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

Part 2: Specifications of categories CKH, CKJ and CKM (lubricants open and semi-enclosed gear systems)

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

Partie 2: Spécifications des lubrifiants de catégories CKH, CKJ et CKM pour engrenages nus et sous carter semi-fermé

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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 of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 28, *Petroleum and related products, fuels and lubricants from natural or synthetic sources*, Subcommittee SC 4, *Classifications and specifications.*

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Lubricants for gear systems are used in diverse types of gear designs, ranging from simple parallel spur to 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) and additives friction modifying and / or extreme-pressure. Depending on the type of application and range, viscosity grades, in accordance with ISO 3448, vary from the low viscosity ISO VG 32 to high viscosity ISO VG 1 500; 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 sources of heat like in the cement industry or in the steel industry.

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

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

Part 2: Specifications of categories CKH, CKJ and CKM (lubricants open and semi-enclosed gear systems)

1 Scope

This document establishes an extended classification which includes sub-categories of environmentally acceptable lubricants and specifies the minimum requirements for mineral or synthetic based lubricants for the categories CKH, CKJ and CKM, according to ISO 6743-6, and their sub-categories of environmentally acceptable lubricants, intended for the lubrication of open and semi-enclosed gears.

This document covers the lubricants applied in the open and semi-enclosed gear systems most currently encountered in the industry. It does not cover the extreme cases of use with regards to temperature and extreme charges conditions.

NOTE 1 For use in exceptional conditions, suppliers and purchasers of lubricants can mutually agree on additional testing methods and acceptability criteria of the products.

NOTE 2 This document can be read in conjunction with ISO 6743-6.

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

ISO 3016, *Petroleum and related products from natural or synthetic sources — Determination of pour point*

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 3838, *Crude petroleum and liquid or solid petroleum products — Determination of density or relative density — Capillary-stoppered pyknometer and graduated bicapillary pyknometer methods*

ISO 4259-2, *Petroleum and related products — Precision of measurement methods and results — Part 2: Interpretation and application of precision data in relation to methods of test*

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

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

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 14635-3, *Gears — FZG test procedures — Part 3: FZG test method A/2, 8/50 for relative scuffing load-carrying capacity and wear characteristics of semifluid gear greases*

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*

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

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

CEN/TS 16640, *Bio-based products — Determination of the bio based carbon content of products using the radiocarbon method*

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 https://www.iso.org/obp

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

4 Sampling

Sampling of gear oils for the purpose of this document, unless otherwise specified, 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 Open gear lubricants

5.1 Open gears

Open gears are generally high modulus and large diameter gears, operating at relatively low pitch line velocities. The lubrication needs of open gears are not less than those of enclosed gears, but the large size and the generally used application devices add additional needs, mainly adhesion to the gear flanks. The low speed and the relatively low tooth surface finish require much more viscous lubricants than for enclosed gears; in addition, high viscosity favours a better adhesion, a better resistance to flow and a better rust protection.

5.2 Viscosity of open gear lubricants

According to ISO 3448, viscosity classification of industrial lubricants is limited to viscosity, as determined by ISO 3104, of 3 200 mm^2/s at 40 °C. Some commonly used open gear lubricants have viscosity above 3 200 mm^2/s at 40 °C. A need therefore exists to define other viscosity grades. For some very viscous products, viscosity at 40 °C cannot longer be determined. To define the grade of very viscous products, temperatures higher than 40 °C shall be chosen.

To extend ISO 3448 viscosity classification of industrial lubricants, the grades given in Table 1 have been established for the classification of open gear lubricants. The viscosities of grades 1 and 2 follow the logical of the ISO 3448 viscosity classification with respect to the progression of the viscosity grades. For the grades 3, 4 and 5, the classification is established using the kinematic viscosity at 100 °C.

Table 1 — Viscosity grades for open gear lubricants

Grade	Kinematic viscosity at 40 °C mm^2/s		Kinematic viscosity at 100 °C mm^2/s	
	minimum	maximum	minimum	maximum
1	4 140	5 060	-	-
2	6 120	7 480	-	-
3	-	-	200	400
4	-	-	400	800
5	-	-	800	

6 Extended classification for open gear lubricants

The classification in accordance with ISO 6743-6 gives three categories of open gear lubricants, CKH, CKJ and CKM. In the CKJ category, additional sub-categories have been added, corresponding to products intended for applications where environmentally acceptable products are required. For the products containing solid lubricants or mineral fillers, the suffix "–F" is added.

The extended classification of open gear lubricants is defined in Table 2. The extended classification for environmentally acceptable products is defined in Table 3.

Table 2 — Classification of lubricants for open and semi-enclosed gear systems

Particular application	More specific application	Composition and properties	Symbol ISO -L	Typical applications	Remarks
Open or semi-enclosed gears	Continuous or intermittent application, manual, splash or spray	Viscous products, mineral, partially synthetic or synthetic, with enhanced corrosion protection properties.	CKH	Open gears operating under moderate loads, at average temperature.	These products may be diluted in a solvent to make their application easier. In such a case, the suffix DIL is added to the ISO symbol.
		CKH type products with additional extreme-pressure and anti-wear properties.	CKJ	Open gears operating under high loads, at average temperature.	
		CKJ type products, containing solid lubricants (graphite, molybdenum disulfide or other fillers).	CKJ-F	Open or semi-enclosed spur and helical gears, straight bevel gears operating under very high and shock loads.	
	Intermittent application, manual	Viscous products, mineral, partially synthetic or synthetic, with corrosion protection properties, and reinforced anti-seizure properties authorizing a use under extreme loads.	CKM	Open or semi-enclosed spur and helical gears, straight bevel gears operating occasionally under exceptionally high loads.	Non sprayable products.

Table 3 — Classification of lubricants for open and semi-enclosed gear systems, environmentally acceptable

Particular application	Open or semi-enclosed gears		
More specific application	Continuous or intermittent application, manual, splash or spray Applications requiring products environmentally acceptable: biodegradability and / or low eco-toxicity		
Composition and properties	Symbol ISO -L	Typical applications	Remarks
Viscous products, based on triglycerides and triglycerides derivatives, with enhanced corrosion protection (ferrous and non- ferrous metals), extreme-pressure and anti-wear properties	CKJTG	Open or semi-enclosed gears (parallel straight or helical, bevel straight or helical) operating under high loads, at average temperature	These products may be diluted in a solvent to make their application easier. In such a case, the suffix DIL is added to the ISO symbol.
Viscous products, based on synthetic esters, with enhanced corrosion protection (ferrous and non-ferrous metals), extreme-pressure and anti-wear properties	CKJES	Open or semi-enclosed gears (parallel straight or helical, bevel straight or helical) operating under high loads, at average temperature	
Viscous products, based on poly-glycols, with enhanced corrosion protection (ferrous and non- ferrous metals), extreme-pressure and anti-wear properties	CKJPG	Open or semi-enclosed gears (parallel straight or helical, bevel straight or helical) operating under high loads, at average temperature	
For the lubricants containing solid lubricants, like molybdenum disulphide, graphite, or any type of filler, add to the symbol the suffix –F.			

Table 3 *(continued)*

Particular application	**Open or semi-enclosed gears**		
More specific application	**Continuous or intermittent application, manual, splash or spray** **Applications requiring products environmentally acceptable: bio-degradability and / or low eco-toxicity**		
Composition and properties	**Symbol ISO -L**	**Typical applications**	**Remarks**
Viscous products, based poly α-olefins, related hydrocarbons, or white mineral oils as a main component, with other types of bases (poly-glycols miscible with hydrocarbons, esters) in various proportions, with enhanced corrosion protection (ferrous and non-ferrous metals), extreme-pressure and anti-wear properties	CKJPR	Open or semi-enclosed gears (parallel straight or helical, bevel straight or helical) operating under high loads, at average temperature	
For the lubricants containing solid lubricants, like molybdenum disulphide, graphite, or any type of filler, add to the symbol the suffix –F.			

7 Additional requirements for the environmentally acceptable lubricants

The requirements published in EN 16807 are intended as horizontal requirements for all bio-based lubricants, and represent minimum requirements compared to, for example, the European Ecolabel for Lubricants[1]. With the exception of content of carbon of biological origin these requirements are also seen as minimum requirements for any other type of environmental standard existing in the world.

Environmentally acceptable lubricants shall conform with all or part of the requirements of EN 16807. CKJTG, CKJES, CKJPG, and CKJPR shall conform with the toxicity requirements. Additionally, CKJTG and CKJES shall conform with the biodegradability and the carbon of biological origin requirements in accordance with Table 4.

In a product line of either of the categories, toxicity requirements are not required 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 4 — Environmental requirements for categories CKJTG, CKJES, CKJPG, CKJPR

Characteristic of test	**Unit**	**Requirement**	**Test method**
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
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 or CEN/TS 16640

[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.

[b] Applies only to CKJTG and CKJES type products.

[c] CKJPG and CKJPR type products may not completely fulfil this requirement.