

TECHNICAL REPORT

**Wind energy generation systems -
Part 4-2: Lubrication of drivetrain components in wind turbines**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**Wind energy generation systems -
Part 4-2: Lubrication of drivetrain components in wind turbines**

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IEC TR 61400-4-2 has been prepared by IEC technical committee 88: Wind energy generation systems, in co-operation with ISO technical committee 60: Gears. It is a Technical Report.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
88/1132/DTR	88/1162/RVDTR

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Report is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts of the IEC 61400 series, published under the general title *Wind energy generation systems*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

The purpose of this IEC Technical Report (TR) is to provide a common reference for lubrication related matters for wind turbine drive trains. ISO/TR 18792 provides information for lubrication of industrial gearboxes. Some information is similar or identical to this document.

The contents are non-normative but useful to wind turbine system and component designers, wind turbine manufacturers, and owners/operators to ensure that lubricant related matters are addressed in the gearbox design and operation phases.

This current edition of the document covers oil lubricated gearboxes and is developed based on experience with predominantly gearboxes with rolling bearings. It can be applied to gearboxes with plain bearings, but possibly does not yet address all aspects of this technology. The document structure is prepared to receive further content related to other components in the wind turbine drivetrain and include additional types of lubricants.

1 Scope

This document, which is a Technical Report, provides non-binding information regarding the lubricant, lubrication system layout, and performance for wind turbine gearboxes. This document covers oil lubricated gearboxes. Additionally, guidance for selected lubricant parameters as well as for monitoring and maintaining lubricant characteristics is offered.

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.

IEC 61400-1, *Wind energy generation systems - Part 1: Design requirements*

IEC 61400-3 (all parts), *Wind energy generation systems - Part 3: Design requirements*

IEC 61400-4, *Wind energy generation systems - Part 4: Design requirements for wind turbine gearboxes*

Bibliography

IEC 60034-14, *Rotating electrical machines - Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher - Measurement, evaluation and limits of vibration severity*

ISO 281, *Rolling bearings - Dynamic load ratings and rating life*

ISO 1522, *Paints and varnishes - Pendulum damping test*

ISO 1817, *Rubber, vulcanized or thermoplastic - Determination of the effect of liquids*

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

ISO 2178, *Non-magnetic coatings on magnetic substrates - Measurement of coating thickness - Magnetic method*

ISO 2409, *Paints and varnishes - Cross-cut test*

ISO 2812-1, *Paints and varnishes - Determination of resistance to liquids - Part 1: Immersion in liquids other than water*

ISO 2812-3, *Paints and varnishes - Determination of resistance to liquids - Part 3: Method using an absorbent medium*

ISO 2943, *Hydraulic fluid power - Filter elements - Verification of material compatibility with fluids*

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

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

ISO 3722, *Hydraulic fluid power - Fluid sample containers - Qualifying and controlling cleaning methods*

ISO 4021, *Hydraulic fluid power - Particulate contamination analysis - Extraction of fluid samples from lines of an operating system*

ISO 4406, *Hydraulic fluid power - Fluids - Method for coding the level of contamination by solid particles*

ISO 4407, *Hydraulic fluid power - Fluid contamination - Determination of particulate contamination by the counting method using an optical microscope*

ISO 4587, *Adhesives - Determination of tensile lap-shear strength of rigid-to-rigid bonded assemblies*

ISO 4628-1, *Paints and varnishes - Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance - Part 1: General introduction and designation system*

ISO 4628-2, *Paints and varnishes - Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance - Part 2: Assessment of degree of blistering*

ISO 6194-4, *Rotary shaft lip-type seals incorporating elastomeric sealing elements - Part 4: Performance test procedures*

ISO/TS 6336-20, *Calculation of load capacity of spur and helical gears: Calculation of scuffing load capacity - Flash temperature method*

ISO/TS 6336-21, *Calculation of load capacity of spur and helical gears: Calculation of scuffing load capacity - Integral temperature method*

ISO/TS 6336-22, *Calculation of load capacity of spur and helical gears: Calculation of micropitting load capacity*

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 10123, *Adhesives - Determination of shear strength of anaerobic adhesives using pin-and-collar specimens*

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

ISO 11500, *Hydraulic fluid power - Determination of the particulate contamination level of a liquid sample by automatic particle counting using the light-extinction principle*

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

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

ISO 13357-1:2017, *Petroleum products - Determination of the filterability of lubricating oils - Procedure for oils in the presence of water³*

ISO 13357-2:2017, *Petroleum products - Determination of the filterability of lubricating oils - Procedure for dry oils⁴*

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 16276-1, *Corrosion protection of steel structures by protective paint systems - Assessment of, and acceptance criteria for, the adhesion/cohesion (fracture strength) of a coating - Part 1: Pull-off testing*

³ A new edition of this document exists but the listed edition applies.

⁴ A new edition of this document exists but the listed edition applies.

ISO 16276-2, *Corrosion protection of steel structures by protective paint systems - Assessment of, and acceptance criteria for, the adhesion/cohesion (fracture strength) of a coating - Part 2: Cross-cut testing and X-cut testing*

ISO 16889, *Hydraulic fluid power - Filters - Multi-pass method for evaluating filtration performance of a filter element*

ISO/TR 18792, *Lubrication of industrial gear drives*

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

ISO 26422, *Petroleum and related products - Determination of shear stability of lubricating oils containing polymers - Method using a tapered roller bearing*

ASTM D445, *Standard test method for kinematic viscosity of transparent and opaque liquids (and calculation of dynamic viscosity)*

ASTM D5185, *Standard test method for multielement determination of used and unused lubricating oils and base oils by inductively coupled plasma atomic emission spectrometry (ICP-AES)*

ASTM D5662, *Standard test method for determining automotive gear oil compatibility with typical oil seal elastomers*

ASTM D6304, *Standard test method for determination of water in petroleum products, lubricating oils, and additives by coulometric Karl Fischer titration*

ASTM D7647, *Standard test method for automatic particle counting of lubricating and hydraulic fluids using dilution techniques to eliminate the contribution of water and interfering soft particles by light extinction*

ASTM E2412, *Standard practice for condition monitoring of in-service lubricants by trend analysis using Fourier transform infrared (FT-IR) spectrometry*

DIN 3990-16, *Gears - FZG test procedures - Part 16: Determination of the micro-pitting load-carrying capacity of lubricants - FZG-test-method GT-C/8,3/90*

DIN 51451, *Testing of petroleum products and related products - Analysis by infrared spectrometry - General working principles*

DIN 51453, *Testing of lubricants - Determination of oxidation and nitration of used motor oils - Infrared spectrometric method*

DIN 51777, *Petroleum products - Determination of water content using titration according to Karl Fischer*

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*

VDMA 23901, *Components and systems for wind turbines in cold environments*

Schaeffler, *Lubrication of Rolling Bearings: Principles, Lubrication Methods, Lubricant Selection and Testing, Storage and Handling, TPI-176, March 2013*

Following standardized test methods were specified in previous versions of IEC 61400-4 and are still widely used in the industry. Whilst the (primarily national) standards are superseded, they are maintained here for reference to guide a structured transition of industrial practice to the test methods specified in this document.

CEC-L-45-A99, *Viscosity shear stability of transmission lubricants (Taper roller bearing rig)*⁵

ASTM D664, *Standard test method for acid number of petroleum products by potentiometric titration*⁶

ASTM D974, *Standard test method for acid and base number by color-indicator titration*⁷

DIN 51360-2, *Prüfung von Schmierstoffen - Prüfung im Shell-Vierkugel-Apparat - Teil 2: Bestimmung der Scherstabilität von polymerhaltigen Schmierölen*⁸

DIN 51517-3, *Lubricants: Lubricating oils - Part 3: Lubricating oils CLP; Minimum requirements*⁹

Following standardized test methods are specified in previous versions of IEC 61400-4 and are widely used in the industry. Whilst they are not referred to in the document, they are maintained here for reference to common industrial practice.

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

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

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

ANSI/AGMA 9005, *Industrial gear lubrication*

ASTM D2893, *Standard test method for oxidation characteristics of extreme-pressure lubrication oils*

ASTM D2983, *Standard test method for low-temperature viscosity of automatic transmission fluids, hydraulic fluids, and lubricants using a rotational viscometer*

⁵ Superseded by ISO 26422.

⁶ Superseded by ISO 6618.

⁷ Superseded by ISO 6619.

⁸ Superseded by ISO 26422.

⁹ For this application substituted by ISO 12925-1.