BRITISH STANDARD

BS ISO
19378:2003

Lubricants, industrial oils and related products (class L) — Machine-tool lubricants — Categories and specifications

ICS 75.100

BSI
British Standards

National foreword

This British Standard reproduces verbatim ISO 19378:2003 and implements it as the UK national standard. It supersedes BS 5063:1992 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee PTI/7, Lubricants and process fluids, to Subcommittee PTI/7/5, Machine tool lubricants, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

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Lubricants, industrial oils and related products (class L) — Machine-tool lubricants — Categories and specifications

Lubrifiants, huiles industrielles et produits connexes (classe L) — Lubrifiants pour machines outils — Catégories et spécifications

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 19378 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Subcommittee SC 4, *Classifications and specifications*.

This first edition cancels and replaces both ISO/TR 3498:1986 and ISO/TR 10481:1993, which have been technically revised.

Lubricants, industrial oils and related products (class L) — Machine-tool lubricants — Categories and specifications

WARNING — The handling and use of products specified in this International Standard may be hazardous, if suitable precautions are not observed. This International Standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This International Standard provides the manufacturers and users of machine tools with criteria for the choice among the various categories of lubricants and gives specifications for these lubricants. This International Standard facilitates the application of ISO 5169 relating to the presentation of lubrication instructions for machine tools.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1817:1999, *Rubber, vulcanized — Determination of the effect of liquids*

ISO 2160:1998, *Petroleum products — Corrosiveness to copper — Copper strip test*

ISO 2592:2000, *Determination of flash and fire points — Cleveland open cup method*

ISO 2719:2002, *Determination of flash point — Pensky-Martens closed cup method*

ISO 2909:2002, *Petroleum products — Calculation of viscosity index from kinematic viscosity*

ISO 3016:1994, *Petroleum products — Determination of pour point*

ISO 3104:1994, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity*

ISO 3104:1994, Technical Corrigendum 1:1997

ISO 3170:—[1)], *Petroleum liquids — Manual sampling*

ISO 3448:1992, *Industrial liquid lubricants — ISO viscosity classification*

ISO 3675:1998, *Crude petroleum and liquid petroleum products — Laboratory determination of density — Hydrometer method*

1) To be published. (Revision of ISO 3170:1988)

ISO 4259:1992, *Petroleum products — Determination and application of precision data in relation to methods of test* [incl. Tech. Cor. 1:1993 (English only)]

ISO 4263-1:2003, *Petroleum and related products — Determination of the ageing behaviour of inhibited oils and fluids — TOST test — Part: Procedure for mineral oils*

ISO 5169:1977, *Machine tools — Presentation of lubrication instructions*

ISO 6247:1998, *Petroleum products — Determination of foaming characteristics of lubricating oils*

ISO 6614:1994, *Petroleum products — Determination of water separability of petroleum oils and synthetic fluids*

ISO 6618:1997, *Petroleum products and lubricants — Determination of acid or base number — Colour-indicator titration method*

ISO 6743-1:2002, *Lubricants, industrial oils and related products (class L) — Classification — Part 1: Family A (Total loss systems)*

ISO 6743-2:1981, *Lubricants, industrial oils and related products (class L) — Classification — Part 2: Family F (Spindle bearings, bearings and associated clutches)*

ISO 6743-4:1999, *Lubricants, industrial oils and related products (class L) — Classification — Part 4: Family H (Hydraulic systems)*

ISO 6743-6:1990, *Lubricants, industrial oils and related products (class L) — Classification — Part 6: Family C (Gears)*

ISO 6743-9:2003, *Lubricants, industrial oils and related products (class L) — Classification — Part 9: Family X (Greases)*

ISO 6743-13:2002, *Lubricants, industrial oils and related products (class L) — Classification — Part 13: Family G (Slideways)*

ISO 6743-99:2002, *Lubricants, industrial oils and related products (class L) — Classification — Part 99: General*

ISO 7120:1987, *Petroleum products and lubricants — Petroleum oils and other fluids — Determination of rust-preventing characteristics in the presence of water*

ISO 11158:1997, *Lubricants, industrial oils and related products (class L) — Family H (Hydraulic systems) — Specifications for categories HH, HL, HM, HR, HV and HG*

ISO 12925-1:1996, *Lubricants, industrial oils and related products (class L) — Family C (Gears) — Part 1: Specifications for lubricants for enclosed gear systems*

ISO 12925-1:1996, Technical Corrigendum 1:2002

XP T 60-183:1994, *Lubricants, industrials oils and related products — Lubricants for slideways — Anti-slick slip lubricating ability*

ASTM D4172-94, *Standard test method for wear preventive characteristics of lubricating fluid (Four-ball method)*

3 Sampling

Unless otherwise specified in a commodity specification, samples of lubricants shall be taken in accordance with ISO 3170.

4 Categories of products for the lubrication of machine tools — Criteria for the choice

The various mechanical parts of machine tools shall be lubricated with certain families of products defined and described in ISO 6743-1, ISO 6743-2, ISO 6743-4, ISO 6743-6, ISO 6743-9, ISO 6743-13 and ISO 6743-99.

Each part of ISO 6743 defines categories inside a lubricant family. Within each category, all the grades defined in accordance with ISO 3448 for liquid lubricants or ISO 6743-9 for greases are possible. For the lubrication of machine tools, all the categories of products and all the possible grades in each category are not useful. Therefore, to facilitate the selection by the manufacturers or the users of machine tools, it is advisable to limit the number of categories and grades of products.

Table 1 gives criteria for the applications and defines a limited range of products appearing underlined. It is recommended to the manufacturers of machine tools, whenever possible, to select the lubricants in the limited range.

Table 1 does not cover special applications requiring the use of specific lubricants. These special applications should be examined separately, case by case, by the manufacturers or users of machine tools.

5 Specifications of products

The products of Family H, classified in ISO 6743-4, are specified in ISO 11158 and the products of Family C, classified in ISO 6743-6, are specified in ISO 12925-1.

There is presently no specification covering the products of Family X, classified in ISO 6743-9.

NOTE At the time of publication of this International Standard, an International Standard for specifications of greases is in the course of development at the preliminary stage (see Annex A).

Table 2 gives the requirements of the categories of lubricants L-AN (ISO 6743-1), L-FC and L-FD (ISO 6743-2) and L-G (ISO 6743-13) covered by Table 1.

The properties are those applying to the products at the time of their delivery. The application of the accuracy in interpreting the results of tests is described in ISO 4259. This procedure shall be applied in case of dispute.

6 Packaging and labelling

6.1 Packaging

The lubricants shall be packed in suitable packaging and according to the regulations in use.

6.2 Labelling

The labelling shall comprise at least the following information:

a) the commercial name of the product;

b) the ISO designation code (including the viscosity grade);

c) the batch number;

d) the date of manufacturing;

e) the legal labelling (transportation, safety) if the product is liable for this labelling.

Table 1 — Range of machine-tool lubricants

Code letter	General application	Particular application	More specific application	Product type and/or performance requirements	Symbol ISO L[a]	Typical applications	Remarks
A	Total loss systems			Refined mineral oils	AN 32 AN 68 AN 220	Lightly loaded parts	
C	Gears	Enclosed gears	Continuous lubrication: splash lubrication, lubrication by circulation or spray	Refined mineral oils exhibiting improved properties of oxidation stability, corrosion protection (ferrous and non-ferrous metals), and foaming	CKB 32 CKB 68 CKB 100 CKB 150	Enclosed gears, operating under moderate loads (see ISO 6743-6) Bearings, headstocks, feed-boxes, carriages	CKB 32 and CKB 68 oils can also be used for flood-lubricated, mechanically controlled clutches CKB 68 may replace AN 68
				Refined mineral oils exhibiting improved properties of oxidation stability, corrosion protection (ferrous and non-ferrous metals), extreme-pressure, anti-wear and foaming	CKC 68 CKC 100 CKC 150 CKC 220 CKC 320 CKC 460	Enclosed gears, whose stabilized temperature of oil in service remains normal or average, and operating under high loads (see ISO 6743-6) All types of enclosed gears (except hypoid gears) Heavily loaded plain and roller bearings	These oils can also be used for manual or centralized lubrication of lead and feed screws and slideways operating under light loads, or whose conditions of use do not require any particular anti-stick-slip properties
F	Spindle bearings, bearings and associated clutches		Spindle bearings, bearings and associated clutches	Refined mineral oils exhibiting improved properties of oxidation stability and corrosion protection	FC 2 FC 5 FC 10 FC 22	Lubrication by recirculation, splash or oil mist of plain bearings, roller bearings and associated clutches	These oils are intended for the lubrication of parts including clutches. Oils containing extreme-pressure and anti-wear agents are not allowed
			Spindle bearings, bearings	Refined mineral oils exhibiting improved properties of oxidation stability, corrosion protection and anti-wear	FD 2 FD 5 FD 10 FD 22	Lubrication by recirculation, splash or oil mist of plain bearings and roller bearings	These oils can also be used in applications requiring the use of particularly low viscosity oils, such as fine mechanisms, hydraulic or hydropneumatic mechanisms, electro-magnetic clutches, airline lubricators and hydrostatic bearings
G	Slideways	Lubrication	Lubrication of slideways systems in which the contacting surfaces are both metallic	Refined mineral oils exhibiting improved properties of wear protection, corrosion protection, tackiness and preventing discontinuous or intermittent motion of the slider (stick-slip)	GA 68 GA 100 GA 150 GA 220	Lubrication of machine-tool parts including plain slideways, nut-screw systems, ball nut-screw systems, plain bearings, in which anti-stick-slip and friction-reduction properties are essential	The GA oils may be replaced by HG oils (ISO 6743-4) of the same viscosity grade, provided that requirements of anti-stick-slip properties are met

Table 1 (*continued*)

Code letter	General application	Particular application	More specific application	Product type and/or performance requirements	Symbol ISO L[a]	Typical applications	Remarks
			Lubrication of slideways systems in which one of the two contacting surfaces is constituted by a non-metallic material (pigmented polymer, resin, etc...)	Refined mineral oil exhibiting improved properties of wear protection, corrosion protection, tackiness and preventing discontinuous or intermittent motion of the slider (stick-slip)	GB 68 GB 100 GB 150 GB 220	Lubrication of machine-tool parts including plain slideways with one non-metallic material sensitive to pollution by aqueous cutting fluids, nut-screw systems, ball nut-screw systems, plain bearings, in which anti-stick-slip and friction-reduction properties are essential	The considered compatibility is between the non-metallic sliding material and the slideways lubricant, in the presence of aqueous coolants
			Lubrication of slideways systems in which the contacting surfaces are both metallic	Synthetic lubricants exhibiting improved properties of wear protection, corrosion protection, tackiness and preventing discontinuous or intermittent motion of the slider (stick-slip)	GS 68 GS 220	Lubrication of machine-tool parts including plain slideways, nut-screw systems, ball nut-screw systems, plain bearings, in which anti-stick-slip and friction-reduction properties and aqueous coolant compatibility are essential	The considered compatibility is between the slideways lubricant and the aqueous coolant ; the contamination of the coolant by the slideways lubricant has a minimum impact on the coolant performance (the slideways lubricant is either emulsified or solubilized)
H	Hydraulic systems	Hydrostatic systems		Refined mineral oils with improved anti-rust and anti-oxidation properties	HL 32 HL 46 HL 68	Lubrication of hydraulic systems not requiring any particular anti-wear properties Splash or injection lubrication of lightly loaded gears, bearings and roller bearings	HL 32 and HL 68 oils may replace, in the same applications, CKB 32 and CKB 68 oils
				Refined mineral oils with improved anti-rust, anti-oxidation and anti-wear properties	HM 15 HM 32 HM 46 HM 68	General hydraulic systems including highly loaded components	These oils are also suitable for the lubrication of plain and roller bearings, gears with light to average loading (except hypoid and worm gears). HM 32 and HM 68 oils may replace, in the same applications, CKB 32 and CKB 68 oils, except clutches.

Table 1 (*continued*)

Code letter	General application	Particular application	More specific application	Product type and/or performance requirements	Symbol ISO L[a]	Typical applications	Remarks
H(contd)				Refined mineral oils with improved anti-rust, anti-oxidation, anti-wear and viscosity/temperature properties	HV 22 HV 32 HV 46	Applications in numerically controlled machine tools and in hydraulic circuits operating in a wide temperature range	In some cases, it is possible to replace HM oils by HV oils.
			Hydraulic slideways systems	Refined mineral oils with improved anti-rust, anti-oxidation, anti-wear and ant-stick-slip properties.	HG 32 HG 68	Applications in machine tools fitted with a single circuit for hydraulic command and plain-bearing slideways for which, at low sliding speeds, the stick-slip phenomenon shall be prevented	These oils may be used for slideways lubrication, when a low-viscosity oil is required A HG 68 may replace a GA 68 oil or a GB oil, provided it exhibits enough anti-stick-slip properties
X	Applications requiring grease	Multi-purpose greases		Greases with improved anti-oxidation and anti-corrosion properties	XBCEA 00 XBCEA 0 XBCEA 1 XBCEA 2 XBCEA 3	Plain and roller bearings, enclosed and open gears, and miscellaneous grease-lubricated parts	Grease XBCEA 1 is used in centralized systems, whereas greases XBCEA 2 and XBCEA 3 are preferably dispensed by a cup or a hand-gun (see Annex A). The equipment manufacturer should identify the grease used for the initial filling of each item to ensure that the grease subsequently introduced is compatible with it.

[a] A limited range of products appears underlined. It is recommended to the manufacturers of machine tools, whenever possible, to select the lubricants in the limited range (see Clause 4).

Table 2 — Lubricants for machine tools and related products — Properties and requirements

No.	Property or test	Unit	Reference of test method	Category AN			Category FD					Categories FC and FD [a]					Categories GA and GB [b]				Category GS	
				Class			Class					Class					Class				Class	
				32	68	220	2	5	10	22	32	2	5	10	22	32	68	100	150	220	68	220
1	Viscosity grade [c]	mm^2/s	IS0 3448	32	68	220	2	5	10	22	32	2	5	10	22	32	68	100	150	220	68	220
2	Viscosity index		ISO 2909	+			Not applicable			+	+	Not applicable			+	+	+				+	
3	Density at 15 °C	kg/m^3	ISO 3675	+			+					+					+				+	
4	Acid number	mg KOH/g	ISO 6618	+			+					+					+				+	
5	Appearance		To be determined	Clear and bright		Bright	Clear and bright					Clear and bright					Clear and bright		Bright		Clear and bright	
6	Flash point (open cup)	°C	ISO 2592	⩾ 140		⩾ 180	Not applicable		⩾ 140			Not applicable		⩾ 140			⩾ 180				⩾ 180	
7	Flash point (closed cup)	°C	ISO 2719	No requirements			⩾ 85	⩾ 110	No requirement			⩾ 85	⩾110	No requirement			No requirement				No requirement	
8	Foaming characteristics at 24 °C at 93 °C at 24 °C after 93 °C	ml	ISO 6247	No requirements			T ⩽ 100	S ⩽ 10	T ⩽ 100 ⩽ 100 ⩽ 100	S ⩽ 10 ⩽ 10 ⩽ 10		T ⩽ 100	S ⩽ 10	T ⩽ 100 ⩽ 100 ⩽ 100	S ⩽ 10 ⩽ 10 ⩽ 10		No requirement				No requirement	
9	Copper corrosion (3 h at 100 °C)	rating	ISO 2160	< 2			< 2 [d]		< 2			< 2 [d]		< 2			< 2				< 2	
10	Corrosion-preventive properties	rating	ISO 7120 (procedure A)	No requirement			pass					pass					pass				pass	
11	Pour point	°C	ISO 3016	⩽ −9	⩽ −9	⩽ −6	⩽ −18		⩽ −15			⩽ −18		⩽ −15			⩽ −9		⩽ −3		⩽ −9	
12	Anti-wear properties [e]		ASTM D4172	No requirement			+ [f]					+ [f]					+ [g]				+ [g]	
13	Demulsibility [h]		ISO 6614	No requirement			+					+					No requirement				No requirement	
14	Oxidation stability		ISO 4263-1	Not applicable			Not applicable		⩾ 1 000 h to reach 2 mg KOH/g			Not applicable		⩾ 1 000 h to reach 2 mg KOH/g			No requirement				No requirement	
15	Compatibility with construction materials		ISO 1817	+ [i]			+ [i]					+ [i]					+ [i]				+ [i]	

Table 2 (*continued*)

No.	Property or test	Unit	Reference of test method	Category AN			Category FD					Categories FC and FD [a]					Categories GA and GB [b]				Category GS	
				Class			Class					Class					Class				Class	
				32	68	220	2	5	10	22	32	2	5	10	22	32	68	100	150	220	68	220
16	Friction characteristics		XP T 60-183	Not applicable			No requirement					No requirement					+ [j k]				+ [j]	
17	Compatibility with aqueous cutting fluids			Not applicable			+ [l]					+ [l]					+ [l]				+ [m]	

NOTE T means tendency. S means stability. Sign + designates properties which are important to the manufacturer, but vary with machine design, construction, operating environment, etc. Values for these properties should be provided by the lubricant supplier and compared with the minimal requirements established by the manufacturer and/or the end user.

a The anti-wear properties requirement only applies to the FD category.

b The supplier should provide data demonstrating that the products are compatible with synthetic sliding materials in the presence of aqueous cutting fluids, on the basis of testing methods agreed with the manufacturer and/or the end user.

c The kinematic viscosity at 40 °C, that shall be measured according to ISO 3104, shall be within the limits of viscosities defined in ISO 3448.

d The temperature is limited to 60 °C for these low viscosity grades.

e Although the four-ball method is debatable, it allows selection of lubricants exhibiting anti-wear properties over those that do not have any of these properties.

f ASTM D4172, A conditions — Ambient temperatures for grades 2 and 5.

g ASTM D4172, B conditions.

h Adopt 25 °C for viscosity grades below 32.

i The supplier should provide information to the manufacturer and/or to the end user about the behaviour of the product towards elastomers/synthetic materials.

j AFNOR XP T 60-183 tribometer test method, or any other suitable method agreed with the manufacturer and/or the end user, may be used to demonstrate the frictional properties of the oil, and the absence of stick-slip phenomena (steel/steel contact).

k For the GB category, the supplier should provide data on friction properties and absence of stick-slip phenomenon in synthetic material/steel contact on the basis of a method agreed with the manufacturer and / or the end user. AFNOR XP T 60-183, with a slider modified by insertion of synthetic material may be used.

l The supplier should provide data on the basis of a method agreed with the end user.

m The supplier should provide data demonstrating that the product, when leaking into an aqueous coolant, has no impact on the coolant performance.

Annex A
(informative)

Preliminary information about the future International Standard for specifications of greases

For product category X, the relevant International Standard (ISO 6743-9:1987) dealing with classification has been revised and will be published in 2003. The application of this classification, which defines the products in terms of high- and low-temperature operability, anti-rust protection, water resistance and ability to lubricate under high loads [Extreme-pressure properties (EP)], is tied up to the existence of specification limits for each of the properties mentioned.

The International Standard for specifications of greases is still in the course of development, and will be referenced as ISO 12924, *Lubricants, industrial oils and related products (class L) — Family X (Greases) — Specifications*.

At present, these specification limits are being established to determine how to evaluate the following properties:

— lower operating temperature — for symbol 1;

— upper operating temperature — for symbol 2;

— water contamination — for symbol 3;

— anti-rust protection — for symbol 3;

— ability to lubricate under high loads — for symbol 4.

Symbol 1: The applicability of greases at the various temperatures listed in Table 2 is defined by a flowability criterion at the said temperature, using one of the following methods: ISO 13737[3], or DIN 51805[4] or ASTM D1478[8].

Symbol 2: The applicability of greases at the various temperatures listed in Table 2 is defined by a life test in a bearing running at the said temperature, using either of the following methods: ASTM D3336[10] or DIN 51821-2[6].

Symbol 3: This defines the level of water resistance and protection against corrosion; it corresponds to the combination of two properties, e.g. the resistance to water contamination and the level of anti-rust protection. The level of anti-rust protection is assessed using ISO 11007[1]. The resistance to water contamination is assessed using ISO 11009[2] for the water wash conditions, and using DIN 51807-1[5] for the static conditions.

Symbol 4: The ability to lubricate under high loads is defined by setting limits for the four-ball weld load using either IP 239[7] (European conditions) or ASTM D2596[9] (American conditions).

Bibliography

[1] ISO 11007:1997, *Petroleum products and lubricants — Determination of rust-prevention characteristics of lubricating greases*

[2] ISO 11009:2000, *Petroleum products and lubricants — Determination of water washout characteristics of lubricating greases*

[3] ISO 13737:—[2)], *Petroleum products — Determination of low-temperature cone penetration of lubricating greases*

[4] DIN 51805:1974, *Testing of lubricants; determination of flow pressure of lubricating greases, Kesternich method*

[5] DIN 51807-1:1979, *Testing of lubricants; Test of the behaviour of lubricating greases in the presence of water; Static test*

[6] DIN 51821-2:1989, *Testing of lubricants; test using the FAG roller bearing grease testing apparatus FE9; Test method A/1500/6000*

[7] IP 239/01, *Determination of extreme pressure and anti-wear properties of lubricating fluids — Four ball method (European conditions)*

[8] ASTM D1478-97, *Standard test method for low-temperature torque of ball bearing grease*

[9] ASTM D2596-02, *Standard test method for measurement of extreme-pressure properties of lubricating grease (Four-ball method)*

[10] ASTM D3336-97, *Standard test method for life of lubricating greases in ball bearings at elevated temperatures*

2) To be published.

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