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

INDUSTRIAL LUBRICANT STANDARD

SAE MS1001

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Lubricants, Industrial Oils, and Related Products Type A Lubricant for General Purpose and Total Loss Systems -- 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 with BSI
British Standards Institution (BSI), BS 2000: XXX where XXX is the corresponding IP number
European Committee on Hydraulic Oil and Pneumatics (CETOP)

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 MS1002, SAE MS1006, SAE MS1007)
e. Lubricating greases (SAE MS1011)
f. Metal Removal Fluids (SAE MS1008)
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 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 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 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

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 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 ILI as referenced in 2.1.1.

BS 1883—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)
CETOP RP81H

2.1.5 DIN PUBLICATIONS—Available from ILI as referenced in 2.1.1.

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

2.1.6 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 2.1.1.

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 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

2.1.8 ISO PUBLICATIONS—Available from ILI as referenced 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 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 fuid 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 rroducts 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 Tables 2A and 2B.

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

TABLE 2A—TYPE A (GENERAL PURPOSE LUBRICANTS)

Property 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	1000 Max.	1000 Max.				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 TAN (1000 h)	≤ 2.0		4263	51 587	D 943	IP 157
Gear rig test by the FZG method; minimum damage power stage (at test conditions as stated in ASTM D5182)		11 min.		51 354 Part 2	D 5182	IP 334, IP 166
Timken OK load, kg	≥ 16	≥ 25			D 2782	IP 240

TABLE 2B—TYPE A (GENERAL PURPOSE LUBRICANTS)

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	Cincinnati
Comparative IR Scan	Report	Report			(except 75 ml	Milacron
Acid Number Change	≤ 0.15	≤ 50%			oil, 101° C	Procedure B
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	DIN ISO 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	DIN ISO 2592	D 92	IP 36
Fire Point °C	≥ 230	≥ 230	2592	DIN ISO 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	≤ 100	3733	DIN ISO 3733	D 95 D1744	IP 74 BS 4385

TABLE 2B—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
Oxidation Stability (EP oils) Viscosity Increase at 100 °C Precipitation Number Comparative IR Scan		 ≤ 6 % ≤ 0.1 Report			D 2893	
Misting Reclassified Oil lost in manifold Oil lost in stray fog		 ≥ 50 % Report ≤ 5 %			D 3705	
Behavior towards the SRE-NBR 1 sealant.(2) Relative change in volume, %.	– 10 to + 10	– 10 to + 10	1817 6072	53 521	D 471	
Change in shore hardness	– 7 to + 10	– 7 to + 10	1817 868 7619	53 521 with 53 505	D 471	CETOP RP81H, IP 278, BS 4832
Density at 15 °C in g/ml	To be specified by the supplier	To be specified by the supplier	3675	51 757	D 1298 D 4052	IP 160
Neutralization number (acid or alkaline), in mg KOH/g	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

1. To be met at point of delivery by the supplier, and at point of use by the customer.
2. 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.

PREPARED BY THE SAE INDUSTRIAL LUBRICANTS COMMITTEE

SAE MS1001 Issued MAY2002

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 SectionReference Section

SAE MS 1000—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 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

BS 188—Determination Of The Viscosity Of Liquids