SAE International

INDUSTRIAL LUBRICANT STANDARD

SAE MS1001 JUN2010

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Superseding MS1001 MAY2002

(R) Lubricants, Industrial Oils, and Related Products Type A Lubricant for General Purpose and Total Loss Systems - Specification

RATIONALE

The revision of SAE MS1001 was necessary to reflect changes to test limits, changes to test methods and additional standards that have been incorporated since SAE MS1001 was originally released.

FOREWORD

The SAE International 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]

[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)

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SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/MS1001_201006

Industrial lubricant classifications targeted:

a. Lubricants, Industrial Oils and Related Products - Classification (SAE MS1000)

b. General purpose and total loss lubricants (SAE MS1001)

c. Gear oils (SAE MS1002)

d. Compressor oils (SAE MS1003)

e. Hydraulic fluids (SAE MS1004)

f. Fire resistant hydraulic fluids (SAE MS1005)

g. Lubricants for spindle bearings and associated clutches (SAE MS1006)

h. Slideway lubricants (SAE MS1007)

i. Metal removal fluids (SAE MS1008)

j. Lubricants for pneumatic tools (SAE MS1009)

k. Turbine oils (SAE MS 1010)

l. Lubricating greases (SAE MS1011)

See SAE MS1000 - Index of lubricants and symbols.

NOTE 1: Environmental, Technical Reports, and/or health and safety regulations may present additional specifications to the supplier.

NOTE 2: There can be issues related to the quality of industrial lubricants that fall outside of the scope of this specification.

1. SCOPE

See Table 1.

TABLE 1 - SCOPE AND FIELD OF APPLICATIONS

Code letter	General Applications	More specific applications	Composition and properties	Symbol	Typical Applications
A	Total loss systems		Refined mineral oils with improved properties, for example, adhesiveness, extreme pressure, anti-corrosion, which may be obtained with bitumen and/ or additives	AB	Typically open gears, wire ropes, etc.
			Refined mineral oils.-oxidation and anti-wear properties	AN	Typically lightly loaded parts.
			Unrefined mineral oils	AY	Undemanding applications, axles, railways points, etc.

NOTE: Properties for type AY oils are not addressed in this document.

2. REFERENCES

2.1 Applicable Documents

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 International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE MS1000 Lubricants, Industrial Oils, and Related Products – Classification

SAE MS1002 Lubricants, Industrial Oils, and Related Products Type C (Gears) Specification

SAE MS1003 Lubricants, Industrial Oils and Related Products Type D Compressor Oils –Specification

SAE MS1004 Lubricants, Industrial Oils, and Related Products Type H (Hydraulic Fluids) - Specification

SAE MS1005 Lubricants, Industrial Oils, and Related Products Type HF Fire-Resistant Hydraulic Fluids - Specification

SAE MS1006 Lubricants, Industrial Oils, and Related Products Type F Lubricant for Spindle Bearings, and Associated Clutches - Specification

SAE MS1007 Lubricants, Industrial Oils, and Related Products Type G Slideway Lubricants - Specification

SAE MS1008 Lubricants, Industrial Oils and Related Products Type M (Metal Removal Fluids) – Specification

SAE MS1009 Lubricants, Industrial Oils and Related Products Type P Pneumatic Tool Oils –Specification

SAE MS1010 Lubricants, Industrial Oils and Related Products Type T Turbine Oils –Specification

SAE MS1011 Lubricants, Industrial Oils and Related Products - Type X (Greases) - Specification

2.1.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

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 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 665B Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Synthetic Sea 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 2422 Classification of Industrial Fluid Lubricants by Viscosity System

ASTM D 2711 Test Method for Demulsibility Characteristics of Lubricating Oils

ASTM D 2782 Test Method for Measurement of Extreme-Pressure Properties of Lubricating Fluids (Timken Method)

ASTM D 2893 Test Method for Oxidation Characteristics of Extreme-Pressure Lubrication 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 3705 Test Method for Misting Properties of Lubricating Fluids

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 D 5182 Test Method for Evaluating the Scuffing (Scoring) Load Capacity of Oils (FZG Visual Method)

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

2.1.4 BS Publications

Available from British Standards Institution, Customer Services, 389 Chiswick High Road, London W4 4AL, United Kingdom, Tel: +44-0-20-8996-9001, www.bsi-global.com.

BS 188 Determination of the Viscosity of Liquids

BS 4231 Classification for Viscosity Grades of Industrial Liquid Lubricants

BS 4385 Methods for Determination of Water in Crude Petroleum, Petroleum Products and Bituminous Materials by Distillation (Superseded by ISO 9029)

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

2.1.5 CETOP Publications

Available from the European Oil Hydraulic and Committee Website (http://www.cetop.org).

CETOP RP81H

2.1.6 DIN Publications

Available from Deutsches Institut für Normung e.V., Burggrafenstrasse 6, 10787 Berlin, Germany, www.din.de.

DIN 51 354/2 Mechanical Testing of Lubricants by the FZG Gear Rig Test Method; Method A/8, 3/90 for Testing Lubricating Oils

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 Behaviour 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 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

2.1.7 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

2.1.8 IP Publications

Available from http://www.intertek-cb.com/news/IP_Methods.shtml, Europe +44 1708.680.248, North America 713.844.3263, Asia Pacific: +65 6322 8228.

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 157 Determination of the Oxidation Stability of Inhibited Mineral Oils (The TOST Test)

IP 160 Determination of Density - Hydrometer Method

IP 166 Determination of Load-Carrying Capacity of Lubricants - IAE Gear Machine Method

IP 177 Test Method for Acid Number by Potentiometric Titration

IP 226 Petroleum Products - Calculation of Viscosity Index from Kinematic Viscosity

IP 240 Determination of Extreme-Pressure Properties of Lubricating Fluids (Timken Method)

IP 278 Determination of Seal Compatibility Index of Petroleum Oils

IP 334 Determination of Load Carrying Capacity of Lubricants - FZG Gear Machine Method

2.1.9 ISO Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

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 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 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 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. CONCEPT

This specification defines characteristics and requirements for a rust and oxidation inhibited oil for general purpose lubrication, type AN, and an improved oil with extreme pressure, anti-corrosion, and other properties, type AB.

Properties for type AY (unrefined oils) are not addressed in this document.

4. REQUIREMENTS AND TESTING

See Table 2.

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

TABLE 2 - TYPE A (GENERAL PURPOSE LUBRICANTS)

roperty Type of fluid	Requirements AN Total Loss Systems	Requirements AB General Lubrication	Testing as Specified in ISO	Technical Equivalent Standards DIN	Technical Equivalent Standards ASTM	Technical Equivalent Standards CETOP IP / BS Other
ISO Viscosity Grade	VG 5 <----------> VG 460	VG 5 <----------> VG 460	3448	51 519	D 2422	IP 226
Base Oil Specification: Paraffinic, Naphthenic, Aromatic Content	Report	Report			D 3238	
Total PNA, ppm	100Max.	100Max.				EPA SW-846 TN 8270C
Total PCB, ppm	Not Detectable	Not Detectable			D 2140	EPA SW-846 TN 8082
Total Organic Halogens, ppm	5 Max.	5 Max.				EPA SW-846 TN 8121
Ames Mutagenicity: Fold Increase Mutagenicity Index Mutagen.Potency Index	 Report 1 Max Report	 Report 1 Max Report			E 1687	
Corrosive effect on Steel	Not exceeding degree of corrosion ISO 7120 - O – A	Not exceeding degree of corrosion ISO 7120 - O – A	7120	51 585	D 665 B	IP 135
Corrosive effect on copper 3 h at 100 °C	Not exceeding degree of corrosion 1B; ISO 2160 - 100A3	Not exceeding degree of corrosion 1B; ISO 2160 - 100A3	2160	51 759	D 130	IP 154
Four ball wear test (20 kg load) wear scar diameter, mm		≤ 0.35			D 4172	
Oxidation stability ΔTAN (1000 h)	≤ 2.0	≤ 2.0	4263	51 587	D 943	IP 157
Gear rig test by the FZG method; minimum passing stage (at test conditions as stated in ASTM D 5182)		11 min.		51 354 Part 2	D 5182	IP 334, IP 166
Timken OK load, kg	≥ 16	≥ 25			D 2782	IP 240

TABLE 2 - TYPE A (GENERAL PURPOSE LUBRICANTS) (CONTINUED)

Property Type of fluid	Requirements AN Total Loss Oils	Requirements AB General Lubrication	Testing as Specified in ISO	Technical Equivalent Standards DIN	Technical Equivalent Standards ASTM	Technical Equivalent Standards CETOP IP / BS Other
ISO viscosity classification	VG 5 <----------> VG 460	VG 5 <----------> VG 460	3448	51 519	D 2422	BS 4231
Kinematic viscosity in mm²/s at 40 °C	ISO Grade ± 10 %	ISO Grade ± 10 %	3104	51 561, 51 562 Part 1 or 51 569	D 445	IP 71 BS 188
Water separability, (30 mins. at 54 °C, or 60 mins. at 82 °C for VG ≥ 100)	≥ 40 / 37 / 3		6614	51 599	D 1401	IP 19
Demulsibility					D 2711	
Water in oil after 5 h		≤ 1 %				
Emulsion after centrifuge		≤ 2 ml				
Total free water		≥ 60 ml				
Thermal stability					D 2070	
Comparative IR Scan	Report	Report			(except 75 ml	
Acid Number Change	≤ 0.15	≤ 50%			oil, 101° C	
Viscosity Change	≤ 5%	≤ 5%			72 h)	
Sludge, mg/100 ml	≤ 25	≤ 25				
Copper rod color (Cinn. Mil.)	≤ 5	≤ 5				
Copper weight loss, mg	≤ 10	≤ 10				
Steel rod color (Cinn. Mil.)	1 max.	1 max.				
Pour Point °C	ISO 5 to 68 ≤ -5 ISO 100 to 460 ≤ +5	ISO 5 to 68 ≤ -5 ISO 100 to 460 ≤ +5	3016		D 97	IP 15
Flash Point °C	ISO 5 and 10 ≥ 160 ISO 15 to 68 ≥ 165 ISO 100 to 460 ≥ 200	ISO 5 and 10 ≥ 160 ISO 15 to 68 ≥ 165 ISO 100 to 460 ≥ 200	2592		D 92	IP 36
Fire Point °C	≥ 230	≥ 230	2592		D 92	IP 36
Level of contamination by solid particles, max.[1]	20 / 18 / 14	20 / 18 / 14	4406			
Foam Volume, in ml Seq. I, II, and III per ASTM D 892	≤ 50 / 0	≤ 50 / 0	6247	51 566	D 892	IP 146
Water content, expressed as a proportion by mass, ppm	≤ 100	≤ 1000	3733		D 95 D 1744	IP 74 BS 4385