SLOVENSKI STANDARD
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Tekoči naftni proizvodi - Biomaziva - Kriteriji in zahteve za biomaziva in maziva na biološki osnovi

Liquid petroleum products - Bio-lubricants - Criteria and requirements of bio-lubricants and bio-based lubricants

Flüssige Mineralöl-Erzeugnisse - Bio-Schmierstoffe - Kriterien und Anforderungen an Bio -Schmierstoffe und bio-basierte Schmierstoffe

Produits pétroliers liquides - Bio-lubrifiants - Critère et exigences de bio-lubrifiants et lubrifiant en basse biologique

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Produits pétroliers liquides - Bio-lubrifiants - Critères et exigences sur les bio-lubrifiants et lubrifiants d'origines biologiques

Flüssige Mineralöl-Erzeugnisse - Bio-Schmierstoffe - Kriterien und Anforderungen für Bio-Schmierstoffe und bio-basierte Schmierstoffe

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European foreword

This document (EN 16807:2016) has been prepared by Technical Committee CEN/TC 19 “Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin”, the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2017, and conflicting national standards shall be withdrawn at the latest by April 2017.

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

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association. Mandate M/430 covers the development of European standards for bio-lubricants in relation to bio-based product aspects. It has been prepared by CEN/TC 19/WG 33 “Bio-Lubricants”, the secretariat of which is held by DIN.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

General technical specifications for the different types of lubricants, the test methods and criteria for performance are well defined compared to characteristics of the relatively new class of bio-lubricants.

Despite the great interest in 'environmentally compatible lubricants', the lack of standards and technical language describing these fluids and greases has impeded the growth of the market for these types of lubricants. Standards and definitions are only available for single groups of lubricants, for example for hydraulic fluids (ISO 15380 [1], some Ecolabels). However, a general, non-contentious and well-accepted description and definition including biodegradability, renewability and aquatic toxicity, consistently valid for all kinds of lubricants, still is missing.

The "bio-"prefix is often considered as a synonym of good for the environment, or in another situation, good for health. The prefix, when associated with lubricants, can be perceived by the consumers as an indication of biodegradability. In other words, a "bio-lubricant" is expected to biodegrade (to break down in the environment), needed for instance in case of leakages or technically intended losses.

In addition, the use of bio-based raw materials could be beneficial with reference to two current problems: fossil resources depletion and climate change. Today, regarding the latter issue, we have to manage the carbon in order to avoid its accumulation in the atmosphere. Efficient use of all available resources and responsible utilization of renewable carbon is a way to participate in this reduction; the prefix "bio" in this sense is taken as an indication of the biological circle.

Further detailed information is given in CEN/TR 16227 [2].

Lubricants are important materials which contribute significantly to efficient use of resources: thanks to their tailor-made properties they reduce energy losses and wear in machines and aggregates. The global manufacture of lubricants in all applications only uses a small part of the entire consumed mineral oil: in Europe, it makes up only about 1 %. The major fraction (>80 %) of the residual fossil material is used for energy production, predominantly for transportation and heating purposes. Besides crude oil, biomass is an additional raw material source for lubricants.

The currently available biomass is consumed in different segments: food and feed production, power and heat generation, biofuel production and industrial applications (e.g. production of paper, fine chemicals). Due to the limited capacity of ecosystems, the utilization efficiency of biomass and availability issues have to be addressed across the whole bio-economy landscape. The eco-efficiency in this competitive use (e.g. energetic use vs. manufacture of goods) should always be in focus.

Today it is mostly acknowledged that it would appear appropriate to use agricultural raw materials predominantly in a cascade of uses, instead of burning them directly in furnaces or engines. That would mean, for example, first producing a bio-lubricant from biomass: around 1 t to 2 t of bio-lubricants can be produced per hectare of agriculture land. The bio-lubricant thereby stores carbon dioxide in the form of vegetable carbon and removes it from atmosphere. It would be desirable to trap this carbon dioxide in the lubricant for as long as possible. Finally, after maximum utilization including recycling when achievable and appropriate, the lubricant can then be used either as energy source or – after re-refining – as downshifted base oil – to return the bound carbon to the natural cycle in the form of carbon dioxide.

In order to ensure responsible and environmentally conscious use of natural (fossil and renewable) resources, a clear and unambiguous terminology is of particular importance.

The approach which is published in this European Standard is focused on the view of the customer: *Are the referred criteria for "bio-lubricants" potentially provable for the formulated product?*

The statement of this document is: *Every announcement with regard to biodegradability, toxicity and renewability should be measurable through the final product in the hands of the customer.*

It has to be stated that this approach, based on testing of mixtures, is in principle complementary to the basics of the chemicals policy in Europe, which is focused on testing of single components and not on

testing of mixtures. Hence, adverse effects in humans and/or the environment are considered for specific chemicals but not for the mixture made of them. However, it has to be stated that the combination of well-tested single components in a mixture can generate synergistic or antagonistic effects. Even if biodegradability or bioaccumulation tests for mixtures maybe difficult to interpret, the view on the mixture is the view of the end-user. Thus, the approach of this standard is meaningful for business-to-consumer communication.

Adverse effects of single components are generally acknowledged and documented in the Safety Data Sheet for the mixture, according to the Classification, Labelling and Packaging Regulation [3].

Finally, this approach intends to enhance the reputation of "bio-lubricants" and the confidence of the customer in this product group.

The criteria and requirements for "bio-lubricants" published in this document are intended as horizontal requirements for all kinds of bio-based lubricants, and should be seen as minimum requirements compared to the European Ecolabel for Lubricants (EEL) [4].

The lubricants' base oils can be made from both biomass and fossil resources. Lubricants made from biomass can be rapidly, slowly, or not biodegradable; their base oils can be natural (unchanged renewable material) or synthetic (chemically modified biomass). Bio-lubricants can be a combination of both natural and synthetic base oils. All the different examples shown in Table 1 are present in the marketplace today and use the term "bio". This is a cause of concern as it can be the source of misleading information and confusion for the final consumers. The dissemination of confusing, ambiguous or misleading information should be prevented in order not to jeopardize the success of such schemes as well as the credibility of industry itself – this is the aim of this European Standard.

Table 1 — Examples for the use of the term "bio" with regard to lubricants

Origin of material	Biodegradability	Example	Occasional wording for the prefix "bio-"
Renewable	Rapidly biodegradable[a]	Rapeseed oil, Tri-methylol-propane-trioleate (TMP-O)	Biodegradable[a] and bio-based[b]
Non-renewable	Biodegradable[a]	Di-isotridecyl-adipate (DITA)	Biodegradable[a]
Renewable	Inherently or non biodegradable	Hydrocarbons from process "Biomass-to-Liquid" (BtL)	Bio-based[b]
Non-renewable	Non biodegradable	White oil for foodgrade lubricants	Biocompatible

[a] According to OECD 301[5].

[b] According to EN 16575.

NOTE In addition, consideration of soil dwelling organisms could be reflected in a future edition.

Even if in a more general approach "environmentally compatible lubricants" can be seen under additional aspects, up to a comprehensive Life Cycle Assessment (LCA), this European Standard focuses on the term bio-lubricant, which comprises requirements regarding biodegradability, aquatic toxicity, content of biomass and performance.

The initial issue of this standard is the qualification of the term “bio-based product” with regard to lubricants.

Since the bio-based content of a lubricant is not acknowledged as an adequate attribute per se, the combination with other environmentally relevant aspects like biodegradability and aquatic toxicity is obvious.

Similarly, the historical view on “bio-lubricants” only in relation to biodegradability shall be extended to aspects of renewable, biological resources.

Hence, this standard combines both the term “bio-based lubricant” and the term “bio-lubricant”, and to avoid misunderstandings, both terms are seen as equivalent according to this standard.

1 Scope

This European Standard specifies the term *bio-lubricant* and minimum requirements for all kinds of bio-lubricants and bio-based lubricants, while e.g. the EEL [4] refers to specific bio-lubricant families.

This European Standard also briefly describes relevant test method needs with respect to the characterization of bio-lubricants. It presents recommendation for related standards in the field of biodegradability, product functionality and the amount of different renewable raw materials and/or different bio-based contents used during manufacturing of such bio-lubricants forming one product group.

WARNING — Not all potential risks for the environment can be addressed by this standard.

2 Normative references

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

CEN/TS 16640:2014, *Bio-based products - Determination of the bio based carbon content of products using the radiocarbon method*

EN 16575, *Bio-based products - Vocabulary*

EN ISO 3170, *Petroleum liquids - Manual sampling (ISO 3170)*

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

EN 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 7346-1)*

EN ISO 8692, *Water quality - Fresh water algal growth inhibition test with unicellular green algae (ISO 8692)*

EN 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 9408)*

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

EN ISO 10253, *Water quality - Marine algal growth inhibition test with Skeletonema costatum and Phaeodactylum tricornutum (ISO 10253)*

EN ISO 12922, *Lubricants, industrial oils and related products (class L) - Family H (Hydraulic systems) - Specifications for hydraulic fluids in categories HFAE, HFAS, HFB, HFC, HFDR and HFDU (ISO 12922)*

EN 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 14593)*

ISO 8068, *Lubricants, industrial oils and related products (class L) — Family T (Turbines) — Specification for lubricating oils for turbines*

ISO 10050, *Lubricants, industrial oils and related products (class L) — Family T (Turbines) — Specifications of triaryl phosphate ester turbine control fluids (category ISO-L-TCD)*

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

ISO 12924, *Lubricants, industrial oils and related products (Class L) — Family X (Greases) — Specification*

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

ISO/TS 12927, *Lubricants, industrial oils and related products (class L) — Family M (Metalworking) — Guidelines for establishing specifications*

ISO/TS 12928, *Lubricants, industrial oils and related products (class L) — Family R (Products for temporary protection against corrosion) - Guidelines for establishing specifications*

ISO 13738, *Lubricants, industrial oils and related products (class L) — Family E (Internal combustion engine oils) — Specifications for two-stroke-cycle gasoline engine oils (categories EGB, EGC and EGD)*

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 19378, *Lubricants, industrial oils and related products (class L) — Machine-tool lubricants — Categories and specifications*

ISO 24254, *Lubricants, industrial oils and related products (class L) — Family E (internal combustion engine oils) — Specifications for oils for use in four-stroke cycle motorcycle gasoline engines and associated drivetrains (categories EMA and EMB)*

EN 61039, *Classification of insulating liquids (IEC 61039)*

ASTM D6081, *Standard Practice for Aquatic Toxicity Testing of Lubricants: Sample Preparation and Results Interpretation*

ASTM D6866-12, *Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 16575 and the following apply.

3.1
constituent
any chemical, material or substance of which a product is composed, including mixtures

4 Sampling

Samples shall be taken as described in EN ISO 3170 and/or in accordance with the requirements of national standards or regulations for the sampling of the product under test.

The purchaser may choose to sample and analyse each drum, barrel, tanker compartment or any type of container delivered to the end user.

5 Test methods

5.1 Biodegradation

Basically the biodegradability – the mostly connected wording for bio-lubricants – has been defined. The most commonly used test methods with regard to biodegradation are shown in Table 2; beyond these methods ASTM, DIN and other national procedures with more or less similar methods and restrictions do exist.

For requirements see 6.3.

Table 2 — Test methods for testing the biodegradation of lubricants

Test method	Corresponding OECD test method	Short description – relation to other test methods
EN ISO 9439	OECD 301B [5]	"Modified Sturm test", aerobic degradation, ultimate biodegradation (for non water soluble substances)
EN ISO 14593	OECD 310 [6]	CO_2 -Headspace Test (for non water soluble substances)
ISO 16221	OECD 306 [7]	Biodegradation in Seawater (for non water soluble substances, only to be used for marine environments)
EN ISO 9408	OECD 301F [5]	Manometric respirometric test (for water soluble substances)

NOTE 1 All actual ecolabels, regulations and recommendations are working with the respective ISO or OECD test methods described in Table 2, which include also a limit for "ready biodegradation".

NOTE 2 Claims of biodegradability in other environments (e.g. landfill) currently lack appropriate standards although development work is ongoing.

NOTE 3 Precision information is currently under development.

5.2 Ecotoxicity

For bio-lubricants, toxicological criteria are to be considered. The aim is to protect life in various environments, especially in water (aquatic) and on land (non-aquatic area). Table 3 shows test methods of importance, especially used in the ecolabelling systems. It has to be noted that current EU legislation requests permission for the execution of some of these test methods.

For mixtures like lubricants the CLP Regulation 1272/2008/EC [3] (Classification, Labelling, and Packaging Regulation) is of main importance for assessing the hazard potential, whereas the test methods are detailed in Regulation 440/2008/EC [8]. As a consequence, lubricants not meeting the criteria in 6.4 shall be labelled as "Dangerous for the Environment" (DfE) and may be labelled with the hazard symbol "dead fish/dead tree" (symbol GHS 09), based on the amount of DfE classified components they contain and/or their intrinsic hazard properties.

To avoid this negative labelling for bio-lubricants special toxicity limits are provided, the criteria of 6.4 are required for bio-lubricants.

According to the CLP the health and environmental hazards of a mixture may be evaluated by:

1) either a "conventional" (or "calculation") test method, with limits for single components, or