



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

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1. Scope

1.1 This specification covers mineral oils used in steam and gas turbine lubrication systems where the performance requirements demand a highly refined mineral base oil compounded with rust and oxidation inhibitors plus selected additives as needed to control foam, wear, demulsibility, and so forth.

1.2 This specification is intended to define the properties of mineral 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.

2. Referenced Documents

2.1 ASTM Standards:

- D 92 Test Method for Flash and Fire Points by Cleveland Open Cup²
- D 97 Test Method for Pour Point of Petroleum Oils²
- D 130 Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test²
- D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (the Calculation of Dynamic Viscosity)²
- D 664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration²
- D 665 Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water²
- D 892 Test Method for Foaming Characteristics of Lubricating Oils²
- D 943 Test Method for Oxidation Characteristics of Inhibited Mineral Oils²
- D 974 Test Method for Acid and Base Number by Color-Indicator Titration²

- D 1401 Test Method for Water Separability of Petroleum Oils and Synthetic Fluids²
- D 2272 Test Method for Oxidation Stability of Steam Turbine Oils by Rotating Bomb²
- D 2422 Classification of Industrial Fluid Lubricants by Viscosity System²
- D 3339 Test Method for Acid Number of Petroleum Products by Semi-Micro Color Indicator Titration³
- D 3427 Test Method for Air Release Properties of Petroleum Oils³
- D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products³
- D 4310 Test Method for Determination of the Sludging and Corrosion Tendencies of Inhibited Mineral Oils³
- D 5182 Test Method for Evaluating the Scuffing (Scoring) Load Capacity of Oils (FZG Visual Method)³

3. Terminology

3.1 Definitions:

3.1.1 *Type I mineral oils, n*—oils for steam and gas turbine lubricating systems where the machinery does *not* require lubricants with enhanced load carrying capacity. Such oils normally contain rust and oxidation inhibitors plus other additives as needed to meet the specified performance characteristics. Type I oils usually are available in ISO-VG 32, 46, 68, and 100 (see Classification D 2422).

3.1.2 *Type II mineral oils, n*—oils for steam and gas turbine lubricating systems where the machinery requires enhanced load carrying capacity. These oils are similar to Type I and are typically used in gas turbines with a load carrying gear marine turbines. Such oils contain rust and oxidation inhibitors, plus mild extreme pressure (EP) additives and other additives as needed to meet the specified performance characteristics. Type II oils usually are available in ISO-VG 32, 46, 68, 100, and 150.

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

4. Sampling and Testing

4.1 *Sampling*—Generally, take all oil samples in accordance with Practice D 4057.

¹ This specification is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.C on Turbine Oils.

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² *Annual Book of ASTM Standards*, Vol 05.01.

³ *Annual Book of ASTM Standards*, Vol 05.02.

TABLE 1 Requirements for Type I Turbine Oils

NOTE 1—The nature of some tests are such that they are not necessarily run on each batch. The values are representative.

Property	ASTM Test Method	Limits			
Physical:					
ISO—viscosity grade	D 2422	32	46	68	100
Flash point, °C, min	D 92	180	180	180	180
Pour point, °C, max	D 97 ^A	–6	–6	–6	–6
Viscosity, cSt (mm ² /s) 40°C	D 445	28.8–35.2	41.4–50.6	61.2–74.8	90–110
Visual examination at 20°C	...	clear and bright			
Chemical:					
Total Acid Number, mg KOH/g, max	D 974 ^B	report	report	report	report
Performance					
Emulsion characteristics:					
at 54°C, minutes to 3 mL emulsion, max	D 1401	30	30	30	...
at 82°C, minutes to 3 mL emulsion, max		60
Foaming characteristics:					
Sequence I, tendency/stability, mL, max	D 892	50/0	50/0	50/0	50/0
Air release, 50°C, minutes max	D 3427	5	7	10	17
Rust preventing characteristics	D 665A	Pass	Pass	Pass	Pass
Copper corrosion, 3 h at 100°C, max	D 130	1	1	1	1
Oxidation stability ^C :					
Hours to neut. No. 2.0, min	D 943	2000	2000	1500	1000
Minutes to 175 kPa drop, min	D 2272	350	350	175	150

^A Lower pour point may be required for some applications.

^B Test Method D 664 may be used as an alternative test method.

^C Test Method D 943 is the accepted test method for oxidation stability of new steam turbine oils in the United States and Canada. It is recognized that Test Method D 943 is a lengthy procedure. Test Method D 2272 is a shorter test for quality control. See X1.3.6 for significance of Test Method D 2272.

TABLE 2 Requirements for Type II Turbine Oils

NOTE 1—The nature of some tests are such that they are not necessarily run on each batch.

Property	ASTM Test Method	Limits			
Physical:					
ISO—viscosity grade	D 2422	32	46	68	100
Flash point, °C, min	D 92	180	180	180	210
Pour point, °C, max	D 97 ^A	–5	–5	–5	–5
Viscosity, cSt, 40°C (mm ² /s)	D 445	28.8–35.2	41.4–50.6	61.2–74.8	90–110
Visual examination at 20°C	...	clear and bright			
Chemical:					
Total Acid Number, mg KOH/g, max	D 974 ^B	report	report	report	report
Performance					
Emulsion characteristics:					
at 54°C, minutes to 3 mL emulsion, max	D 1401	30	30	30	...
at 82°C, minutes to 3 mL emulsion, max		60
Foaming characteristics:					
Sequence I, tendency/stability, mL, max	D 892	50/0	50/0	50/0	50/0
Air release, 50°C minutes max	D 3427	5	10	10	25
Rust preventing characteristics	D 665B	pass	pass	pass	pass
Copper corrosion, 3 h at 100°C, max	D 130	1	1	1	1
Oxidation stability ^C :					
Hours to neut. No. 2.0, min	D 943	2000	2000	1500	1000
Minutes to 175 kPa drop, min	D 2272	350	350	175	150
Load carrying capacity:					
fail stage, min	D 5182 ^D	8	8	8	8

^A Lower pour point may be required for some applications.

^B Test Method D 664 may be used as alternative method.

^C Test Method D 943 is the accepted test method for oxidation stability of new steam turbine oils in the United States and Canada. It is recognized that Test Method D 943 is a lengthy procedure. Thus, Test Method D 2272 is a suggested shorter test for quality control. See X1.3.6 for significance of Test Method D 2272.

^D Higher values may be required for some applications.

4.2 Use the ASTM and other test methods described in Tables 1 and 2.

5. Functional Property Requirements

5.1 Mineral lubricating oils conforming to the specification shall meet the functional property limits specified in 5.2 and 5.3 and Table 1 and Table 2. 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.

6. Keywords

6.1 gas turbine oil; mineral oil; R and O oils; steam turbine oil; turbine lubricating oils; turbine lubrication systems