INTERNATIONAL STANDARD

ISO 12925-1

Second edition
2018-01

Lubricants, industrial oils and related products (class L) — Family C (gears) —

Part 1: Specifications for lubricants for enclosed gear systems

Lubrifiants, huiles industrielles et produits connexes (classe L) — Famille C (engrenages) —

Partie 1: Spécifications des lubrifiants pour systèmes d'engrenages sous carter

Reference number
ISO 12925-1:2018(E)

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by ISO/TC 28, *Petroleum products*, Subcommittee SC 4, *Specifications.*

This second edition cancels and replaces the first edition (ISO 12925-1:1996), which has been technically revised. It also incorporates the Technical Corrigendum ISO 12925-1:1996/Cor 1:2002.

The main change from the previous edition is that new tables have been added to cover with specifications all the new categories added in ISO 6743-6.

New requirements have been added in terms of elastomer compatibility, low speed wear for the extreme pressures grades

A list of all the parts of ISO 12925 can be found on the ISO website.

Introduction

Lubricants for gear systems are used in diverse types of gear designs, ranging from simple parallel spur gears to bevel gears (straight or helical), worm gears and hypoid gears. Industrial gear systems, which are either of open type or enclosed type, vary in size from small enclosed systems used in machine tools to very large systems used in mining, steel mills and cement plants.

Lubricants for these applications vary in composition from refined straight mineral oils to more complex blends, based on mineral oils, synthetic oils (e.g. poly α-olefins, esters, poly-glycols), to vegetable oils and derivatives and additives friction modifying and/or extreme-pressure. ISO 3448 viscosity grades vary depending on the type of application and range from the low viscosity ISO VG 32 to high viscosity ISO VG 1500, even more for the very low velocities and very high loads. In exceptional cases, viscosity grades may be even higher. Temperature conditions to which the gear systems are exposed also vary considerably, not only due to the ambient conditions of operation, but also depending on the sliding between the gear teeth, on the size of the casings, on the presence on the circulating systems of heat exchangers, on the vicinity of heat sources as in the cement industry or in the steel industry.

Greases may also be used for the splash lubrication of enclosed gears or for the application on open gear teeth.

This document was first published in 1996 and covers the lubricants applied in enclosed gear systems most currently encountered in the industry. Since the first edition (ISO 12925-1:1996), the requirements for lubricants for enclosed gear systems have largely changed to suit to new gear technologies and applications. More demanding requirements have appeared with respect to extreme pressure properties (resistance to micro-pitting), ability to lubricate low velocity mechanisms, resistance to pitting), to foaming and air release characteristics. In addition, the need has also appeared for environmentally acceptable products.

This revision of ISO 12925-1 covers all the grades described in the ISO 6743-6 classification, intended for enclosed gear lubrication; it includes new requirements with respect to lubrication under low speed conditions (DIN 51819-3), resistance to foaming (ISO 12152). With respect to the micro-pitting protection properties, a specification will be introduced when a recognized standard is available. This revision includes also the environmental acceptability of some grades.

This document does not cover the extreme cases of use in terms of gear design, temperature and extreme conditions. For use in exceptional conditions, suppliers and purchasers of lubricants can mutually agree on the testing methods and the acceptability criteria of the products, not covered by this part of ISO 12925.

Lubricants, industrial oils and related products (class L) — Family C (gears) —

Part 1: Specifications for lubricants for enclosed gear systems

1 Scope

This document establishes the specifications relative to family C (gears) for lubricants, industrial oils and related products of Class L (see ISO 6743-6). This document deals only with lubricants for enclosed gear systems. Lubricants for open gears and greases for gears (enclosed or open) are not covered.

This document can be read in conjunction with ISO 6743-6. The following categories specified in ISO 6743-6 are covered by this document: CKB, CKC, CKD, CKE, CKSMP, CKTG, CKES, CKPG, CKPR.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

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

ISO 2592, *Petroleum and related 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 3170, *Petroleum liquids — Manual sampling*

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

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

ISO 4259, *Petroleum products — Determination and application of precision data in relation to methods of test*

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

ISO 4263-4, *Petroleum and related products — Determination of the ageing behaviour of inhibited oils and fluids — TOST test — Part 4: Procedure for industrial gear oils*

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

ISO 6341, *Water quality — Determination of the inhibition of the mobility of Daphnia magna Straus (Cladocera, Crustacea) — Acute toxicity test*

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 6619, *Petroleum products and lubricants — Neutralization number — Potentiometric titration method*

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

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

ISO 7346-1, *Water quality — Determination of the acute lethal toxicity of substances to a freshwater fish [Brachydanio rerio Hamilton-Buchanan (Teleostei, Cyprinidae)] — Part 1: Static method*

ISO 8692, *Water quality — Fresh water algal growth inhibition test with unicellular green algae*

ISO 9408, *Water quality — Evaluation of ultimate aerobic biodegradability of organic compounds in aqueous medium by determination of oxygen demand in a closed respirometer*

ISO 9439, *Water quality — Evaluation of ultimate aerobic biodegradability of organic compounds in aqueous medium — Carbon dioxide evolution test*

ISO 10253, *Water quality — Marine algal growth inhibition test with Skeletonema sp. and Phaeodactylum tricornutum*

ISO 12152, *Lubricants, industrial oils and related products — Determination of the foaming and air release properties of industrial gear oils using a spur gear test rig — Flender foam test procedure*

ISO 12185, *Crude petroleum and petroleum products — Determination of density — Oscillating U-tube method*

ISO 12937, *Petroleum products — Determination of water — Coulometric Karl Fischer titration method*

ISO 13226, *Rubber —Standard reference elastomers (SREs) for characterizing the effect of liquids on vulcanized rubbers*

ISO 14593, *Water quality — Evaluation of ultimate aerobic biodegradability of organic compounds in aqueous medium — Method by analysis of inorganic carbon in sealed vessels (CO2 headspace test)*

ISO 14635-1, *Gears — FZG test procedures — Part 1: FZG test method A/8,3/90 for relative scuffing load-carrying capacity of oils*

ISO 14669, *Water quality — Determination of acute lethal toxicity to marine copepods (Copepoda, Crustacea)*

ISO 16221, *Water quality — Guidance for determination of biodegradability in the marine environment*

ISO 19291, *Lubricants — Determination of tribological quantities for oils and greases — Tribological test in the translator oscillation apparatus*

ISO 20764, *Petroleum and related products — Preparation of a test portion of high-boiling liquids for the determination of water content — Nitrogen purge method*

EN 16807, *Liquid petroleum products. Bio-lubricants. Criteria and requirements of bio-lubricants and bio-based lubricants*

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

ASTM D 6866-12, *Standard Test Method for Determining the Biobased Content of Solid, Liquid and Gaseous Samples using Radiocarbon Analysis*

DIN 51819-3, *Testing of lubricants — Mechanical-dynamic testing in the roller bearing test apparatus FE8 — Part 3: Test method for lubricating oils, axial cylindrical roller bearing*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Sampling

Sampling of gear oils for the purpose of this document shall be carried out in accordance with the pertinent procedure described in ISO 3170. The sample shall be evaluated on a representative portion. Any drum, barrel, tanker compartment or any type of container delivered to the end user may be sampled and analysed at the discretion of the purchaser.

5 Environmental requirements for categories CKTG, CKES, CKPG, CKPR

Environmentally acceptable lubricants shall comply with all or part of the requirements of EN 16807. CKTG, CKES, CKPG, and CKPR shall comply with the toxicity requirements. Additionally, CKTG and CKES shall comply with the biodegradability and carbon of biological origin requirements (see Table 1).

In a product line of either of the categories, toxicity requirements have not to be tested on all grades of a line that uses the same additive package and the same range of base stocks. Testing can be limited to the lightest, medium and heaviest grade of the line.

Table 1 — Environmental requirements for categories CKTG, CKES, CKPG, CKPR

Characteristic of test	Unit	Requirement	Test method or applicable standard
Biodegradability, min.[a c]	%	60	ISO 14593 or ISO 9439 or ISO 16221 or ISO 9408
Toxicity EC 50 (algal growth inhibition or marine algal growth inhibition)	mg/l	>100	ISO 8692 or ISO 10253
Toxicity in terrestrial environment. Terrestrial plant test: seeding emergence and seeding growth test	%	Report	OECD 208
EC50 (daphnia or copepods)	mg/l	>100	ISO 6341 or ISO 14669
LC 50 (fish)	mg/l	>100	ISO 7346-1
Content of carbon of biological origin, min [b]	%	25	ASTM D 6866

[a] All actual eco-labels, regulations and recommendations are referring to the ISO and EN test methods given in this table. Claims of biodegradability in other environments (e.g. landfill) currently lack appropriate standards, although development work is ongoing. Precision information is currently under development.

[b] Applies only to CKTG and CKES type products.

[c] CKPG and CKPR type products may not completely fulfill this requirement.

6 Specifications

Detailed specifications for each category mentioned in this part of ISO 12925 are provided in Tables 2 to 14, as indicated below:

— Table 2: category CKB;

— Table 3: category CKC;

— Table 4: category CKD;

— Table 5: category CKSMP;

This category concerns products exhibiting protection against micro-pitting. So far, no recognized industry standard exists to assess the micro-pitting protection performance. Once one relevant standard is available, the specification will be changed.

— Table 6: category CKE;

— Table 7: category CKTG;

— Table 8: category CKES;

— Table 9: category CKPG;

— Table 10: category CKPR;

— Table 11: category CSPG;

— Table 12: category CSPR;

— Table 13: category CTPG;

— Table 14: category CTPR.

The composition, properties and typical applications of each category are stated at the top of the tables. These elements shall be in accordance with ISO 6743-6.

The precision (repeatability and reproducibility) of the test methods in this document and the interpretation of the results shall be in accordance with ISO 4259, which shall be consulted in instances of uncertainty or dispute.

Table 2 — Specifications for lubricants for enclosed gear systems of category CKB

Composition and properties: Refined mineral oils with oxidation stability, corrosion protection (ferrous and nonferrous metals) and antifoam properties. **Typical application:** Gears operating under light to moderate loads													
Property		**Test method**	**Unit**	**Specifications**									
Viscosity class		ISO 3448		VG 32	VG 46	VG 68	VG 100	VG 150	VG 220	VG 320	VG 460	VG 680	VG 1 000	VG 1 500
Kinematic viscosity at 40°C	Min.	ISO 3104	mm^2/s	28,8	41,4	61,2	90	135	198	288	414	612	900	1 350
	Max.			35,2	50,6	74,8	110	165	242	352	506	748	1 100	1 650
Appearance		[a]		B and C[b]	B and C[b]	B and C[b]	B and C[b]	B and C[b]	B[c]	B[c]	B[c]	B	B[c]	B[c]
Viscosity index, min.		ISO 2909		90	90	90	90	90	90	90	90	85	85	85
Density		ISO 12185 or ISO 3675	kg/m^3	Report										
Water content, max.		ISO 12937 or ISO 20764	% (m/m)	<0,1										
Acid number		ISO 6618 or ISO 6619	mg KOH/g	Report										
Pour point, max.		ISO 3016	°C	–12	–12	–12	–12	–9	–9	–9	–9	–3	–3	–3
Flash point, min.		ISO 2592	°C	180	180	180	200	200	200	200	200	200	200	200
Foaming Tendency / stability max.		ISO 6247										1		
Sequence 1 at 24 °C			ml/ml	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10	00/10	100/10	100/10
Sequence 2 at 93 °C			ml/ml	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10
Sequence 3 at 24 °C after 93 °C			ml/ml	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10
Copper corrosion 3 h, 100 °C, max.		ISO 2160	rating	1	1	1	1	1	1	1	1	1	1	1
Demulsibility [f] Test temperature 54 °C Time to reach ≤3 ml emulsion max.		ISO 6614	minutes	30	30	30	—	—	—	—	—	—	—	—
Test temperature 82 °C Time to reach ≤3 ml emulsion max.			minutes	—	—	—	30	—	—	—	—	—	—	—

Table 2 *(continued)*

Composition and properties: Refined mineral oils with oxidation stability, corrosion protection (ferrous and nonferrous metals) and antifoam properties. **Typical application:** Gears operating under light to moderate loads													
Property	**Test method**	**Unit**	**Specifications**										
Viscosity class	ISO 3448		VG 32	VG 46	VG 68	VG 100	VG 150	VG 220	VG 320	VG 460	VG 680	VG 1 000	VG 1 500
Demulsibility (45 ml water) [f] Procedure A	ASTM D 2711												
Free water volume min.		ml	—	—	—	—	30	30	30	30	30	30	30
Emulsion volume max.		ml	—	—	—	—	2	4,0	4,0	4,0	4,0	4,0	4,0
Water in oil max.		%	—	—	—	—	0,5	2,0	2,0	2,0	2,0	2,0	2,0
Rust test (24 h) A and B methods	ISO 7120	Rating	Pass										
Oxidation stability Time to reach an acid number of 2 mg KOH/g, min.	ISO 4263-1	Hours	1 000	1 000	1 000	1 000	1 000	1 000	1 000	1 000	1 000	1 000	1 000

Table 2 *(continued)*

Composition and properties: Refined mineral oils with oxidation stability, corrosion protection (ferrous and nonferrous metals) and antifoam properties. **Typical application:** Gears operating under light to moderate loads												
Property	**Test method**	**Unit**	**Specifications**									
Viscosity class	ISO 3448		VG 32	VG 46	VG 68	VG 100	VG 150	VG 220	VG 320	VG 460	VG 680	VG 1 000	VG 1 500
Elastomer compatibility[e] NBR/SRE 28SX[d] 168 h ± 2 h at 100 °C ± 1 °C	ISO 18107												
Volume variation, max;		%						Report					
Shore A hardness variation max.		points						Report					
Elongation at break variation, max.		%						Report					
Tensile strength variation, max.		%						Report					

[a] There is presently no accepted test method. Visual observation is to be reported as indicated. The objective is to ensure that the lubricant does not appear turbid or contain suspended or settled impurities.

[b] Bright and clear.

[c] Bright.

[d] Standard reference elastomer according to ISO 13226.

[e] The elastomer compatibility with the reference elastomer SRE NBR 28/SX is not a quality criterion. Correlation to elastomers used in practice should be checked. The values serve as guidance for the selection of elastomers used in practice by the elastomer manufacturer. For information and orientation, the formerly used limits (7 days at 100 °C) are reported here as follows: volume change: 0/+10%; Shore A hardness change: -10/+5%; tensile strength change: max. +30%; elongation at break change: max. +30%.

[f] This characteristic does not apply to products containing detergents and dispersing agents and to hygroscopic products.

Table 3 — Specifications for lubricants for enclosed gear systems of category CKC

Composition and properties: Oils of category CKB with enhanced extreme pressure and anti-wear properties. **Typical applications**: Gear systems operating at a stabilized temperature that remains normal or medium, and under high load.														
Property		**Test method**	**Unit**	**Specifications**										
Viscosity class		ISO 3448		VG 32	VG 46	VG 68	VG 100	VG 150	VG 220	VG 320	VG 460	VG 680	VG 1 000	VG 1 500
Kinematic viscosity at 40 °C	Min.	ISO 3104	mm^2/s	28,8	41,4	61,2	90	135	198	288	414	612	900	1 350
	Max.			35,2	50,6	74,8	110	165	242	352	506	748	1 100	1 650
Appearance		[a]		B and C[b]	B and C[b]	B and C[b]	B and C[b]	B and C[b]	B[c]	B[c]	B[c]	B[c]	B[c]	B[c]
Viscosity index, min		ISO 2909		90	90	90	90	90	90	90	90	85	85	85
Density		ISO 12185 or ISO 3675	kg/m^3	Report										
Water content, max.		ISO 12937 or ISO 20764	% (m/m)	<0,1										
Acid number		ISO 6618 or ISO 6619	mg KOH/g	Report										
Pour point, max.		ISO 3016	°C	- 12	- 12	- 12	- 12	- 9	- 9	- 9	- 9	–3	–3	–3
Flash point, min.		ISO 2592	°C	180	180	180	200	200	200	200	200	200	200	200
Foaming Tendency / stability max.		ISO 6247												
Sequence 1 at 24 °C			ml/ml	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10	00/10	100/10
Sequence 2 at 93 °C			ml/ml	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10
Sequence 3 at 24 °C after 93 °C			ml/ml	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10	100/10
Copper corrosion 3 h, 100 °C, max.		ISO 2160	Rating	1	1	1	1	1	1	1	1	1	1	1
Demulsibility [h] Test temperature 54 °C		ISO 6614												
Time to reach ≤3 ml emulsion max.			minutes	30	30	30	—	—	—	—	—	—	—	—
Test temperature 82 °C														
Time to reach ≤3 ml emulsion max.			minutes	—	—	—	30	—	—	—	—	—	—	—

Table 3 *(continued)*

Composition and properties: Oils of category CKB with enhanced extreme pressure and anti-wear properties. **Typical applications**: Gear systems operating at a stabilized temperature that remains normal or medium, and under high load.													
Property	**Test method**	**Unit**	**Specifications**										
Viscosity class	ISO 3448		VG 32	VG 46	VG 68	VG 100	VG 150	VG 220	VG 320	VG 460	VG 680	VG 1 000	VG 1 500
Demulsibility (90 ml water) [h] Procedure B	ASTM D 2711												
Free water volume min.		ml	—	—	—	—	80,0	80,0	80,0	50,0	50,0	50,0	50,0
Emulsion volume max.		ml	—	—	—	—	1,0	1,0	1,0	4,0	4,0	4,0	4,0
Water in oil max.		%	—	—	—	—	2,0	2,0	2,0	2,0	2,0	2,0	2,0
Rust test (24 h) A and B methods	ISO 7120	Rating	Pass										
Oxidation stability (95 °C)	ISO 4263-4												
Kinematic viscosity at 100 °C increase, max.		%						6					
Precipitation number increase, max.		—						0,1					
Load carrying properties[e] – A/8,3/90	ISO 14635-1												
Failure stage, min.								12					
Antifriction bearing wear test FE 8 machine D 7,5/80–80[f]	DIN 51819–3												
Rolling elements wear, max.		mg						30					
Foaming and air release characteristics – Flender foam test	ISO 12152	%											
Total volume increase after 1 min stand-by.			No requirement				15 max.						Report
Total oil air dispersion after 5 min stand-by.							10 max.						