SAE International™

INDUSTRIAL LUBRICANTS STANDARD

SAE MS1003-2

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Lubricants, Industrial Oils, and Related Products Type D
Compressor Oils – Specification - Addendum

Foreword

The Society of Automotive Engineers (SAE) Industrial Lubricants Committee has developed a number of industrial, non-production lubricant performance specifications.

The purpose of these voluntary SAE specifications is to:

a. Define minimum performance requirements for industrial lubricants.
b. Provide lubricant suppliers with performance targets for a minimum number of key industrial lubricants.
c. Improve the availability of these lubricants to member companies.
d. Provide a plant oriented, user friendly, classification system using common test standards and properties.

ISO Standard 6743 - Lubricants, industrial oils and related products (class L) - Classification is the foundation for these documents.

a. Performance characteristics and test procedures are specified.
b. For information, equivalent ISO, DIN, CEN, BSI, ASTM, AFNOR, CETOP, and IP test methods are referenced.[1]

Industrial lubricant classifications targeted:

a. Lubricants, Industrial Oils and Related Products - Classification (SAE MS1000)
b. Hydraulic fluids (SAE MS1004)
c. Fire resistant hydraulic fluids (SAE MS1005)
d. Lubricating oils (various applications, SAE MS 1001, 1002, 1003, 1006, 1007, 1009, 1010)

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[1] International Standards Organization (ISO)
Deutsches Institut fur Normung e. V. (DIN)
European Committee for Standardization (CEN)
American Society for Testing and Materials (ASTM)
Association of Francaise de Normalisation (AFNOR)
The Institute of Petroleum (IP) NOTE: Now combined with BSI
British Standards Institution (BSI), BS 2000: XXX where XXX is the corresponding IP number
European Committee on Hydraulic Oil and Pneumatics (CETOP)

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

e. Lubricating greases (SAE MS1011)
f. Metal Removal Fluids (SAE MS1008)

See SAE MS1000 - Index of lubricants and symbols.

NOTE—Environmental, Technical Reports, and/or health and safety regulations may present additional specifications to the supplier.

1. Scope

See Table 1.

TABLE 1—SCOPE AND FIELD OF APPLICATIONS

Code Letter	General Application	Particular Application	More specific application	Product type	Symbol	Typical application	Remarks
D	Air compressors	Positive displacement air compressors with oil lubricated compression chambers	Reciprocating crosshead and trunk pistons or Rotary drip feed (vane)		DPA poly-alpha olefin (PAO) - based DEA ester-based DPB PAO-based DEB ester-based	Light duty Medium duty	See Table 2.
					DPC, DEC	Heavy duty	
			Rotary oil-flooded (vane and screw compressors)		DPG, DEG DPH, DEH	Light duty Medium duty	See Table 3.
					DPJ, DEJ	Heavy duty	
		Positive displacement air compressors with oil-free compression chambers	Liquid ring compressors and water-flooded vane and screw compressors Reciprocating oil-free compressors Rotary oil-free compressors		------	------	Lubricants suitable for gears, bearings, and transmissions

		Dynamic compressors	Radial and axial turbocompressors		------	------	Lubricants suitable for bearings, and gears

1.1 Introduction concerning duties of compressors

The following guidelines are given to help interested parties in differentiating between

-light duty

-medium duty

-heavy duty

(see also ISO 5388)

1.2 Reciprocating oil-lubricated and rotary drip-feed air compressors

Whether the duty of reciprocating and rotary drip feed compressors is to be classified as light, medium, or heavy depends on many parameters, for example

a) the compressor design, i.e., type of cooling, number of stages, valve velocities, oil retention time, etc. ;
b) ambient conditions, i.e., intake “air” temperature, coolant temperature, presence of catalytic dust or gases, etc. ;
c) operating conditions, i.e., continuous or intermittent service, layout of the pressure system, maintenance, oil change intervals, etc.

The ultimate criterion is satisfactory, reliable air compressor operation with the prevention of excessive oil retention or the formation of coke deposits in the hot discharge air system.

1.3 Rotary oil-flooded air compressors

Whether the duty of rotary oil-flooded air compressors is to be classified as light, medium, or heavy depends on many parameters, for example

a) the compressor design, i.e., air discharge pressure and pressure ratio, number of stages, oil recirculation rate, oil separating system, etc. ;
b) ambient conditions, i.e., intake air temperature and humidity, presence of contaminants (dust or gases), etc. ;
c) operating conditions, i.e., continuous or intermittent service, maintenance, oil change intervals, discharge temperature, etc.

NOTE—Conditions such as air humidity or low circulating air volume may recommend an oil for heavier duty.

TABLE 2—RECIPROCATING OIL-LUBRICATED AIR COMPRESSORS

Duty	Symbol	Operating conditions	
Light	DPA PAO-based[1] DEA ester based	Intermittent operation	Sufficient time to allow cooling between periods of operation - compressor stop and start - variable discharge capacity
		Continuous operation	a) discharge pressure < 1000 kPa (10 bar) discharge temperature < 160°C stage pressure ratio < 3: 1 or b) discharge pressure > 1000 kPa (10 bar) discharge temperature < 140°C stage pressure ratio < 3: 1
Medium	DPB, DEB	Intermittent operation	Sufficient time to allow cooling between periods of operation
		Continuous operation	a) discharge pressure < 1000 kPa (10 bar) discharge temperature > 160°C or b) discharge pressure > 1000 kPa (10 bar) discharge temperature > 140°C but < 160°C or c) stage pressure ratio > 3: 1
Heavy	DPC, DEC	Intermittent or continuous operation	As for "medium" when conditions a), b), or c) above are fulfilled and where severe coke formation in a discharge might be anticipated as a result of previous experience with a medium duty oil.

1 The composiition of DP_ oils would typiclaly be expected to be polyalpha olefin based. Other oils, such as very high viscosity index mineral oils and other synthetic hydrocarbons, would be acceptable provided they meet all specification requirements.

TABLE 3—ROTARY OIL-FLOODED AIR COMPRESSORS

Duty	Symbol	Operating conditions
Light	DPG, DEG	Air and air/oil discharge temperature < 90°C Discharge pressure < 800 kPa (< 8 bar)
Medium	DPH, DEH	Air and air/oil discharge temperature < 100°C Discharge pressure 800 to 1500 kPa (8 to 15 bar) Or Air and air/oil discharge temperature between 100 and 110 °C Discharge pressure < 800 kPa (< 8 bar)
Heavy	DPJ, DEJ	Air and air/oil discharge temperature > 110°C Discharge pressure < 800 kPa (< 8 bar) Or Air and air/oil discharge temperature > 110°C Discharge pressure 800 to 1500 kPa (8 to 15 bar) Or Discharge pressure > 1500 kPa (> 15 bar)

1.4 Concept

The lubricants defined by this specification are high quality oils formulated with additives to provide good oxidation resistance, corrosion protection, demulsibility, and foam stability. This specification addresses ester and PAO-type fluids.

2. References

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

2.1.1 PUBLICATIONS

Referenced AFNOR, ASTM, BS, CEN, DIN, IP and ISO Standard hardcopies are available from the ILI Website (http://www.ili-info.com) or by contacting ILI at

Europe
ILI, Index House, Ascot, Berkshire, SL5 7EU, UK
Tel: +44 (0)1344 636400 Fax: +44 (0)1344 291194
Email: databases@ili.co.uk

USA
ILI, 610 Winters Avenue, Paramus, NJ 07652, USA
Tel: 201-986-1131 Fax: 201-986-7886
Email: sales@ili-info.com

2.1.2 SAE PUBLICATIONS

Available from SAE 400 Commonwealth Drive, Warrendale, PA 15096-0001

SAE MS 1000—Lubricants, Industrial Oils and Related Products – Classification
SAE MS 1001—Lubricants, Industrial Oils and Related Products Type A (General Purpose and Total Loss Systems) - Specification
SAE MS 1002—Lubricants, Industrial Oils and Related Products Type C (Gears)—Specification
SAE MS 1003—Lubricants, Industrial Oils and Related Products Type D (Compressor Oils)—Specification
SAE MS 1004—Lubricants, Industrial Oils and Related Products Type H (Hydraulic Fluids)—Specification
SAE MS 1005—Lubricants, Industrial Oils and Related Products Type HF (Fire-Resistant Hydraulic Fluids)—Specification
SAE MS 1006—Lubricants, Industrial Oils and Related Products Type F (Lubricant for Spindle Bearings and Associated Clutches) –Specification
SAE MS 1007—Lubricants, Industrial Oils and Related Products Type G (Slideway Lubricants) – Specification
SAE MS 1008—Lubricants, Industrial Oils and Related Products Type M (Metal Removal Fluids) – Specification
SAE MS 1009—Lubricants, Industrial Oils and Related Products Type P (Pneumatic Tool Oils) – Specification
SAE MS 1010—Lubricants, Industrial Oils and Related Products Type T (Turbine Oils) – Specification
SAE MS 1011—Lubricants, Industrial Oils and Related Products Type X (Greases) -Specification

2.1.3 ASTM PUBLICATIONS

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

ASTM D 92—Test Method for Flash and Fire Points by Cleveland Open Cup
ASTM D 95—Test Method for Water in Petroleum Products and Bituminous Materials by Distillation
ASTM D 97—Test Methods for Pour Point of Petroleum Products
ASTM D 130—Method for Detection of Copper Corrosion from Petroleum Products by Copper Strip Tarnish Test
ASTM D 189—Standard Test Method for Conradson Carbon Residue of Petroleum Products
ASTM D 445—Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
ASTM D 471—Test Method for Rubber Property - Effect of Liquids
ASTM D 664—Test Method for Neutralization Number of Petroleum Products by Potentiometric Titration
ASTM D 665A—Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water
ASTM D 892—Test Method for Foaming Characteristics of Lubricating Oils
ASTM D 943—Standard Test Method for Oxidation Characteristics of Inhibited Mineral Oils

ASTM D 974—Test Method for Acid and Base Number by Color-Indicator Titration
ASTM D 1298—Test Method for Density, Relative Density (Specific Gravity), Or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
ASTM D 1401—Test Method for Water Separability of Petroleum Oils and Synthetic Fluids
ASTM D 1744—Test Method for Determination of Water in Liquid Petroleum Products by Karl Fischer Reagent
ASTM D 2070—Standard Test Method for Thermal Stability of Hydraulic Oils
ASTM D 2140—Test Method for Carbon-Type Composition of Insulating Oils of Petroleum Origin
ASTM D 2270—Practice for Calculating Viscosity Index from Kinematic Viscosity at 40 and 100°C
ASTM D 2422—Classification of Industrial Fluid Lubricants by Viscosity System
ASTM D 2711—Standard Test Method for Demulsibility Characteristics of Lubricating Oils
ASTM D 3238—Method for Calculation of Carbon Distribution and Structural Group Analysis of Petroleum Oils by the N-D-M Method
ASTM D 4052—Test Method for Density and Relative Density of Liquids by Digital Density Meter
ASTM D 4172—Test Method for Wear Preventive Characteristics of Lubricating Fluid (Four-Ball Method)
ASTM E 659—Test Method for Autoignition Temperature of Liquid Chemicals
ASTM E 1687—Standard Test Method for Determining Carcinogenic Potential of Virgin Base Oils in Metalworking Fluids

2.1.4 BS PUBLICATIONS

Available from ILI as referenced above in 2.1.1

BS 188—Determination of the Viscosity of Liquids
BS 4056—Determination of Autoignition Temperature
BS 4231—Classification for Viscosity Grades of Industrial Liquid Lubricants
BS 4459—Petroleum Products-Calculation of Viscosity Index from Kinematic Viscosity
BS 4832—Determination of the Behavior of Rubber and Elastomers when Exposed To Liquids, Vapors and Gases ***(Superseded by ISO 6072)***

2.1.5 DIN PUBLICATIONS

Available from ILI as referenced above in 2.1.1

DIN 51 519—Lubricants; ISO Viscosity Classification for Industrial Liquid Lubricants
DIN 51 558/1—Testing of Mineral Oils; Determination of the Neutralization Number, Colour Indicator Titration
DIN 51 561—Testing of Mineral Oils, Liquid Fuels and Related Liquids; Measurement of Viscosity Using the Vogel-Ossag Viscometer; Temperature Range: Approximately 10 to 150-Deg C ***(CANCELLED)***
DIN 51 562/1—Viscometry - Determination of Kinematic Viscosity Using the Ubbelohde Viscometer - Part 1: Apparatus and Measurement Procedure
DIN 51 566—Testing of Lubricants; Determination of Foaming Characteristics ***(CANCELLED)***
DIN 51 569—Determination of Viscosity of Mineral Oils, Liquid Fuels and Related Liquids at Temperatures from -55°C To Approximately 10°C Using the Vogel-Ossag Viscometer
DIN 51 585—Testing of Lubricants; Testing of Corrosion Protection Properties of Steam Turbine Oils and Hydraulic Oils Containing Additives

DIN 51 587—Testing of Lubricants; Determination of the Ageing Behavior of Steam Turbine Oils and Hydraulic Oils Containing Additives
DIN 51 599—Testing of Lubricating Oils; Determination of Demulsification Capacity According to the Stirring Method
DIN 51 757—Testing of Mineral Oils and Related Materials; Determination of Density
DIN 51 759/1—Testing of Liquid Mineral Oil Products; Method of Test for Copper Corrosion; Copper Strip Test (SUPERSEDED BY ISO 2160)
DIN 51 794—Testing of Mineral Oil Hydrocarbons; Determination of Ignition Temperature
DIN 53 505—Testing of Rubber, Elastomers, and Plastics; Shore Hardness Testing A and D
DIN 53 521—Determination of the Behaviour of Rubber and Elastomers when Exposed to Fluids and Vapours
DIN 53 538—Standard Reference Elastomers: Acrylonitrile-Butadiene Rubber (NBR); Peroxide Cured, for Characterizing Service Fluids with Respect to Their Action on NBR

2.1.6 EPA PUBLICATIONS

Standard test methods of the U. S. Environmental Protection Agency. SW-846 Methods are available on-line (Website: http://www.epa.gov/epaoswer/hazwaste/test/8xxx.htm). Method 24 available in the Code of Federal Regulations in 40 CFR, Part 60, Appendix A)

EPA SW 846, Method 8082—Polychlorinated Biphenyls (PCB's) By Gas Chromatography
EPA SW 846, Method 8121—Chlorinated Hydrocarbons By Gas Chromatography: Capillary Column Technique
EPA SW 846, Method 8270C—Semivolatile Organic Compounds By Gas Chromatography/Mass Spectrometry

2.1.7 IP PUBLICATIONS

Available from ILI as referenced above in 2.1.1

IP 15—Petroleum Products - Determination of Pour Point
IP 19—Determination of Demulsibility Characteristics of Lubricating Oil
IP 36—Determination of Open Flash and Fire Point - Cleveland Method
IP 71 (Sect. 1)—Petroleum Products - Transparent and Opaque Liquids - Determination of Kinematic Viscosity and Calculation of Dynamic Viscosity
IP 74—Determination of Water Content of Petroleum Products - Distillation Method
IP 135—Determination of Rust-Preventing Characteristics of Steam Turbine Oil In the Presence of Water
IP 139—Petroleum Products and Lubricants - Determination of Acid or Base Number - Colour-Indicator Titration Method
IP 146—Determination of Foaming Characteristics of Lubricating Oils
IP 154—Petroleum Products - Corrosiveness to Copper - Copper Strip Test
IP 160—Determination of Density - Hydrometer Method
IP 177—Test Method for Acid Number by Potentiometric Titration
IP 226—Petroleum Products - Calculation of Viscosity Index from Kinematic Viscosity
IP 278—Determination of Seal Compatibility Index of Petroleum Oils

2.1.8 ISO PUBLICATIONS

Available from ILI as referenced above in 2.1.1

ISO 868—Plastics and Ebonite - Determination of Indentation Hardness By Means of a Durometer (Shore Hardness)
ISO 1817—Rubber Vulcanized - Determination of the Effect of Liquids
ISO 2160—Petroleum Products - Corrosiveness to Copper - Copper Strip Test
ISO 2592—Petroleum Products; Determination of Flash and Fire Points; Cleveland Open Cup Method
ISO 2909—Petroleum Products; Calculation of Viscosity Index from Kinematic Viscosity
ISO 3016—Petroleum Products; Determination of Pour Point
ISO 3104—Petroleum Products - Transparent and Opaque Liquids - Determination of Kinematic Viscosity and Calculation of Dynamic Viscosity
ISO 3448—Industrial Liquid Lubricants - ISO Viscosity Classification
ISO 3675—Crude Petroleum and Liquid Petroleum Products - Laboratory Determination of Density Or Relative Density - Hydrometer Method
ISO 3733—Petroleum Products and Bituminous Materials; Determination of Water; Distillation Method
ISO 4263—Petroleum Products - Inhibited Mineral Oils - Determination of Oxidation Characteristics
ISO 4406—Hydraulic Fluid Power - Fluids - Method for Coding Level of Contamination by Solid Particles
ISO 5388—Stationary Air Compressors – Safety Rules and Code of Practice
ISO 6072—Hydraulic Fluid Power - Compatibility between Elastomeric Materials and Fluids
ISO 6247—Petroleum Products - Lubricating Oils - Determination of Foaming Characteristics
ISO 6614—Petroleum Products - Determination of Water Separability of Petroleum Oils and Synthetic Fluids
ISO 6615—Petroleum Products and Lubricants - Determination of Conradson Carbon Residue
ISO 6618—Petroleum Products and Lubricants - Determination of Acid or Base Number - Colour-Indicator Titration Method
ISO 6743/0—Lubricants, Industrial Oils and Related Products (Class L); Classification; General
ISO 7120—Petroleum Products and Lubricants - Petroleum Oils and Other Fluids - Determination of Rust - Preventing Characteristics In the Presence of Water
ISO 7619—Rubber - Determination of Indentation Hardness by Means of Pocket Hardness Meters

3. Requirements and testing

See Table 4.

Type D lubricating oils shall be compatible with all materials normally encountered, including elastomer seals, coatings, metallic and non-metallic components, etc.

TABLE 4—TYPE D (COMPRESSOR OILS - ESTER BASED)

Property	Requirements Ester Type						Testing as specified in	Technical Equivalent Standards		
Type of lubricating oil	DEA	DEB	DEC	DEG	DEH	DEJ	ISO	DIN	ASTM	IP/BS
ISO viscosity classification	VG 32 <----------> 150						3448	51 519	D 2422	BS 4231 IP 226
Base Oil Specification:	Required for mineral oil components only									
Paraffinic, Naphthenic, Aromatic Content	Report								D 3238 D 2140	
Total PNA, ppm	1000 max									EPA SW-846 TN 8270C
Total PCB, ppm	Not Detectable									EPA SW-846 TN 8082
Total Organic Halogens, ppm	5 max									EPA SW-846 TN 8121
Ames Mutagenicity: Fold Increase Mutagenicity Index Mutagen.Potency Index	 Report 1 max Report								E 1687	
Kinematic Viscosity in mm²/s at 40°C	ISO Grade ± 10%						3104	51 561 51 562 Part 1; or 51 569	D 445	IP 71 BS 188
Pour Point °C	≤ -20						3016	DIN ISO 3016	D 97	IP 15
Flash Point °C	VG 32 ≥ 220 VG46 ≥ 230 VG68 ≥ 240 VG100-150 ≥ 250						2592	DIN ISO 2592	D 92	IP 36
Water separability[1] Demulsibility Water in oil after 5 h Emulsion after centrifuge Total free water	 Report Report Report			 40/37/3 min Report Report Report			6614	51 599	D 1401 D 2711	IP 19
Water content, expressed as a proportion by mass, in ppm	≤ 100						3733	DIN ISO 3733	D 95 D 1744	IP 74
Corrosive effect on steel	Not exceeding degree of corrosion ISO 7120 - 0 - A						7120	51 585	D 665A	IP 135
Corrosive effect on copper 3 hours at 100°C	Not exceeding degree of corrosion 1B; ISO 2160 - 100A3						2160	51 759	D 130	IP 154
Foam Volume, in ml.. Seq. I Seq. II Seq. III per ASTM D 892*	 ≤ 50/0 ≤ 50/0 ≤ 50/0						6247	51 566	D 892	IP 146

[1] 30 minutes @ 54°C, or 60 minutes @ 82°C for ISO VG ≥ 100

TABLE 4—TYPE D (COMPRESSOR OILS - ESTER BASED) (CONTINUED)

Property	Requirements						Testing as specified in	Technical Equivalent Standards		
Type of lubricating oil	DEA	DEB	DEC	DEG	DEH	DEJ	ISO	DIN	ASTM	IP/BS
Oxidation stability, run without water, delta TAN <2	1000	1500	2000	1000	1500	2000	4263	51 587	D 943	IP 160
Autoignition Temperature,°C	380 min							51 794	E 659	BS 4056
Density at 15 °C in g/ml	To be specified by the supplier						3675	51 757	D 4052 D 1298	
Four ball wear test (40 kg load) wear scar diameter, mm	NA		≤ 0.4						D 4172	
Behavior towards agreed upon sealant[2]. Relative change in % volume	- 10 to + 10						1817 6072	53 521	D 471	
Behavior towards agreed upon sealant. Change in Shore hardness. Elastomers tested to be agreed upon between user and supplier	- 7 to + 10						1817 868 7619	53 521 with 53 505	D 471	IP 278, BS 4832
Level of contamination by solid particles, max[3]	20/18/14						4406			
Thermal stability Comparative IR Scan Acid Number Change Viscosity Change Sludge, mg/ 100 ml Copper rod color Copper weight loss, mg Steel rod color (Cinn. Mil.)	Report 0.15 ≤ 5% ≤ 25 ≤ 5 ≤ 10 1 max								D 2070	
Neutralization number to be run on base oil only (acid or alkaline), in mg KOH/g	1.0 max						6618	51 558 Part 1	D 664 D 974	IP 139 IP 177
Conradson Carbon residue to be run on base oil only	0.05% max						6615		D 189	

[2] SRE-NBR 1 sealant may be used as specified in DIN 53 538, specified reference sealant is available from Bundesantalt fur, Berlin Materialforschung und-prufung (BAM) Unter den Eichen 87, D-12205 Berlin, Germany Telephone ++49 30 8104-0, or other elastomers as agreed upon.

[3] To be met at point of delivery by supplier; and point of use by customer.

TABLE 5—TYPE D (COMPRESSOR OILS - POLY ALPHA OLEFIN BASED)[1]

Property	Requirements PAO Based						Testing as specified in	Technical Equivalent Standards		
Type of lubricating oil	DPA	DPB	DPC	DPG	DPH	DPJ	ISO	DIN	ASTM	IP/BS
ISO viscosity classification	VG 32 <----------> 100						3448	51 519	D 2422	BS 4231 IP 226
Base Oil Specification:	Required for mineral oil components only									
Paraffinic, Naphthenic, Aromatic Content	Report								D 3238 D 2140	
Total PNA, ppm	1000 max									EPA SW-846 TN 8270C
Total PCB, ppm	Not Detectable									EPA SW-846 TN 8082
Total Organic Halogens, ppm	5 max									EPA SW-846 TN 8121
Ames Mutagenicity: Fold Increase Mutagenicity Index Mutagen. Potency Index	 Report 1 max Report								E 1687	
Kinematic Viscosity in mm^2/s at 40°C	ISO Grade ± 10%						3104	51 561, 51 562 Part 1; or 51 569	D 445	IP 71 BS 188
Viscosity Index	130 min						2909		D 2270	BS 4459, IP 226
Pour Point °C	≤ -35						3016	DIN ISO 3016	D 97	IP 15
Flash Point °C	VG 32 ≥ 210 VG46 ≥ 230 VG68, 100 ≥ 250						2592	DIN ISO 2592	D 92	IP 36
Water separability[2] Demulsibility Water in oil after 5 h Emulsion after centrifuge Total free water	 Report Report Report			 40/40/0 min ≤ 1% ≤ 2 ml ≥ 60 ml			6614	51599	D 1401 D 2711	IP 19
Water content, expressed as a proportion by mass, in ppm	≤ 100						3733	DIN ISO 3733	D 95 D 1744	IP 74
Corrosive effect on steel	Not exceeding degree of corrosion ISO 7120 - 0 - A						7120	51 585	D 665A	IP 135
Corrosive effect on copper 3 hours at 100°C	Not exceeding degree of corrosion 1B; ISO 2160 - 100A3						2160	51 759	D 130	IP 154
Foam Volume, in ml. Seq. I Seq. II Seq. III per ASTM D 892	 ≤ 50/0 ≤ 50/0 ≤ 50/0						6247	51 566	D 892	IP 146

[1] Or VHVI mineral oils or other synthetic hydrocarbon oils
[2] 30 minutes @ 54°C, or 60 minutes @ 82°C for ISO VG ≥ 100

TABLE 5—TYPE D (COMPRESSOR OILS - POLY ALPHA OLEFIN BASED) (CONTINUED)[1]

Property	Requirements						Testing as specified in	Technical Equivalent Standards		
Type of lubricating oil	DPA	DPB	DPC	DPG	DPH	DPJ	ISO	DIN	ASTM	IP/BS
Oxidation stability TAN <2	2000	3000	4000	2000	3000	4000	4263	51587	D 943	IP160
Density at 15 °C in g/ml	To be specified by the supplier						3675	51 757	D 4052 D 1298	
Four ball wear test (40 kg load) wear scar diameter, mm	NA		≤ 0.4						D 4172	
Behavior towards SRE-NBR1.[3] Relative change in % volume	- 10 to + 10						1817 6072	53 521	D 471	
Behavior towards SRE-NBR1. Change in Shore hardness.	- 7 to + 10						1817 868 7619	53 521 with 53 505	D 471	IP 278, BS 4832
Level of Contamination by solid particles, max[4]	20/18/14						4406			
Thermal stability Comparative IR Scan Acid Number Change Viscosity Change Sludge, mg/ 100 ml Copper rod color Copper weight loss, mg Steel rod color (Cinn. Mil.)	Report 0.15 ≤ 5% ≤ 25 ≤ 5 ≤ 10 1 max								D 2070	
Neutralization number to be run on base oil only (acid or alkaline), in mg KOH/g	0.5 max						6618	51 558 Part 1	D 664 D 974	IP 139 IP 177

[3] SRE-NBR 1 sealant may be used as specified in DIN 53 538, specified reference sealant is available from Bundesantalt fur, Berlin Materialforschung und-prufung (BAM) Unter den Eichen 87, D-12205 Berlin, Germany Telephone ++49 30 8104-0, or other elastomers as agreed upon.

[4] To be met at point of delivery by supplier; and point of use by customer.

Rationale

Not applicable

Relationship of SAE standard to ISO Standard

Not applicable

Application

The Society of Automotive Engineers (SAE) Industrial Lubricants Committee has developed a number of industrial, non-production lubricant performance specifications.

The purpose of these voluntary SAE documents is to:

a. Define minimum performance requirements for industrial lubricants, where tests are available.
b. Provide lubricant suppliers with performance targets for key industrial lubricants.
c. Promote the availability of these lubricants to member companies and others that may wish to use these specifications.
d. Provide a user-friendly classification system using common test standards and properties.

ISO Standard 6743 - Lubricants, industrial oils and related products (class L) - Classification is the foundation for these documents.

a. Performance properties, requirements, and test procedures are specified.
b. For information, equivalent ISO, DIN, CEN, BSI, ASTM, AFNOR, CETOP and IP test methods are referenced.

Reference Section

SAE MS 1000-Lubricants, Industrial Oils and Related Products – Classification

SAE MS 1001-Lubricants, Industrial Oils and Related Products Type A (General Purpose and Total Loss Systems) - Specification

SAE MS 1002-Lubricants, Industrial Oils and Related Products Type C (Gears) –Specification

SAE MS 1003-Lubricants, Industrial Oils and Related Products Type D (Compessor Oils) -Specification

SAE MS 1004-Lubricants, Industrial Oils and Related Products Type H (Hydraulic Fluids) -Specification

SAE MS 1005-Lubricants, Industrial Oils and Related Products Type HF (Fire-Resistant Hydraulic Fluids) -Specification

SAE MS 1006-Lubricants, Industrial Oils and Related Products Type F (Lubricant for Spindle Bearings and Associated Clutches) –Specification

SAE MS 1007-Lubricants, Industrial Oils and Related Products Type G (Slideway Lubricants) – Specification

SAE MS 1008-Lubricants, Industrial Oils and Related Products Type M (Metal Removal Fluids) – Specification

SAE MS 1009-Lubricants, Industrial Oils and Related Products Type P (Pneumatic Tool Oils) – Specification

SAE MS 1010-Lubricants, Industrial Oils and Related Products Type T (Turbine Oils) – Specification

SAE MS 1011-Lubricants, Industrial Oils and Related Products Type X (Greases) -Specification

ASTM D 92—Test Method for Flash and Fire Points by Cleveland Open Cup

ASTM D 95—Test Method for Water in Petroleum Products and Bituminous Materials by Distillation

ASTM D 97—Test Methods for Pour Point of Petroleum Products

ASTM D 130—Method for Detection of Copper Corrosion from Petroleum Products by Copper Strip Tarnish Test

ASTM D 189—Standard Test Method for Conradson Carbon Residue of Petroleum Products

ASTM D 445—Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

ASTM D 471—Test Method for Rubber Property - Effect of Liquids

ASTM D 664—Test Method for Neutralization Number of Petroleum Products by Potentiometric Titration

ASTM D 665A—Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water

ASTM D 892—Test Method for Foaming Characteristics of Lubricating Oils

ASTM D 943—Standard Test Method for Oxidation Characteristics of Inhibited Mineral Oils

ASTM D 974—Test Method for Acid and Base Number by Color-Indicator Titration

ASTM D 1298—Test Method for Density, Relative Density (Specific Gravity), Or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method

ASTM D 1401—Test Method for Water Separability of Petroleum Oils and Synthetic Fluids

ASTM D 1744—Test Method for Determination of Water in Liquid Petroleum Products by Karl Fischer Reagent

ASTM D 2070—Standard Test Method for Thermal Stability of Hydraulic Oils

ASTM D 2140—Test Method for Carbon-Type Composition of Insulating Oils of Petroleum Origin

ASTM D 2270— Practice for Calculating Viscosity Index from Kinematic Viscosity at 40 and 100°C

ASTM D 2422—Classification of Industrial Fluid Lubricants by Viscosity System

ASTM D 2711—Standard Test Method for Demulsibility Characteristics of Lubricating Oils

ASTM D 3238—Method for Calculation of Carbon Distribution and Structural Group Analysis of Petroleum Oils by the N-D-M Method

ASTM D 4052—Test Method for Density and Relative Density of Liquids by Digital Density Meter

ASTM D 4172—Test Method for Wear Preventive Characteristics of Lubricating Fluid (Four-Ball Method)

ASTM E 659—Test Method for Autoignition Temperature of Liquid Chemicals

ASTM E 1687—Standard Test Method for Determining Carcinogenic Potential of Virgin Base Oils in Metalworking Fluids

BS 188—Determination of the Viscosity of Liquids

BS 4056—Determination of Autoignition Temperature

BS 4231—Classification for Viscosity Grades of Industrial Liquid Lubricants

BS 4459— Petroleum Products-Calculation of Viscosity Index from Kinematic Viscosity

BS 4832—Determination of the Behavior of Rubber and Elastomers when Exposed To Liquids, Vapors and Gases ***(Superseded by ISO 6072)***

DIN 51 519—Lubricants; ISO Viscosity Classification for Industrial Liquid Lubricants

DIN 51 558/1—Testing of Mineral Oils; Determination of the Neutralization Number, Colour Indicator Titration

DIN 51 561—Testing of Mineral Oils, Liquid Fuels and Related Liquids; Measurement of Viscosity Using the Vogel-Ossag Viscometer; Temperature Range: Approximately 10 to 150-Deg C ***(CANCELLED)***

DIN 51 562/1—Viscometry - Determination of Kinematic Viscosity Using the Ubbelohde Viscometer - Part 1: Apparatus and Measurement Procedure

DIN 51 566—Testing of Lubricants; Determination of Foaming Characteristics ***(CANCELLED)***