Designation: D6158 – 10

StandardSpecification for Mineral Hydraulic Oils[1]

This standard is issued under the fixed designation D6158; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

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

1.5.1 *Exception*—In X1.3.9 on Wear Protection, the values of pump pressure are in MPa, and the psi follows in brackets as a reference point immediately recognized by a large part of the industry.

1.6 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:*[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)

D471 Test Method for Rubber Property—Effect of Liquids

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

D1298 Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method

D1401 Test Method for Water Separability of Petroleum Oils and Synthetic Fluids

D2070 Test Method for Thermal Stability of Hydraulic Oils

D2270 Practice for Calculating Viscosity Index from Kinematic Viscosity at 40 and 100°C

D2422 Classification of Industrial Fluid Lubricants by Viscosity System

D2619 Test Method for Hydrolytic Stability of Hydraulic Fluids (Beverage Bottle Method)

D2983 Test Method for Low-Temperature Viscosity of Lubricants Measured by Brookfield Viscometer

D3427 Test Method for Air Release Properties of Petroleum Oils

D4052 Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter

[1] This specification is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.N0.10 on Specifications.

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[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.

D4310 Test Method for Determination of Sludging and Corrosion Tendencies of Inhibited Mineral Oils
D6080 Practice for Defining the Viscosity Characteristics of Hydraulic Fluids
D7043 Test Method for Indicating Wear Characteristics of Non-Petroleum and Petroleum Hydraulic Fluids in a Constant Volume Vane Pump

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 D2422.

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 D2422.

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 D2422.

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 D2422.

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

TABLE 1 Requirements for Type HH Mineral Oil Hydraulic Fluids

Properties	Test Method ASTM (Other)	Parameters	Limits							
Physical										
ISO viscosity grade	D2422		10	15	22	32	46	68	100	150
Viscosity	D445	kinematic viscosity at 40°C, mm^2/s	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	D2983[A]	temperature, °/C	report	report	report	report	report	report	report	report
Viscosity index	D2270		report	report	report	report	report	report	report	report
Specific gravity	D1298[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	D92	temperature, °C, min	125	145	165	175	185	195	205	215
Pour point	D97	temperature, °C, max	-15	-12	-9	-6	-6	-6	-6	-6
Chemical										
Acid number	D974/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	D471	100 ± 1°C/288 ± 2h ± 2h SRE-NBR 1 Elastomer (DIN53 538, Part 1 or AMA 524, Part 1)	report	report	report	report	report	report	report	report
		relative volume change, % C	report	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 C	report	report	0 to –8	0 to –7	0 to –7	0 to –6	0 to –6	0 to –6

[A] Precision of the test method for hydraulic oils at low temperatures is being improved by Subcommittee D02.07.C0, but the test method is applicable.
[B] Test Method D4052 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	D2422		10	15	22	32	45	68	100	150
Viscosity	D445	kinematic viscosity at 40°C, mm²/s	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	D2983[A]	temperature, °C, max	-33	-23	-15	-8	-2	4	10	16
Viscosity index	D2270	min	90	90	90	90	90	90	90	90
Specific gravity	D1298[B]		report	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	clear and bright
Flash point	D92	temperature, °C, min	125	145	165	175	185	195	205	215
Pour point	D97	temperature, °C, max	-33	-24	-21	-18	-15	-12	-12	-12
Chemical:										
Acid Number	D974/D 664	mg KOHg	report	report	report	report	report	report	report	report
Performance:										
Rust prevention	D665A[C]	visual evaluation pass or fail	pass	pass	pass	pass	pass	pass	pass	pass
	D665B[C]		pass	pass	pass	pass	pass	pass	pass	pass
Corrosion	D130	copper corrosion, 3 h at 100°C, visual, max	2	2	2	2	2	2	2	2
Water separation	D1401	time (mins) to 3 mL emulsion at 54°C, max	30	30	30	30	30	30	...	...
		time (mins) to 3 mL emulsion at 82°C, max	...	...	...	...	...	...	60	60
Elastomer compatibility	D471	100 ± °C/288, ± 2 h SRE-NBR 1 Elastomer (DIN 53 538, Part 1 or AAMA 524 Part 1)								
		relative volume change, %[D]	report	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	report	0 to -8	0 to -7	0 to -7	0 to -6	0 to -6	0 to -6
Foam	D892	Sequence I, tendency/stability, mL, max	150/0	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	75/0
		Sequence III, tendency/stability, mL, max	150/0	150/0	150/0	150/0	150/0	150/0	150/0	150/0
Air release	D3427	time, (mins. at 50°C, max)	5	5	5	5	10	10	...	...
		time, (mins. at 75°C, max)	...	...	...	...	...	...	report	report
Oxidation stability	D943	time for acid number of 2 mg KOH/g, h, min	1000	1000	1000	1000	1000	1000	1000	1000
Sludge tendency	D4310	total insoluble sludge, mg, max	200	200	200	200	200	200	200	200
		copper in oil/water/sludge, mg	report	report	report	report	report	report	report	report
Thermal stability	D2070	copper appearance, visual max	report	report	report	5	5	5	report	report
		steel appearance, visual max	report	report	report	1	1	1	report	report
		sludge, mg/100 mL, max	report	report	report	25	25	25	report	report

[A] Precision of the test method for hydraulic fuels at low temperatures is being improved by Subcommittee D02.07.C0, but the test method is applicable.
[B] Test Method D4052 can also be used.
[C] Test Method D665 — soak time is 24 h.
[D] These numbers are provisional; ASTM is trying to establish a technical consensus for possible revision.