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Designation: <del>D6158 - 14</del><u>D6158 - 16</u>

# Standard Specification for Mineral Hydraulic Oils<sup>1</sup>

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 ( $\varepsilon$ ) indicates an editorial change since the last revision or reapproval.

#### 1. Scope\*

1.1 This specification covers mineral oils and synthetic oils of the types API groups I, II, III, and IV used in hydraulic systems, where the performance requirements demand fluids with one of the following characteristics:

1.1.1 A refined base oil or synthetic base stock (Class HH),

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

1.1.3 A refined mineral base oil or synthetic base stock with rust and oxidation inhibitors plus anti-wear characteristics (Class HM),

1.1.4 A refined mineral base oil <u>or synthetic base stock</u> with rust and oxidation <del>inhibitors plus antiwear characteristics (Class HM),</del> inhibitors, anti-wear characteristics, and increased viscosity index higher than 140 (Class HV),

1.1.5 A refined mineral base oil or synthetic base stock with rust and oxidation inhibitors plus anti-wear characteristics meeting a higher performance level than an HM fluid to address higher demanding hydraulic systems (Class HMHP), and

<u>1.1.6 A refined mineral base oil with rust or synthetic base stock and oxidation inhibitors, anti-wear characteristics, and increased viscosity index higher than 140 meeting a higher performance level than an HV fluid to address higher demanding hydraulic systems (Class HVHP).</u>

1.2 This specification defines the requirements of mineral oil-based or synthetic-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. 44472-8444-241401406380/astm-d6158-16

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:<sup>2</sup>

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

<sup>&</sup>lt;sup>1</sup> 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.N0.10D02.N0 on SpecificationsHydraulic Fluids.

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<sup>&</sup>lt;sup>2</sup> 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.

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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, 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 Hydrocarbon Based Oils

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

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)

D5950 Test Method for Pour Point of Petroleum Products (Automatic Tilt Method)

D6080 Practice for Defining the Viscosity Characteristics of Hydraulic Fluids

D6973 Test Method for Indicating Wear Characteristics of Petroleum Hydraulic Fluids in a High Pressure Constant Volume Vane Pump

D7043 Test Method for Indicating Wear Characteristics of Non-Petroleum and Petroleum Hydraulic Fluids in a Constant Volume Vane Pump

D7752 Practice for Evaluating Compatibility of Mixtures of Hydraulic Fluids

2.2 Other Standards:

ISO 13357-1 Petroleum Products—Determination of the Filterability of Lubricating Oils—Part 1: Procedure for Oils in the Presence of Water<sup>3</sup>

ISO 13357-2 Petroleum Products—Determination of the Filterability of Lubricating oils—Part 2: Procedure for Dry Oils<sup>3</sup> DIN 51350-6 Testing of Shear Stability of Lubricating Oils Containing Polymers<sup>4</sup>

CEC L-45-A-99 Viscosity Shear Stability of Transmission Lubricants (KRL Taper Roller Bearing Rig)<sup>5</sup>

#### 3. Classification

3.1 *Type HH Hydraulic Oils*—Non-inhibited refined mineral oils <u>or synthetic base stock</u> 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 <u>or synthetic base stock</u> 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 <u>metal to metal metal-to-metal</u> 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 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.

<u>3.5 Type HMHP Hydraulic Oils</u>—Oils of HM meeting a higher performance level to meet the changing needs of hydraulic systems, especially for those working at high pressures and temperatures intended to work at maximum pump capacity for long periods of time.

<u>3.6 *Type HVHP Hydraulic Oils*</u>—Oils of HMHP type with improved viscosity/temperature properties, for more demanding 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.

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

<sup>&</sup>lt;sup>4</sup> Available from Deutsches Institut für Normung e.V.(DIN), Am DIN-Platz, Burggrafenstrasse 6, 10787 Berlin, Germany, http://www.din.de.

<sup>&</sup>lt;sup>5</sup> Available from Coordinating European Council (CEC), Services provided by Kellen Europe, Avenue Jules Bordet 142 - 1140, Brussels, Belgium, http://www.cectests.org.

Droportion	Test Method	Devemetere					imite			
Properties	ASTM (Other)	Parameters				L	limits			
Physical Dhysical										
ISO viscosity grade	D2422		<del>10</del>	15	22	32	46	68	100	150
ISO-viscosity grade	D2422		10	15	22	32	46	68	100	150
Viscosity	D445	kinematic viscosity at	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
<del>Viscosity, ≤ 750 cP</del>	<del>D2983</del>	temperature, °C	report	report	report	report	report	report	report	report
Viscosity, ≤750 mPa⋅s	D2983	temperature, °C	report	report	report	report	report	report	report	report
Viscosity index	D2270		report	report	report	report	report	report	report	report
Specific gravity	D1298 <sup>A</sup>		report	report	report	report	report	report	report	report
Appearance	Visual		clear and	clear and	clear and	clear and	clear and	clear and	clear and	clear and
			en	bright	bright	blight	bright	blight	blight	blight
Flash point	D92	temperature, °C, min	125	145	165	175	185	195	205	215
Pour point	D97 <sup>B</sup>	temperature, °C, max	-15	-12	-9 - 1	-6	-6	-6	-6	-6
<b>Chemical</b>										
Chemical:										
Acid number	<del>D974/D 664</del>	<del>mg KOH/g, max</del>	<del>0.05</del>	0.05	0.05	0.05	<del>0.05</del>	<del>0.05</del>	<del>0.05</del>	<del>0.05</del>
Acid number	D974/D664	KOH, mg/g, max	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Performance										
Performance:										
Elastomer compatibility	<del>D471</del>	$\frac{100 \text{ °C} \pm 1 \text{ °C}}{288 \text{ h} \pm 2 \text{ h}}$	report	report	report	report	report	report	report	report
		(DIN52 528 Part 1 or								
Elastomer compatibility	D471	$100 \ ^{\circ}\text{C} + 1 \ ^{\circ}\text{C} / 288 \ \text{h} + 2 \ \text{h}$								
Elastomor compatibility	<u></u>	NBR-1 Elastomer								
		AMA 524, Part 1)								
		relative volume change,	report	report	<del>0 to 15</del>	<del>0 to 12</del>	<del>0 to 12</del>	<del>0 to 10</del>	<del>0 to 10</del>	<del>0 to 10</del>
		<del>percent C</del>								
		relative volume change,	report	report	<u>0 to 15</u>	0 to 12	0 to 12	<u>0 to 10</u>	<u>0 to 10</u>	<u>0 to 10</u>
		percent	rapart	roport	0 to 9	0 to 7	0 to 7	0 to 6	0 to 6	0 to 6
		hardness-	терон	Tepon	010-0	<del>0 10 -7</del>	010-7	010-0	010-0	010-0
		rating C								
		change in Shore A	report	report	0 to –8	0 to -7	0 to -7	0 to –6	0 to –6	0 to –6
		hardness,								
		rating								

TABLE 1 Requirements for Type HH Mineral Oil or Synthetic Base Stock Hydraulic Fluids

<sup>A</sup> Test Method D4052 can also be used.

<sup>B</sup> Test Method D5950 can also be used.

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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.

4.5 *Type HMHP*—The requirements for this type of oil are presented in Table 5 and include Viscosity Grades ISO VG from 22 to 150 in accordance with Classification D2422.

<u>4.6 *Type HVHP*</u>—The requirements for this type of oil are presented in Table 6 and include Viscosity Grades ISO VG from 22 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 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 of material, volume content, and any other information required by state or federal law.

#### 7. Keywords

7.1 antiwear protection; guideline; hydraulic oils; mineral oils; rust and oxidation protection; synthetic base stocks; viscosity index

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Conversion   Properiate Sector   Links   Links     Properiate Sector   Example Sector   Exam		TABLE 2 R	equirements for Type HL Min	neral Oil <u>or</u>	Synthetic Ba	ise Stock Hy	draulic Fluid	ls (Rust and C	xidation)		
Properties   AS M (UR0e)   Parameters   Links     HSO-consisty prive   D2429   Homeselve According to the parameters   10   15   22   24   66   66   100   100     Viscopity prive   D2429   Homeselve According to the parameters   10   15   22   24   44   60   66   100   100     Viscopity prive   D2429   Homeselve According to the parameters   10   15   10   <	colwidth= 0.02in /COLSPEC										
Physical isourcessing parts isourcessing parts isourcessisourcessisourcesparts isourcessing parts isourcessing parts isourc	Properties	ASTM (Other)	Parameters					Limits			
Ide-originate bioconstry made bioconstry made bioconstr	Physical:										
Boldstand   Defendence   Defenden	-ISO-viscosity grade	<del>D2422</del>		<del>10</del>	<del>15</del>	22	<del>32</del>	<del>45</del>	<del>68</del>	<del>100</del>	<del>150</del>
Viscosity   Di45   Internate viscosity at 0°C, 0 0-110   135-165   135-242   25-35.2   41.4-60.6   61.2-7.40   00-110   135-165     Viscosity (r250 mPas)   D2595   Image: C_max   -33   -23   -15   -8   -2   4   10   16     Viscosity (r250 mPas)   D2595   Image: C_max   -33   -23   -15   -8   -2   4   10   16     Viscosity (r250 mPas)   D259   Image: C_max   -33   -23   -15   -8   -2   4   10   16     Viscosity (r260 mproting r0, max   -33   -24   -21   -15   -15   -12	ISO-viscosity grade	D2422		<u>10</u>	<u>15</u>	22	<u>32</u>	<u>46</u>	<u>68</u>	<u>100</u>	<u>150</u>
Amenaber Vacable Vacable (rescale, r-260 drag Vacable (rescale, r-260 drag (rescale, r-260 drag (resc	Viscosity	D445	kinematic viscosity at 40 °C, mm <sup>2</sup> /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
Maccanity reform Pres   D2983   Immer report and power and powe	<del>Viscosity, ≤ 750 cP</del>	<del>D2983</del>	temperature, °C, max	<del>-33</del>	<del>-23</del>	<del>-15</del>	<del>8</del>	<del>_2</del>	4	<del>10</del>	<del>16</del>
Microaction index Specific gravity   D2270 (main profile specific gravity)   min   90 (main profile specific gravity)   90 (main profile specif	Viscosity, ≤750 mPa⋅s	D2983	temperature, °C, max	-33	-23	-15	<u>-8</u>	-2	4	<u>10</u>	<u>16</u>
Special gravity protect   D1288 <sup>4</sup> (all or C) bright   Teport (all or C) bright   report (bar and bright   report (bar and bright <threport (bar and bright   report (bar and b</threport 	Viscosity index	D2270	min	90	90	90	90	90	90	90	90
Appearancevisualvisualclear and bightclear and brightclear and <bright< th="">clear and<bright< th="">clear and<bright< th="">clear and<bright< th="">PerformPerformPerformPerformPerform<td>Specific gravity</td><td>D1298<sup>A</sup></td><td></td><td>report</td><td>report</td><td>report</td><td>report</td><td>report</td><td>report</td><td>report</td><td>report</td></bright<></bright<></bright<></bright<>	Specific gravity	D1298 <sup>A</sup>		report	report	report	report	report	report	report	report
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Appearance	visual,		clear and	clear and	clear and	clear and	clear and	clear and	clear and	clear and
Plane point   DB2 Pour point   temperature, "C, min   125   145   165   175   185   195   205   215     Pour point   D079 <sup>2</sup> temperature, "C, min   125   145   165   175   185   195   205   215     Chemical: (ad lumber   D074/D 64/ (ad lumber)   member/ (sport   report   repor		at 20 °C		bright	bright	bright	bright	bright	bright	bright	bright
Pour point   Def <sup>n</sup> temperature, °C, max  33  24  21   -18   -15   -12   <	Flash point	D92	temperature, °C, min	125	145	165	175	185	195	205	215
Performance:Performance:reportr	Pour point	D97 <sup>B</sup>	temperature, °C, max	-33	-24	-21	-18	-15	-12	-12	-12
Add Number Acid NumberD974.0684 Controlmg/CMpg reportreport re	Chemical:										
Acid NumberD974/D664KOH, mg'nreport </td <td>Acid Number</td> <td>D974/D 664</td> <td><del>mg KOHg</del></td> <td>report</td> <td>report</td> <td>report</td> <td>report</td> <td>report</td> <td>report</td> <td>report</td> <td>report</td>	Acid Number	D974/D 664	<del>mg KOHg</del>	report	report	report	report	report	report	report	report
Performance: Performa: Performance: Pe	Acid Number	D974/D664	KOH, mg/g	report	report	report	report	report	report	report	report
Hut prevention Lut prevention Pass Pa	Performance:										
Bust prevention   Desch Desc	-Rust prevention	D665A <sup>B</sup>	visual evaluation pass or fail	pass	pass	pass	pass	pass	pass	pass	pass
Image: CorrestorDescriptionpress	Rust prevention	D665A <sup>C</sup>	visual evaluation pass or fail	pass	pass	pass	n pass	pass	pass	pass	pass
CorrosionDess D130pass copper corosion, 3 ha 1100°C, 2''''''''''''''''''''''''''''''''''''		D665B <sup>B</sup>		pass	pass	pass	pass	pass	pass	pass	pass
Corrosion   D130   copper corrosion 3 h at 100 °C, 2 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 -		D665B <sup>C</sup>	visual evaluation pass or fail	pass	pass	pass	pass	pass	pass	pass	pass
Water separation   D1401   image interaction is 0.3 minimized in the control interaction is 0.3 minimized in the control interaction is 0.3 minimized in the control interaction is 0.3 minimized interaction is 0.3 minininteractinteraction is 0.3 minimized interactinteraction is 0.3	Corrosion	D130	copper corrosion. 3 h at 100 °C.	2	2	2	2	2	2	2	2
Water separation   D1401   time (mins) to 3 mL emulsion at 30   30   30   30   30   30   30   30   30       Elastomer compatibility   D471   400-C ± 1-C/288 h ± 2 h 54F-NDF + Elastomer (mins) to 3 mL emulsion at   AST MI DELSE IF      60   60     Elastomer compatibility   D471   400-C ± 1-C/288 h ± 2 h 54F-NDF + Elastomer (NH 53 58, Part + 1 or AAMA reds. ich a reation statistic 4-C77. 564-Part +) retative volume change, percent report   AST MI DELSE IF  <			visual. max								
-Elastomer compatibility 947, max 60 60   -Elastomer compatibility 9471 400°C + 1°C / 288 h ± 2 h MBR - HSR - F Lastomer - - 60 60   Elastomer compatibility 9471 100°C + 1°C / 288 h ± 2 h MBR - I Elastomer - - Secure compatibility 0 to 10 0 to 12 0 to 10 0 to 10 0 to 10 0 to -6 0 to -7	Water separation	D1401	time (mins) to 3 mL emulsion at	30	30	30	30	30	30		
Eastomer compatibility   D471   B2°C, max        60   60     Elastomer compatibility   D471   100°C±1*67/288 h ± 2 h S47-RMR + Elastomer   ASTM D6158-16 <t< td=""><td></td><td></td><td>54 °C, max</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>			54 °C, max								
-Elastomer compatibilityP471Image: C-r-G-r288 h + 2 h SPE + 12 h SPE + NBR + Elastomer SPE + NBR + Elastomer (DV C + 1 °C/288 h + 2 h SPE + NBR + Elastomer (DV C + 1 °C/288 h + 2			time (mins) to 3 mL emulsion at 82 °C, max	cum	entr	Fevi	ew 🛛			60	60
Elastomer compatibility D471 NBR-1 Elastomer 100 °C ± 1 °C/288 h ± 2 h NBR-1 Elastomer (PIN 50 530; Part 1 or AAMA ands ticch arc analogistandards/sist/4e77; 524 Part 1) relative volume change, percent change in Shore A hardness, report report d-2a report 1003 % to 15m - d' 0 to 12 0 to -7 0 to 12 0 to -2 0 to 10 0 to -6 0 to 10 0 to -6 0 to 10 0 to -6   Foam D892 Sequence I, tendency/stability, m, max 150/0 <td< td=""><td>-Elastomer compatibility</td><td><del>D471</del></td><td><del>100 °C ± 1 °C/288 h ± 2 h</del></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>	-Elastomer compatibility	<del>D471</del>	<del>100 °C ± 1 °C/288 h ± 2 h</del>								
Elastomer compatibility   D471   100 °C + 1 °C / 288 h ± 2 h NBR+ 1 Elastomer (DN 50 536; Part 1 or AAMA and s. itch an catalog (standards/sist/4E77; 524 Part 1); 524 Part 1); 525 Part 1 50/0   0 to 12 0 to -8   0 to 12 0 to -8   0 to 10 0 to -6   0 to 10 0 to 10 0 to -6     Foam   D892   Sequence 1, tendency/stability, 150/0   150/0			SRE-NBR 1 Elastomer								
NBR-1 Elastomer (DIN 53-538, Part 1 or AAMA) set 4 Part 1) relative volume change, percent reportreportcatalog/standards/sist/4c77: report0 to 120 to 100 to 100 to 100 to 10FoamD892Sequence I, tendency/stability, mi, max Sequence II, tendency/stability, m, max150/0<	Elastomer compatibility	D471	100 °C ± 1 °C/288 h ± 2 h								
FoamD892Sequence I, tendency/stability, nm, max150/0150/0150/0150/0150/00 to 12 0 to -70 to 10 0 to -60 to 10 0 to -60 to 10 0 to -6FoamD892Sequence I, tendency/stability, nm, max150/0150			NBR-1 Elastomer								
FoamD892 $\frac{524 - part - 1}{report}$ reportreport $report$ report $report$ report $report$ $0$ to $-3$ $0$ to $12$ $0$ to $-7$ $0$ to $12$ $0$ to $-7$ $0$ to $16$ $0$ to $-6$ $0$ to $-6$ $0$ to $-6$ FoamD892B892Sequence 1, tendency/stability, mL, max Sequence 1, tendency/stability, mL, max $150/0$ <			(DIN 53 538, Part 1 or AAMA								
Foam   D892   Sequence I, tendency/stability, mL, max   150/0			524 Part 1)								
FoamD892change in Shore A hardness, rating rating Sequence I, tendency/stability, mL, max Sequence II, tendency/stability, mL, max mL, max mL, max150/0150/			relative volume change, percent	report d-28	report 0063	0 to 15	0 to 12	0 to 12	0 to 10	0 to 10	0 to 10
FoamD892rating Sequence I, tendency/stability, mL, max Sequence II, tendency/stability, mL, max mL, max Sequence II, tendency/stability, mL, max Sequence II, tendency/stability, mL, max mL, m			change in Shore A hardness,	report	report	0 to –8	0 to -7	0 to -7	0 to6	0 to –6	0 to –6
Foam   D892   Sequence I, tendency/stability, nax sequence II, tendency/stability, nax sequence II, tendency/stability, nax   150/0			rating								
mL, max Sequence II, tendency/stability, mL, max Sequence III, tendency/stability, mL, max75/0	Foam	D892	Sequence I, tendency/stability,	150/0	150/0	150/0	150/0	150/0	150/0	150/0	150/0
Sequence II, tendency/stability, mL, max $75/0$			mL, max								
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			Sequence II, tendency/stability,	75/0	75/0	75/0	75/0	75/0	75/0	75/0	75/0
Sequence III, tendency/stability, nax150/0 <td></td> <td></td> <td>mL, max</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>			mL, max								
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			Sequence III, tendency/stability,	150/0	150/0	150/0	150/0	150/0	150/0	150/0	150/0
$ \frac{\text{Air release}}{\text{Air release}} = \frac{\text{D3427}}{\text{D3427}} + \frac{\text{time, (mins. at 50 °C, max)}}{\text{time, mins. at 50 °C, max}} = \frac{5}{5} + \frac{5}{5} + \frac{5}{5} + \frac{10}{10} + 1$			mL, max								
Air releaseD3427time, mins. at 50 °C, max555551010Oxidation stabilityD943ime, for acid number of 2 mg KOH/g, h, mini000 </td <td>Air release</td> <td><del>D3427</del></td> <td>time, (mins. at 50 °C, max)</td> <td>5</td> <td>5</td> <td>5</td> <td>5</td> <td><del>10</del></td> <td><del>10</del></td> <td><del></del></td> <td><del></del></td>	Air release	<del>D3427</del>	time, (mins. at 50 °C, max)	5	5	5	5	<del>10</del>	<del>10</del>	<del></del>	<del></del>
$\frac{1}{1000} + \frac{1}{1000} + 1$	Air release	D3427	time, mins. at 50 °C, max	5	5	5	5	10	10		
Oxidation stabilityD943time, mins. at 75 °C time for acid number of 2 mg KOH/g, h, min 1000 <t< td=""><td></td><td></td><td>time, (mins. at 75 °C, max)</td><td>- </td><td></td><td>- </td><td></td><td></td><td></td><td></td><td></td></t<>			time, (mins. at 75 °C, max)	- 		- 					
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Oxidation stabilityD943time for KOH acid number of 2 mg/kg, h, min1000	Oxidation stability	<del>D943</del>	time for acid number of	<del>1000</del>	1000	1000	<del>1000</del>	1000	1000	1000	1000
Oxidation stabilityD943time for KOH acid number of 2 mg/kg, h, min1000	,		<del>2 mg KOH/g, h, min</del>								
2 mg/kg, h, min 2 mg/kg, h, min 2 mg/kg, h, min 1 mm 1 mm 1 mm 1 mm 1 mm   Sludge tendency D4310 total insoluble sludge, mg, max 200	Oxidation stability	D943	time for KOH acid number of	1000	1000	1000	1000	1000	1000	1000	1000
Sludge tendency D4310 total insoluble sludge, mg, max 200 <			2 mg/kg, h, min							<u> </u>	
copper in oil/water/sludge, mg report	Sludge tendency	D4310	total insoluble sludge, ma. max	200	200	200	200	200	200	200	200
Thermal stability D2070 copper appearance, visual max report report report 5 5 5 report report steel appearance, visual max report report report 2 2 2 report report report steel appearance, visual max report report report 2 2 2 report report report report report report 2 2 2 report re	<b>.</b> .,		copper in oil/water/sludge. mg	report	report	report	report	report	report	report	report
steel appearance, visual max report report report 2 2 2 report report	Thermal stability	D2070	copper appearance, visual max	report	report	report	5	5	5	report	report
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