SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

INDUSTRIAL LUBRICANTS STANDARD

SAE MS1009

ISSUED JUL2002

Issued 2002-07

Lubricants, Industrial Oils, and Related Products Type P Pneumatic Tool Oils -- Specification

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]

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 wtih 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

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 MS1001, 1002, 1006,1007, 1009)
e. Lubricating greases (SAE MS1011)
f. Metal Removal Fluids
g. Metal Forming Fluids

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
P	Pneumatic tools and machinery	Percussive pneumatic tools	Automatic or manual lubrication	Non-inhibited straight mineral oil	PAA	Tools operating at low load, and without condensate present in the air
				Mineral oil with anti-corrosion and anti-wear properties	PAB	Tools operating at high load with condensate present in the air
				Mineral oil with anti-corrosion and anti-wear, emulsifying and foam inhibiting properties	PAC	Tools subject to extended service cycles, operating under moderate to severe load conditions and with condensate present in the air
				Synthetic base fluid lubricants	PAD	Especially for open-air operations at sub-zero temperatures
			Greasing	Semi-fluid grease	PAE	For special operating conditions, e.g., reduced oil-mist exhaust (1)
		Rotary pneumatic tools and air-driven machines	Automatic or manual lubrication	Non-inhibited straight mineral oil	PBA	Tools operating at low load, and without condensate present in the air
				Mineral oil with anti-corrosion and anti-wear properties	PBB	Tools operating under low to moderate load conditions and with condensate present in the air
				Mineral oil with anti-corrosion and anti-wear, emulsifying and foam inhibiting properties	PBC	Tools subject to extended service cycles, operating under moderate to severe load conditions and with condensate present in the air
				Synthetic base fluid lubricants	PBD	For special applications

1. An L-XB1B 000 type product in accordance with ISO 6743-9 may also be suitable.

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

SAE MS1000—Lubricants, Industrial Oils and Related Products – Classification
SAE MS1001—Lubricants, Industrial Oils and Related Products Type A (General Purpose and Total Loss Systems)—Specification
SAE MS1002—Lubricants, Industrial Oils and Related Products Type C Gears—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 MS1011—Lubricants, Industrial Oils and Related Products Type X (Greases) -Specification

2.1.2 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 91—Standard Test Method for Precipitation Number of Lubricating Oils
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 2270—Practice for Calculating Viscosity Index from kinematic Viscosity at 40°C and 100°C
ASTM D 2422—Classification of Industrial Fluid Lubricants by Viscosity System
ASTM D 2782—Standard Test Method for Measurement of Extreme Pressure Properties of Lubricating Fluids (Timken Method)
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 1687—Standard Test Method for Determining Carcinogenic Potential of Virgin Base Oils in Metalworking Fluids

2.1.3 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

2.1.4 BS PUBLICATIONS—Available from ILI as referenced in 2.1.3

BS 188—Determination Of The Viscosity Of Liquids
BS 4231—Classification for Viscosity Grades of Industrial Liquid Lubricants
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 in 2.1.3.

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

2.1.6 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 in 2.1.3.

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 240—Determination of Extreme-Pressure Properties of Lubricating Fluids (Timken Method)
IP 278—Determination of Seal Compatibility Index of Petroleum Oils

2.1.8 ISO PUBLICATIONS—Available from ILI as referenced in 2.1.3.

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 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—***The lubricants defined by this specification are rust and oxidation inhibited oils which may also contain anti-wear additives. They are intended to be used in rotary pneumatic tools. They may be also used in air line lubricators.

a. Properties for Type PAD, PAE, and PBD oils are not addressed in this document.

4. ***Requirements and Testing—***See Table 2.

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

TABLE 2—TYPE P (PNEUMATIC TOOL LUBRICANTS)

Property Type of Lubricating Oil	Requirements PAA PBA	Requirements PAB PBB	Requirements PAC PBC	Testing as specified in ISO	Technical Equivalent Standards DIN	Technical Equivalent Standards ASTM	Technical Equivalent Standards IP/BS
ISO viscosity classification	VG 15 <----------> 32	VG 15 <----------> 32	VG 15 <----------> 32	3448	51 519	D 2422	BS 4231 IP 226
Base Oil Specification:							
Paraffinic, Naphthenic, Aromatic Content	Report	Report	Report			D 3238 D 2140	
Total PNA, ppm	1000 Max.	1000 Max.	1000 Max.				EPA SW-846 TN 8270C
Total PCB, ppm	Not Detectable	Not Detectable	Not Detectable				EPA SW-846 TN 8082
Total Organic Halogens, ppm	5 Max.	5 Max.	5 Max.				EPA SW-846 TN 8121
Ames Mutagenicity:						E 1687	
Fold Increase	Report	Report	Report				
Mutagenicity Index	1 Max	1 Max	1 Max				
Mutagen.Potency Index	Report	Report	Report				
Corrosive effect on steel	Not exceeding degree of corrosion ISO 7120 - 0 - A	Not exceeding degree of corrosion ISO 7120 - 0 - A	Not exceeding degree of corrosion ISO 7120 - 0 - A	7120	51 585	D 665B	IP 135
Corrosive effect on copper 3 hours at 100 °C	Not exceeding degree of corrosion 1B; ISO 2160 - 100A3	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
Foam Volume, in mL.	≤50/0	≤50/0	≤50/0	6247	51 566	D 892	IP 146
Seq. I							
Seq. II							
Seq. III							
per ASTM D 892							
Timken OK load, kg	NA	≥10	≥10			D 2782	IP 240
Four ball wear test (20 kg load) wear scar diameter, mm	NA	≤0.45	≤0.45			D 4172	
Behavior towards the SRE-NBR 1 sealant.(1)				1817 6072	53 521	D 471	
Relative change in volume, %.	–10 to + 10	–10 to + 10	–10 to + 10				
Change in shore hardness	–7 to + 10	–7 to + 10	–7 to + 10	1817 868 7619	53 521 with 53 505	D 471	IP 278, BS 4832
Level of contamination by solid particles, max.(2)	20/18/14	20/18/14	20/18/14	4406			

TABLE 2—TYPE P (PNEUMATIC TOOL LUBRICANTS) (CONTINUED)

Property Type of Lubricating Oil	Requirements PAA PBA	Requirements PAB PBB	Requirements PAC PBC	Testing as specified in ISO	Technical Equivalent Standards DIN	Technical Equivalent Standards ASTM	Technical Equivalent Standards IP/BS
Thermal stability						D 2070	Cincinnati
Comparative IR Scan	Report	Report	Report			(except 75 mL	Milacron
Acid Number Change	≤0.15	≤0.15	≤0.15			oil, 101 °C,	Procedure B
Viscosity Change	≤5%	≤5%	≤5%			72 h)	
Sludge, mg/ 100 mL	≤25	≤25	≤25				
Copper rod color	≤5	≤5	≤5				
Copper weight loss, mg	≤10	≤10	≤10				
Steel rod color (Cin. Mil.)	1 max	1 max	1 max				
Oxidation stability TAN (1000 h)	≤2.0	≤2.0	≤2.0	4263	51 587	D 943	
Water separability, 30 min maximum at 54 °C	Report	Report	Time to 40 / 40 / 0	6614	51 599	D 1401	IP 19
Viscosity index	90 minimum	90 minimum	90 minimum	2909	DIN ISO 2909	D 2270	IP 226 BS 2000: PTA226
Kinematic viscosity in mm²/s at 40 °C	ISO Grade ± 10%	ISO Grade ± 10%	ISO Grade ± 10%	3104	51561, 51 562 Part 1; or 51 569	D 445	IP 71 BS 188
Pour Point °C	≤–10	≤–10	≤–10	3016	DIN ISO 3016	D 97	IP 15
Flash Point °C	≥175	≥175	≥175	2592	DIN ISO 2592	D 92	IP 36
Water content, expressed as a proportion by mass, ppm	≤100	≤100	≤100	3733	DIN ISO 3733	D 95 D 1744	IP 74
Precipitation Number	<0.05	<0.05	<0.05			D 91	
Neutralization number (acid or alkaline), in mg KOH/g	To be specified by the supplier	To be specified by the supplier	To be specified by the supplier	6618	51 558 Part 1	D 664 D 974	IP 139 IP 177
Density at 15 °C in g/mL	To be specified by the supplier	To be specified by the supplier	To be specified by the supplier	3675	51 757	D 1298 D 4052	IP 160

1. SRE-NBR 1 sealant must 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.
2. To be met at point of delivery by the supplier, and at point of use by the customer.

PREPARED BY THE SAE INDUSTRIAL LUBRICANTS COMMITTEE

SAE MS1009 Issued JUL2002

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, and 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 1001—Lubricants, Industrial Oils and Related Products—Classification

SAE MS 1002—Lubricants, Industrial Oils and Related Products Type C Gears—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 1011—Lubricants, Industrial Oils and Related Products Type X (Greases)—Specification

ASTM D 91—Standard Test Method for Precipitation Number of Lubricating Oils

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 2270—Practice for Calculating Viscosity Index from kinematic Viscosity at 40°C and 100°C

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

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

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

BS 188—Determination of the Viscosity of Liquids

BS 4231—Classification for Viscosity Grades of Industrial Liquid Lubricants

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