



Designation: D4304 – 22

Standard Specification for Mineral and Synthetic Lubricating Oil Used in Steam or Gas Turbines¹

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1. Scope*

1.1 This specification covers mineral and synthetic (API group I, II, III, or IV) oils used in steam and gas turbine lubrication systems where the performance requirements demand highly refined mineral or synthetic base oils compounded with rust and oxidation inhibitors plus selected additives as needed to control foam, wear, demulsibility, and so forth. This standard may also be applied to “combined cycle” turbine systems, where a single lubricant circulating system is used to supply oil to a steam and gas turbine configured in tandem either on a single or separate shaft for enhanced energy efficiency.

1.2 This specification is intended to define the properties of mineral and synthetic oil-based turbine lubricating oils that are functionally interchangeable with existing oils of this type, are compatible with most existing machinery components, and with appropriate field maintenance, will maintain their functional characteristics.

1.3 This specification is intended to define only new lubricating oil before it is installed in the machinery.

1.4 This specification is intended to be used as a guide. It is possible that oils that do not meet this specification may perform satisfactorily in some turbines.

1.5 This specification does not include API Group V fluids. For polyol ester fluids used to lubricate land-based gas turbines, the user is referred to the current version of military specification MIL-PRF-23699 for fluid performance requirements. For phosphate ester fluids used as turbine lubricants or steam turbine electro-hydraulic control (EHC) fluids, the user is referred to the current version of Specification **D4293** for fluid performance requirements.

1.6 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

¹ This specification is under the jurisdiction of ASTM Committee **D02** on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee **D02.C0.01** on Turbine Oil Monitoring, Problems and Systems.

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1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- D92** Test Method for Flash and Fire Points by Cleveland Open Cup Tester
- D97** Test Method for Pour Point of Petroleum Products
- D130** Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
- D445** Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
- D664** Test Method for Acid Number of Petroleum Products by Potentiometric Titration
- D665** Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water
- D892** Test Method for Foaming Characteristics of Lubricating Oils
- D943** Test Method for Oxidation Characteristics of Inhibited Mineral Oils
- D974** Test Method for Acid and Base Number by Color-Indicator Titration
- D1401** Test Method for Water Separability of Petroleum Oils and Synthetic Fluids
- D1500** Test Method for ASTM Color of Petroleum Products (ASTM Color Scale)
- D2272** Test Method for Oxidation Stability of Steam Turbine Oils by Rotating Pressure Vessel
- D2422** Classification of Industrial Fluid Lubricants by Viscosity System
- D3339** Test Method for Acid Number of Petroleum Products by Semi-Micro Color Indicator Titration

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard

- D3427** Test Method for Air Release Properties of Hydrocarbon Based Oils
- D4052** Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter
- D4057** Practice for Manual Sampling of Petroleum and Petroleum Products
- D4175** Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants
- D4293** Specification for Phosphate Ester Based Fluids for Turbine Lubrication and Steam Turbine Electro-Hydraulic Control (EHC) Applications
- D4310** Test Method for Determination of Sludging and Corrosion Tendencies of Inhibited Mineral Oils
- D5182** Test Method for Evaluating the Scuffing Load Capacity of Oils (FZG Visual Method)
- D6304** Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration
- D6439** Guide for Cleaning, Flushing, and Purification of Steam, Gas, and Hydroelectric Turbine Lubrication Systems
- D7155** Practice for Evaluating Compatibility of Mixtures of Turbine Lubricating Oils
- D7546** Test Method for Determination of Moisture in New and In-Service Lubricating Oils and Additives by Relative Humidity Sensor
- D7547** Specification for Hydrocarbon Unleaded Aviation Gasoline
- D7647** Test Method for Automatic Particle Counting of Lubricating and Hydraulic Fluids Using Dilution Techniques to Eliminate the Contribution of Water and Interfering Soft Particles by Light Extinction

2.2 ISO Standards:³

- ISO 4406–99** Particle Count Analysis
- ISO 6072** Rubber—Compatibility Between Hydraulic Fluids and Standard Elastomeric Materials
- ISO 8068** Lubricants, Industrial Oils and Related Products (Class L)—Family T (Turbines)—Specification for Lubricating Turbines

2.3 Military Standards:

- MIL-PRF-23699G** Performance Specification Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code Numbers: O-152, O-154, O-156, and O-167⁴

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this specification, refer to Terminology **D4175**.

3.1.2 *functional properties, n*—those properties of the mineral or synthetic lubricating oil that are required for satisfactory operation of the machinery. These properties are listed in Section 5.

3.1.3 *Type I mineral or synthetic oils, n*—oils for steam, gas, or combined cycle turbine lubricating systems where the machinery does *not* require lubricants with enhanced load carrying capacity.

3.1.3.1 *Discussion*—Type I oils usually are available in ISO VG 32, 46, 68 and 100 (see Classification **D2422**). Such oils normally contain rust and oxidation inhibitors in addition to other additives as required to meet the specified performance characteristic. Type I oils are generally satisfactory for turbine sets where bearing temperatures do not exceed 110 °C.

3.1.4 *Type II mineral or synthetic oils, n*—oils for steam, gas, or combined cycle turbine lubricating systems where the machinery requires enhanced load carrying capacity.

3.1.4.1 *Discussion*—Type II oils usually are available in ISO VG 32, 46, 68, 100, and 150. These oils are similar to Type I but contain additional anti-wear additives for use in turbines equipped with a gearbox. Type II oils are generally satisfactory for turbine sets where bearing temperatures do not exceed 110 °C. Oils ISO VG 68 and above have been used in marine, hydro, or water turbines.

3.1.5 *Type III mineral or synthetic oils, n*—oils for heavy duty gas or combined cycle turbine lubricating systems where the lubricant shall withstand higher temperatures and exhibit higher thermal stability than Type I or Type II oils.

3.1.5.1 *Discussion*—Type III oils usually are available in ISO VG 32 and 46. Such oils are normally comprised of a highly refined mineral or synthetic base oil (API group I, II, III, or IV) with suitable rust and oxidation inhibitors in addition to other additives as needed to meet specified performance characteristics. Type III oils are formulated for use in turbine sets where bearing temperatures may exceed 110 °C. The turbine lubrication systems using Type III oils may be equipped with a gearbox that may require the selection of oils that contain additional anti-wear additives to impart the specified load carrying capacity.

4. Sampling, Testing, and System Preparation

4.1 *Sampling*—Generally, take all oil samples in accordance with Practice **D4057**.

4.2 Use the ASTM and other test methods described in **Tables 1–3**.

4.3 Test Method **D6439** should be referenced for turbine flushing guidance.

4.4 Practice **D7155** should be referenced to confirm oil to oil compatibility.

5. Functional Property Requirements

5.1 Mineral and synthetic lubricating oils conforming to the specification shall meet the functional property limits specified in **5.2 – 5.4** and **Tables 1–3**. The significance of these properties is discussed in **Appendix X1**.

5.2 Requirements for Type I oils are shown in **Table 1**.

5.3 Requirements for Type II oils are shown in **Table 2**.

5.4 Requirements for Type III oils are shown in **Table 3**.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ Available from US Military document web site, <http://quicksearch.dla.mil/>