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

**Part 3:
Specifications for greases for enclosed
and open gear systems**

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

*Partie 3: Specifications des graisses pour engrenages sous carter et
engrenages nus*



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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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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 gears to bevel gears (straight or helical), worm gears and hypoid gears. Industrial gear systems, which are either of opened 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. Viscosity grades according to ISO 3448^[5] vary, depending on the type of application and range, 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 can 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.

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

Part 3: Specifications for greases for enclosed and open gear systems

1 Scope

This document establishes a classification and specifies the minimum requirements for mineral or synthetic base stock-based greases for the categories CKG and CKL according to ISO 6743-6 intended for the lubrication of enclosed and open gear systems.

This document does not cover the extreme cases of use in terms of temperature and extreme charges conditions. For use in exceptional conditions, suppliers and purchasers of lubricants are intended to mutually agree on the testing methods and the acceptability criteria of the products, not covered by this document.

NOTE 1 This document can be read in conjunction with ISO 6743-6, ISO 6743-9^[1], ISO 12924^[3] and ISO 6743-99^[2].

NOTE 2 For the purpose of this document, the terms “% (m/m)” and “% (V/V)” are used to represent respectively the mass fraction and the volume fraction of a material.

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 2137, *Petroleum products and lubricants — Determination of cone penetration of lubricating greases and petrolatum*

ISO 2176, *Petroleum products — Lubricating grease — Determination of dropping point*

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

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

ISO 3733, *Petroleum products and bituminous materials — Determination of water — Distillation method*

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 6299, *Petroleum products — Determination of dropping point of lubricating greases (wide temperature range)*

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

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 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 11007, *Petroleum products and lubricants — Determination of rust-prevention characteristics of lubricating greases*

ISO 11009, *Petroleum products and lubricants — Determination of water washout characteristics of lubricating greases*

ISO 13737, *Petroleum products and lubricants — Determination of low-temperature cone penetration of lubricating greases*

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 14635-3, *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 22285, *Petroleum products and lubricants — Determination of oil separation from grease — Pressure filtration method*

ISO 22286, *Petroleum products and lubricants - Determination of the dropping point of grease with an automatic apparatus*

ISO 23572, *Petroleum products — Lubricating greases — Sampling of greases*

EN 16807, *Liquid petroleum products — Bio-lubricants — Criteria and requirement of bio-lubricants and bio-based lubricants*

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

EN 17181, *Lubricants — Determination of aerobic biological degradation of fully formulated lubricants in an aqueous solution — Test method based on CO₂-production*

ASTM D6866, *Standard Test Methods for Determining the Biobased Content of Solid, Liquid and Gaseous Samples Using Radiocarbon Analysis*

DIN 51819-2, *Testing of lubricants — Mechanical-dynamic testing in the roller bearing test apparatus FE8 - Part 2: Test method for lubricating greases - applied test bearing: oblique ball bearing or tapered roller bearing*

OECD 208, *Terrestrial Plant Test — Seedling Emergence and Seedling Growth Test*

3 Terms and definitions

No terms and definitions are listed in this document.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

4 Sampling

Unless otherwise specified, sampling of gear greases shall be carried out in accordance with the relevant procedure described in ISO 23572. 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 Greases for gear systems

5.1 Penetrability of gear greases

Gear greases are greases of NLGI consistencies, as per ISO 6743-99, in the range of 000 to 1, i.e. greases that are very soft up to soft at ambient temperature.

5.2 Classes of gear greases

5.2.1 Greases for enclosed gear systems CKG

These are generally NLGI 000, 00, 0 consistency grade greases, made from mineral or synthetic base stocks (most generally in the ISO VG 150 to 460 range), thickeners of various types (most generally conventional lithium or lithium/calcium soaps), antioxidants and corrosion inhibitors. They might also contain additives to improve the load carrying properties. These greases are generally used with splash lubrication.

5.2.2 Greases for open and semi-enclosed gear systems CKL

These are generally NLGI 0, 1, less frequently 2 consistency grade greases made from mineral or synthetic base stocks (most generally in the ISO VG 680 to 3200 range), thickeners of various types (most generally conventional lithium or lithium/calcium soaps), antioxidants and corrosion inhibitors. They might also contain additives to improve the load carrying properties and solid lubricants like graphite, molybdenum disulfide, etc.

6 Classification of greases for gear systems

6.1 Classification of greases for enclosed gear systems

[Table 1](#) gives the classification of greases for enclosed gear systems. The ISO-L symbol is completed by the NLGI grade.

[Table 2](#) gives the classification of greases for enclosed gear systems for applications requiring environmentally acceptable products: biodegradability and/or low eco-toxicity. The ISO-L symbol is completed by the NLGI grade.

Table 1 — Classification of greases for enclosed gear systems

Particular application	Enclosed gears		
More specific application	Splash lubrication		
Composition and properties	Symbol ISO-L	Typical applications	Remarks
Greases based on mineral oils, exhibiting rust protection properties and protected against oxidation	CKGB	Enclosed gears (parallel straight or helical, bevel straight or helical, worm), operating under moderate loads	Pitch line velocity of enclosed gears grease lubricated is limited to 4,5 m/s.
Greases based on mineral oils, exhibiting rust protection properties, improved load carrying properties, and protected against oxidation	CKGD	Enclosed gears (parallel straight or helical, bevel straight or helical, worm), operating under high loads	
Greases based on poly-glycols, with enhanced oxidation, corrosion protection (ferrous and non-ferrous metals), extreme-pressure and anti-wear properties	CKGPG	Enclosed gears (parallel straight or helical, bevel straight or helical, worm) operating under moderate to high loads, at very low, low, or very high running temperatures.	Pitch line velocity of enclosed gears grease lubricated is limited to 4,5 m/s – some synthetic oil-based greases are particularly adapted for worm gears lubrication.
Greases based on poly α -olefins as a main base oil, with enhanced oxidation, corrosion protection (ferrous and non-ferrous metals), extreme-pressure and anti-wear properties	CKGPR		

Table 2 — Classification of environmentally acceptable greases for enclosed gear systems

Particular application	Enclosed gears		
More specific application	Splash lubrication Applications requiring products environmentally acceptable: biodegradability and/or low eco-toxicity		
Composition and properties	Symbol ISO -L	Typical applications	Remarks
Greases based on triglycerides and triglycerides derivatives, with enhanced oxidation, corrosion protection (ferrous and non-ferrous metals), extreme-pressure and anti-wear properties	CGTG	Enclosed gears (parallel straight or helical, bevel straight or helical, worm) operating under moderate to high loads, at average temperatures	Pitch line velocity of enclosed gears grease lubricated is limited to 4,5 m/s
Greases based on synthetic esters, with enhanced oxidation, corrosion protection (ferrous and non-ferrous metals), extreme-pressure and anti-wear properties	CGES		
Greases based on poly-glycols, with enhanced oxidation, corrosion protection (ferrous and non-ferrous metals), extreme-pressure and anti-wear properties	CGPG		
Greases based on poly α -olefins, related hydrocarbons, or white mineral oils as main component, with other types of bases (poly-glycols miscible with hydrocarbons, esters) in various proportions, with enhanced oxidation, corrosion protection (ferrous and non-ferrous metals), extreme-pressure and anti-wear properties	CGPR		

6.2 Classification of greases for open and semi-enclosed gears

The classification of greases for open and semi-enclosed gears is given in [Table 3](#). This classification covers environmentally acceptable products (biodegradable and/or low eco-toxicity).

Table 3 — Classification of greases for open gear systems

Particular application	Open and semi-enclosed gears		
More specific application	Continuous or intermittent application, manual, splash or spray. Possibly environmentally acceptable in terms of biodegradability and/or eco-toxicity		
Composition and properties	Symbol ISO -L	Typical applications	Remarks
Greases based on mineral oils, exhibiting improved load carrying properties, rust protection properties, adhesiveness and water resistance.	CKLC	Parallel straight or helical gears operating under high loads.	
NOTE For the lubricants containing solid lubricants, like molybdenum disulfide, graphite, or any type of filler, the suffix -F is added to the symbol.			

Table 3 (continued)

Particular application	Open and semi-enclosed gears		
More specific application	Continuous or intermittent application, manual, splash or spray. Possibly environmentally acceptable in terms of biodegradability and/or eco-toxicity		
Composition and properties	Symbol ISO -L	Typical applications	Remarks
Greases based on triglycerides and triglycerides derivatives, exhibiting improved load carrying properties, rust protection properties, adhesiveness and water resistance.	CKLTG	Parallel straight or helical gears operating under high loads. Eventually, when biodegradability is required.	
Greases based on synthetic esters, exhibiting improved load carrying properties, rust protection properties, adhesiveness and water resistance.	CKLES	Parallel straight or helical gears operating under high loads, at low or high temperatures. Eventually, when biodegradability is required.	
Greases based on poly-glycols, exhibiting improved load carrying properties, rust protection properties, adhesiveness and water resistance.	CKLPG	Parallel straight or helical gears operating under high loads, at low or high temperatures. Eventually, when environment acceptability is required.	
Greases based on 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, exhibiting improved load carrying properties, rust protection properties, adhesiveness and water resistance.	CKLPR		
NOTE For the lubricants containing solid lubricants, like molybdenum disulfide, graphite, or any type of filler, the suffix -F is added to the symbol.			

6.3 Environmentally acceptable gear greases

6.3.1 Requirements

The requirements of 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^[4]. Except for content of carbon of biological origin, these requirements are also considered as minimum requirements for any other type of environmental standard available globally.

Environmentally acceptable gear greases shall comply with all or part of the requirements of EN 16807. CKLTG, CKLES, CKLPG, CKLPR, CGTG, CGES, CGPG, CGPR shall comply with the toxicity requirements. Additionally, CKLTG, CKLES, CGTG and CGES shall comply with the biodegradability and carbon of biological origin requirements as defined in [Table 4](#).

Table 4 — Environmental requirements for gear greases categories CKLTG, CKLES, CKLPG, CKLPR, CGTG, CGES, CGPG, CGPR

Characteristic of test	Unit	Requirement	Test method
Biodegradability, min. ^{a c}	% (m/m)	50	ISO 14593 ^d or ISO 9439 ^d or EN 17181 ^d
Toxicity			
EC 50 (algal growth inhibition or marine algal growth inhibition)	mg/l	> 100	ISO 8692 or ISO 10253
Toxicity in terrestrial environment	% (m/m)	report	OECD 208
Terrestrial plant test: seeding emergence and seeding growth test			
EC50 (daphnia or copepods)	mg/l	> 100	ISO 6341 ^d or ISO 14669 ^d
LC 50 (fish)	mg/l	> 100	ISO 7346-1 ^d
Content of carbon of biological origin, min. ^b	% (m/m)	25	ASTM D6866 or EN 16640
^a ISO and EN test methods given in this table cover all eco-labels, regulations and recommendations applicable at the time of publication of this document. Claims of biodegradability in other environments (e.g. landfill) currently lack appropriate standards, although development work is ongoing. Precision information is under development. ^b Applies only to CKLTG, CKLES, CGTG, CGES type products. ^c CKLPG, CKLPR, CGPG, CGPR type products may not completely fulfil this requirement. ^d The interpretation of the results of this test method is limited due to missing or inapplicable precision data. In case of dispute or doubt, a referee test should be performed in an independent laboratory.			

6.3.2 Biodegradability

In case of dispute, the referee method for compliance with the biodegradability requirement shall be EN 17181. In order to check the procedure during the referee process, a reference compound of known biodegradability shall be tested in parallel. Aniline may be used when testing water-soluble test compounds; for poorly soluble test substances, high oleic reference oil (HORO) should be used.

6.3.3 Acute daphnia or copepods toxicity

In case of dispute, the referee method for compliance with the invertebrate requirement shall be ISO 6341. In order to check the procedure during the referee process, a reference compound of known toxicity shall be tested in parallel. Tetrapropylenebenzenesulfonic acid may be used when testing water-soluble test compounds; for poorly soluble test substances potassium 2,4,5 trichlorophenoxyacetate should be used.

7 Specifications of greases for gear systems

7.1 General

Most of the test methods used in [Table 5](#) contain a precision statement. In cases of dispute, if the conditions of the ISO 4259 series can be met with the relevant test method, the procedure described in ISO 4259-2 shall apply.

7.2 Specifications of greases for gear systems

The specifications of the greases for gear systems are given in [Table 5](#). The greases for enclosed gears are normally intended for use in the operating temperature range –20 °C up to 120 °C. However, starting temperature lower than –20 °C can be envisaged. The supplier shall demonstrate that the grease will not channel at the starting temperature.

The greases for open or semi-enclosed gears can operate, depending on the climate conditions, in very diverse temperature conditions: down to -40 °C and up to 60 °C. The supplier shall demonstrate that the grease is adapted to the dispensing devices at the lowest operating temperature.

Table 5 — Specifications of greases for gear systems

Property	Method	Unit	NLGI consistency grade			
			000	00	0	1
Penetration at 25 °C	ISO 2137					
minimum		1/10 mm	445	400	365	310
maximum		1/10 mm	475	430	385	340
Shear stability – Worked penetration after 100 000 strokes	ISO 2137	1/10 mm	No requirement		Shall not differ by more than 75 1/10 mm from the 60 strokes worked penetration	
Dropping point	ISO 2176 or ISO 6299 or ISO 22286	°C	Report			
Oil separation at 40 °C	ISO 22285	% (m/m)	Report			
Corrosiveness to copper (24 h at 100 °C)	ISO 2160	rating	< 2			
Rust protection ^a (maximum)	ISO 11007	rating	To be agreed upon		2-2	
Extreme-pressure properties A/2,8/50	ISO 14635-3	Rating	12			
Failure load stage (minimum)						
Antifriction bearing wear test FE 8 machine A 7,5/80-80	DIN 51819-2		Not required		Report	
Rolling elements wear, maximum						
Base oil viscosity			Report			
at 40 °C	ISO 3104	mm ² /s				
at 100 °C	ISO 3104	mm ² /s	Report			
Thickener type			Report			
Water content	ISO 3733		Report			
Water resistance ^b	ISO 11009	% (m/m)	Not required		< 30	
Solid lubricant/filler ^c			Report type, concentration and size distribution			

^a Corrosion protection properties: in very difficult weather conditions, additional rust protection properties may be required for the products of the CKL (open and semi-enclosed gears) range. ISO 11007 is not applicable to the greases of NLGI grades 000 and 00. In any case, test methods and limits are to be agreed between the end user and the supplier.

^b ISO 11009 does not apply for greases softer than NLGI N°1 grades. For products of the CKL range, test methods and limits are to be agreed between the end user and the supplier.

^c Solid lubricant/filler: applies to -F type products.

^d Elastomer, temperature and duration, limits for the variation of the elastomer properties to be agreed between the end user and the supplier.

^e Applies to products of the CKL range. Test methods and limits are to be agreed between the end user and the supplier.

^f Any other suitable method can be used. Applies to CKG range products. The supplier shall demonstrate that, at the starting temperature, the grease does not channel and ensures good lubrication of the contacting gears.