or Asphaltinic	TOL 5048
Crude Oil Contamination in Non-Aqueous Drilling Fluids by GC-MS, EPA Appendix 5, Subpart A of Part 435	EPA Part 435, App 5
Cyanide, Reactive	EPA 9010B
Cyanide, Total, Solid Waste	EPA 9012A
D	
Demulsibility Characteristics of Lubricating Oils	ASTM D 2711
Density and Relative Density of Crude Oils by Digital Density Analyzer	ASTM D 5002
Density and Relative Density of Engine Coolants	ASTM D 5931
Density and Relative Density of Liquids by Digital Density Meter	ASTM D 4052
Density and Relative Density of Viscous Materials by Bingham Pycnometer	ASTM D 1480
Density of Calcined Petroleum Coke by Xylene Displacement	ASTM D 5004
Density of Liquids by Bingham Pycnometer	ASTM D 1217
Density of Solid Pitch and Asphalt	ASTM D 71
Density or Relative Density	ASTM D 3505
Density or Relative Density of Engine Coolant Concentrates and Engine Coolants	ASTM D 1122
Determination of C ₂ through C ₅ Hydrocarbons by GC (Fractionation)	ASTM D 2427
Determination of Equivalent Alkane Carbon Number (EACN)	TOL 3178
Dew-Point Temperature at specified psia	ASTM D 1142.b
Dielectric Breakdown Voltage of Insulating Oils Under Impulse Conditions	ASTM D 3300
Dielectric Breakdown Voltage, Disc Electrodes	ASTM D 877
Dielectric Breakdown Voltage, VDE Electrodes	ASTM D 1816
Dielectric Constant and Power Factor of Electrical Insulating Liquids, 60 Hz, 25°C	ASTM D 924.a
Dielectric Dissipation Factor	IEC 60247
Dielectric Dissipation Factor	IEC 61620
Diene Value	UOP 326
Diesel Index, Calculated Value	IP 21
Dilution of Crankcase Oils, Diesel Engine Oils, by Gas Chromatography	ASTM D 3524
Dilution of Crankcase Oils, Gasoline Engine Oils, by Gas Chromatography	ASTM D 3525
Dioxins Scan, Low Resolution	EPA 8280
Dissolved Gases in Electrical Insulating Oil by Gas Chromatography	ASTM D 3612
Dissolved Oxygen in Water	ASTM D 5543
Distillation of Bituminous Materials (Road Tars)	ASTM D 20
Distillation of Cut-Back Asphaltic Products	ASTM D 402
Distillation of Heavy Hydrocarbon Mixtures (Vacuum Potstill Method)	ASTM D 5236
Distillation of Petroleum Products at Atmospheric Pressure	ASTM D 86.b

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Distillation of Petroleum Products at Reduced Pressures, at 10 mm	ASTM D 1160.b
Distillation of Petroleum Products at Reduced Pressures, at 5 and 10 mm	ASTM D 1160
Distillation of Petroleum Products at Reduced Pressures, at 5 mm	ASTM D 1160.a
Distillation Range of Volatile Organic Liquids	ASTM D 1078
Distillation, Industrial Aromatic Hydrocarbons	ASTM D 850
Doctor Test, Sulfur Species in Fuels and Solvents	ASTM D 4952
Dropping Point of Lubricating Greases, Wide Temperature Range	ASTM D 2265
Dropping Point, Lubricating Greases	ASTM D 566
Dryness of Propane, Valve Freeze Method (Performed on site only)	ASTM D 2713
Ductility of Bituminous Materials	ASTM D 113
Durometer Hardness of Rubber	ASTM D 2240
E	
Elastomer Compatibility of Lubricating Greases and Fluids	ASTM D 4289
Elastomer Compatibility, Hardness and Relative Volume Change	ASTM D 471
Electrical Conductivity and Resistivity of Water	ASTM D 1125
Electrical Conductivity of Liquid Hydrocarbons	ASTM D 4308
Electrical Conductivity, Aviation Fuels	ASTM D 2624
Electrical Conductivity, Water and Wastewater	EPA 120.1
Elemental Analysis Coal and Coke Ash by AA	ASTM D 3682
Elemental Analysis Major and Minor Elements in Coal, Coke, and Solid Residues from Combustion of Coal and Coke, by ICP-AES.	ASTM D 6349
Elemental Analysis of Lubricants and Additives per element	ASTM D 4927
Emulsion Characteristics of Lubricating Oils (Water Separability)	ASTM D 1401
Engler Specific Viscosity of Tar Products	ASTM D 1665
Epoxy Content of Epoxy Resins	ASTM D 1652
Ester Content	EN 14103
Ethanol Content of Denatured Fuel Ethanol by Gas Chromatography	ASTM D 5501
Ethylene and Carbon Dioxide in High-Purity Ethylene by Gas Chromatography	ASTM D 2505
Ethylene Glycols and Propylene Glycols by Gas Chromatography	ASTM E 202.b
Evaporation Loss of Lubricating Greases	ASTM D 2595
Evaporation Loss of Lubricating Greases and Oils	ASTM D 972
Evaporation Loss of Lubricating Oils by the Noack Method	ASTM D 5800
Evaporation Loss of Lubricating Oils by ThermoAnalyzer (Noack Method)	ASTM D 6375
Evaporation Loss of Lubricating Oils, Noack Test	DIN 51.581
Evaporation Rate of Volatile Liquids, Relative to Butyl Acetate = 1	ASTM D 3539
Extractable Organic Halides (EOX) in Solids	EPA 9023
Extraction Procedure (EP) Toxicity Test Method	EPA 1310A
Extraction Procedure for Oily Wastes	EPA 1330A
Extraction Procedure, Zero-Head Space, Purgeables	EPA 3810
Extreme Pressure Properties of Greases, Four-Ball	ASTM D 2596
Extreme Pressure Properties of Lubricants, Falex Pin and Vee-Block	ASTM D 3233
Extreme-Pressure Properties of Fluids, Four-Ball	ASTM D 2783
Extreme-Pressure Properties of Fluids, Timken	ASTM D 2782

See page 70 for a list of Abbreviations and Acronyms

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
F	
Falex Pin and Vee-Block Test for Load Carrying Capacity of Solid Film Lubricants	ASTM D 2625
FAME Content of Diesel Fuel Oil by Mid Infrared Spectroscopy, FTIR-ATR-PLS Method	ASTM D 7371
Fatty Acid Methyl Ester	EN 14078
Ferrography, Analytical	Atlas.a
Ferrography, Direct Reading and Analytical (Trend)	Atlas.b
Filter Flow of Aviation Fuels at Low Temperature	ASTM D 4305
Filter Plugging Tendency of Distillate	IP 387
Filter Plugging Tendency of Distillate Fuel Oils	ASTM D 2068
Filterability of Diesel Fuels by Low Temperature Flow Test (LTFT) Method	ASTM D 4539
Filterability of Middle Distillate Fuel Oils	ASTM D 6426
Filterability, Cold Soak Filtration Test (CSFT), ASTM D 6751 Annex 1	ASTM D 6751.a
Filterable and Nonfilterable Matter in Water	ASTM D 5907
Fire Point, Cleveland Open Cup	ASTM D 92.b
Fixed Carbon	ASTM D 3172.c
Fixed Carbon, Calculated	ASTM D 388
Flame Atomic Absorption Spectro (Consolidate FLAA). LOD = 0.05 ppm, per element	EPA 7000B
Flame Propagation Rate of Lubricating Oils and Hydraulic Fluids	ASTM D 5306
Flammability of Chemicals, Upper and Lower Limits	ASTM E 681
Flash Point	DIN 51 755
Flash Point and Fire Point, Cleveland Open Cup	ASTM D 92.c
Flash Point by Small Scale Closed Cup Tester, (Ramp Method)	ASTM D 7236
Flash Point of Liquids by Small Scale Closed Cup Apparatus (Seta-Flash)	ASTM D 3278
Flash Point, Cleveland Open Cup	ASTM D 92.a
Flash Point, Continuous, by Closed Cup	ASTM D 6450
Flash Point, Pensky-Martens Closed Cup	ASTM D 93
Flash Point, Small Scale Closed Tester, Seta-Flash, 32 to 230°F Range	ASTM D 3828
Flash Point, Tag Closed Tester	ASTM D 56
Flash Point, Tag Open Cup	ASTM D 1310
Flash Point, Tag Open Cup, Cutback Asphalt	ASTM D 3143
Flocculation Ratio and Peptizing Power of Asphaltenes in Residual and Heavy Fuel Oils	ASTM D 7060
Flock Point, Refrigerant Compressor Oil	FTM 1303.1
Fluidity of Hydraulic Fluids at Low Temperature	ASTM D 6351
Fluoride Content, Ion Selective Electrode	EPA 340.2
Fluoride Ion in Water	ASTM D 1179
Fluoride Ions in Brackish Water, Seawater, and Brines	ASTM D 3868
Fluorine, Total, in Coal by Oxygen Bomb Combustion	ASTM D 3761
Foam in Aqueous Media, Blender Test	ASTM D 3519
Foaming Characteristics of Lubricating Oils, High Temperature	ASTM D 6082
Foaming Tendencies of Engine Coolants	ASTM D 1881
Foaming Tendencies of Engine Coolants at Room Temperature, Shake Test	ASTM D 4921
Foaming Tendencies of Lubricating Oils	ASTM D 892
Fractionation of Petroleum Distillates	UOP 79
Free Water and Particulate Contamination in Distillate Fuels	ASTM D 4176.a
Free Water and Particulate Contamination in Mid-Distillate Fuels	ASTM D 4860
Free Water Content, Visual Method	ASTM D 1835.a
Freezing Point of Aqueous Engine Coolants	ASTM D 1177
Freezing Point of Aqueous Engine Coolants, Refractometer Method	ASTM D 3321

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Freezing Point of Aviation Fuels	ASTM D 2386
Freezing Point of Aviation Fuels, Automatic Laser Method	ASTM D 7153
Freezing Point of Aviation Fuels, Automatic Optical Method	ASTM D 5901
Freezing Point of Aviation Fuels, Automatic Phase Transition Method	ASTM D 5972
Freezing Points of High Purity Hydrocarbons	ASTM D 1015
Fretting Wear Protection by Lubricating Greases and Fluids	ASTM D 4170
Fuel Injector Shear Stability Test (FISST) for Polymer Containing Fluids	ASTM D 5275
Furanic Compounds in Electrical Insulating Liquids by HPLC	ASTM D 5837
Furfural Content	IEC 61198
Fusibility of Coal and Coke Ash	ASTM D 1857
G	
Gas Bubble Separation Time of Petroleum Oils (Air Release Properties)	ASTM D 3427
Gaseous Organic Compounds by Direct Interface Gas Chromatography-Mass "Spectrometry" (GC-MS)	ASTM D 6420
Gaseous Organic Compounds by Direct Interface Gas Chromatography-Mass "Spectrometry" (GC-MS)	ASTM D 6420.a
Gaseous Organic Emissions	EPA 25EM
Gaseous Organic Emissions	EPA 25M
Gassing Tendency of Insulating Oils under Electrical Stress	ASTM D 2300
Glass Transition Temperature by Thermomechanical Analysis Under Tension	ASTM E 1824
Glycerin, Free and Total, in Biodiesel Fuel B 100 (Methyl Esters) by GC	ASTM D 6584
Glycol and/or Alcohol in Water by Gas Chromatography	ASTM D 3695
Glycol Composition by Gas Chromatography	ASTM E 202.a
Glycol-Base Antifreeze in Used Lubricating Oils	ASTM D 2982
Gross Calorific Value of Refuse-Derived Fuel	ASTM E 711
Gum Content, Existent, in Fuels by Air Jet Evaporation	ASTM D 381.a
Gum Content, Existent, in Fuels by Steam Jet Evaporation	ASTM D 381.b
H	
Halide Ion, Water Soluble, in Halogenated Organic Solvents	ASTM D 2988
Haloacetic Acid Compounds	EPA 552.2
Halogenated Volatile Organics by GC, Purge and Trap	EPA 8010B
Halogens, Purgeable Organic (POX)	EPA 9021
Halogens, Total Organic (TOX), Carbon Adsorption with Microcoulometric-Titration Detector	EPA 9020B
Hardgrove Grindability Index (HGI) of Petroleum Coke	ASTM D 5003
Hardness in Water	ASTM D 1126
Haze on Diesel Oil, Colonial Pipeline Scale	CPL Scale
Heat Aging of Asphalt Film, Rolling Thin-Film Oven Test (RTFOT)	ASTM D 2872
Heat Capacity of Petroleum Distillate Fuels	ASTM D 2890
Heat of Combustion of Aviation Fuels, estimated	ASTM D 3338
Heat of Combustion of Aviation Fuels, Net, estimated	ASTM D 1405
Heat of Combustion of Liquid Hydrocarbon Fuel by Bomb Calorimeter	ASTM D 4809
Heat of Combustion, Aviation Fuels, estimation of	ASTM D 4529
Heat of Combustion, by Bomb Calorimeter	ASTM D 240
Heat of Combustion, Estimation of Gross/Net Heat	ASTM D 4868
Heat of Reaction of Thermally Reactive Materials by Differential Scanning Calorimetry	ASTM E 2160
Herbicides	EPA 515

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Hexane Extractable Material (HEM; Oil and Grease), and Silica Gel Treated n-Hexane Extractable Material(SGT-HEM)	EPA 1664A
High Boiling Impurities	BB-F-1421 B.d
High Boiling Residues	BB-F-1421 B.a
Homogeneity and Miscibility in Automotive Engine Oils	ASTM D 6922
Humic Acid, Ulmic Acid, Fulvic Acid Detection, Liquid	TOL 4-1790
Humic Acid, Ulmic Acid, Fulvic Acid Detection, Solids	TOL 4-2090
Hydrocarbon Impurities in Ethylene by Gas Chromatography	ASTM D 6159
Hydrocarbon Types (PONA/PIONA) in Middle Distillates, Mass Spectrometry	ASTM D 2425
Hydrocarbon Types in Gas Oils by Mass Spectrometry	ASTM D 2786
Hydrocarbon Types in Liquid Petroleum by Fluorescent Indicator Absorption (FIA)	ASTM D 1319
Hydrocarbon Types in Low Olefinic Gasoline by MS	ASTM D 2789
Hydrocarbon Types, Oxygenated Compounds & Benzene in Spark Ignition Fuels by GC	ASTM D 6839
Hydrogen Content of Aviation Fuel	ASTM D 3343
Hydrogen Content of Aviation Turbine Fuels by NMRS	ASTM D 3701
Hydrogen Content of Distillates by NMR Spectroscopy (NMRS)	ASTM D 4808
Hydrogen Content of Middle Distillate Petroleum Products by Low-Resolution Pulsed Nuclear Magnetic Resonance Spectroscopy	ASTM D 7171
Hydrogen in Petroleum Fractions	ASTM D 1018
Hydrogen Sulfide and Mercaptan Sulfur in Petroleum Products	UOP 163
Hydrogen Sulfide and Sulfur Dioxide in Aromatic Hydrocarbons, Qualitative	ASTM D 853
Hydrogen Sulfide in Fuel Oils	IP 399
Hydrogen Sulfide in Gaseous Fuels, Lead Acetate Method	ASTM D 4084
Hydrogen Sulfide in Liquefied Petroleum (LP) Gases	ASTM D 2420
Hydrogen Sulfide in Natural Gas Using Length of Stain Detector Tubes	ASTM D 4810
Hydrogen Sulfide, Measurement of, in the Vapor Phase Above Residual Fuels	ASTM D 5705
Hydroperoxide Number by Volumetric Analysis	ASTM D 6447
Hydroquinone in Vinyl Acetate	ASTM D 2193
Hydroxyl Number of Drying Oils and Fatty Acid	ASTM D 1957
Hydroxyl Number of Polyols	ASTM D 4274
I	
Ignitability of Solids	EPA 1030
Ignitability, Flash Point, Pensky-Martens (PMCC)	EPA 1010
Ignitability, Flash Point, Seta-Flash Closed Cup	EPA 1020
Ignitable Liquid Residues in Extracts from Fire Debris Samples by GC-MS	ASTM E 1618
Impurities in Aromatic Hydrocarbons by GC	ASTM D 2306
Impurities in High Purity Ethyl benzene by Gas Chromatography	ASTM D 5060
Impurities in Monocyclic Aromatic Hydrocarbons by GC	ASTM D 2360
Individual Sample Aging (already at Swi) at temperature with NCS, Dead Oil, three weeks, w/o Ko Measured	TOL 3018.a
Induction Period, Gasolines (Oxidation Stability)	ASTM D 525
Infrared Spectrochemistry; Fuel Soot, Oxidation, Nitration	TOL 5047.b
Infrared Spectrochemistry; Full Spectrum FT-IR	TOL 5047.a
Inorganic Sulfate	ASTM D 6174
Inorganics by Atomic Emission Spectroscopy (ICP), per element	EPA 6010B
Insoluble Contamination of Hydraulic Fluids by Gravimetric Analysis	ASTM D 4898
Insolubles in Use Lubricating Oils by LMOA Paper Filtration Method	ASTM D 7317
Insolubles in Used Lubricating Oils	ASTM D 893

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Interfacial Tension	ISO 6295
Interfacial Tension of Oil against Water by the Ring Method	ASTM D 971
Interfacial Tension of Oils by Drop-Weight Method	ASTM D 2285
Interfacial Tension Tests by Spinning Drop Method vs. Chemical Concentrations, 5 measurements	TOL 3177
Interpretation, per sample	TOL 3170.a
Iodide and Bromide Ions in Brackish Water, Seawater, and Brines	ASTM D 3869
Iodide Ions by Ion Chromatography	ASTM D 5542.b
Iodine Value of Drying Oils and Fatty Acids	ASTM D 1959
Iodine Value of Fats and Oils	ASTM D 5554
Iodine Value of Tall Oil Fatty Acids	ASTM D 5768
Iron and Copper in Refinery Waters	UOP 314
Iron in Trace Quantities	ASTM E 394
ISO Viscosity Grade	ASTM D 2422
Isopropyl benzene (Cumene) Analysis by Gas Chromatography	ASTM D 3760
K	
Kauri-Butanol Value of Hydrocarbon Solvents	ASTM D 1133
Knock Characteristics of Aviation Gasolines by the Supercharge Method	ASTM D 909
L	
Lead by Inductively Coupled Plasma - Atomic Emission Spectrometry	ASTM E 1613.b
Lead Content, Atomic Absorption Graphite Furnace	EPA 7421
Lead in Gasoline by Iodine Monochloride Method	ASTM D 3341
Lead in Gasoline by X-ray Spectroscopy (Method A and B) (Leaded Grade)	ASTM D 5059.a
Lead in Gasoline by X-ray Spectroscopy (Method C) (Unleaded Grade)	ASTM D 5059.b
Lead in Unleaded Gasoline by Atomic Absorption Spectrometry, LOD = <0.03 g/L	ASTM D 3237
Lead in Water	ASTM D 3559
Limestone Content	TEX 406-A
Liquefied Petroleum (LP) Gases, Physical Properties Calculated from Compositional Analysis	ASTM D 2598
Lithium and Sodium in Lubricating Greases by Flame Photometer	ASTM D 3340
Loss on Drying by Thermogravimetry	ASTM E 1868
Loss on Heating of Asphaltic Materials, Thin Film Oven Test	ASTM D 1754
Low Temperature Performance of Grease-Lubricated Wheel Bearings	ASTM D 4693
Lubricity of Aviation Turbine Fuels, Ball-on-Cylinder Lubricity Evaluation (BOCLE)	ASTM D 5001
Lubricity of Diesel Fuels by the High Frequency Reciprocating Rig (HFRR)	ASTM D 6079
Lubricity of Diesel Fuels by the Scuffing Load Ball-on-Cylinder Lubricity Evaluator, (SLBOCLE), Procedure A: Incremental Load	ASTM D 6078.a
Lubricity of Diesel Fuels by the Scuffing Load Ball-on-Cylinder Lubricity Evaluator, (SLBOCLE), Procedure B: Single-Load Test	ASTM D 6078.b
Luminometer Numbers of Aviation Fuels	ASTM D 1740
M	
Manganese in Gasoline by AA Spectrometry	ASTM D 3831
Melting Point of Petroleum Wax	ASTM D 87
Melting Point of Petroleum Wax and Petroleum, Drop Melting Point	ASTM D 127
Mercaptan Sulfur in Gasoline, Kerosene and Distillate Fuels	ASTM D 3277
Mercaptan Sulfur, Potentiometric Method	ASTM D 3227

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Mercaptans in Natural Gas Using Length of Stain Detector Tubes	ASTM D 1988
Mercury by Cold Vapor Atomic Absorption, Limit of Detection. LOD = 0.05 ppm	EPA 7040A
Mercury by Cold Vapor Atomic Absorption, LOD = 0.05 ppm	EPA 245.1
Mercury, by Cold Vapor Atomic Absorption, Liquid Waste	EPA 7470A
Mercury, by Cold Vapor Atomic Absorption, Solid Waste	EPA 7471A
Mercury, Total, in Coal by Acid Extraction/Cold Vapor AA	ASTM D 6414
Mercury, Total, in Coal by Direct Combustion Analysis	ASTM D 6722
Mercury, Total, in Coal by Oxygen Bomb Combustion	ASTM D 3684
Mercury, Total, in Water	ASTM D 3223
Metal removal Fluids by Tapping Torque Test	ASTM D 5619
Metals Analysis, Examination of Water and Wastewater	Std M 3110
Metals and Contaminants in Gas Turbine and Diesel Engine Fuel by Rotating Disc Electrode Atomic Emission Spectrometry	ASTM D 6728
Metals by Atomic Absorption (AA). LOD = 0.05 ppm, per element	EPA 7000A
Metals by Graphite Furnace Atomic Absorption Spectroscopy, GFAA. Includes: Vanadium, Sodium, Potassium, Lithium, Lead, and Calcium. LOD = 0.01 ppm	ASTM E 1184
Metals by ICP-AES, Semi-Quantitative Scan, 27 metals	ASTM E 1613.a
Metals in Soils, Sludge, Solids, and Petroleum Products by ICP-AES. Includes: Arsenic, Cadmium, Chromium, and Lead. Limit of Detection. LOD = 1 ppm	EPA 6010B.1
Metals Content	EN 14538
Metals Detection by X-Ray	TOL 5053
Metals in Compounding Materials, Flame AA, per element	ASTM D 4075
Metals in Gas Oils by AAS; V, Fe, Pb, Cu, Na	UOP 848
Metals in Lubricating Greases by ICP-AES	ASTM D 7303
Metals in Petroleum Coke by Inductively Coupled Plasma Atomic - Emission Spectrometry (ICP-AES)	ASTM D 5600
Metals in Refuse-Derived Fuel by Atomic Absorption Spectroscopy	ASTM E 885
Metals in Water by Inductively Coupled Plasma - Mass Spectrometry, per element	EPA 6020
Metals in Water or Aqueous Matrices by ICP-AES	ASTM D 1976
Methanol Content	EN 14110
Methanol in Crude Oil by Gas Chromatography	ASTM D 7059
Methanol in LPG by GC	UOP 845
Methanol Purity	ASTM D 1152
Methyl Tert-Butyl Ether (MTBE) in Gasoline by Gas Chromatography	ASTM D 5441
Micro-Organism Culture Study in Fuel Oils, bacteria count/mL	ASTM E 1259
Microbial Contamination in Fuels and Fuel Systems	ASTM D 6469
Microscope Examination and Microphotography	TOL 7074
Microscopical Sizing, Counting Particles from Aerospace Fluids on Membrane Filters	ASTM F 312
Moisture Content by Measurement of Dew Point	ASTM D 1142
Moisture in the Analysis Sample of Coal and Coke	ASTM D 3173
Moisture, Ash, and Organic Matter of Peat and Other Organic Soils	ASTM D 2974
Moisture, As-Received Basis, Calculated from As-Determined Basis	ASTM D 3180.b
Moisture, Dry Basis, Calculated from As-Determined Basis	ASTM D 3180.a
Moisture, Total, in Coal	ASTM D 3302
Moisture, Total, in Coal Reduced to 2.36 mm. Top size	ASTM D 2961
Molecular Mass of Hydrocarbons by Thermoelectric Measurement of Vapor Pressure	ASTM D 2503
Molecular Weight Averages and Molecular Weight Distribution of Polystyrene by High-Performance Size-Exclusion Chromatography	ASTM D 5296
Molecular Weight from Viscosity Measurements	ASTM D 2502

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Test Description	Test Code
Molybdenum in Water	ASTM D 3372
Monomethyl Ether of Hydroquinone (MEHQ) in Acrylate Esters and Acrylic Acid	ASTM D 3125
MTBE, ETBE, TAME, DIPE, tertiary-Amyl Alcohol and C1 to C4 in Gasoline by GC	ASTM D 4815
N	
N-Hexane Extractable Material in Oil and Grease (HEM)	EPA 9071B
Naphthalene Content in Aviation Turbine Fuels	ASTM D 1840
Nickel and Vanadium in FCC Equilibrium Catalysts by Acid Decomposition and Atomic Spectroscopy Determination	ASTM D 1977
Nickel, Vanadium, and Iron in Crude Oils and Residual Fuels by Inductively Couple Plasma - Atomic Emission Spectrometry (ICP-AES)	ASTM D 5708
Nickel, Vanadium, Iron, and Sodium in Crude Oils and Residual Fuels	ASTM D 5863
Nitrate	EPA 9200
Nitrate and Nitrite, Colorimetric	EPA 353.4
Nitrite-Nitrate in Water	ASTM D 3867
Nitrogen Content by Ion Chromatography	UOP 939
Nitrogen in Petroleum and Petroleum Products	ASTM D 5762
Nitrogen in the Analysis Sample of Coal and Coke	ASTM D 3179
Nitrogen, (Ammonia), Colorimetric	EPA 350.1
Nitrogen, Organically Bound, by Chemiluminescence	ASTM D 4629
Nitrogen, Total, in Petroleum Products by Modified Kjeldahl Method	ASTM D 3228
Non-halogenated Organics Using GC-FID	EPA 8015B
Non-halogenated Volatiles (GRO, DRO) by GC-FID	EPA 8015C
Non-volatile Matter in Halogenated Organic Solvents	ASTM D 2109
Nonvolatile Matter in Volatile Solvents	ASTM D 1353
Non-volatile Residue of Butadiene, Polymerization Grade	ASTM D 1025
Non-volatile Residue of Solvent Extract from Aerospace	ASTM F 331
O	
o-Xylene Analysis by Gas Chromatography	ASTM D3797
Octane Number, Motor Method	ASTM D 2700
Octane Number, Research (Addition)	ASTM D 2699
Odor in Water	ASTM D 1292
Odor of Volatile Solvents and Diluents	ASTM D 1296
Oil and Grease (Fluorocarbon Extractable Substances) by Gravimetric Determination	ASTM D 4281
Oil and Grease Content in Water - Fluorocarbon-extractable Substances	ASTM D 3921
Oil and Grease Content, Sludge by Extraction	EPA 1664
Oil and Grease Content, Total Recoverable - Gravimetric	EPA 9070
Oil and Grease, Extraction for Sludge and Sediment	EPA 9071A
Oil Content of Petroleum Waxes	ASTM D 721
Oil Separation from Lubricating Grease (Conical Sieve Method)	ASTM D 6184
Oil Separation from Lubricating Grease, Bleed	ASTM D 1742
Oil Spill Source Identification by Gas Chromatography-Mass Spectrometry (GC-MS)	ASTM D 5739.a
Olefin Content by Supercritical Fluid Chromatography	ASTM D 6550
Olefins in Spark-Ignition Engine Fuels by Multi-dimensional Gas Chromatography	ASTM D 6296
Organic Chloride in Aromatic Hydrocarbons by Microcoulometry	ASTM D 5808
Organic Composition Breakdown by GC-MS	ASTM D 5739.b
Organic Compounds in Water by Gas Chromatograph - Mass Spectrometry (GC-MS)	ASTM D 4128
Organic Compounds, Purgeables, by GC-MS	EPA 624

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Test Description	Test Code
Organochlorine Pesticides in Water by Capillary Column Gas Chromatography	ASTM D 5812
Oxidation Induction Time of Hydrocarbons by Differential Scanning Calorimetry	ASTM E 1858
Oxidation Induction Time of Lubricating Greases by Pressure Differential Scanning Calorimetry	ASTM D 5483
Oxidation Inhibitor in Insulating Oil by Gas Chromatography	ASTM D 4768
Oxidation Inhibitor in Insulating Oil by Infrared Absorption	ASTM D 2668
Oxidation of Gear Oils	ASTM D 5763
Oxidation Onset Temperature of Hydrocarbons by Differential Scanning Calorimetry	ASTM E 2009
Oxidation Reduction Potential	Std M 2580
Oxidation Stability	EN 14112
Oxidation Stability by Modified Rotating Pressure Vessel	ASTM D 2272.b
Oxidation Stability by Rotating Pressure Vessel Method, RPVOT (previously RBOT)	ASTM D 2272.a
Oxidation Stability of Biodiesel (B100) and Blends of Biodiesel with Middle Distillate Petroleum Fuel	ASTM D 7462
Oxidation Stability of Lubricants by Thin-Film Oxygen Uptake (TFOUT) Catalyst B	ASTM D 7098
Oxidation Stability of Used Lubricants by FT-IR	ASTM D 7214
Oxidation Stability, Automotive Engine Oils by Thin Film Oxygen Uptake, TFOUT	ASTM D 4742
Oxidation Stability, Distillate Fuels	ASTM D 6468
Oxidation Stability, DuPont, including Color	DuPont F-21
Oxidation Stability, Extreme Pressure Lubricating Oils	ASTM D 2893
Oxidation Stability, Inhibited Steam Turbine Oils (2000 Hours)	ASTM D 943
Oxidation Stability, Light Fuel Oils, 16 hr	ASTM D 2274
Oxidation Stability, Lubricating Grease, Oxygen Bomb Method (Oxy Bomb)	ASTM D 942
Oxidation Stability, Mineral Insulating Oil, 164 hr	ASTM D 2440.a
Oxidation Stability, Mineral Insulating Oil, 72 hr	ASTM D 2440.b
Oxidation Stability, Mineral Insulating Oils, RPVOT (previously RBOT)	ASTM D 2112
Oxidation Stability, Potential Residue Method	ASTM D 873
Oxidation Test for Hydraulic and Turbine Oils using the Universal Oxidation Test Apparatus	ASTM D 5846
Oxidation Test for Turbine Oils, High Temperature Universal Method	ASTM D 6514
Oxygenates and Paraffin, Olefin, Naphthene, Aromatic (O-PONA) Hydrocarbon Types in Low-Olefin Spark Ignition Engine Fuels by Gas Chromatography	ASTM D 6293
Oxygenates by Gas Chromatography	ASTM D 6733M
Oxygenates in Gas by Gas Chromatography	ASTM D 5599
Oxygenates, Benzene, Toluene, C ₈ -C ₁₂ Aromatics in Finished Gasoline by GC	ASTM D 5986
P	
p-tert-Butylcatechol in Styrene Monomer	ASTM D 4590
p-xylene Analysis by Gas Chromatography	ASTM D 3798
Paraffin, Naphthene, and Aromatic Hydrocarbon Type Analysis in Petroleum Distillates through 200°C by Multi-Dimensional Gas Chromatography	ASTM D 5443
Particle Contamination in Hydraulic Fluids	SAE ARP 785
Particle Count in Mineral Insulating Oil Using Automatic Optical Particle Counters	ASTM D 6786
Particle Count, Automatic Optical Counter	SAE ARP 598
Particle Count, Automatic Optical Particle Count	ISO 4406
Particle Count, Automatic Optical Particle Count	NAS 1638
Particle Size Analysis, Dry Sieve, per fraction	ASTM E 11
Particle Size and Distribution by Automated Optical Laser Particle Analyzer with Customer-Designated Size Partition Limits	TOL 5052
Particle Size Distribution of Catalytic Material by Laser Light Scattering	ASTM D 4464

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Particle Size Distribution of Catalytic Material by Sieving per sieve	ASTM D 4513
Particles for Emulsified Asphalts	ASTM D 244
Particles, Deleterious, in Lubricating Greases	ASTM D 1404
Particulate Contaminant in Aviation Fuel by Line Sampling	ASTM D 2276
Particulate Contamination Analysis Using Membrane Filters	ASTM F 311
Particulate Contamination in Aviation Fuels by Laboratory Filtration	ASTM D 5452
Particulate Contamination in Middle Distillate Fuels by Filtration	ASTM D 6217
Particulates in Gas, Maximum Size, μm	TOL SC 6028.b
Partition Coefficient by Liquid Chromatography	ASTM E 1147
PBBs in Liquid and Solid Wastes: Oils and Sludges - Modified Method	ASTM D 6160.b
PCB Content	IEC 61619
PCB Content, Screening Test in Oil, ppm	TOL 5049
PCBs by Cap Column GC	EPA 8082
PCBs by GC	EPA 8082A
PCBs in Insulating Oil by Gas Chromatography	ASTM D 4059
PCBs in Liquid and Solid Wastes: Oils and Sludges, etc.	ASTM D 6160.a
PCBs in Soil by Extraction and Gas Chromatography	EPA 8080A
PCBs in Transformer Insulating Oils by GC	EPA 600
Pendimethalin (Penoxalin)	EPA 8141
Penetration, Cone, Lubricating Grease, Half-Scale	ASTM D 1403
Penetration, Cone, of Bituminous Materials	ASTM D 5
Penetration, Cone, of Lubricating Greases, Unworked	ASTM D 217.a
Penetration, Cone, of Lubricating Greases, Worked	ASTM D 217.b
Penetration, Cone, of Petrolatum	ASTM D 937
Penetration, Needle, of Petroleum Waxes	ASTM D 1321
Pentane Insolubles by Membrane Filtration	ASTM D 4055
Percent Antifreeze	TOL 5050
Permanganate Time of Acetone and Methanol	ASTM D 1363
Peroxide Content, Trace, in Organic Solvents	ASTM E 299
Peroxide Number of Aviation Turbine Fuels	ASTM D 3703
Peroxides in Styrene Monomer	ASTM D 2340
Petroleum Naphthas through n-Nonane by Capillary Gas Chromatography	ASTM D 5134
Petroleum Waxes by Gas Chromatography	ASTM D 5442
pH Measurement of Water of Low Conductivity	ASTM D 5464
pH of Aqueous Solutions with Glass Electrode	ASTM E 70
pH of Engine Coolants, Antifreezes and Anti-Rusts	ASTM D 1287
pH of Soils	ASTM D 4972
pH of Solid Wastes, Electrometric Measurement	EPA 9040B
pH of Waste by Screening Test	ASTM D 4980
pH of Water	ASTM D 1293
pH of Water Extractions of Halogenated Organic Solvents	ASTM D 2110
pHe of Ethanol, Denatured Ethanol and Fuel Ethanol	ASTM D 6423
Phenolics, Total Recoverable	EPA 420.1
Phenols by Spectrophotometry	EPA 420.2
Phosphorous in Unused Engine Oils by ICP	ASTM D 7040
Phosphorus Content in Biodiesel Fuels by ICP-AES	ASTM D 4951.b
Phosphorus in Gasoline, Gravimetric, g/gal	ASTM D 3231
Phosphorus in Lubricating Oils and Additives	ASTM D 1091

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Physical Appearance	Visual
PIONA Analysis by Gas Chromatography	ASTM D 6730
Poly Aromatic Compounds, PACs, DMSO Extraction	IP 346
Polycyclic Aromatic Hydrocarbons (PAH), Gaseous and Particulate, in Ambient Air (Collection on Sorbent-Backed Filters with GC/MS Analysis)	ASTM D 6209
Polymer Content of Styrene Monomer	ASTM D 2121
Polynuclear Aromatic Hydrocarbon Compounds (PAH)	EPA 1654
Polynuclear Aromatic Hydrocarbons (PAH), Wastewater, GC	EPA 610
Polynuclear Aromatics Hydrocarbons by FID	EPA 8100
Polypropylene Contamination in Residual Fuel Oils	TOL T 5035
Potassium and Sodium Content	EN 14538.b
Pour Point of Crude Oils	ASTM D 5853
Pour Point of Petroleum Oils	ASTM D 97
Pour Point of Petroleum Oils, Automated Method	ASTM D 5950
Pour Point of Petroleum Products, Automatic Pressure Pulsing Method	ASTM D 5949
Pour Point, Instrumental	ASTM D 5985
Precipitation Number of Lubricating Oils	ASTM D 91
Preparing Coal Samples for Analysis	ASTM D 2013
Proximate Analysis of Coal and Coke - Referee Method	ASTM D 3172.a
Proximate Analysis of Coal and Coke, Instrumental - Package	ASTM D 5142.a
Pumpability of Industrial Fuel Oils	ASTM D 3245
Purgeable Aromatics by GC	EPA 602
Purgeable Halocarbons in Wastewater by GC	EPA 601
Purgeable Organic Compounds in Water by Capillary Column GC-MS	ASTM D 5790
Purity by Differential Scanning Calorimetry	ASTM E 928
Purity of Acrylate Esters by Gas Chromatography	ASTM D 3362
Purity of Aldehydes and Ketones	ASTM D 2192
Purity of Hydrocarbons from Freezing Points	ASTM D 1016
Purity of Methyl Ethyl Ketone by GC, Includes weight percent Alcohol	ASTM D 2804
Purity of Styrene by Capillary Gas Chromatography (GC)	ASTM D 5135
Pyrolysis FT-IR for Polymer Identification	ASTM D 3677
Q	
Quenching Time of Heat Treating Fluid by Magnetic Quenchometer Test	ASTM D 3520
Quinoline Insoluble (QI) Content of Tar and Pitch	ASTM D 2318
R	
Radiological	EPA 900
Rapid Thermal Degradation of Solid Electrical Insulating Materials by Thermogravimetric Method (TGA)	ASTM D 3850
Red 164 Dye Concentration in Diesel Fuels	ASTM D 6258
Refractive Index and Refractive Dispersion of Hydrocarbon Liquids	ASTM D 1218
Refractive Index of Viscous Materials	ASTM D 1747
Relative Density of Light Hydrocarbons by Pressure Thermohydrometer	ASTM D 1657
Reserve Alkalinity of Engine Coolants and Anti-rusts	ASTM D 1121
Residual Chlorine in Water	ASTM D 1253
Residual Matter in Liquefied Petroleum Gases	ASTM D 2158
Roll Stability of Lubricating Grease, After 2 hours at Ambient Temperature	ASTM D 1831
Rosin Acids Content of Naval Stores, Including Rosin, Tall Oil, and Related Products	ASTM D 1240

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Rust Preventing Characteristics	ASTM D 665.a
Rust Preventing Characteristics in Synthetic Sea Water	ASTM D 665.b
Rust Preventing Characteristics of Steam Turbine Oils	ASTM D 3603
Rust Preventing Characteristics, Gasoline	NACE TM-10-72
S	
Sag, Flow Resistance, Vertical or Overhead Joints	FS SS-S-210A
Salinity	Std M 210B
Salt Content of Crude Oil, Electrometric Method	ASTM D 3230
Salt Contents of Crude Oil, Potentiometric Method	ASTM D 6470
Sample Preparation of Oils and Oily Wastes by High-Pressure, High-Temperature Digestion for Trace Element Determinations	ASTM C 1234
Sample Preparation of Water Samples by Acid Digestion	ASTM D 1971
Sample Preparation of Water Samples Using Reductive Precipitation Pre-concentration Technique for ICP-MS Analysis of Trace Metals	ASTM D 6800
Sample Preparation, Acid Digestion Aqueous Extracts	EPA 3010A
Sample Preparation, Digestion Using Closed Vessel Microwave Heating Technique for the Determination of Total Metals in Water	ASTM D 4309
Sample Preparation, Dissolution, Oil, Grease, Wax	EPA 3040A
Sample Preparation, Extraction of Total Petroleum Hydrocarbons (TPH) by Microwave Heating	ASTM D 5765
Sample Preparation, Microwave Digestion of Industrial Furnace Feedstreams and Waste for Trace Element Analysis	ASTM D 5513
Sample Preparation, Nitric Acid Digestion of Solid Waste	ASTM D 5198
Sample Preparation, Purge-and-Trap, Solid Wastes	EPA 5030B
Sample Preparation, Sediments, Soils, Sludges, Acid Digestion	EPA 3050B
Sample Preparation, Soxhlet Extraction, Solid Waste	ASTM D 5369
Sample Preparation, TCLP Extraction Procedure for Metals and Semi-volatiles	EPA 1311
Sample Preparation, Total Digestion of Sediment Samples for Chemical Analysis of Various Metals	ASTM D 4698
Sample Preparation, Total Recoverable Metals	EPA 3005A
Saponification Number	ASTM D 94
SARA, Saturates, Aromatics, Resins and Asphaltenes Analysis	TOL 5051
Scanning Electronic Microscope (SEM) Analysis	TOL 5054
Scuffing (Scoring) Load Capacity of Oils, FZG Method (12 Stage Standard Test)	ASTM D 5182
Sediment (Particulate Contamination) in Lubricating Oils (Solids Volume)	ASTM D 2273
Sediment and Solid Sludge in Service-Aged Insulating Oils	ASTM D 1698
Sediment by Extraction	ASTM D 473
Sediment by Hot Filtration, Exxon Method	Exxon
Sediment by Hot Filtration, Shell Method	Shell
Sediment Content (Particulates/Solids)	DuPont F3200
Sediment in Crude Oil by Membrane Filtration Test	ASTM D 4870
Selenium in Water	ASTM D 3859
Semivolatile Organic Compounds	EPA 525
Semivolatile Organic Compounds by GC-MS	EPA 8270D
Semivolatile Organic Compounds by GC-MS Capillary Column	EPA 8270C
Separability Characteristics of Way Lubricants	ASTM D 6553
Separability Number of Asphalt Containing Heavy Fuel Oils	ASTM D 7061
Separation of Asphalt into Four Generic Fractions	ASTM D 4124
Separometer Index, Water Separation Characteristics, Micro (WSIM or MSEP)	ASTM D 3948

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Shear Stability of Fluids, European Diesel Injector Apparatus	ASTM D 6278
Shear Stability of Grease in Presence of Water Procedure A (100,000 stroke)	ASTM D 7342.a
Shear Stability of Grease in Presence of Water Procedure B (roll stability)	ASTM D 7342.b
Shear Stability of Polymer-Containing Oils, Sonic	ASTM D 2603
Sieve Analysis of Coal and Designating Coal Size, per Sieve	ASTM D 4749
Sieve Analysis of Coke, per sieve	ASTM D 293
Sieve Analysis of Petroleum Coke, per sieve	ASTM D 5709
Silica in High-Purity Water by Flameless AA	ASTM D 4517
Silica in RDF and RDF Ash	ASTM E 887
Silica in Water and Wastewater	ASTM D 859
Silt Density Index of Water	ASTM D 4189
Silver in Water	ASTM D 3866
Simulated Distillation, SimDis, High Temperature Range, 360 to 575°C, C10 to C50	ASTM D 2887.d
Simulated Distillation, SimDis, Lower Temperature Range, 55 to 538°C, C5 to C44	ASTM D 2887.c
Sludging Tendencies of Inhibited Mineral Oils	ASTM D 4310
Smoke Point of Kerosene and Aviation Turbine Fuels	ASTM D 1322
Sodium in High Purity Water by Graphite Furnace Atomic Absorption Spectroscopy	ASTM D 6071
Softening Point of Bitumen by Ring-and-Ball	ASTM D 36
Solidification Point of Benzene	ASTM D 852
Solidification Point of Organic Chemicals	ASTM D 6875
Solidification Point of Petroleum Wax	ASTM D 3944
Solids, n-Heptane Insoluble, by 5 micron Millipore Filtration	ASTM D 3279
Solubility of Asphalt in Trichloroethylene	ASTM D 2042
Solubility of Fixed Gases in Liquids	ASTM D 2780
Solubility of Water in Hydrocarbon Lubricants	ASTM D 4056
Solubility, Estimation of Gases in Petroleum and Other Organic Liquids	ASTM D 3827
Solvent Extractables in Petroleum Waxes	ASTM D 3235
Solvents Analysis in Hazardous Waste Using Gas Chromatography	ASTM D 5830
Sonication Extraction, Solid Wastes SW-846	EPA 3550B
Soxhlet Extraction, Sludges	EPA 3540C
Specific Conductance	EPA 9050
Specific Gravity (Density, Relative Density) of Petroleum Products, See API Gravity	ASTM D 287.b
Specific Gravity (Relative Density), Gaseous Fuel	ASTM D 1070
Specific Gravity and Bulk Density of Waste	ASTM D 5057
Specific Gravity and Density of Halogenated Organic Solvents	ASTM D 2111
Specific Gravity and Density of Semi-Solid Bituminous Materials by Pycnometer Method	ASTM D 70
Specific Gravity at 60°F and 100°F	ASTM D 1298
Specific Gravity of Liquid Chemicals, Hydrometer Method	ASTM D 891.a
Specific Gravity of Liquid Chemicals, Pycnometer Method	ASTM D 891.b
Specific Gravity of Soil Solids by Water Pycnometer	ASTM D 854
Specific Gravity of Water and Brine	ASTM D 1429
Specific Heat Capacity by Differential Scanning Calorimetry	ASTM E 1269.a
Specific Heat of Liquids and Solids	ASTM D 2766
Specific Heat, Aircraft Turbine Lubricants by Differential Scanning Calorimeter (Replaces ASTM D 4816)	ASTM E 1269.b
Specific Resistance (Resistivity) of Electrical Insulating Liquids	ASTM D 1169
Stability of Water-in-Oil Emulsions, Oven Test	ASTM D 3707
Storage Stability and Compatibility	FTM 3430

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Storage Stability of Distillate Fuel at 43°C (110°F)	ASTM D 4625
Storage Stability of Middle Distillate Fuel by Oxygen Overpressure	ASTM D 5304
Strong Acid Number	IP 139
Strong Acid Number, Color-Indicator Titration	ASTM D 974.b
Strontium-90 in Water, by ICP-MS	ASTM D 5811
Sugar in Crankcase Oil	TOL 5001
Sulfate Ion in Brackish Water, Seawater, and Brines	ASTM D 4130
Sulfate Ion in Water	ASTM D 516
Sulfide Ion in Water by Ion Selective Electrode	ASTM D 4658
Sulfide, Reactive, in Solid Wastes, mg/L	EPA 9030B
Sulfur Analysis in Coal and Coke Using High Temp Tube Furnace Combustion	ASTM D 4239
Sulfur by X-Ray Fluorescence Spectroscopy. LOD = 0.01 wt%	ASTM D 4294
Sulfur Compounds in Light Petroleum Liquids by GC and Sulfur Selective Detection	ASTM D 5623
Sulfur Compounds in Natural Gas and Gaseous Fuels by GC	ASTM D 5504
Sulfur Compounds in Natural Gas and Gaseous Fuels by GC/FPD	ASTM D 6228
Sulfur in Automotive Fuels by Polarization X-ray Fluorescence Spectrometry	ASTM D 7220
Sulfur in Gaseous by Energy Dispersive X-ray Fluorescence Spectrometry	ASTM D 6445
Sulfur in Gasoline by Wavelength Dispersive X-Ray Fluorescence	ASTM D 6334
Sulfur in Liquefied Petroleum Gases	ASTM D 2784
Sulfur in Liquid Hydrocarbons by Oxidative Combustion and Electrochemical Detection	ASTM D 6920
Sulfur in Petroleum Products by Hydrogenolysis and Rateometric Colorimetry	ASTM D 4045
Sulfur Total Volatile, in Gaseous Hydrocarbons and LPG	ASTM D 6667
Sulfur, Bomb Method. LOD = 0.1 wt%	ASTM D 129
Sulfur, by Microcoulometry, Light Hydrocarbons	ASTM D 3120
Sulfur, Forms of, in Coal	ASTM D 2492
Sulfur, High Temperature Method LOD = 0.06 wt%	ASTM D 1552
Sulfur, Lamp Method. LOD = 0.01 wt%	ASTM D 1266
Sulfur, Total, in Light Hydrocarbons, Oxidative Combustion Method	ASTM D 6428
Sulfur, Total, in the Analysis Sample of Coal and Coke	ASTM D 3177
Sulfur, X-Ray Spectrometry. LOD = 0.001 wt%	ASTM D 2622
Surface and Interfacial Tension of Solutions of Surface-Active Agents	ASTM D 1331
Surface Tension by Fast Bubble Technique	ASTM D 3825
Sustained Burning of Liquids Mixtures by the Seta-Flash Tester	ASTM D 4206
T	
Tensile Strength of Vulcanized Rubber and Thermoplastic Elastomers	ASTM D 412
Thermal Conductivity and Thermal Diffusivity by Modulated Temperature Differential Scanning Calorimetry	ASTM E 1952
Thermal Conductivity of Liquids (400°F maximum)	ASTM D 2717
Thermal Conductivity of Solids by Guarded-Comparative Longitudinal Heat-Flow Technique	ASTM E 1225
Thermal Expansion of Electrical Insulating Liquids of Petroleum Origin and Askarels	ASTM D 1903
Thermal Oxidation Stability of Aviation Turbine Fuels, JFTOT Procedure	ASTM D 3241
Thermal Stability of Chemicals by Differential Scanning Calorimetry	ASTM E 537
Thermal Stability of Hydraulic Oils, 165 hours	ASTM D 2070
Thermal Stability of Organic Heat Transfer Fluids	ASTM D 6743
Thermal Stability of Way Lubricants	ASTM D 6203
Thiophene in Refined Benzene by Gas Chromatography	ASTM D 4735
Timken Extreme Pressure (EP) Properties of Lubricating Greases	ASTM D 2509

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Total Acid Number	IP 182
Total and Organic Carbon in Water	ASTM D 4839
Total and Organic Carbon in Water by Hi-Temp Oxidation, Coulometric Detection	ASTM D 4129
Total Carbon by CHN Analyzer	ASTM D 5291.b
Total Chemical Bound Nitrogen in Water by Pyrolysis	ASTM D 5176
Total Chlorides	EPA 9253
Total Chlorine in Coal by Oxygen Bomb Combustion, Ion Selective Electrode	ASTM D 4208
Total Combustible and Carbonate Carbon in Solid Residues from Coal and Coke	ASTM D 6316
Total Dissolved Solids, TDS	Std M 2540C
Total Fluorine in Coal and Coke by Pyrohydrolytic Extraction	ASTM D 5987
Total Hydrogen Sulfide in Residual Fuels	ASTM D 6021
Total Inhibitor Content (TBC) of Light Hydrocarbons	ASTM D 1157
Total Inorganic Chloride, by Ion Chromatography (for Water Samples and Organic Samples that have been prepared using Method EPA 5050)	EPA 9056A
Total Kjeldahl Nitrogen in Water	ASTM D 3590
Total Organic Carbon (TOC)	Std M 5310B
Total Organic Carbon, (TOC)	EPA 9060
Total Oxygen in Gasoline and Methanol Fuels by Reductive Pyrolysis	ASTM D 5622
Total Petroleum Hydrocarbon (TPH)	EPA 8015
Total Petroleum Hydrocarbon (TPH) Speciation	Texas 1006
Total Petroleum Hydrocarbons (TPH)	Texas 1005
Total Sediment by Hot Filtration, Procedure A	ASTM D 4870.a
Total Sediment by Hot Filtration, Procedure B	ASTM D 4870.b
Total Sediment in Residual Fuels	ASTM D 4870
Total Solids, TS	Std M 2540B
Total Sulfur In Fuel Gases	ASTM D 1072
Total Sulfur in Gaseous Fuels by Hydrogenolysis and Rateometric Colorimetry	ASTM D 4468
Total Sulfur in Light Hydrocarbons, Motor Fuels and Oils by UV Fluorescence	ASTM D 5453
Total Sulfur in Petroleum Gas by Microcoulometry	ASTM D 3246
Total Suspended Solids, TSS	Std M 2540D
Total Trihalomethane	EPA 524.2
Total Volatile Solids	EPA 160.4
Trace Chloride (Organic and Inorganic) in Liquid Aromatic Hydrocarbons, Titration Method	ASTM D 5194
Trace Element in Hazardous Waste Fuel, per element	ASTM D 5839
Trace Elements by Inductively Coupled Plasma in Water and Waste (ICP-AES), per element	EPA 200.7 CL
Trace Elements by Inductively Coupled Plasma, (ICP-AES), per element	EPA 200.7
Trace Elements in Coal and Coke Ash by Atomic Absorption	ASTM D 3683.b
Trace Elements in Coal and Coke Ash by Atomic Absorption: Beryllium, Chromium, Copper, Manganese, Nickel, Lead, Vanadium, and Zinc, per element	ASTM D 3683.a
Trace Elements in Coal, Coke, and Combustion Residues by ICP-AES, ICP-MS, and GFAA	ASTM D 6357
Trace Elements in Middle Distillate Fuels by ICP-AES	ASTM D 7111
Trace Elements in Waste Streams, by ICP-AES, per element	ASTM C 1111
Trace Elements in Water by Flame Atomic Absorption Spectrophotometry, 14 elements. LOD = 0.5 ppm	ASTM D 4691
Trace Elements in Water by Graphite Furnace Atomic Absorption Spectrometry (GFAA). Includes: Sodium, Potassium, and Calcium. LOD = 0.01 ppm	ASTM D 3919.c

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Trace Elements in Water by Graphite Furnace Atomic Absorption Spectrometry (GFAA). Includes: Sodium, Potassium, Calcium, Iron, and Copper. LOD = 0.01 ppm	ASTM D 3919.d
Trace Elements in Water by Graphite Furnace Atomic Absorption Spectrometry, (GFAA). Includes: Sodium and Potassium. LOD = 0.01 ppm	ASTM D 3919.b
Trace Elements in Water by Graphite Furnace Atomic Absorption Spectrophotometry, per Element	ASTM D 3919.a
Trace Elements in Water by Inductively Coupled Plasma - Mass Spectrometry (ICP-MS), per element	ASTM D 5673.a
Trace Ethylene Glycol in Used Engine Oil	ASTM D 4291
Trace Metals by ICP-MS Includes: Vanadium, Sodium, Potassium, Lithium, Lead, and Calcium. LOD = 0.01 ppm	ASTM D 5673.b
Trace Metals in Oils by Wet Ashing and ICP-AES	UOP 389
Trace Metals in Petroleum Coke by Atomic Absorption, per element	ASTM D 5056
Trace Metals in Petroleum Coke by Wavelength Dispersive X-ray Fluorescence Spectroscopy	ASTM D 6376
Trace Nitrogen in Aromatic Hydrocarbons, Chemiluminescence Detector	ASTM D 6069
Transition Temperature by Differential Scanning Calorimeter (DSC)	ASTM D 4419
Transition Temperature of Polymers by Differential Scanning Calorimeter (DSC)	ASTM D 3418
True Boiling Point and Distillation of Crude Petroleum (15 Theoretical Plates)	ASTM D 2892
True Vapor Pressure of Petroleum Distillate Fuels	ASTM D 2889
Turbidity of Water	ASTM D 1889
U	
Ultimate Analysis (C, H, N, S, O) for Coke and Coal (See test package for coal).	ASTM D 3176
Ultraviolet Absorbance and Absorptivity, A-1 Oils	ASTM D 2008.a
Ultraviolet Absorbance and Absorptivity, A-4 Oils	ASTM D 2008.b
Ultraviolet Absorption Limits, Mineral Oils, FDA	FDA 21-CFR 178
Ultraviolet Absorption Limits, Mineral Oils, USP	ASTM D 2269
Undissolved Water in Aviation Turbine Fuels	ASTM D 3240
Unulfonated Residue	ASTM D 483
Urin for Technetium-99 by Inductively Coupled Plasma-Mass Spectrometry	ASTM C 1476
Used Oil Burned for Energy Recovery, Package	40 CFR, 266.40
V	
Vanadium by X-Ray Spectrometry	DIN 51790 Part 2
Vanadium in Water	ASTM D 3373
Vapor Density	TOL 7070
Vapor Phase, Organic Concentration	EPA 25E
Vapor Pressure and Molecular Weight, of Lubricating Oils	ASTM D 2878
Vapor Pressure in Crude Oil, Expansion Method	ASTM D 6377
Vapor Pressure of Gasoline, Dry Method	ASTM D 4953
Vapor Pressure of Liquefied Petroleum (LP) Gases	ASTM D 1267
Vapor Pressure of Liquids by Ebulliometry	ASTM E 1719
Vapor Pressure of Liquefied Petroleum Gases (LPG) by Expansion Method	ASTM D 6897
Vapor Pressure of Petroleum Products (Automatic Method)	ASTM D 5190
Vapor Pressure of Petroleum Products (Mini Method-Atmospheric)	ASTM D 5482
Vapor Pressure of Petroleum Products, Mini Method	ASTM D 5191
Vapor Pressure of Petroleum Products, Reid Method	ASTM D 323
Vapor Pressure of Petroleum Products, Triple Expansion Method	ASTM D 6738

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Vapor Pressure-Temperature Relationship and Initial Decomposition Temperature of Liquids by Isoteniscope	ASTM D 2879
Viscosity Change After Low Temperature Standing, Aircraft Turbine Lubricants	ASTM D 2532
Viscosity Characteristics of Hydraulic Fluids at Low Temperature	ASTM D 6080
Viscosity Index, Calculated From Kinematic Viscosity Tests at 40°C and 100°C	ASTM D 2270
Viscosity of Heavy Duty Diesel Drain Oils at 100°C	ASTM D 6895
Viscosity, Brookfield	ASTM D 2196
Viscosity, Capillary, of Asphalts at 140°F, Poise	ASTM D 2171
Viscosity, Dynamic, and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)	ASTM D 7042
Viscosity, Fann VG Meter, AV, PV, YP, Gel, at 150°F	API RP 13B.b
Viscosity, Fann VG Meter, AV, PV, YP, Gel, at 75°F	API RP 13B.a
Viscosity, Kinematic, at 100°C, cSt	ASTM D 445.b
Viscosity, Kinematic, at 40°C, cSt	ASTM D 445.a
Viscosity, Kinematic, at any other Temperature	ASTM D 445.c
Viscosity, Kinematic, of Asphalts at 275°F, cP	ASTM D 2170
Viscosity, Low Temperature, of Lubricants by Brookfield Viscometer	ASTM D 2983
Viscosity, Saybolt Furol, at 122°F, SFS	ASTM D 88
Viscosity, Saybolt Universal, at 100°F, SUS	ASTM D 2161.a
Viscosity, Saybolt Universal, at 210°F, SUS	ASTM D 2161.b
Viscosity, Saybolt Universal, at other temperature, SUS	ASTM D 2161.c
Viscosity/Temperature Dependence, Low Temperature, Low Shear Rate, of Lubricating Oils Using a Temperature-Scanning Technique	ASTM D 5133
Viscosity-Gravity Constant (VGC) of Petroleum Oils	ASTM D 2501
Visual Examination of Electrical Insulating Oils	ASTM D 1524
Visual Inspection of Aviation Fuels for Free Water, Particulates, Other Contaminants	ASTM D 6986
Visual Inspection, Procedure B	ASTM D 4176.b
Volatile Content of Water-Borne Aerosol Paints	ASTM D 5325
Volatile Matter Content, at 110°C, Gravimetric	EPA Method 24
Volatile Matter in the Analysis Sample of Coal and Coke	ASTM D 3175
Volatile Matter, Loss on Heating of Oils and Asphaltic Compounds	ASTM D 6
Volatile Organic Chemicals in Atmospheres (Canisters Sampling Methodology)	ASTM D 5466
Volatile Organic Compounds (VOC) of Electrical Insulating Varnishes	ASTM D 6053
Volatile Organic Compounds by GC/MS	EPA 8260B.b
Volatile Organic Compounds in Solid Waste, GC-MS	EPA 8240B
Volatile Organic Compounds, Purge-and-Trap, GC-MS	EPA 8260B.a
Volatility of Engine Oils by Gas Chromatography	ASTM D 6417
Volatility of Liquefied Petroleum (LP) Gases	ASTM D 1837
Volatility Rate by Thermogravimetry	ASTM E 2008
Volatilization Rates of Lubricants in Vacuum	ASTM D 2715
W	
Water and Sediment in Crude Oil, BS&W	ASTM D 4007
Water and Sediment in Distillate Fuels, BS&W	ASTM D 2709
Water and Sediment in Fuel Oils, BS&W	ASTM D 1796
Water by Distillation, Crude Oil	ASTM D 4006
Water by Distillation, Petroleum Products	ASTM D 95
Water Content	IEC 60814
Water Content (Moisture) of Soil by Direct Heating Method	ASTM D 4959

ALPHABETICAL LIST OF TESTS

Test Description	Test Code
Water Content by Karl Fischer Method, Antifreeze	ASTM D 1123
Water Content by Karl Fischer Method, Aromatic Hydrocarbons and their Admixtures	ASTM D 7375
Water Content by Karl Fischer Method, Crude Oil	ASTM D 4928
Water Content by Karl Fischer Method, Halogenated Organic Solvents	ASTM D 3401
Water Content by Karl Fischer Method, Hazardous Waste Fuels	ASTM D 5530
Water Content by Karl Fischer Method, Insulating Liquids	ASTM D 1533
Water Content by Karl Fischer Method, Liquid Naval Stores	ASTM D 809
Water Content by Karl Fischer Method, Lubricating Oils and Additives	ASTM D 6304
Water Content by Karl Fischer Method, Organic Liquids	ASTM E 1064
Water Content by Karl Fischer Method, Paints and Paint Materials	ASTM D 4017
Water Content by Karl Fischer Method, Volatile Solvents	ASTM D 1364
Water Content by Volumetric Karl Fischer Method	ASTM E 203
Water in Crude Oils by Potentiometric Karl Fischer Titration	ASTM D 4377
Water Miscibility of Water-Soluble Solvents	ASTM D 1722
Water Reaction of Aviation Fuels	ASTM D 1094
Water Separation Characteristics of Diesel Fuels by Portable Separometer, DSEP Rating	ASTM D 7261
Water Separation Characteristics of Kerosene-type Aviation Turbine Fuels containing Additives	ASTM D 7224
Water Spray Resistance of Lubricating Grease	ASTM D 4049
Water Tolerance	ASTM D 6422
Water Vapor Content of Gaseous Fuels Using Electronic Moisture Analyzers	ASTM D 5454
Water Vapor in Natural Gas Using Length-of-Stain Detector Tubes	ASTM D 4888
Water Washout Characteristics of Greases at 38°C (100°F)	ASTM D 1264.a
Water Washout Characteristics of Greases at 80°C (175°F)	ASTM D 1264.b
Wax Appearance Point of Distillate Fuels	ASTM D 3117
Wax Content in Oil (Paraffin Wax)	UOP 46
Wear Metals and Contaminants in Lubricating Oils by Rotating Disc Electrode-Atomic Emission Spectrometry, (RDE-AES)	ASTM D 6595
Wear Preventive Characteristics of Grease, Four-Ball Method	ASTM D 2266
Wear Preventive Characteristics of Lube Oil, Four-Ball Method	ASTM D 4172
Wear Preventive Properties of Lubricating Greases using the Falex Block on Ring Test	ASTM D 3704
Wear Properties of Fluid Lubricants, Falex Pin and Vee-Block Method	ASTM D 2670
X, Y, and Z	
X-Ray Diffraction (XRD), Quantitative Analysis	TOL 5055
Xylene Equivalent of Asphalt	AASHTO 102
Yield Stress and Apparent Viscosity of Engine Oils at Low Temperature	ASTM D 4684
Zinc Dust (Metallic Zinc Powder), Paint Pigments (Section 7-25)	ASTM D 521
Zippers, Corrosion Resistance to Salt Spray (Fog)	ASTM D 2059

**For a more complete alphabetical list of our test capabilities,
check out our website at www.tol-lp.com**



Fuels

GASEOUS FUELS FOR GAS TURBINES

The recommended and optional test packages developed in this section are based on the international specification for Natural Gas and Gaseous Mixtures, ISO 6974. These required tests are further supplemented according to guidelines provided by the various turbine manufacturers. A list of other optional tests is also given. A combination of our recommended tests and the available optional tests should satisfy the requirements for gaseous fuels for most turbine manufacturers.

ISO 6974 Specification for Gas Fuel	
Test Code	Description
ASTM D 1945.a	Composition of Natural Gas by Gas Chromatography: Includes Hydrogen, Nitrogen, Oxygen, Carbon Monoxide, Carbon Dioxide, Argon, Helium, Methane, Ethane, Propane, iso-Butane, n-Butane, iso-Pentane, n-Pentane, and Hexane
Calculated	Hydrocarbon Dewpoint (client must provide measurement at sampling point)
ASTM D 3588.a	Calorific Value and Specific Gravity of Gaseous Fuels
ASTM D 3588.b	Higher Heating Value (HHV), as Btu/SCF and as Btu/lb.
ASTM D 3588.c	Lower Heating Value (LHV), as Btu/SCF and as Btu/lb.
Calculated	Molecular Weight
ASTM D 3588.d	Specific Gravity at 59°F and 1 atmosphere
Calculated	Density
ASTM D 3246	Total Sulfur in Petroleum Gas by Microcoulometry, (Condensables)
ASTM D 1142	Water Vapor Content (Moisture Content) of Gaseous Fuels by Measurements of Dew Point Temperature
Additional Tests	
ASTM D 1945.b	Extended Composition of Natural Gas by Gas Chromatography. Includes mole percent of the following components when their presence is suspected: Acetylene, Ethylene, Propylene, Butylene, Octane, Nonane, Decane, Undecane, Dodecane, and Tridecane
TOL SC 6028.a	Collection and Microscopical Sizing, Counting of Particulates in Gas, μm
TOL SC 6028.b	Maximum Size of Particulates in Gas, μm
ASTM D 3605.g	Trace Metals in Gas Turbine Fuels by Flame Atomic Absorption Spectroscopy. Includes: Sodium, Potassium, Vanadium, Lead, Calcium, Barium, Magnesium, and Phosphorous, LOD = 0.05 ppm
ASTM D 4629	Nitrogen, Organically Bound, by Chemiluminescence
ASTM D 5504	Determination of Sulfur Compounds in Natural Gas and Gaseous Fuels by Gas Chromatography and Chemiluminescence. Includes: Hydrogen Sulfide, Carbonyl Sulfide, Hydrogen Cyanide, Ammonia, and other contaminants above 0.001 vol. % (above 1 ppm)

GASEOUS FUELS FOR GAS TURBINES

Individual gas turbine manufacturers have specifications that may be more detailed than those identified in ISO 6974. This is often true with regard to higher carbon number contaminants, particulates, or trace metals. Texas OilTech Laboratories, Inc. is prepared to recommend specific test packages for individual turbine manufacturers based on our knowledge of their fuel specifications.

Some turbine manufacturers have fuel specifications with additional testing requirements and these include:

Siemens Specification ZDX555-DC02-MPB-2500-01

a. Qualification Tests

b. Performance Tests

General Electric Corporation Specification TMD-TD-00001

Pratt & Whitney Specification FR-2

Solar Turbines Specification ES-9-98

Siemens Specification ZDX555-DC01-MBP-2500-01, Qualification Tests for Gas Fuels

Note 1: This test is included for the following Gas Turbine Frames: SGT-1000F, SGT6-2000E(6), SGT5-2000(3),(6),(7), SGT5-3000E(2), SGT6-4000F(2),(4), SGT5-4000F(2),(4)

Note 2: Higher Heating Value, HHV, and Lower Heating Value, LHV, can also be provided in units of Btu/lb or Btu/scf

Note 3: In lieu of ASTM D 3605. This method is more accurate and has better detection limit.

Siemens Specification Package ZDX555-DC01-MBP-2500-01 Performance Tests for Gas Fuels

General Electric Corporation MID-TD-00001 Specification, Recommended Tests

PWPS Specification FR-2, Recommended Tests

Solar Turbines Specification ES 9-98-U, Recommended Tests

GASEOUS FUELS FOR GAS TURBINES

Liquid Petroleum Gas (LPG) specifications can be found in GPA 2140 from the Gas Producers Association or in ASTM D 1835, as shown below.

LPG Quality Assurance Test Package per ASTM D 1835 and GPA 2140	
Test Code	Description
ASTM D 1267	Vapor Pressure of Liquefied Petroleum (LP) Gases
ASTM D 1837	Volatility of Liquefied Petroleum (LP) Gases
ASTM D 2158	Residual Matter in Liquefied Petroleum Gases
ASTM D 1838	Corrosion, Copper Strip, Liquefied Petroleum Gas
ASTM D 2784	Sulfur in Liquefied Petroleum Gases
ASTM D 2420	Hydrogen Sulfide in Liquefied Petroleum (LP) Gases
ASTM D 2163	Composition of Liquid Petroleum (LP) Gas and Propane by GC
ASTM D 1835.a	Free Water Content, Visual Method
ASTM D 1657	Relative Density at 60/60°F (15.6/15.6°C)
Additional Tests	
ASTM D 2713	Dryness of Propane, Valve Freeze Method (Performed on site only)
ASTM D 2598	Calculation of Certain Physical Properties of Liquefied Petroleum (LP) Gases from Compositional Analysis (price includes compositional analysis)
ASTM D 3605.c	Trace Metals in Gas Turbine Fuels by Flame Atomic Absorption Spectrometry. Includes: Sodium, Potassium, and Lithium, LOD = 0.05 ppm

When the focus is on contaminants in Pipeline Gas, a special group of tests is also identified below:

Gas Pipeline Contaminants Analysis	
Test Code	Description
ASTM D 4951.a	Additive Elements in Lubricating Oils by Inductively Coupled Plasma - Atomic Emission Spectrometry (ICP-AES)
ASTM D 482	Ash Content of Petroleum Products
ASTM F 1375	Energy Dispersive X-Ray Analysis (EDX)
TOL 5054	Scanning Electronic Microscope (SEM) Analysis
Optional Tests for Gas Fuel Analysis	
Test Codes	Description
ASTM D 6420	Aromatics, Paraffins, and Olefins Content by GC/MS
ASTM D 5504	Hydrogen Sulfide, Carbonyl Sulfide, Hydrogen Cyanide, Ammonia
ASTM D 3588.a	Calorific Value and Specific Gravity, Compressibility, and Molecular Weight of Gases
ASTM D 3246	Total Sulfur in Gas
ASTM D 5454	Water Vapor Content of Gaseous Fuels Using Electronic Moisture Analyzers
ASTM D 1142	Water Vapor Content of Gaseous Fuels by Dewpoint
ASTM D 4629	Nitrogen, Organically Bound, by Chemiluminescence
ASTM D 3605.g	Metals by Flame AA. Includes: Na, K, V, Pb, Ca, Ba, Mg, P, Cr, ppm.
TOL SC 6028.a	Collection and Microscopical Sizing, Counting of Particulates in Gas (Recommended for overseas gas samples)

GAS TURBINE LIQUID FUEL

The test packages for liquid fuels for stationary gas turbines in power plants are based on ASTM Specification D 2880. ISO 4261 is a parallel document to ASTM D 2880 with similar testing procedures and specifications for gas turbine liquid fuels. ASTM Specification D 6615 covers jet fuels for aircraft.

There are five grades of fuel covered by ASTM D 2880. Grades 1-GT and 2-GT are distillate fuels, which differ in viscosity range. Grade 1-GT (1 to 2 cP) is the most widely used in power plants. Grade 2-GT (2 to 4 cP) may be slightly less clean burning.

Grades 3-GT and 4-GT are typically residual fuel oils or blends with viscosity from 5 cP upward to semi-solid hydrocarbons that require fuel heating. The gas turbine manufacturers should be consulted for appropriate specification limits. Grade 0-GT includes naphtha, Jet B fuel, and other light hydrocarbon liquids with low flash point and low viscosity.

Individual gas turbine manufacturers have specifications that may be more detailed than those identified in ASTM D 2880. This is often true with regard to contaminants such as water, microbial slimes, particulates, and trace metals. We can recommend specific test packages to meet individual turbine manufacturers' specifications.

Gas Turbine Fuel Oil General Electric Corporation MID-TD-00002 Specification

Gas Turbine Liquid Fuel Qualification Test Package Siemens Specification ZDX555-DC01-MBN-2500-01

Gas Turbine Liquid Fuel Performance Test Package Siemens Specification ZDX555-DC01-MBN-2500-01

Test Package per PWPS Fuel Specification FR-1

Solar Turbines Liquid Fuel Specification ES 9-98-U Qualification Tests

GAS TURBINE LIQUID FUEL

ISO 4261 is a parallel document to ASTM D 2880 and offers similar testing procedures and specifications for gas turbine fuel oils. Individual gas turbine manufacturers have specifications that may be more detailed than those identified in ASTM D 2880. This is often true with regard to contaminants such as water, microbial slimes, particulates, and trace metals. Texas OilTech Laboratories, Inc. is prepared to recommend specific test packages for individual turbine manufacturers based on our knowledge of their fuel specifications.

Gas Turbine Fuel Oil, ASTM D 2880 Specification Distillate Grades No. 1-GT and No. 2-G T

Test Code	Description
ASTM D 93	Flash Point, Pensky-Martens Closed Cup
ASTM D 2709	Water and Sediment in Distillate Fuels, BS&W
ASTM D 86.b	Distillation of Petroleum Products
ASTM D 445.a	Viscosity, Kinematic, at 40°C, cSt
ASTM D 524.b	Carbon Residue, Ramsbottom on 10% Residue
ASTM D 482	Ash Content of Petroleum Products
ASTM D 1298	API Gravity of Petroleum Products, Hydrometer Method (Density, Relative Density, Specific Gravity)
ASTM D 97	Pour Point of Petroleum Oils

Gas Turbine Fuel Oil, ASTM D 2880 Specification Additional Tests for Liquid Turbine Fuels

Test Code	Description
ASTM D 95	Water by Distillation, Petroleum Products
ASTM E 203	Water Content by Karl Fischer Method, Engine Coolants
ASTM D 512	Chloride, Inorganic, in Water and Wastewater
ASTM D 130	Corrosion from Petroleum Products, Copper Strip Tarnish Test, 2 hours @ 100°C
ASTM D 6469	Microbial Contamination in Fuels and Fuel Systems
ASTM D 5452	Particulate Contamination in Aviation Fuels by Laboratory Filtration
ASTM D 6217	Particulate Contamination in Middle Distillate Fuels by Filtration
ASTM D 4294	Sulfur by X-Ray Fluorescence Spectroscopy LOD = 0.01 wt%
ASTM D 3605.b	Trace Metals by Flame Atomic Absorption Spectroscopy. Includes: Sodium and Potassium, LOD = 0.05 ppm
ASTM D 5673.b	Trace Metals by ICP-MS Includes: Vanadium, Sodium, Potassium, Lithium, Lead, and Calcium. LOD = 0.05 ppm
ASTM D 6728	Metals and Contaminants in Gas Turbine and Diesel Engine Fuel by Rotating Disc Electrode Atomic Emission Spectrometry

AVIATION TURBINE FUEL

Aviation turbine fuels are Middle Distillate products containing special additives to achieve the desired performance.

ASTM Specification D 6615 identifies a specific type of aviation turbine fuel for civil use which is a wide boiling range distillate fuel and has an advantage of operating in very low temperature environments. ASTM D 6155 is a related specification for Aviation Turbine Fuels that requires many of the same test procedures.

ASTM D 7223 is the current standard specification for Jet C-1 Aviation Certification Turbine Fuel.

Aviation Turbine Fuel, Jet B, Wide Boiling Range ASTM D 6615 Specification, Qualification Test Package	
Test Code	Description
ASTM D 1319	Hydrocarbon Types in Liquid Petroleum by Fluorescent Indicator Absorption (FIA)
ASTM D 6379	Aromatic Hydrocarbon Types in Aviation Fuels and Petroleum Distillates
ASTM D 3277	Mercaptan Sulfur in Gasoline, Kerosene and Distillate Fuels
ASTM D 4294	Sulfur by X-Ray Fluorescence Spectroscopy LOD = 0.01 wt%
ASTM D 86.b	Distillation of Petroleum Products at Atmospheric Pressure
ASTM D 4052	Density and Relative Density of Liquids by Digital Density Meter
ASTM D 5191	Vapor Pressure of Petroleum Products, Automatic Method
ASTM D 2386	Freezing Point of Aviation Fuels
ASTM D 4809	Heat of Combustion of Liquid Hydrocarbon Fuel by Bomb Calorimeter
ASTM D 1322	Smoke Point of Kerosene and Aviation Turbine Fuels
ASTM D 1840	Naphthalene Content in Aviation Turbine Fuels
ASTM D 130	Corrosion from Petroleum Products, Copper Strip Tarnish Test, 2 hours @ 100°C
ASTM D 3241	Thermal Oxidation Stability of Aviation Turbine Fuels, JFTOT Procedure
ASTM D 381.b	Gum Content, Existent, in Fuels by Steam Jet Evaporation
ASTM D 2624	Electrical Conductivity, Aviation Fuels
ASTM D 3948	Separometer Index, Water Separation Characteristics, Micro (WISM or MSEA)
Additional Tests	
ASTM D 4952	Doctor Test, Sulfur Species in Fuels and Solvents
ASTM D 5901	Freezing Point of Aviation Fuels, Automatic Optical Method
ASTM D 5972	Freezing Point of Aviation Fuels, Automatic Phase Transition Method
ASTM D 445.a	Viscosity, Kinematic, at 40°C, cSt
ASTM D 6469	Microbial Contamination in Fuels and Fuel Systems

Additives: Any additives to be used as supplements to an approved Aviation Turbine fuel must be separately approved on an individual basis. These may include: Antioxidants, Metal Deactivators, Electrical Conductivity Additives, Leak Detecting Additives, and Fuel System Icing Inhibitors. Request separate quotation.

AVIATION TURBINE FUEL

Aviation Turbine Fuel, Grades JP-4 (NATO F-40) and JP-5 (NATO F-44) MIL-DTL-5624U Specification, Qualification Test Package

Test Code	Description
ASTM D 156	Color, Saybolt Chromometer Method
ASTM D 3242	Acidity in Aviation Turbine Fuel, Acid Number
ASTM D 1319	Hydrocarbon Types in Liquid Petroleum by Fluorescent Indicator Absorption (FIA)
ASTM D 3277	Mercaptan Sulfur in Gasoline, Kerosene and Distillate Fuels
ASTM D 4294	Sulfur by X-Ray Fluorescence Spectroscopy LOD = 0.01 wt%
ASTM D 93	Flash Point, Pensky-Martens Closed Cup
ASTM D 86.b	Distillation of Petroleum Products at Atmospheric Pressure
ASTM D 1298	Specific Gravity at 60°F and 100°F
ASTM D 976	Cetane Index, Calculated from API Gravity and Distillation
ASTM D 323	Vapor Pressure of Petroleum Products, Reid Method
ASTM D 2386	Freezing Point of Aviation Fuels
ASTM D 445.c	Viscosity, Kinematic, at -20°C
ASTM D 4809	Heat of Combustion of Liquid Hydrocarbon Fuel by Bomb Calorimeter
ASTM D 3701	Hydrogen Content of Aviation Turbine Fuels by NMRS
ASTM D 1322	Smoke Point of Kerosene and Aviation Turbine Fuels
ASTM D 130	Corrosion from Petroleum Products, Copper Strip Tarnish Test, 2 hours at 100°C
ASTM D 3241	Thermal Oxidation Stability of Aviation Turbine Fuels, JFTOT Procedure
ASTM D 381.b	Gum Content, Existent, in Fuels by Steam Jet Evaporation
ASTM D 5452	Particulate Contamination in Aviation Fuels by Laboratory Filtration
ASTM D 1094	Water Reaction of Aviation Fuels
ASTM D 4948	Separometer Index, Water Separation Characteristics, Micro (WISM or MSEA)
ASTM D 5006	Anti-Icing Inhibitors (Ether) in Aviation Fuel
ASTM D 2624	Electrical Conductivity, Aviation Fuels

Test Code	Description
ASTM D 6045	Color of Petroleum Products by Tristimulus Method
ASTM D 4952	Doctor Test, Sulfur Species in Fuels and Solvents
ASTM D 2622	Sulfur, X-Ray Spectrometry, LOD = 0.001 wt%
ASTM D 5972	Freezing Point of Aviation Fuels, Automatic Phase Transition Method

Fuel System Icing Inhibitors Type III - DiEGME Diethylene Glycol Monomethyl Ether - ASTM D 4171.b

Test Code	Description
ASTM D 1613	Acidity in Volatile Solvents and Chemical Inhibitors
ASTM D1209	Color, APHA, Platinum Cobalt Scale
ASTM E 70	pH of Aqueous Solutions, with Glass Electrode
ASTM D 4052	Density and Relative Density of Liquids by Digital Density Meter
ASTM D 1364	Water Content by Karl Fischer Method, Volatile Solvents
ASTM D 93	Flash Point, Pensky-Martens Closed Cup
ASTM D 6810	Antioxidant Concentration in HL Turbine Oils

Test Code	Description
ASTM D 5006	Anti-Icing Inhibitors (Ether) in Aviation Fuels
ASTM E 1064	Water Content by Karl Fischer Method, Organic Liquids
ASTM E 203	Water Content by Volumetric Karl Fischer Method

DIESEL FUELS AND BIODIESEL

Diesel engines can burn a wide range of hydrocarbon fuels ranging from light distillate fuels such as No 1 Diesel to heavy residual fuels such as Bunker C or No. 5 Fuel Oil. New regulations for Diesel Motor Fuels dictate low sulfur levels.

ASTM D 975 covers seven grades of diesel fuel oils that are suitable for various types of diesel engines:

1. Grade No. 1-D S15 is a special purpose, light middle distillate fuel with a maximum of 15 ppm sulfur.
2. Grade No. 1-D S500 is a special purpose, light middle distillate fuel with a maximum of 500 ppm sulfur.
3. Grade No. 1-D S5000 is a special purpose, light middle distillate fuel with a maximum of 5000 ppm sulfur.
4. Grade No. 2-D S15 is a general purpose, middle distillate fuel with a maximum of 15 ppm sulfur.
5. Grade No. 2-D S500 is a special purpose, middle distillate fuel with a maximum of 500 ppm sulfur.
6. Grade No. 2-D S5000 is a special purpose, middle distillate fuel with a maximum of 5000 ppm sulfur.
7. Grade No. 4-D is a heavy distillate fuel, or blend of distillate and residual oil.

The S5000 grades correspond to the previous “regular” sulfur grades. The S500 grades correspond to the previous “low sulfur” grades. The S15 grades were previously called “ultra-low sulfur” grades or ULSD.

Diesel Fuel Oils, ASTM D 975 Specification

Qualification Test Package, Grades No. 1-D S500 and 2-D S500

Test Code	Description
ASTM D 93	Flash Point, Pensky-Martens Closed Cup
ASTM D 2709	Water and Sediment in Distillate Fuels, BS&W
ASTM D 86.b	Distillation of Petroleum Products at Atmospheric Pressure
ASTM D 445.a	Viscosity, Kinematic, at 40°C, cSt
ASTM D 482	Ash Content of Petroleum Products
ASTM D 2622	Sulfur, X-Ray Spectrometry. LOD = 0.001 wt%
ASTM D 130	Corrosion from Petroleum Products, Copper Strip Tarnish Test, 2 hours @ 100°C
ASTM D 613	Cetane Number, Ignition Quality of Diesel Fuels
ASTM D 287.a	API Gravity, Hydrometer Method
ASTM D 976	Cetane Index, Calculated from Distillation and API Gravity
ASTM D 2500	Cloud Point of Petroleum Products
ASTM D 4539	Filterability of Diesel Fuels by Low Temperature Flow Test (LTFT) Method
ASTM D 524.b	Carbon Residue, Ramsbottom on 10% Residue
ASTM D 6079	Lubricity of Diesel Fuels by the High Frequency Reciprocating Rig (HFRR)
ASTM D 4308	Electrical Conductivity of Liquid Hydrocarbons

Additional Tests

ASTM D 4294	Sulfur by X-Ray Fluorescence Spectroscopy. LOD = 0.01 wt%
ASTM D 6469	Microbial Contamination in Fuels and Fuel Systems
ASTM D 6468	Oxidation Stability, Distillate Fuels
ASTM D 2274	Oxidation Stability, Light Fuel Oils, 16 hr
ASTM D 1319	Hydrocarbon Types in Liquid Petroleum by Fluorescent Indicator Absorption (FIA)
ASTM D 2624	Electrical Conductivity, Aviation Fuels
ASTM D 6217	Particulate Contamination in Middle Distillate Fuels by Filtration
ASTM D 97	Pour Point of Petroleum Oils
ASTM D 2887.c	Simulated Distillation, SimDis, Lower Temperature Range, 55 to 538°C, C ₅ to C ₄₄
ASTM D 3117	Wax Appearance Point of Distillate Fuels
ASTM D 6371	Cold Filter Plugging Point of Diesel and Heating Fuels, CFPP
ASTM D 6078.a	Lubricity of Diesel Fuels by the Scuffing Load Ball-on-Cylinder Lubricity Evaluator, (SLBOCLE), Procedure A: Incremental Load
ASTM D 6078.b	Lubricity of Diesel Fuels by the Scuffing Load Ball-on-Cylinder Lubricity Evaluator, (SLBOCLE). Procedure B: Single-Load Test

BIODIESEL FUEL, B 100 BLEND STOCK

Biodiesel Blend Stock is derived from vegetable oil and animal fat and may be blended with petroleum distillate fuels to achieve regulated levels of sulfur or aromatics. Presently, Biodiesel B 100 Blend Stock is available in two grades. S15 has a sulfur content of less than 15 ppm (0.0015 wt %), S500 has a sulfur content of less than 500 ppm (0.05 wt %).

Up to 5% Biodiesel that meets ASTM Specification D 6751-08 is permitted for use in No. 1 and No. 2 grades of Diesel Fuel. Test method EN 14078 for Fatty Acid Methyl Esters (FAME) is used to determine the percentage of Biodiesel in a diesel fuel.

Biodiesel Fuel (B 100) Blend Stock, ASTM D 6751 Specification Grade S15 and Grade S500, Qualification Test Package

Test Code	Description
EN 14538.a	Calcium, Magnesium Content
ASTM D 93	Flash Point, Pensky-Martens Closed Cup
ASTM D 2709	Water and Sediment in Distillate Fuels, BS&W
ASTM D 445.a	Viscosity, Kinematic, at 40°C, cSt
ASTM D 874	Ash, Sulfated Residue, Lube Oils and Additives
ASTM D 5453	Total Sulfur in Light Hydrocarbons, Motor Fuels and Oils by UV Fluorescence
ASTM D 130	Corrosion from Petroleum Products, Copper Strip Tarnish Test, 2 hours @ 100°C
ASTM D 613	Cetane Number, Ignition Quality of Diesel Fuels
ASTM D 2500	Cloud Point of Petroleum Products
ASTM D 4530	Carbon Residue (Micro Method)
ASTM D 664	Acid Number of Petroleum Products, Potentiometric Titration
ASTM D 6584	Glycerin, Free and Total, in Biodiesel Fuel B 100 (Methyl Esters) by Gas Chromatography
ASTM D 4951.b	Phosphorus Content in Biodiesel Fuels by ICP-AES
ASTM D 1160	Distillation of Petroleum Products at Reduced Pressures, 5 and 10 mm
ASTM D 6469	Microbial Contamination in Fuels and Fuel Systems
EN 14538.b	Potassium and Sodium Content
EN 14112	Oxidation Stability

Additional Tests	
ASTM D 3242	Acidity in Aviation Turbine Fuel, Acid Number
ASTM D 287.a	API Gravity, Hydrometer Method
ASTM D 189.b	Carbon Residue, Conradson on 10% Residue
ASTM D 524.b	Carbon Residue, Ramsbottom on 10% Residue
ASTM D 4737	Cetane Index, Calculated by Four Variable Equation (may be substituted for Cetane Number when ASTM D 613 is not available).
ASTM D 976	Cetane Index, Calculated from Distillation and API Gravity
ASTM D 86.b	Distillation of Petroleum Products at Atmospheric Pressure
ASTM D 6079	Lubricity of Diesel Fuels by the High Frequency Reciprocating Rig (HFRR)
ASTM D 6078.a	Lubricity of Diesel Fuels by the Scuffing Load Ball-on-Cylinder Lubricity Evaluator, (SLBOCLE), Procedure A: Incremental Load
ASTM D 6078.b	Lubricity of Diesel Fuels by the Scuffing Load Ball-on-Cylinder Lubricity Evaluator, (SLBOCLE), Procedure B: Single-Load Test
EN 14110	Methanol Content
ASTM D 2274	Oxidation Stability, Light Fuel Oils, 16 hr
ASTM D 6217	Particulate Contamination in Middle Distillate Fuels by Filtration
ASTM D 1266	Sulfur, Lamp Method. LOD = 0.01 wt%
ASTM D 2622	Sulfur, X-Ray Spectrometry. LOD = 0.001 wt%
ASTM D 3120	Sulfur, by Microcoulometry, Light Hydrocarbons
ASTM D 4294	Sulfur by X-Ray Fluorescence Spectroscopy. LOD = 0.01 wt%
ASTM D 1796	Water and Sediment in Fuel Oils, BS&W
ASTM D 3117	Wax Appearance Point of Distillate Fuels

FUEL OILS, RESIDUAL OILS, AND KEROSENE

Distilled petroleum products, and blends of distilled and residual products, are covered by several specifications. Fuel oils are middle distillate fuels and resemble diesel fuels in terms of distillate range. However, the products described in ASTM D 396 (Fuel Oils) and ASTM D 3699 (Kerosene) are primarily non-automotive grades and are used for heating in burners and furnaces.

U.S. Regulations 40CFR, Part 80 requires that a sufficient amount of Red Dye 164 be added to non-taxable middle distillates for off-road use

Fuel Oil, ASTM D 396 Specification Grades No 1S 500, No 1S 5000, No 2S 5000, and No 4 (Light)	
Test Code	Description
ASTM D 93	Flash Point, Pensky-Martens Closed Cup
ASTM D 2709	Water and Sediment in Distillate Fuels, BS&W
ASTM D 86.b	Distillation of Petroleum Products at Atmospheric Pressure
ASTM D 445.a	Viscosity, Kinematic, at 40°C, cSt
ASTM D 524.b	Carbon Residue, Ramsbottom on 10% Residue
ASTM D 482	Ash Content of Petroleum Products
ASTM D 2622	Sulfur, X-Ray Spectrometry. LOD = 0.001 wt%
ASTM D 130	Corrosion from Petroleum Products, Copper Strip Tarnish Test, 2 hours @ 100°C
ASTM D 1298	API Gravity of Petroleum Products, Hydrometer Method (Density, Relative Density, Specific Gravity)
ASTM D 97	Pour Point of Petroleum Oils
Additional Tests	
ASTM D 5291.a	Carbon, Hydrogen, and Nitrogen in Petroleum Products, Instrumental
ASTM D 2500	Cloud Point of Petroleum Products
ASTM D 6469	Microbial Contamination in Fuels and Fuel Systems
ASTM D 3245	Pumpability of Industrial Fuel Oils
ASTM D 95	Water by Distillation, Petroleum Products
ASTM D 5673.b	Trace Metals by ICP-MS Includes: Vanadium, Sodium, Potassium, Lithium, Lead, and Calcium. LOD = 0.05 ppm
ASTM D 473	Sediment by Extraction
ASTM D 2887.c	Simulated Distillation, SimDis, Lower Temperature Range, 55 to 538°C, C5 to C44
ASTM D 4294	Sulfur by X-Ray Fluorescence Spectroscopy. LOD = 0.01 wt%

Kerosene, ASTM D 3699 Specification Qualification Test Package for Grades 1K (Low Sulfur) and 2K	
Test Code	Description
ASTM D 56	Flash Point, Tag Closed Tester
ASTM D 86.b	Distillation of Petroleum Products at Atmospheric Pressure
ASTM D 445.a	Viscosity, Kinematic, at 40°C, cSt
ASTM D 1266	Sulfur, Lamp Method LOD = 0.01 wt%, Referee Method
ASTM D 3277	Mercaptan Sulfur in Gasoline, Kerosene and Distillate Fuels
ASTM D 130	Corrosion from Petroleum Products, Copper Strip Tarnish Test, 2 hours @ 100°C
ASTM D 2386	Freezing Point of Aviation Fuels
ASTM D 187	Burning Quality of Kerosene, 16 hr and 48 hr
ASTM D 156	Color, Saybolt Chromometer Method

FUEL OILS, RESIDUAL OILS, AND KEROSENE

The Basic 6 Test Package represents the traditional test for quality control of distillate fuels. The Basic 8 Test Package also includes Water by Distillation and Sediment by Extraction for heavier distillates or blends distillate with residual fuel, or when BS&W is greater than 0.5 vol%. The Basic 10 Test Package, in keeping with current best practice for fuel oil quality control, further adds Ash and Trace Metals analysis by ICP/MS.

Fuel Oil Quality Control, ASTM D 396 Specification Basic 6, Basic 8, and Basic 10 Test Packages	
Test Code	Description
ASTM D 287.a	API Gravity of Petroleum Products, Hydrometer Method (Density, Relative Density, Specific Gravity).
ASTM D 93	Flash Point, Pensky-Martens Closed Cup
ASTM D 97	Pour Point of Petroleum Oils
ASTM D 445.a	Viscosity, Kinematic, at 40°C, cSt
ASTM D 4294	Sulfur by X-Ray Fluorescence Spectroscopy. LOD = 0.01 wt%
ASTM D 1796	Water and Sediment in Fuel Oils, BS&W
	Additional Tests
ASTM D 473	Sediment by Extraction
ASTM D 482	Ash Content of Petroleum Products
ASTM D 5673.b	Trace Metals by ICP-MS Includes: Vanadium, Sodium, Potassium, Lithium, Lead, and Calcium. LOD = 0.05 ppm
ASTM D 95	Water by Distillation, Petroleum Products

MARINE FUELS

Marine diesel engines are designed to burn a wide range of hydrocarbon fuels ranging from light distillate fuels to residual fuels such as Bunker C or No. 5 Fuel Oil.

Test packages for marine diesel fuels are based on the International Standards Specification ISO 8217. The corresponding ASTM D 2069 Specification was withdrawn in the year 2003. There is a direct correspondence between the two specifications and for each required test.

The specification ISO 8217 covers a total of nineteen grades of Marine Fuel (Class F), which include four grades of Marine Distillate Fuel and fifteen grades of Marine Residual Fuel. This classification reflects the wide range of petroleum fuels that are used in marine diesel engines and boilers.

Our test packages show the recommended tests for qualifying a given fuel grade. Other optional tests are also shown to give a more detailed description of stored fuels when oxidation or contamination may be of special concern.

Marine Distillate Fuels, Class F, ISO 8217 Specification Qualification Test Package for Grades DMX and DMA	
Test Code	Description
ASTM D 4176.b	Visual Inspection, Procedure B
ASTM D 1298	API Gravity of Petroleum Products, Hydrometer Method (Density, Relative Density, Specific Gravity)
ASTM D 445.a	Viscosity, Kinematic, at 40°C, cSt
ASTM D 93	Flash Point, Pensky-Martens Closed Cup
ASTM D 97	Pour Point of Petroleum Oils
ASTM D 2500	Cloud Point of Petroleum Products
ASTM D 524.b	Carbon Residue, Ramsbottom on 10% Residue
ASTM D 482	Ash Content of Petroleum Products
ASTM D 95	Water by Distillation, Petroleum Products
ASTM D 473	Sediment by Extraction
ASTM D 613	Cetane Number, Ignition Quality of Diesel Fuels
ASTM D 4294	Sulfur by X-Ray Fluorescence Spectroscopy. LOD = 0.01 wt%
Additional Tests	
ASTM D 976	Cetane Index, Calculated from Distillation and API Gravity
ASTM D 130	Corrosion from Petroleum Products, Copper Strip Tarnish Test, 2 hours @ 100°C
ASTM D 4052	Density and Relative Density of Liquids by Digital Density Meter
ASTM D 86.b	Distillation of Petroleum Products at Atmospheric Pressure
ASTM D 6079	Lubricity of Diesel Fuels by the High Frequency Reciprocating Rig (HFRR)
ASTM D 6078.b	Lubricity of Diesel Fuels by the Scuffing Load Ball-on-Cylinder Lubricity Evaluator, (SLBOCLE). Procedure B: Single-Load Test
ASTM D 2709	Water and Sediment in Distillate Fuels, BS&W
ASTM D 381.b	Gum Content, Existent, in Fuels by Steam Jet Evaporation
ASTM D 3605.g	Trace Metals by Flame Atomic Absorption Spectroscopy. Includes: Sodium, Potassium, Vanadium, Lead, Calcium, Barium, Magnesium, and Phosphorous, LOD = 0.05 ppm

The test codes used to identify a test method are for identification and are generally related to the ASTM or other protocol. We use suffix letters with the test codes to identify different practices that may be defined within the same ASTM procedure, e.g., different test temperatures, or different test times.

FUELS FROM USED LUBRICATING OILS

There are two ASTM Specifications related to the use of used or reprocessed lubricating oils (lube oils), hydraulic fluids, or other hydrocarbon-based oils. Federal, state, and local regulations may dictate more restrictive requirements than are outlined in the ASTM documents.

ASTM D 6448 covers four grades of fuel oil that are made partly or entirely from used oils and are intended for use in industrial equipment (not residential heaters, combustion engines, or marine applications). The four grades, known as Reprocessed Fuel Oils (RFO) include RFO-4, RFO-5L, RFO-5H, and RFO-6, which differ in viscosity range.

Industrial Burner Fuels from Used Lubricating Oils ASTM D 6448 Specification Grades RFO-4, RFO-5L, RFO-5H, and RFO-6	
Test Code	Description
ASTM D 445.b	Viscosity, Kinematic, at 100°C, cSt
ASTM D 93	Flash Point, Pensky-Martens Closed Cup
ASTM D 95	Water by Distillation, Petroleum Products
ASTM D 473	Sediment by Extraction
ASTM D 97	Pour Point of Petroleum Oils Only required for Grade RFO4
ASTM D 1298	API Gravity of Petroleum Products, Hydrometer Method (Density, Relative Density, Specific Gravity)
ASTM D 482	Ash Content of Petroleum Products
ASTM D 4294	Sulfur by X-Ray Fluorescence Spectroscopy. LOD = 0.01 wt%
ASTM D 4980	pH of Waste by Screening Test
ASTM D 240	Heat of Combustion, by Bomb Calorimeter
Additional Tests	
ASTM D 4052	Density and Relative Density of Liquids by Digital Density Meter
ASTM D 129	Sulfur, Bomb Method. LOD = 0.1 wt%, Referee Method
ASTM D 5673.b	Trace Metals by ICP-MS Includes: Vanadium, Sodium, Potassium, Lithium, Lead, and Calcium. LOD = 0.05 ppm
ASTM D 6304	Water Content by Karl Fischer Method, Lubricating Oils and Additives
ASTM D 6469	Microbial Contamination in Fuels and Fuel Systems

ASTM D 6823 covers Recycled Fuel for Commercial Boilers (RFC) and identifies four grades; RFC-4, RFC-5L, RFC-5H, and RFC-6. The specification requires a minimum of 25% used lubricating oil and is intended for use in commercial boilers. Because Gross Heating Value, Trace Metals, and PCBs are defined, the RFO fuels often can qualify as Marine Fuels. Request a Quotation.

*The parameters listed above may also be used as an indicator of when more extensive testing is required.
In the United States, fuel must also meet the Federal Environmental Protection Agency (EPA)
parameters for recycled used oils as defined in Federal Code 40 CFR 279.11.
Some state and local jurisdictions may have more stringent requirements than the EPA.*

For a test package to meet your specific requirements, please request a quotation.

COAL, COKE AND SOLID FUELS

The grade of a sample of coal or coke does not precisely define its composition. The usefulness of coal or coke as a fuel requires a proximate and an ultimate (elemental) analysis.

Proximate analysis permits cursory valuation of coals and coke as fuel and requires moisture, volatile matter, ash, and fixed carbon. ASTM D 5142 is an instrumental method for these parameters while ASTM D 3172 is considered the referee method.

Proximate Analysis of Coal and Coke, ASTM D 5142 Instrumental Method

Test Code	Description
ASTM D 5142.a	Proximate Analysis of Coal and Coke, Instrumental - Package

Proximate Analysis of Coal and Coke, ASTM D 3172 Referee Method

Test Code	Description
ASTM D 3173	Moisture in the Analysis Sample of Coal and Coke
ASTM D 3175	Volatile Matter in the Analysis Sample of Coal and Coke
ASTM D 3174.a	Ash in the Analysis Sample of Coal and Coke, wt%
ASTM D 3174.b	Fixed Carbon

The elemental or ultimate analysis of coal or coke provides a uniform system for comparing coals and coke and requires the determination of Carbon, Hydrogen, Nitrogen, Sulfur, Oxygen, and Ash. Other tests for Heating Value or Trace Metals may also be required.

Ultimate (Elemental) Analysis of Coal and Coke, ASTM D 3176

Test Code	Description
ASTM D 5373	Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Sample of Coal and Coke
ASTM D 3173	Moisture (as-received basis)
ASTM D 3177	Sulfur, Total, in the Analysis Sample of Coal and Coke
ASTM D 3174.a	Ash in the Analysis Sample of Coal and Coke, wt%
Calculated.1	Oxygen, calculated. (No direct method in ASTM tests for oxygen in coal)

	Additional Tests
ASTM D 3178	Carbon and Hydrogen in the Analysis Sample of Coal and Coke
ASTM D 3179	Nitrogen in the Analysis Sample of Coal and Coke
ASTM D 4239	Sulfur Analysis in Coal and Coke Using High Temperature Tube Furnace Combustion
ASTM D 3683.b	Trace Elements in Coal and Coke Ash by Atomic Absorption
ASTM D 6357	Trace Elements in Coal, Coke, and Combustion Residues by ICP-AES, ICP-MS, and GFAA.

ALTERNATIVE FUELS AND BIOFUELS

Bioenergy is energy contained in living, or recently living, biological organisms, a definition, which specifically excludes fossil fuels. In order to be considered a Biofuel, a fuel must contain over 80% renewable material. Biofuels are considered Alternative Fuels and may be used alone or as supplemental fuels to provide electricity and heat.

Liquid Biofuels are primarily Ethanol, Biodiesel, Vegetable Oil, Algae Oil, and Pyrolysis Oil. Biogas is usually methane gas recovered from manure, sludge, solid waste, or other biomass. Solid Biofuels include wood, dried manure, charcoal, and biomass pellets.

Many analytical procedures for Coal and Coke are also suitable for Solid Biofuels and Alternative Fuels, such as Tire Chips and Refuse Derived Fuel (RFD), share many analytical procedures as Coal and Coke.

TIRE DERIVED FUEL (TDF)

ASTM Standard Practice D 6270 gives guidance for the evaluation of chips from scrap tires, commonly called Tire-Derived Fuel or TDF, when used as a boiler fuel either alone, or co-fired with, coal, sludge, or wood.

TDF is defined as a tire that has been shredded and processed into a rubber chip ranging from 1 to 4 inches in size. These rubber-oil-carbon black chips are a high quality fuel with an energy content of about 30 MBtu/ton which ranks it below fuel oil but above sub-bituminous coal.

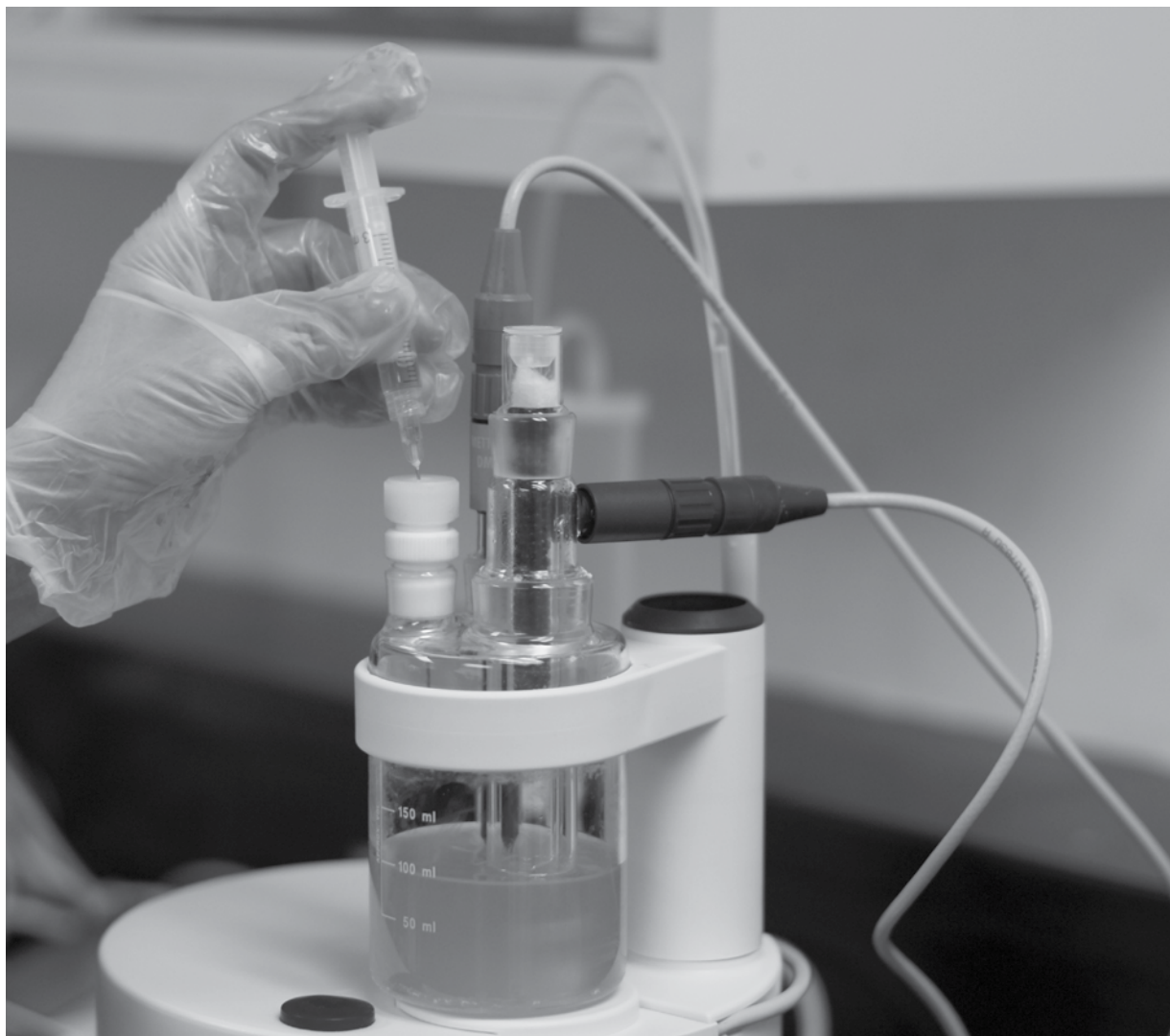
TDF provides a competitively priced fuel for use in co-fired boilers (10 to 30%) with wood or coal, or to supplement an existing fuel that is in limited supply.

Many of the test procedures parallel those for coal and those listed below serve as a guideline. As in all fuels, the emphasis is in the hydrocarbon content, the heating value of the fuel, the moisture and volatility, and the potential contaminants in the fuel and in the ash.

Scrap Tire-Derived Fuel (TDF), ASTM D 6270

Test Code	Description
ASTM D 2361	Chloride
ASTM D 3172.a	Proximate Analysis - Referee Method
ASTM D 3176	Ultimate Analysis (C, H, N, S, O)
ASTM D 3173	Moisture in the Analysis Sample
ASTM D 3174.a	Ash in the Analysis Sample, wt%
ASTM D 3175	Volatile Matter
ASTM D 3177	Sulfur, Total, in the Analysis Sample
ASTM D 3178	Carbon and Hydrogen in the Analysis Sample
ASTM D 3179	Nitrogen in the Analysis Sample
ASTM D 3682	Elemental Analysis in Ash by AA
ASTM D 4239	Sulfur Analysis Using High Temp Tube Furnace Combustion
ASTM D 5865	Calorific Value, Gross
ASTM D 4749	Sieve Analysis, per Sieve

These test procedures, or something related, can also be applied to many of the other Alternative Fuels and Biofuel products that are being developed as supplemental fuels. When no formal specifications are available, Biofuels must be evaluated in terms of their carbon, hydrogen, and nitrogen content, moisture and volatiles, potential Btu content, and for chlorine, fluorine, and any regulated metals in the combustion residue including zinc, calcium, iron, chromium, cadmium and lead.



Lubricants

AUTOMOTIVE LUBRICANTS

ASTM Specification D 6074 is a standard guide for lubricant base oils from various refining processes including, re-refining of used oils and refining of crude oils. Finished lubricants may require additional testing.

Characterization Tests for New and Re-refined Base Oils, ASTM D 6074 Specification

Test Code	Description
ASTM D 1500	Color, ASTM Color Scale
ASTM D 4052	Density and Relative Density of Liquids by Digital Density Meter
ASTM D 92.b	Flash Point, Pensky-Martens Closed Cup
ASTM D 445.a	Viscosity, Kinematic, at 40°C, cSt
ASTM D 445.b	Viscosity, Kinematic, at 100°C, cSt
ASTM D 2270	Viscosity Index, Calculated From Kinematic Viscosity Tests at 40°C and 100°C
ASTM D 97	Pour Point of Petroleum Oils
ASTM D 5800	Evaporation Loss of Lubricating Oils by the Noack Method
ASTM D 1401	Emulsion Characteristics of Lubricating Oils (Water Separability)
ASTM D 524.a	Carbon Residue, Ramsbottom
ASTM D 4629	Nitrogen, Organically Bound, by Chemiluminescence
ASTM D 91	Precipitation Number of Lubricating Oils
ASTM D 2007	Clay-Gel Separation Test, Chromatographic Method for Characterizing Process Oils
ASTM D 4294	Sulfur by X-Ray Fluorescence Spectroscopy. LOD = 0.01 wt%

Additional Tests

ASTM D 664	Acid Number of Petroleum Products, Potentiometric Titration
ASTM D 4739	Base Number by Potentiometric Titration
ASTM D 4929	Chlorides, Organic, in Crude Oil (Naphtha Cut)
ASTM D 130	Corrosion from Petroleum Products, Copper Strip Tarnish Test, 2 hours @ 100°C
ASTM D 5185	Additive Elements, Wear Metals, and Contaminants in Used Lubricating Oils and Determination of Selected Elements in Base Oils by Inductively Coupled Plasma – Atomic Emission Spectrometry (ICP-AES)
ASTM D 4951.a	Additive Elements in Lubricating Oils by Inductively Coupled Plasma - Atomic Emission Spectrometry (ICP-AES)
ASTM D 4291	Trace Ethylene Glycol in Used Engine Oil
ASTM D 4059	PCBs in Insulating Oil by Gas Chromatography
EPA 8120	Halogenated Volatile Organic Compounds (VOC)
ASTM D 6304	Water Content by Karl Fischer Method, Lubricating Oils and Additives
IP 346	Poly Aromatic Compounds, PACs, DSMO Extraction

HYDRAULIC FLUIDS

Hydraulic fluids are oils used to transmit power in hydraulic equipment and power transmission applications.

ASTM D 6158 specification relates to the refined mineral based oils used for hydraulic fluids.

Type HH	non-inhibited, very light duty.
Type HL	rust and oxidation resistance inhibitors for higher temperature use.
Type HM	improved anti-wear properties for high pressure use.
Type HV	multi-grade anti-wear for wide range temperature use.

Mineral Hydraulic Oils, ASTM D 6158 Specification Qualification Test for Type HV Fluids, Multi-grade Anti-wear

Test Code	Description
ASTM D 445.a	Viscosity, Kinematic, at 40°C, cSt
ASTM D 2422	ISO Viscosity Grade
ASTM D 445.b	Viscosity, Kinematic, at 100°C, cSt
ASTM D 2270	Viscosity Index, Calculated From Kinematic Viscosity Tests at 40°C and 100°C
ASTM D 2983	Viscosity, Low Temperature of Lubricants by Brookfield Viscometer
ASTM D 6080	Viscosity Characteristics of Hydraulic Fluids at Low Temperature
ASTM D 1298	API Gravity of Petroleum Products, Hydrometer Method (Density, Relative Density, Specific Gravity)
ASTM D 1500	Color, ASTM Color Scale
ASTM D 92.a	Flash Point, Cleveland Open Cup
ASTM D 97	Pour Point of Petroleum Oils
ASTM D 974.a	Acid Number, Color-Indicator Titration (TAN)
ASTM D 665.a	Rust Preventing Characteristics
ASTM D 665.b	Rust Preventing Characteristics in Synthetic Sea Water
ASTM D 130	Corrosion from Petroleum Products, Copper Strip Tarnish Test, 2 hours @ 100°C
ASTM D 1401	Emulsion Characteristics of Lubricating Oils (Water Separability)
ASTM D 471	Elastomer Compatibility, Hardness and Relative Volume Change
ASTM D 892	Foaming Tendencies of Lubricating Oils
ASTM D 3427	Gas Bubble Separation Time of Petroleum Oils (Air Release Properties)
ASTM D 943	Oxidation Stability, Inhibited Steam Turbine Oils
ASTM D 4310	Sludging Tendencies of Inhibited Mineral Oils
ASTM D 2070	Thermal Stability of Hydraulic Oils, 165 hours

Other base fluids for hydraulic oils are used for special applications such as fire resistance and extreme pressure. Base stocks for biodegradable hydraulic fluids are also available for environmentally sensitive applications (see ASTM D 6606 and ASTM D 6046).

There are also specific test packages for power steering fluids, transmission fluids, brake fluids, marine and aircraft hydraulic systems, heavy-duty equipment such as excavators, and for industrial machinery. Visit our web site at: www.tol-lp.com, or request a quotation for other recommended test packages.

Ultra-clean glass bottles and their mailers specially designed for sampling of turbine oils, hydraulic fluids, and lubrication oils, are available to our clients at no charge. These bottles are provided to ensure that the results are not affected by potential contamination present in ordinary sample containers.

Mailers, labels and shipping instructions for domestic and international shipment of your samples are also provided upon request.

LUBRICANTS FOR GAS AND STEAM TURBINES

The in-service monitoring of turbine oils will help insure trouble-free operation and provide a guide to scheduled maintenance periods. The RPVOT test is a guide for oxidation stability reserve and the recommended schedule is every 1500 to 2000 hours for Gas Turbines and 6 to 12 months for Steam Turbines.

A sample of fresh turbine oil should be measured as a base-line reference. Then, trend analysis can be used to estimate the remaining useful service life of turbine oil. Other tests, such as viscosity or acid number should be run more frequently. Cleanliness is measured by optical particle counter and NAS Class 6 is typically considered a clean fluid. Trace metals analysis will identify the additive elements and contaminants.

Turbine Oils, ASTM D 4378 Specification In-Service Monitoring of Mineral Turbine Oils.

Test Code	Description
ASTM D 445.a	Viscosity, Kinematic, at 40°C, cSt
ASTM D 974.a	Acid Number, Color-Indicator Titration (TAN)
ASTM D 1500	Color, ASTM Color Scale
ASTM E 203	Water Content by Karl Fischer Method, Engine Coolants
ASTM D 665.a	Rust Preventing Characteristics
ISO 4406	Particle Count, Automatic Optical Particle Count
ASTM D 2272.a	Oxidation Stability by Rotating Pressure Vessel Method, RPVOT (previously RBOT)

	Additional Tests
ASTM D 664	Acid Number of Petroleum Products, Potentiometric Titration
ASTM D 5185	Additive Elements, Wear Metals, and Contaminants in Used Lubricating Oils and Determination of Selected Elements in Base Oils by Inductively Coupled Plasma - Atomic Emission Spectrometry (ICP-AES)
ASTM D 6810	Antioxidant Concentration in HL Turbine Oils
ASTM D 130	Corrosion from Petroleum Products, Copper Strip Tarnish Test, 2 hours @ 100°C
ASTM D 1401	Emulsion Characteristics of Lubricating Oils (Water Separability)
ASTM D 892	Foaming Tendencies of Lubricating Oils
ASTM F 312	Microscopical Sizing, Counting Particles from Aerospace Fluids on Membrane Filters
ASTM F 311	Particulate Contamination Analysis Using Membrane Filters

Turbine Oils Test Package VAX and Radial Turbines, ISO V6 Classification

Test Code	Description
ASTM E 1478	Color and Appearance, Visual
ASTM D 445.a	Viscosity, Kinematic, at 40°C, cSt
ASTM D 445.b	Viscosity, Kinematic, at 100°C, cSt
ASTM D 2270	Viscosity, Index
ASTM D 6304	Water Content by Karl Fischer Method, Lubricating Oils and Additives
ISO 4406	Particle Count, Automatic Optical Particle Count
ASTM D 1401	Emulsion Characteristics of Lubricating Oils (Water Separability)
ASTM D 3427	Gas Bubble Separation Time of Petroleum Oils (Air Release Properties)
Atlas.a	Ferrography, Analytical
ASTM D 6595	Wear Metals and Contaminants in Lubricating Oils by Rotating Disc Electrode Atomic Emission Spectrometry, (RDE-AES)
ASTM D 892	Foaming Tendencies of Lubricating Oils
ASTM D 2272.a	Oxidation Stability by Rotating Pressure Vessel Method, RPVOT (previously RBOT)

LUBRICANTS FOR GAS AND STEAM TURBINES

Lubricants for Steam Turbine Siemens AG Specification 1.1.3-410000

Steam Turbine Generator, Electrohydraulic Control (EHC) Fluid GEK Specification 46357E

Additional Tests

ASTM D 2161.a	Viscosity, Saybolt Universal, at 100°F, SUS
ASTM D 2161.b	Viscosity, Saybolt Universal, at 210°F, SUS
ASTM D 892	Foaming Tendencies of Lubricating Oils
ASTM D 3603	Rust Preventing Characteristics of Steam Turbine Oils
ASTM D 3427	Gas Bubble Separation Time of Petroleum Oils (Air Release Properties)
ASTM D 1401	Emulsion Characteristics of Lubricating Oils (Water Separability)
ASTM D 6595	Wear Metals and Contaminants in Lubricating Oils by Rotating Disc Electrode Atomic Emission Spectrometry, (RDE-AES)
ASTM D 5185	Additive Elements, Wear Metals, and Contaminants in Used Lubricating Oils and Determination of Selected Elements in Base Oils by Inductively Coupled Plasma – Atomic Emission Spectrometry (ICP-AES)

For a test package to meet your specific requirements, please request a quotation.



LUBRICATING GREASES

Automotive Greases typically carry a NLGI (National Lubricating Grease Institute) Consistency Number as well as a Category Description. There are two general groups identified in ASTM Specification D 4950.

Prefix Letter “L” identifies chassis greases intended for service lubrication of ball joints, steering pivots, universal joints, and other chassis components, as designated by the equipment manufacturers. There is a Class LA for mild duty and a Class LB for severe duty.

Prefix Letter “G” identifies wheel bearing greases. Three classes are provided for differing service conditions.

The recommended testing packages for automotive greases consist of tests for basic physical properties and additional performance tests depending on the grease category or level of severity in use.

Automotive Chassis Grease, ASTM D 4950 Specification Class LB, Mild to Severe Duty	
Test Code	Description
ASTM D 217.b	Penetration, Cone, of Lubricating Greases, Worked
NLGI	NLGI Consistency Number
ASTM D 566	Dropping Point, Lubricating Greases
ASTM D 2266	Wear Preventive Characteristics of Grease, Four-Ball Method
ASTM D 4289	Elastomer Compatibility of Lubricating Greases and Fluids
ASTM D 1742	Oil Separation from Lubricating Grease, Bleed
ASTM D 1743	Corrosion Preventive Properties, Greases (Rust Protection)
ASTM D 2596	Extreme Pressure Properties of Greases, Four-Ball
ASTM D 4170	Fretting Wear Protection by Lubricating Greases and Fluids
ASTM D 4693	Low Temperature Performance of Grease-Lubricated Wheel Bearings

Automotive Wheel Bearing Grease, ASTM D 4950 Specification Class GB, Moderate to Severe Duty	
Test Code	Description
ASTM D 217.b	Penetration, Cone, of Lubricating Greases, Worked
NLGI	NLGI Consistency Number
ASTM D 566	Dropping Point, Lubricating Greases
ASTM D 4693	Low Temperature Performance of Grease-Lubricated Wheel Bearings
ASTM D 1264.b	Water Washout Characteristics of Greases at 80°C (175°F)
ASTM D 1742	Oil Separation from Lubricating Grease, Bleed
ASTM D 1743	Corrosion Preventive Properties, Greases (Rust Protection)
ASTM D 2266	Wear Preventive Characteristics of Grease, Four-Ball Method
ASTM D 4289	Elastomer Compatibility of Lubricating Greases and Fluids
ASTM D 2596	Extreme Pressure Properties of Greases, Four-Ball

Other grease testing packages can be found on our web site at www.tol-lp.com, or you may request a quotation to meet your grease specification.



Petroleum Products

GLYCOLS AND ENGINE COOLANTS

Automotive engine coolants for light duty service are based on ethylene glycol or propylene glycol. They are provided either as concentrates (40 to 70% glycol), or as pre-diluted, ready to use glycol base engine coolants (50 vol% minimum). The specification for engine coolant for heavy-duty use is ASTM D 6210.

ASTM D 3306 specification relates to engine coolants made from new or virgin ingredients. It also applies to coolants made from recycled or reprocessed glycol coolant or from reprocessed industrial source glycol. The glycol for the ASTM D 3306 Specification must meet the freezing point requirements of ASTM D 1177.

There are separate specifications in ASTM D 6471 and ASTM D 6472 for engine coolants prepared from reprocessed and recycled glycols which do not meet the freezing point requirements according to ASTM D 1177. These coolants must be further evaluated to identify the trace metals and other chemical compounds that may be present.

Glycol Base Engine Coolants for Automobile Light Duty Service ASTM D 3306

Test Code	Description
ASTM D 5931	Density and Relative Density of Engine Coolants
ASTM D 1177	Freezing Point of Aqueous Engine Coolants
ASTM D 1120	Boiling Point of Engine Coolants
ASTM D 1119	Ash Content of Engine Coolants and Anti-Rusts
ASTM D 1287	pH of Engine Coolants, Antifreezes and Anti-Rusts
ASTM D 3634	Chloride Ion in Engine Coolants
ASTM D 1123	Water Content by Karl Fischer Method, Antifreeze
ASTM D 1121	Reserve Alkalinity of Engine Coolants and Anti-rusts
ASTM D 1384	Corrosion Test for Engine Coolants
ASTM D 1881	Foaming Tendencies of Engine Coolants
ASTM D 2809	Cavitation Corrosion and Erosion Characteristics of New Aluminum Pumps With Engine Coolants

Applications for glycols also include gas dehydration which is a liquid desiccant system for removal of water from Natural Gas Liquids (NGL). The test package for Rich and Lean glycol identifies the water-rich (wet glycol) and the water-lean (dry glycol) in the dehydration process along with other characteristics. Triethylene glycol (TEG) is most common desiccant although other glycols are sometimes used. The Gas Producers Association (GPA) has a specification for pipeline quality gas that sets the allowed moisture from the dehydration process.

Gas Dehydration, Rich and Lean Glycols

Test Code	Description
Visual	Physical Appearance
EPA 160.1.b	Total Suspended Solids, TSS
EPA 6010B	Inorganics by Atomic Emission Spectroscopy (ICP), includes: Iron
EPA 150.1	pH, 50% Aqueous Solution
ASTM E 203	Water Content by Karl Fischer Method, Engine Coolants
ASTM D 512	Chloride, Inorganic, in Water and Wastewater
ASTM D 1979	Salt, Calculated as Na and Cl
ASTM D 2887.b	Composition Breakdown (C1 to C40) by GC, Sludge

ELECTRICAL INSULATING OILS

There are two types of specifications for electrical insulating oils. These two types are specified:

- Type I Mineral Oil for normal oxidation resistance
- Type II Mineral Oil for greater oxidation resistance.

Specification tests for physical and electrical properties are common to both Types. ASTM D 3487 relates to hydrocarbon based mineral oils that are used in new and existing apparatus for power distribution. They serve as an insulating and cooling medium in apparatus such as transformers, regulators, circuit breakers, switch gear, and associated equipment.

All specifications in ASTM D 3487 apply to new oils. Other test packages are available to monitor the quality of in-service Mineral Oils.

Electrical Insulating Oils, ASTM D 3487	
Qualification Tests for Oils Used in Transformers, Circuit Breakers, Switching Gear	
Test Code	Description
ASTM D 611.a	Aniline Point of Petroleum Products
ASTM D 1500	Color, ASTM Color Scale
ASTM D 92.a	Flash Point, Cleveland Open Cup
ASTM D 971	Interfacial Tension of Oil against Water by the Ring Method
ASTM D 97	Pour Point of Petroleum Oils
ASTM D 1298	API Gravity of Petroleum Products, Hydrometer Method (Density, Relative Density, Specific Gravity)
ASTM D 445.a	Viscosity, Kinematic, at 40°C, cSt
ASTM D 445.b	Viscosity, Kinematic, at 100°C, cSt
ASTM D 1816	Dielectric Breakdown Voltage, VDE Electrodes
ASTM D 2300	Gassing Tendency of Insulating Oils under Electrical Stress
ASTM D 924	Dielectric Constant and Power Factor of Electrical Insulating Liquids, 60 Hz, 25°C
ASTM D 1275.b	Corrosive Sulfur in Electrical Insulating Oil - Part B (48 hrs)
ASTM D 1533	Water Content by Karl Fischer Method, Insulating Liquids
ASTM D 974.a	Acid Number, Color-Indicator Titration (TAN)
ASTM D 2440.b	Oxidation Stability, Mineral Insulating Oil, 72 hr
ASTM D 2112	Oxidation Stability, Mineral Insulating Oils, RPVOT (previously RBOT)
ASTM D 4768	Oxidation Inhibitor in Insulating Oil by Gas Chromatography
Additional Tests	
ASTM D 445.c	Viscosity, Kinematic, at other test temperatures
ASTM D 1524	Visual Examination of Electrical Insulating Oils
ASTM D 4059	PCBs in Insulating Oil by Gas Chromatography
ASTM D 877	Dielectric Breakdown Voltage, Disc Electrodes
ASTM D 3300	Dielectric Breakdown Voltage of Insulating Oils under Impulse Conditions
ASTM D 2440.a	Oxidation Stability, Mineral Insulating Oil, 164 hr
ASTM D 1903	Thermal Expansion of Electrical Insulating Liquids of Petroleum Origin and Askarels
ASTM D 2766	Specific Heat of Liquids and Solids
ASTM D 2717	Thermal Conductivity of Liquids (400°F maximum)

SOLVENTS AND CHEMICAL INTERMEDIATES

A large number of Paint Solvents, Chemical Intermediates, and Aromatic Hydrocarbons are produced in the Texas Gulf Coast region. In addition, traders blend composites of odd lots and end-of-run materials into useful products. We can provide sample containers, courtesy sample pickup, and rapid turnaround for quality control testing for such materials in our Houston laboratory. A sampling of typical test packages is given below.

Methyl Ethyl Ketone, ASTM D 790

Test Code	Description
ASTM D 1613	Acidity in Volatile Solvents and Chemical Intermediates
ASTM D 2804	Purity of Methyl Ethyl Ketone by GC, Includes weight percent Alcohol
ASTM D 1209	Color, APHA, Platinum-Cobalt Scale
ASTM D 1078	Distillation Range of Volatile Organic Liquids
ASTM D 1353	Nonvolatile Matter in Volatile Solvents
ASTM D 4052	Density and Relative Density of Liquids by Digital Density Meter
ASTM D 1364	Water Content by Karl Fischer Method, Volatile Solvents

Dibutyl Phthalate, ASTM D 608

Test Code	Description
ASTM D 4052	Density and Relative Density of Liquids by Digital Density Meter
ASTM D 1209	Color, APHA, Platinum-Cobalt Scale
ASTM D 1296	Odor of Volatile Solvents and Diluents
ASTM D 1364	Water Content by Karl Fischer Method, Volatile Solvents
ASTM D 1613	Acidity in Volatile Solvents and Chemical Intermediates

Acetaldehyde, ASTM D 4710

Test Code	Description
ASTM D 2192	Purity of Aldehydes and Ketones
ASTM D 1209	Color, APHA, Platinum-Cobalt Scale
ASTM D 2086	Acidity in Vinyl Acetate and Acetaldehyde
ASTM D 1353	Nonvolatile Matter in Volatile Solvents

Ultra-clean glass bottles and their mailers specially designed for lubrication oil analyses are available to our clients at no charge. These bottles are provided to ensure that the results are not affected by potential contamination present in ordinary sample containers.

ASPHALTS AND BITUMENS

Cutback Asphalts are made from a base asphalt of selected hardness or viscosity which is dissolved in a solvent of high, medium or low volatility to provide distinct differences for construction purposes among the types. ASTM D 2399 is a standard for the selection of cutback asphalts for various paving and related road construction uses. Thirteen different grades are defined based on rate-of-cure and on viscosity.

Asphalts and Bitumens	
Test Code	Description
ASTM D 402	Distillation of Cut-Back Asphaltic Products
ASTM D 113	Ductility of Bituminous Materials
ASTM D 92.a	Flash Point, Cleveland Open Cup
ASTM D 3143	Flash Point, Tag Open Cup, Cutback Asphalt
ASTM D 5	Penetration, Cone, of Bituminous Materials
ASTM D 4124	Separation of Asphalt into Four Generic Fractions
ASTM D 2042	Solubility of Asphalt in Trichloroethylene
ASTM D 36	Softening Point of Bitumen by Ring-and-Ball
ASTM D 70	Specific Gravity and Density of Semi-Solid Bituminous Materials by Pycnometer Method
ASTM D 2171	Viscosity, Capillary, of Asphalts at 140°F, Poise
ASTM D 2170	Viscosity, Kinematic, of Asphalts at 275°F, cP
ASTM D 6	Volatile Matter, Loss on Heating of Oils and Asphaltic Compounds
AASHTO 102	Xylene Equivalent of Asphalt

Cutback Asphalt for Paving Use, ASTM D 2399 Slow Curing Type, ASTM D 2026 Specification Medium Curing Type, ASTM D 2027 Specification Fast Curing Type, ASTM D 2028 Specification	
Test Code	Description
ASTM D 5	Penetration, Cone, of Bituminous Materials
ASTM D 92.a	Flash Point, Cleveland Open Cup
ASTM D 3143	Flash Point, Tag Open Cup, Cutback Asphalt
ASTM D 95	Water by Distillation, Petroleum Products
ASTM D 113	Ductility of Bituminous Materials
ASTM D 243	Asphalt Residue of Specified Penetration
ASTM D 402	Distillation of Cut-Back Asphaltic Products
ASTM D 2042	Solubility of Asphalt in Trichloroethylene
ASTM D 2170	Viscosity, Kinematic, of Asphalts at 275°F, cP

INVESTIGATIVE STUDIES

The various test packages offered by Texas OilTech Laboratories follow the guidelines of ASTM or a manufacturer's specification when appropriate. We will substitute an analytical procedure that is more accurate (has better detection limits) or is more cost effective, or both. Then the ASTM specified test will be given as an option and identified as the "Referee Test."

At times an ASTM test is withdrawn because of the 5-year rule. However, this test may continue to be specified for other products and even by other ASTM groups. TOL may choose to retain such a test if it has no known problems or we may offer a similar test identified with a TOL method number. TOL method numbers also identify test procedures that have not yet been standardized by any technical group.

Clients bring us a variety of samples that can best be classified as Investigative or Exploratory. They are usually beyond the scope of any single test or single test package. A typical case might be, "What caused this filter to fail?" Such questions demand a broad approach and may involve several analytical procedures or tools to reach a conclusion.

Biofuels represent another class of product for which exact specifications may not be standardized. But a reasonable test package can be proposed based on existing protocols for related materials.

Among these analytical techniques that are available are the Scanning Electron Microscope (SEM), Gas Chromatography, Simulated Distillation, and Elemental Analysis for Trace Metals, as discussed in other sections of this catalog.

Texas OilTech Laboratories will undertake investigative studies for clients in the following areas:

- Fuel Filters
- Unknown Composition Breakdown
- Referee Testing
- Failure Analysis
- Advanced Oil Analysis
- High Temperature Gas Chromatography
- Simulated Distillation
- Composition Breakdown by Gas Chromatography/Mass Spectrometer
- Composition Breakdown by Scanning Electron Microscope
- Polynuclear Aromatic Compounds
- Semi-volatiles per EPA 8270-C
- MSDS Testing (Material Safety Data Sheets)

A detailed quotation can be prepared for investigative studies and we invite your inquiry.



Other Analysis & Tests

WATER ANALYSIS FOR GAS TURBINES

Nitrogen Oxides, NO_x, are the main by-products of the combustion process and environmental issues dictate low NO_x emissions. Local regulations vary but NO_x are usually held to less than 15 ppm by volume. Injected water or steam can be used to control NO_x and turbine manufacturers have water specifications to assure that particulates and other contaminants are not introduced into the turbine.

Purified Water for NO_x Suppression GE MID-TD-0000-3 Specification

Demineralized Water Analysis, PWPS Specification TPM-AR1



We invite your inquiry and will be happy to tailor a testing package to your specific needs.

WATER ANALYSIS FOR GAS TURBINES

Compressor Cleaning Water, GE MID-TD-0000-4 Specification

Demineralized Water for NOx Reduction and for Flushing and Washing Water Siemens Specification 970812 AP

Water/Steam Fuel Additive Requirements

Test Code	Description
ASTM D 512	Chloride, Inorganic, in Water and Wastewater
ASTM D 859	Silica in Water and Wastewater
ASTM D 1067	Acidity or Alkalinity of Water
ASTM D 1125	Electrical Conductivity and Resistivity of Water
ASTM D 1293	pH of Water
ASTM D 4691	Trace Elements in Water by Flame Atomic Absorption Spectrophotometry, 14 elements. LOD = 0.5 ppm
ASTM D 5543	Dissolved Oxygen in Water
ASTM D 5907	Filterable and Nonfilterable Matter in Water

	Additional Tests
ASTM D 3919.a	Trace Elements in Water by Graphite Furnace Atomic Absorption Spectrophotometry
ASTM D 2972	Arsenic in Water
ASTM D 3223	Mercury, Total, in Water
ASTM D 3859	Selenium in Water

Please visit our website at www.tol-lp.com for many additional testing packages that we offer.
For a test package to meet your specific requirements, please request a quotation

UPSTREAM TESTING SERVICES

Petroleum oils and natural gas are naturally occurring mixtures that are found in deep underground deposits in zones of high temperature and high pressure. The oil and gas industry is based on the extraction, processing, and production of those petroleum fluids.

The typical petroleum fluids are multi-component mixtures consisting of a variety of hydrocarbons and some non-hydrocarbons such as water, nitrogen, carbon dioxide, hydrogen sulfide, and perhaps others. The success to profitable extraction, production, and processing of such petroleum fluids depends on the true understanding of their phase behavior.

The Fluids Laboratory Services Group at Texas OilTech Laboratories now offers specialists for analysis, testing, and consultation in PVT Testing, Reservoir Fluids Analysis, and Enhanced Oil Recovery (EOC). Our ability to create world reservoir conditions – up to 400 °F and 15,000 psi – enables us to handle difficult problems and to customize analytical testing capabilities that are beyond the scope of other laboratories.

Our state-of-the-art instrumentation includes:

- PVT cells for black and volatile oils
- PVT cells for gases and gas condensates
- PVT cells for rich and lean gases
- Flow assurance equipment
 - Solids detection system (SDS)
 - HTHP microscope
- Crude oil composition
- Interfacial tension
- Core flood systems
- Routine core analysis laboratory

A detailed understanding of the phase behavior of hydrocarbons is essential in predicting optimal conditions for their recovery and processing. While underground petroleum reservoirs can be found at temperatures over 210 °F and at more than 10,000 psi pressure, at surface conditions these fluids are at ambient temperatures and pressures. Hence, these hydrocarbon fluids undergo severe transformations and can exist as single phase (gas, liquid, or solid) or can coexist as liquid plus gas, or as vapor plus solid, or even as liquid-liquid combinations.

Our Fluid Laboratory Services Group can assist you in:

- Reservoir Sampling
- On-site Quality Control Analysis
- Production Support and Optimization
- Specialized Fuel Behavior Studies
- Expert Heavy Oil Analysis

For more details about our Fluids Laboratory Services, please request Catalog B-332.

RESERVOIR FLUID PHASE BEHAVIOR AND PVT STUDIES

Black Oil PVT, Recombined Surface Sample, Complete Study, TOL 3501	
Test Code	Description
TOL 3001	Quality check of the fluid samples. Includes opening pressure measurement at 70°F
TOL 3002	Physical recombination of separator oil and gas to the producing gas/oil ratio (GOR)
TOL 3004	Single stage flash for determination of produces gas/oil ratio (GOR), formation volume factor (FVF), and effluent specific gravity by separator oil flash from separator conditions to ambient
TOL 3005	Bubble point pressure (BP) by Constant Compression Expansion (CCE) of the reservoir fluid. Includes additional determination of oil density, compressibility above the bubble point, Y-function below the bubble point.
TOL 3006	Differential Liberation Expansion (DLE) study of solution gas at reservoir temperature and at pressure steps between the bubble point pressure and the atmospheric pressure to determine the solution GOR, formation volume factors (gas, oil, and total), and evolved gas properties
TOL 3007	Reservoir oil viscosity measurements, made during the depletion study
TOL 3009	Compositional analysis of the evolved gas and stock tank oil (STO) resulting from the reservoir fluid flash to ambient conditions. Includes: separator gas to C ₁₁ ⁺ , oil to C ₃₁ ⁺ , reservoir fluid composition through C ₇ ⁺ , calculated
TOL 3011	Separator pressure test set-up and first pressure test as required with the Differential Liberation Expansion (DLE) study
TOL 3012	Optimum separator pressure determination at room temperature. Includes up to four single stage flash liberation tests from the bubble point pressure to the specified separator pressure
Additional Tests	
TOL 3013	Additional tests for separator pressure determination at defined pressure stages
TOL 3014	Single phase sample transfer at reservoir temperature from sample transport cylinder to PVT cell
TOL 3015	Sample storage/conditioning in PVT cell, per customer's request (daily charge)

Black Oil PVT, Recombined Surface Sample, Basic Study, TOL 3502	
Test Code	Description
TOL 3001	Quality check of the fluid samples. Includes opening pressure measurement at 70°F
TOL 3002	Physical recombination of separator oil and gas to the producing gas/oil ratio (GOR)
TOL 3004	Single stage flash for determination of produces gas/oil ratio (GOR), formation volume factor (FVF), and effluent specific gravity by separator oil flash from separator conditions to ambient
TOL 3005	Bubble point pressure (BP) by Constant Compression Expansion (CCE) of the reservoir fluid. Includes additional determination of oil density, compressibility above the bubble point, Y-function below the bubble point.
TOL 3009	Compositional analysis of the evolved gas and stock tank oil (STO) resulting from the reservoir fluid flash to ambient conditions. Includes: separator gas to C ₁₁ ⁺ , oil to C ₃₁ ⁺ , reservoir fluid composition through C ₇ ⁺ , calculated

FLOW ASSURANCE STUDIES AND SARA ANALYSIS

Oil field operations often begin to experience solids deposition – primarily wax, asphaltene, and scale – within flow lines and other equipment. Frequent maintenance and cleaning operations are necessary. Sometimes hourly filter changes may require that production is shut down or diverted.

To mitigate solids deposition in production, a study of asphaltene-wax-scale inhibitors can be carried out in the laboratory where low dosages can be injected at specified conditions of temperature and pressure. These inhibitors are chemical compounds that prevent the deposits from flocculating. The advantages for using such deposit treatment chemicals are:

- Reduction in deposition of solids which helps to maintain production
- Reduction in equipment plugging leading to reduced non-productive tie
- Reduction in produced water treatment problems
- Less oil-in-water carryover.
- Environmentally safe wastewater disposal
- Lower pumping pressures due to reduced fluid viscosity

We can provide the expertise in designing treatment tests to meet a client's particular asphaltene-wax-scale challenges. The testing program is tailored to the specific issues presented and the laboratory testing is performed to evaluate all potential solutions that can achieve the desired results.

As an alternative, we also offer tests on low-dosage hydrate inhibitors since these often can be demonstrated to be a more cost-effective and environmentally acceptable solution for solids deposition problems.

As a service provider, we make a continuing effort to meet the increasing and exacting needs of the Upstream Industry. We continue to develop new methods and test procedures and are always available to learn of any new requirements so that we can serve from first-oil to end-of-field-life.

SARA Analysis - TOL 5051

SARA analysis (Test Code TOL 5051), uses high performance liquid chromatography (HPLC) to test a fluid for:

- Saturates
- Aromatics
- Resins
- Asphaltenes

A test package for SARA analysis is available. Request Test Code TOL 5051.

Compositional Analysis: Oil, Gas Condensate, and Brines

Texas OilTech Laboratories offers a wide selection of analytical testing services including:

- Crude Assay Services
- Crude Fractionation and Studies
- Heavy Metals and Corrosion Analysis
- Natural Gas Analysis
- Cation and Anion Analysis
- Total Solids (TS)
- Total Dissolved Solids (TDS)
- Organic Acid

CRUDE OIL

Our Texas Laboratories are on the west side of Houston, between many of Texas crude oil gathering points and the local refineries. Crude oil characterization identifies the useful distillate ranges in the product in addition to some the less desirable components. Once a site is characterized, it may only be necessary to conduct a few quality control tests on each truck-load to assure the product uniformity.

Crude Oil Characterization	
Test Code	Description
ASTM D 5002	Density and Relative Density of Crude Oils by Digital Density Analyzer
ASTM D 4007	Water and Sediment in Crude Oil, BS&W
ASTM D 4006	Water by Distillation, Crude Oil
ASTM D 4807	Sediment in Crude Oil by Membrane Filtration Test
ASTM D 5853	Pour Point of Crude Oils
ASTM D 3230	Salt Content of Crude Oil, Electrometric Method
ASTM D 4929	Chlorides, Organic, in Crude Oil (Naphtha Cut)
ASTM D 4294	Sulfur by X-Ray Fluorescence Spectroscopy. LOD = 0.01 wt%
ASTM D 6377	Vapor Pressure in Crude Oil, Expansion Method
TOL 5051	SARA, Saturates, Aromatics, Resins and Asphaltenes Analysis
Additional Tests	
ASTM D 5307	Boiling Range Distribution of Crude Petroleum, by GC
ASTM D 4377	Water in Crude Oils by Potentiometric Karl Fischer Titration
UOP 79	Fractionation of Petroleum Distillates
BMC1	Crude Oil Classification, Bureau of Mines Index
TOL 5048	Crude Oil Classification, Paraffinic or Asphaltinic
ASTM D 2892	True Boiling Point and Distillation of Crude Petroleum (15 Theoretical Plates)
ASTM D 7455	Sample Preparation of Petroleum and Lubricant Products for Elemental Analysis
ASTM D 5708	Nickel, Vanadium, and Iron in Crude Oils and Residual Fuels by Inductively Coupled Plasma - Atomic Emission Spectrometry (ICP-AES)

Crude Oil Quality Control	
Test Code	Description
ASTM D 287.a	API Gravity, Hydrometer Method
ASTM D 4006	Water by Distillation, Crude Oil
ASTM D 473	Sediment by Extraction
ASTM D 4294	Sulfur by X-Ray Fluorescence Spectroscopy. LOD = 0.01 wt%

Note: Quality Control tests for Texas Crude Oils can be provided on a two hour turn-around time in our Houston laboratory when required.

CRUDE OIL

Crude Oil Full Assay	
Test Code	Description
ASTM D 2892	True Boiling Point and Distillation of Crude Petroleum
ASTM D 5236	Distillation of Heavy Hydrocarbon Mixtures (Vacuum Potstill Method)
ASTM D 1298	Specific Gravity at 60°F and 100°F
ASTM D 1298.a	Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
UOP 375	UOP Characterization Factor and Estimator Molecular Weight, Calculated
ASTM D 445	Viscosity, Kinematic, at 100°F, cSt
ASTM D 445	Viscosity, Kinematic, at any other Temperature
ASTM D 445	Viscosity, Kinematic, at 210°F, cSt
ASTM D 323	Vapor Pressure of Petroleum Products, Reid Method
ASTM D 2622	Sulfur, X-Ray Spectrometry. LOD = 0.001 wt%
UOP 163	Hydrogen Sulfide and Mercaptan Sulfur in Petroleum Products
ASTM D 2699	Octane Number, Research (Addition)
ASTM D 2700	Octane Number, Motor Method
ASTM D 1159	Bromine Number by Electrometric Titration Method
ASTM D 2163	Composition of Liquid Petroleum (LP) Gas and Propane by GC
ASTM D 6730	PIONA Analysis of Gas Chromatography
ASTM D 1840	Naphthalene Content in Aviation Turbine Fuels
ASTM D 6591	Aromatic Hydrogen Types in Middle Distillates, High Performance Liquid Chromatography (HPLC) Method with Refractive Index Detection
IP 469	Saturated, Aromatic and Polar compounds by Thin Layer Chromatography, GC-FID
ASTM D 664	Acid Number of Petroleum Products, Potentiometric Titration
ASTM D 3230	Salt Content of Crude Oil, Electrometric Method
ASTM D 4929	Chlorides, Organic, in Crude Oil (Naphtha Cut)
ASTM D 5762	Nitrogen in Petroleum and Petroleum Products
UOP 313	Nitrogen Content
ASTM D 56	Flash Point, Tag Closed Tester
ASTM D 92	Methods for Testing Tall Oils – Flash Point ASTM D 92 or ASTM D 93
ASTM D 93	Flash Point Pensky Marten Closed Cup
ASTM D 1322	Smoke Point of Kerosene and Aviation Turbine Fuels
ASTM D 5853	Pour Point of Crude Oils
ASTM D 2386	Freezing Point of Aviation Fuels
ASTM D 4006	Water by Distillation, Crude Oil
ASTM D 4007	Water and Sediment in Crude Oil, BS&W
ASTM D 473	Sediment by Extraction
ASTM D 6560	Asphaltenes (Heptane Insolubles) in Crude Petroleum and Petroleum
ASTM D 4530	Carbon Residue (Micro Method)
ASTM D 5708 B	Nickel, Vanadium, and Iron in Crude Oils and Residual Fuels by Inductively Coupled Plasma – Atomic Emission Spectrometry (ICP-AES)
ASTM D 2887	Distillation True Boiling Point
ASTM D 86	Distillation of Petroleum Products at Atmospheric Pressure
ASTM D 1160	Distillation of Petroleum Products at Reduced Pressures, at 5 and 10mm

ANALYSIS OF BRINES & DRILLING MUDS

Produced Water Analysis	
Test Code	Description
ASTM D 1976	Metals in Water or Aqueous Matrices by ICP-AES
ASTM D 4327.a	Anions in Water by Chemically Suppressed Ion Chromatography
TOL 6055	Organic Acids in Wastewater Using Ion-Exclusion Chromatography and On-Line Carbonate Removal
Std M 2540D	Total Suspended Solids, TSS
Std M 2540C	Total Dissolved Solids, TDS
ASTM D 1125	Electrical Conductivity and Resistivity of Water
Std M 5310B	Total Organic Carbon (TOC)
ASTM D 1067	Acidity or Alkalinity of Water
ASTM E 70	pH of Aqueous Solutions with Glass Electrode

Drilling Fluids Analysis	
Test Code	Description
API 13B-2	API Recommended Practice for Field Testing Oil-Based Drilling Fluids <ul style="list-style-type: none"> - Mud Balance - Rheometers - Sand Content - API Filtration Test - HTHP Filtration Test
ASTM D 4959	Moisture Content by Direct Heating Method
API RP 13B-1	Resistivity Meter

Note: Other test methods are available for Drilling Fluids Analysis. You may request a quote to meet your Drilling Fluids specification.

ELEMENTAL ANALYSIS (TRACE METALS)

Texas OilTech Laboratories provides a sophisticated and well-equipped commercial facilities for the determination of low concentrations of elements in aqueous and hydrocarbon products. Typical applications include: lubricants, process water and wastewaters, crude oils, natural gas, and other fuel gases, fuel oils, diesel fuel, an assortment of bio fuels, and many refined oil products.

Applications for Elemental Analysis

Elemental Analysis is used to assess the condition of lubricating oil that has been formulated with defined quantities of additives that provide anti-wear, oxidation stability, or water resistance properties to the lubricant. So, elemental analysis (or trace metals analysis) is used to simultaneously monitor disappearance of the desirable additive metals along with the appearance of any undesirable wear metals. This assures that the lubricant can continue to function as intended.

In fuels analysis, the trace metals refer both to those elements present as metallic compounds in solution and to metals present in particles such as rust. They can be dissolved or suspended in the fuel hydrocarbons or in free water present in the fuel. When trace metals are maintained at lower levels in a liquid or gaseous fuel at a power plant, then longer, corrosion-free service can be expected.

Environmental regulations dictate the measurement of discharge waters, sediments, sludges, and stack gases in many plant processes.

Analytical Techniques for Trace Metals

The term, trace, does not imply a single concentration of the element and there is no single definition for "trace". A trace amount will vary according to the nature of the product and to the required specification for a particular product. For example, what is considered an allowable amount in a turbine fuel may be quite different from a trace in a coal or a Refuse Derived Fuel (RDF)?

Texas OilTech Laboratories offers tests for elemental analysis by several analytical techniques that are designed to detect concentrations of parts per million (ppm), or even less. These various procedures provide different Limits of Detection or LOD. The exact LOD will depend on each sample matrix and the specific element.

The concentrations reported in elemental analysis can be expressed in several ways. The unit of parts per million by weight, or ppm, is perhaps the most common. Some alternate expressions are shown in Table 1.

Analytical techniques vary according to the instrumental procedure and also for individual elements. As a guideline, we state the Limit of Detection, or LOD, for an average element for a given instrument.

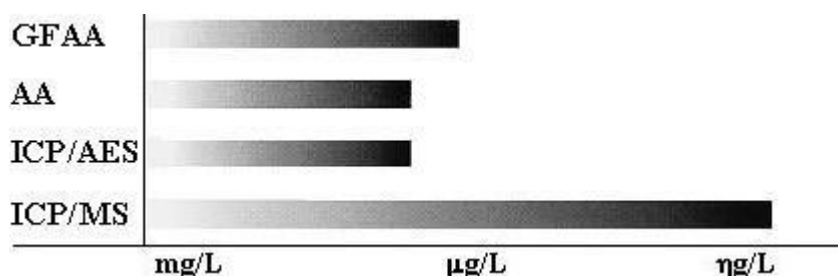
The various techniques we use are generally as follows:

- Spectrochemical Analysis, 21 elements, LOD = 5 ppm (parts per million, weight basis)
- Inductively Coupled Plasma, ICP, 60 elements, LOD = 1 ppm
- Metals by Graphite Furnace Atomic Absorption, GFAA, LOD = 0.5 ppm
- Metals by Atomic Absorption and Flame Emission Spectrometry, LOD = 0.1 ppm
- Trace Elements by Inductively Coupled Plasma - Mass Spectrometer, LOD = 0.001 ppm

Table 1.
Limit of Detection (LOD)

<u>Units of Measurement</u>	<u>LOD</u>
ug/mL	ppm
ug/g	ppm
mg/L	ppm
ug/L	ppb
ug/kg	ppb

Figure 1.
Typical Detection Limits for Analytical Techniques



ELEMENTAL ANALYSIS (TRACE METALS)

The Limit of Detection for trace metals by ICP/MS, LOD = 0.001 ppm, is therefore about 1 part per billion or 1 ug/L. The range of this instrument continues to improve so that it is now possible to detect some elements with LOD of fractional parts per billion, and even, at times, approaching parts per trillion. Analytical techniques used for Elemental Analysis are shown in Table 2 and in Figure 1.

Table 2.
Analytical Techniques for Elemental Analysis (Trace Metals)

1.AAS	Atomic Absorption Spectroscopy, LOD = 0.1 ppm
2.FAAS	Flame Atomic Absorption Spectrometry
3.GFAAS	Graphite Furnace Atomic Absorption Spectrometry, LOD = 0.05 ppm (typically)
4.CVAA	Cold Vapor Atomic Absorption (for Mercury)
5.ICP-AES	Inductively Coupled Plasma/Atomic Emission Spectrometry, LOD = 0.05 ppm
6.ICP-MS	Inductively Coupled Plasma/Mass Spectrometry, LOD = 0.001 ppm or <1 ppb
7.XRF	X-Ray Fluorescence Spectroscopy
8.EDXPF	Energy-Dispersive X-Ray Fluorescence Spectroscopy
9.WDXRF	Wavelength Dispersive X-Ray Fluorescence Spectroscopy
10.RDE	Spectrochemical Analysis, 21 Elements, LOD = 5 ppm

Testing Packages for Trace Metals and Elemental Analysis

In certain cases, and especially when the concentration range for contaminants is unknown, a testing package can be provided. It is necessary to first do some type of semi-quantitative scans so that the elements present and their relative concentrations can be estimated. This prevents damage to an instrument by saturating a sensor. Once the range of each element has been identified, a second test is conducted to quantify the contaminants or trace elements, using either the same instrument with appropriate sample dilution, or, perhaps another instrument that offers lower limits of detection.

We use ASTM and Manufacturers' Specifications as guidelines in Elemental Analysis. It is sometimes possible to offer a more cost-effective alternative for the same LOD, or to offer another method having better detection limits for the same cost. We advise our clients when ASTM test procedures are modified or upgraded and we are always happy to discuss your specific requirements.

ASTM D 7111 is widely used for elemental analysis and for trace metals. Texas OilTech Laboratories instruments are capable of detecting over fifty elements down to a Limit of Detection (LOD) of about 0.05 ppm (50 ppb).

Various sets of elements can be found among the test packages for liquid and gaseous fuels, as specified by various manufacturers. A general discount schedule applies, based on the number of elements in the set. According to the following schedule.

Test Code	Description
ASTM D 7111.1	One element, specify
ASTM D 7111.2	Two elements, specify
ASTM D 7111.3	Three elements, specify
ASTM D 7111.4	Four elements, specify
ASTM D 7111.5	Five elements, specify
ASTM D 7111.6	Six elements, specify
ASTM D 7111.7	Seven elements, specify
ASTM D 7111.8	Eight elements, specify
ASTM D 7111.9	Over eight elements

Other charges for sample preparation may apply for elemental analysis and trace metals, depending on the test matrix.

ENVIRONMENTAL ANALYSIS

Used Oil Burned for Energy Recovery, 40 CFR, 266.40 BIF Fuels, Used Oil Fuels

Test Code	Description
EPA 1010	Ignitability, Flash Point, Pensky-Martens (PMCC)
EPA 9020B	Halogens, Total Organic (TOX)
EPA 3050B	Sample Preparation, Sediments, Soils, Sludges, Acid Digestion
EPA 6010B.1	Metals by Inductively Coupled Plasma - Atomic Emission Spectroscopy (ICP-AES), on Soils, Sludge, Solids, and Petroleum Products. Includes: Arsenic, Cadmium, Chromium, and Lead. Limit of Detection. LOD = 1 ppm

	Additional Tests
ASTM D 482	Ash Content of Petroleum Products
ASTM D 445.a	Viscosity, Kinematic, at 40°C, cSt
ASTM D 240	Heat of Combustion, by Bomb Calorimeter
EPA 7470A	Mercury, by Cold Vapor Atomic Absorption, Liquid Waste
EPA 8080A	PCBs in Soil by Extraction and Gas Chromatography

Hazardous Waste Characterization (RCRA) Toxicity Characteristic Leaching Procedure (TCLP) RCRA Metals, Solid Samples, Soils, and Sludges

Test Code	Description
EPA 3050B	Sample Preparation, Sediments, Soils, Sludges, Acid Digestion
EPA 6010C	TCLP Metals by ICP - AES. Includes: Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver, mg/L LOD = 1 ppm
EPA 245.1	Mercury by Cold Vapor Atomic Absorption, LOD = 0.05 ppm

Drilling Fluids (Muds) Crude Oil Contamination

Test Code	Description
EPA Appendix C	Crude Oil Contamination in Non-Aqueous Drilling Fluids by GC-MS

Test Codes are for identification and are generally related to the ASTM or other protocol. We use suffix letters with the test codes to identify different practices within the same ASTM procedure, e.g., different test temperatures, or different test times.

SIMULATED DISTILLATION BY GAS CHROMATOGRAPHY

Simulated distillation analysis, or Sim-Dis, is a process that used to simulate the actual physical distillation of petroleum products by Gas Chromatography. There are several ASTM test methods that are referred to as Sim-Dis, and these differ from one another as to the type of hydrocarbon product and the temperature range of interest. However, in each method, the non-polar and low polar hydrocarbons are eluted from a gas chromatograph column in a specific boiling point order.

A program of increasing temperature is applied to a GC column and the time axis is converted to temperature by running a calibration standard under the same conditions as the sample, so that the retention times of hydrocarbons are related to their respective boiling points.

Simulated Distillation or Sim-Dis is alternately known as Boiling Range Distribution or Composition Breakdown. The ASTM has at least four approved test procedures for Sim-Dis. These are intended to replace the traditional physical distillation methods such as ASTM D 86 and ASTM D 2892. In fact, ASTM work groups now give consideration to including Sim-Dis as a specification test for such products as diesel fuel, kerosene, jet fuel, fuel oil, and biofuels.

Simulated Distillation Methods:

Texas OilTech Laboratories offers several tests for Sim-Dis and related procedures that are based on the recognized ASTM methods. The temperature range has been extended in several of these tests by applying Sim-Dis procedures.

Simulated Distillation Methods	
Test Code	Description
ASTM D 2887.c	Simulated Distillation, SimDis, Lower Temperature Range, 55 to 538°C, C ₅ to C ₄₄
ASTM D 2887.d	Simulated Distillation, SimDis, High Temperature Range, 360 to 575°C, C ₁₀ to C ₅₀
ASTM D 2887.a	Boiling Range Distribution of Petroleum Fraction by Gas Chromatography
ASTM D 2887.b	Composition Breakdown (C ₁ to C ₄₀) by GC, Sludge
ASTM D 3710	Boiling Range Distribution, Gasoline, by GC
ASTM D 5307	Boiling Range Distribution of Crude Petroleum, by GC
ASTM D 6352	Boiling Range Distribution of Petroleum Distillates in Boiling Range from 174 to 720°C by Gas Chromatography, C ₁₀ to C ₁₀₀
ASTM D 5442	Petroleum Waxes by Gas Chromatography

In addition, other Gas Chromatography procedures can be modified to include the principles of Simulated Distillation for a variety of other petroleum products. It has become an important tool in the investigative work that we perform for clients. Please contact Texas OilTech Laboratories to request information regarding Simulated Distillation procedures that can be applied to your product

ON-SITE ANALYTICAL TESTING SERVICES

On-site testing of fuels and lubricants is the most cost-effective way to provide project engineers and managers with critical, reliable data at power plant construction projects. Results of fuel analysis are available in a matter of hours rather than days so that immediate measures can then be taken in regard to the fuel, the turbines, or to the combustion parameters.

This is also true any time an installation is being serviced, or is undergoing performance testing, or plant commissioning, or at any other time when a large number of personnel are gathered at the plant site. Then it always makes sense to minimize the total number of man-hours on the job site.

There are many other situations when it is practical to call for on-site testing of liquid or gaseous fuels such as pipeline quality issues or at offshore production platforms, or compressor stations, or when the parameters must be defined for dewatering or condensate removal from the raw gas.

Texas OilTech Laboratories is an ISO accredited facility under ISO 9001:2008 and ISO/IEC-17025, and this accreditation also extends to our on-site testing capabilities. We have participated in the completion of several hundred power plant projects and dozens of offshore plant sites in the USA and around the planet. We have the capacity to simultaneously support multiple on-site teams in the field.

Industries Served:

- Independent Power Producers
- Municipal Utilities
- Petroleum Refineries
- Turbine Manufacturers
- Petrochemical Plants
- Engineering and Construction Firms
- Off-shore Production Platforms
- Engineering Consultants

On-Site Testing Services:

- Power Plants and Electric Energy Generation
- Gas Turbine Performance Testing
- Plant Commissioning Testing
- Gas and Liquid Fuel Quality Control Analysis

Benefits:

- High-speed, on-site analysis
- Eliminate sample shipping hassles and costs
- Increased team productivity
- Increased flow of information with timely data
- Fully trained instrumentation chemist on site
- On-site assistance in data interpretation

ON-SITE ANALYTICAL TESTING SERVICES

What Analytical Procedures Are Available On-Site?

Sample Fuel Cylinders and Documentation:

Fuel sample containers are available for both domestic and offshore projects. Gas sample cylinders, one-liter opaque glass bottles, labels, and forms are provided at no cost (shipping charges are invoiced).

Portable GC Quad Detector:

Portable gas chromatographs (GC) are available on-site testing for the extended ASTM D 1945 gas analysis. They contain four independently controlled GC Modules, each designed to determine specific constituent levels present in a gas sample. We have completed multiple studies comparing the precision of on-site testing vs. in-laboratory testing by using retain or duplicate samples. A report is available on our web site or by contacting our office.

Patented Assembly for Determination of Particulates in Gaseous Fuels:

Many gas turbine manufacturers now require quantification of particulates in gaseous fuel streams, both in terms of their particle sizing/count and in the elemental identification of those particles, especially for Sodium, Potassium, Vanadium, and Silica,

On-Site Gas Moisture Analyzer:

Our field staff can provide real-time moisture-in-gas analysis at your plant sites thus eliminating the need to ship large gas cylinders to laboratories for moisture analysis.

Portable Spectrochemical Analyzer for Trace Metals:

Using ASTM D 6595 and a state-of-the-art RDE instrument specifically designed for determination of trace elements in liquid fuels, we can provide maximum sensitivity, lowest levels of detection, and highest degree of accuracy for on-site analysis of trace metals.

Other On-site Tests:

Many other analytical instruments can be brought to your job site. We recommend that you contact our technical personnel to discuss your specific requirements. We will always strive to provide you with the most cost-effective on-site testing program for your products.

ABBREVIATIONS AND ACRONYMS

The following list will be helpful in defining the abbreviations that are commonly used for technical terms in the test methods offered.

AA	Atomic Absorption	MIL-STD	Military Standard
ARI	American Refrigeration Institute	MTBE	Methyl Tert-Butyl Ether
ASME	American Society of Mechanical Engineers	NACE	National Association of Corrosion Engineers
ASTM	American Society for Testing Materials	NAS	National Aerospace Standard
AV	Apparent Viscosity	NASA	National Aeronautical and Space Administration
B20	Biodiesel	NMR	Nuclear Magnetic Resonance
BOCLE	Ball-on-Cylinder Lubricity Evaluator	OAN	Oil Absorption Number
BP	Bubble Point	O-PONA	Oxygenates and Isoparaffins, Olefins, Naphthalenes, Aromatics
BMCI	Bureau of Mines Classification Index	OSHA	Occupational and Safety Health Act
BS	British Standard	OSI	Oil Stability Index
BS&W	Bottom Sediment and Water	PAC	Polyaromatic Compound
BTEX	Benzene, Toluene, Ethyl Benzene, and Xylene	PAH	Polynuclear Aromatic Hydrocarbons
CFPP	Cold Filter Plugging Point	PCB	Polychlorinated Bisphenol
CHN	Carbon, Hydrogen, Nitrogen	PIONA	Paraffins, Isoparaffins, Olefins, Naphthalenes, Aromatics
CNG	Compressed Natural Gas	PMCC	Pensky-Martens Closed Cup
COD	Chemical Oxygen Demand	POX	Purgeable Organic Halides
cP	Centipoise	PV	Plastic Viscosity
cSt	Centistokes	RCRA	Resource Conservation and Recovery Act
DIN	Deutsche Industrie Normen	RDE-AES	Rotating Disc Electrode - Atomic Emission Spectroscopy
DSC	Differential Scanning Calorimeter	RDF	Refuse-Derived Fuel
E85	Ethanol	RFC	Recycled Fuel, Commercial Boiler
EOX	Extractable Organic Halides	RFO	Reprocessed Fuel Oil
EPA	Environmental Protection Agency	RPVOT	Rotating Pressure Vessel Oxidation Test (Formerly RBOT)
FDA	Food and Drug Administration	RTFOT	Rolling-Thin Film Oven Test
FIA	Fluorescent Indicator Absorption	SAE	Society of Automotive Engineers
FID	Flame Ionization Detector	SEM	Scanning Electron Microscope
FLAA	Flame Atomic Absorption Analysis	SIM-DIS	Simulated Distillation by Gas Chromatography
FT-IR	Fourier Transform-Infrared	SL-BOCLE	Scuffing Load Ball-on-Cylinder Lubricity Evaluator
GC	Gas Chromatography	SUS	Saybolt Universal Seconds
GC-MS	Gas Chromatography – Mass Spectrometry	TAN	Total Acid Number
GC-FID	Gas Chromatography - Flame Ionization Detector	TCLP	Toxicity Characteristic Leaching Procedure
GFAA	Graphite Furnace Atomic Absorption	TDF	Tire-Derived Fuel
HFRR	High Frequency Reciprocating Rig	TDS	Total Dissolved Solids
HPLC	High Pressure Liquid Chromatography	TFOUT	Thin Film Oxygen Uptake
ICP	Inductively Coupled Plasma	TOL	Texas OilTech Laboratories
ICP-AES	Inductively Coupled Plasma - Atomic Emission Spectroscopy	TOX	Total Organic Halogens
ICP-MS	Inductively Coupled Plasma - Mass Spectroscopy	TPH	Total Petroleum Hydrocarbons
ISO	International Organization for Standardization	TS	Total Solids
JFTOT	Jet Fuel Thermal Oxidation Tester	TSS	Total Suspended Solids
LNG	Liquefied Natural Gas	UOP	Union Oil Products Specification
LOD	Limit of Detection	VGC	Viscosity-Gravity Constant
LP	Liquefied Petroleum	VOC	Volatile Organic Compounds
LPG	Liquefied Petroleum Gas (Propane)	VPR	Varnish Potential Rate
M85	Methanol	YP	Yield Point.



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