



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.

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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.