



Designation: D 6158 – 99

An American National Standard

Standard Specification for Mineral Hydraulic Oils¹

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1. Scope

1.1 This specification covers mineral oils used in hydraulic systems, where the performance requirements demand fluids with one of the following characteristics:

1.1.1 A refined base oil (Class HH),

1.1.2 A refined mineral base oil with rust and oxidation inhibitors (Class HL), and

1.1.3 A refined mineral base oil with rust and oxidation inhibitors plus antiwear characteristics (Class HM).

1.2 This specification defines the requirements of mineral oil-based hydraulic fluids that are compatible with most existing machinery components when there is adequate maintenance.

1.3 This specification defines only new lubricating oils before they are installed in the hydraulic system.

1.4 This specification defines specific types of hydraulic oils. It does not include all hydraulic oils. Some oils that are not included may be satisfactory for certain hydraulic applications. Certain equipment or conditions of use may permit or require a wider or narrower range of characteristics than those described herein.

1.5 The following safety hazard caveat pertains to the test methods referenced in this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitation prior to use.*

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 471 Test Method for Rubber Property—Effect of Liquids³

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 1298 Practice for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method²

D 1401 Test Method for Water Separability of Petroleum Oils and Synthetic Fluids²

D 2070 Test Method for Thermal Stability of Hydraulic Oils²

D 2270 Practice for Calculating Viscosity Index from Kinematic Viscosity at 40 and 100°C²

D 2422 Classification of Industrial Fluid Lubricants by Viscosity System²

D 2619 Test Method for Hydrolytic Stability of Hydraulic Fluids (Beverage Bottle Method)²

D 2882 Test Method for Indicating the Wear Characteristics of Petroleum and Non-Petroleum Hydraulic Fluids on a Constant Volume Vane Pump²

D 2983 Test Method for Low-Temperature Viscosity of Automotive Fluid Lubricants Measured by Brookfield Viscometer²

D 3427 Test Method for Air Release Properties of Petroleum Oils⁴

D 4052 Test Method for Density and Relative Density of Liquids by Digital Density Meter⁴

D 4310 Test Method for Determination of the Sludging and Corrosion Tendencies of Inhibited Mineral Oils⁴

¹ This specification is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.N on Hydraulic Fluids.

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

³ *Annual Book of ASTM Standards*, Vol 09.01.

⁴ *Annual Book of ASTM Standards*, Vol 05.02.

D 6080 Practice for Defining the Viscosity Characteristics of Hydraulic Fluids⁵

3. Classification

3.1 *Type HH Hydraulic Oils*—Non-inhibited refined mineral oils for hydraulic systems that do not have specific requirements of oxidation stability, rust protection, or anti-wear properties. Type HH oils are usually intended for total loss systems or very light-duty equipment.

3.2 *Type HL Hydraulic Oils*—Refined mineral oils with improved rust protection and oxidation stability for hydraulic systems where relatively high temperatures and long periods of operation time are expected, and where there is the possibility of water or humidity that could rust metal parts of the machinery. These oils are intended for use in systems where no metal to metal contact is expected between the moving parts. Usually systems working at low pressures specify HL oils. Some high-pressure piston pumps can operate satisfactorily on these oils.

3.3 *Type HM Hydraulic Oils*—Oils of HL type with improved anti-wear properties, for general hydraulic systems, especially for those working at high pressures and where the possibility of metal to metal contact between the moving parts exists. Type HM oils are usually specified for hydraulic systems with vane pumps, or when the system is intended to work at maximum pump capacity for long periods of time.

3.4 *Type HV Hydraulic Oils*—Oils of HM type with improved viscosity/temperature properties, for general hydraulic

systems where equipment is intended to operate over a wide range of ambient temperatures.

4. Classification Requirements

4.1 *Type HH*—The requirements for this type of oil are presented in Table 1 and include Viscosity Grades ISO VG from 10 to 150, in accordance with Classification D 2422.

4.2 *Type HL*—The requirements for this type of oil are presented in Table 2 and include Viscosity Grades ISO VG from 10 to 150, in accordance with Classification D 2422.

4.3 *Type HM*—The requirements for this type of oil are presented in Table 3 and include Viscosity Grades ISO VG from 10 to 150, in accordance with Classification D 2422.

4.4 *Type HV*—The requirements for this type of oil are presented in Table 4 and include Viscosity Grades ISO VG from 10 to 150, in accordance with Classification D 2422.

5. Inspection

5.1 Inspection of the material shall be agreed upon between the purchaser and the supplier.

6. Packaging and Package Marking

6.1 The material shall be suitably packaged to permit acceptance by the carrier and to afford adequate protection from normal hazards of handling and shipping. Packaging shall conform to applicable carrier rules and regulations.

6.2 Packaging and labeling shall comply with state or federal regulations.

6.3 Each container shall be plainly marked with the manufacturer's name and brand, production code or lot number, type

⁵ Annual Book of ASTM Standards, Vol 05.03.

TABLE 1 Requirements for Type HH Mineral Oil Hydraulic Fluids

Properties	Test Method ASTM (Other)	Parameters	Limits							
Physical										
ISO viscosity grade	D 2422		10	15	22	32	46	68	100	150
Viscosity	D 445	kinematic viscosity at 40°C, cSt	9.0-11.0	13.5-16.5	19.8-24.2	28.8-35.2	41.4-50.6	61.2-74.8	90.0-110	135-165
Viscosity, ≤ 750 cP	D 2983 ^A	temperature, °C	report	report	report	report	report	report	report	report
Viscosity index	D 2270		report	report	report	report	report	report	report	report
Specific gravity	D 1298 ^B		report	report	report	report	report	report	report	report
Appearance	Visual		clear and bright	clear and bright	clear and bright	clear and bright	clear and bright	clear and bright	clear and bright	clear and bright
Flash point	D 92	temperature, °C, min	125	145	165	175	185	195	205	215
Pour point	D 97	temperature, °C, max	-15	-12	-9	-6	-6	-6	-6	-6
Chemical										
Acid number	D 974/D 664	mg KOH/g, max	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Performance										
Elastomer compatibility	D 471	100 ± 1°C/288 ± 2h ± 2h SRE-NBR 1 Elastomer (DIN53 538, Part 1 or AMA 524, Part 1) relative volume change, % C	report	report	report	report	report	report	report	report
		change in Shore A hardness, rating C	report	report	0 to 15	0 to 12	0 to 12	0 to 10	0 to 10	0 to 10
			report	report	0 to -8	0 to -7	0 to -7	0 to -6	0 to -6	0 to -6

^APrecision of the test method for hydraulic oils at low temperatures is being improved by Subcommittee D02.07.OC, but the test method is applicable.

^BTest Method D 4052 can also be used.



TABLE 2 Requirements for Type HL Mineral Oil Hydraulic Fluids (Rust and Oxidation)

Properties	Test Method ASTM (Other)	Parameters	Limits									
Physical:												
ISO-viscosity grade	D 2422		15	22	32	45	68	100	150			
Viscosity	D 445	kinematic viscosity at 40°C, cSt	13.5-16.5	19.8-24.2	28.8-35.2	41.4-50.6	61.2-74.8	90.0-110	135-165			
Viscosity, $\leq$ 750 cP	D 2983 ^A	temperature, °C, max	-23	-15	-8	-2	4	10	16			
Viscosity index	D 2270	min	90	90	90	90	90	90	90			
Specific gravity	D 1298 ^B		report	report	report	report	report	report	report			
Appearance	visual, at 20°C		clear and bright	clear and bright	clear and bright	clear and bright	clear and bright	clear and bright	clear and bright			
Flash point	D 92	temperature, °C, min	145	165	175	185	195	205	215			
Pour point	D 97	temperature, °C, max	-24	-21	-18	-15	-12	-12	-12			
Chemical:												
Acid Number	D 974/D 664	mg KOH/g	report	report	report	report	report	report	report			
Performance:												
Rust prevention	D 665A ^C	visual evaluation pass or fail	pass	pass	pass	pass	pass	pass	pass			
	D 665B ^C		pass	pass	pass	pass	pass	pass	pass			
Corrosion	D 130	copper corrosion, 3 h at 100°C, visual, max	2	2	2	2	2	2	2			
Water separation	D 1401	time (mins) to 3 mL emulsion at 54°C, max 30	30	30	30	30	30	-	-			
Elastomer compatibility	D 471	time (mins) to 3 mL emulsion at 82°C, max -100± °C/288, ± 2 h SRE-NBR 1	-	-	-	-	-	60	60			
		Elastomer (DIN 53 538, Part 1 or AAMA 524 Part 1)										
		relative volume change, % ^D	report	0 to 15	0 to 12	0 to 12	0 to 10	0 to 10	0 to 10			
		change in Shore A hardness, rating ^D	report	0 to -8	0 to -7	0 to -7	0 to -6	0 to -6	0 to -6			
Foam	D 892	Sequence I, tendency/stability, mL, max	150/0	150/0	150/0	150/0	150/0	150/0	150/0			
		Sequence II, tendency/stability, mL, max	75/0	75/0	75/0	75/0	75/0	75/0	75/0			
		Sequence III, tendency/stability, mL, max	150/0	150/0	150/0	150/0	150/0	150/0	150/0			
Air release	D 3427	time, (mins. at 50°C, max)	5	5	5	10	10	-	-			
		time, (mins. at 75°C, max)	-	-	-	-	-	report	report			
Oxidation stability	D 943	time for acid number of 2 mg KOH/g, h, min	1000	1000	1000	1000	1000	1000	1000			
Sludge tendency	D 4310	total insoluble sludge, mg, max	200	200	200	200	200	200	200			
		copper in oil/water/sludge, mg	report	report	report	report	report	report	report			
Thermal stability	D 2070	copper appearance, visual max	report	report	report	report	report	report	report			
		steel appearance, visual max	report	report	report	report	report	report	report			
		sludge, mg/100 mL, max	report	report	report	report	report	report	report			

^APrecision of the test method for hydraulic fuels at low temperatures is being improved by Subcommittee D02.07.OC, but the test method is applicable.^BTest Method D 4052 can also be used.^CTest Method D 665 — soak time is 24 h.^DThese numbers are provisional; ASTM is trying to establish a technical consensus for possible revision.