



International Standard

ISO 4378-3

Plain bearings — Terms, definitions, classification and symbols —

Part 3: Lubrication

Paliers lisses — Termes, définitions, classification et symboles —

Partie 3: Lubrification

**Fourth edition
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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 document 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).

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This document was prepared by Technical Committee ISO/TC 123 *Plain bearings*, Subcommittee SC 6, *Terms and common items*.

This fourth edition cancels and replaces the third edition (ISO 4378-3:2017), which has been technically revised.

The main changes are as follows:

- editorial revision of the document: instead of referring to the parts in the figure by subclause number, the part numbers have been used and the names in the key have been shown.
- addition of alphabetical index.

A list of all parts in the ISO 4378 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

As there is a large number of multiple designations in the domain of plain bearings, there is a considerable risk of error in the interpretation of standards and technical literature.

This document is an attempt to establish a uniform basic system of designations of lubrication.

in addition, this document is specifically intended for the field of plain bearings the content can be adopted in general to the field of tribology and being adopted to other machinery elements.

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Plain bearings — Terms, definitions, classification and symbols —

Part 3: Lubrication

1 Scope

This document specifies the most commonly used terms relating to lubrication of plain bearings with their definitions and classification.

For some terms and word combinations, their short forms are given, which can be used where they are unambiguous.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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 <https://www.electropedia.org/>

3.1 General terms

3.1.1

lubrication

technique to reduce friction force, wear and deterioration of the surfaces of two bodies in contact and in relative motion due to the action and effect of lubricant

3.1.2

method of lubrication

method of supplying lubricant into the space between two bodies in contact and in relative motion

3.2 Terms related to the types of lubrication and classification

3.2.1 Classification according to physical state of the lubricant

3.2.1.1

gas-film lubrication

lubrication (3.1.1) in which the interacting surfaces in relative motion are separated by a gaseous lubricant

3.2.1.2

liquid-film lubrication

lubrication (3.1.1) in which the interacting surfaces in relative motion are separated by a liquid lubricant

3.2.1.3

fluid-film lubrication

lubrication (3.1.1) in which the interacting surfaces in relative motion are separated by a fluid lubricant (gas or liquid)

3.2.1.4

solid-film lubrication

lubrication (3.1.1) in which the interacting surfaces in relative motion are separated by a *solid lubricant* (3.4.1.4)

3.2.2 Classification according to the mechanism of separation of the interacting surfaces by a lubricant film

3.2.2.1

hydrodynamic lubrication

lubrication (3.1.1) in which the interacting surfaces in relative motion are completely separated by the pressure generated in the fluid film between these surfaces due to their relative motion and the *viscosity* (3.5.1) of the fluid

3.2.2.2

hydrostatic lubrication

lubrication (3.1.1) in which the interacting surfaces, either in relative motion or in a state of rest, are completely separated by supplying high-pressure fluid between the interacting surfaces from the outside

3.2.2.3

aerodynamic lubrication

lubrication (3.1.1) in which the interacting surfaces in relative motion are completely separated by the pressure generated in the gas film between these surfaces due to their relative motion and the *viscosity* (3.5.1) of the gas

3.2.2.4

aerostatic lubrication

lubrication (3.1.1) in which the interacting surfaces, either in relative motion or in a state of rest, are completely separated by supplying high-pressure gas between the interacting surfaces from the outside

3.2.2.5

boundary lubrication

lubrication (3.1.1) in which friction between, and wear of, two surfaces in relative motion are governed by the properties of the surface and by the properties of the lubricant other than bulk *viscosity* (3.5.1)

3.2.2.6

mixed-film lubrication

mixed lubrication

partial-film lubrication

lubrication (3.1.1) in which there is *fluid-film lubrication* (3.2.1.3) and *boundary lubrication* (3.2.2.5)

3.2.2.7

laminar flow lubrication

lubricating condition in which the molecules of the lubricant fluid move steadily and regularly, forming smooth streamlines

Note 1 to entry: This condition appears in a flow in which the viscous force prevails over the inertia force, or where the Reynolds number is relatively small and the Taylor number is less than a critical value.

3.2.2.8

non-laminar flow lubrication

lubricating condition for which the flow is not laminar and which includes transition and *turbulent flow lubrication* (3.2.2.10)

3.2.2.9

transition flow lubrication

Taylor flow lubrication

lubricating condition in which the stream lines are not smooth, but the turbulence is not fully developed

Note 1 to entry: Depending on the operating conditions, the Taylor vortexes can occur or not.

3.2.2.10

turbulent flow lubrication

lubricating condition in which the molecules of the lubricant move in an unsteady and irregular manner in time and space or in a turbulent manner

Note 1 to entry: This condition appears in a flow in which the inertia force prevails over viscous force or where the Reynolds number is large and the Taylor number is greater than a critical value.

3.2.2.11

starved lubrication

lubricating condition in which lubricant is insufficiently supplied between surfaces to be lubricated

3.2.2.12

non-lubrication

condition of relative motion without *lubrication* ([3.1.1](#))

3.2.2.13

oil-free lubrication

lubricating condition in which interacting surfaces in relative motion are not lubricated by oil

3.2.2.14

grease lubrication

lubrication ([3.1.1](#)) in which *grease* ([3.4.1.3](#)) is used as lubricant

3.2.2.15

water lubrication

lubrication ([3.1.1](#)) in which water or sea water is used as lubricant

3.2.3 Calculation model for the EHD and THD lubrication condition

3.2.3.1

elasto-hydrodynamic lubrication

EHL

EHD

lubrication ([3.1.1](#)) in which the pressure, the friction force and the lubricant film thickness between the interacting surfaces in relative motion are governed by the elastic properties of the materials of contacting bodies, as well as the rheological properties of the lubricant, especially the pressure dependence of *viscosity* ([3.5.1](#))

3.2.3.1.1

hard EHL

elasto-hydrodynamic lubrication ([3.2.3.1](#)) in which the effect of elastic deformation of interacting surfaces in relative motion, and the exponential increase in *viscosity* ([3.5.1](#)) of lubricant due to high pressure, prevail

3.2.3.1.2

soft EHL

elasto-hydrodynamic lubrication ([3.2.3.1](#)) in which the interacting surfaces have low elastic modulus and there is no increase in the *viscosity* ([3.5.1](#)) of the lubricant due to high pressure

3.2.3.1.3

micro EHL

lubrication ([3.1.1](#)) in which micro-asperities of the interacting surfaces in relative motion are lubricated under *EHL* ([3.2.3.1](#)) conditions

3.2.3.2

thermo-hydrodynamic lubrication

THL

THD

fluid-film lubrication (3.2.1.3) in which the lubricating conditions between two surfaces in relative motion are governed by the heat balance in the lubricant film, including heat generation due to shear, the heat transfer and the temperature-dependence of the lubricant *viscosity* (3.5.1)

3.2.3.3

thermo-elastohydrodynamic lubrication

TEHL

TEHD

fluid-film lubrication (3.2.1.3) in which the lubricating conditions between two surfaces in relative motion are governed by the heat balance in the lubricant film, including heat generation due to shear, the heat transfer, the elastic properties of friction surfaces and the rheological properties of the lubricant, especially, *viscosity's* (3.5.1) dependence on temperature and pressure

3.3 Terms related to methods of lubrication and classification

3.3.1 Classification according to periodicity of application of lubricant

3.3.1.1

continuous lubrication

method of lubrication (3.1.2) in which the lubricant is continuously supplied to the interacting surfaces in relative motion

3.3.1.2

periodical lubrication

method of lubrication (3.1.2) in which the lubricant is periodically supplied to the interacting surfaces in relative motion

3.3.2 Classification according to the methods of renewing the lubricant

3.3.2.1

recirculating lubrication

method of lubrication (3.1.2) in which the lubricant, having passed the interacting surfaces in relative motion, is mechanically recirculated to them

3.3.2.2

life-time prelubrication

method of lubrication (3.1.2) in which the lubricant is supplied only before the system is put into operation

3.3.2.3

once-through lubrication

method of lubrication (3.1.2) in which the lubricant is periodically or continuously supplied to the interacting surfaces in relative motion, without returning to the lubricating system

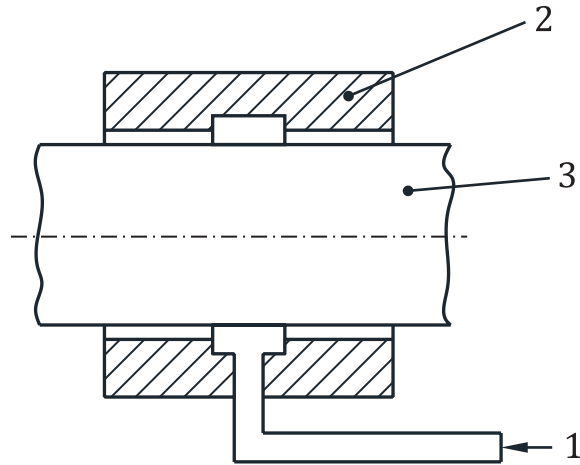
3.3.3 Classification according to the method of application of the lubricant to the friction surface

3.3.3.1

force-feed lubrication

method of lubrication (3.1.2) in which the lubricant is supplied between the interacting surfaces in relative motion by external force

Note 1 to entry: See [Figure 1](#).



Key

- 1 force-feed lubricant
- 2 bearing
- 3 shaft

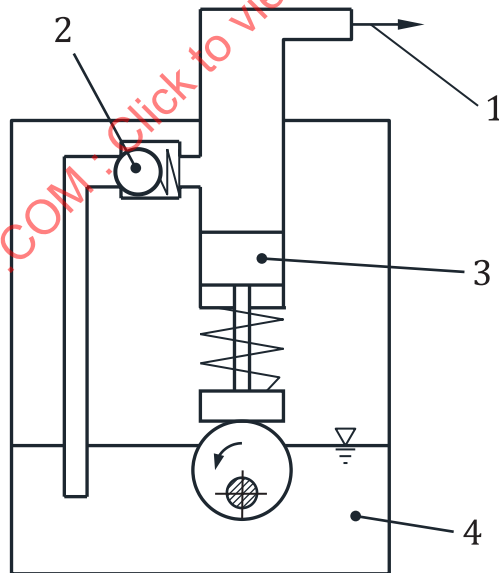
Figure 1 — Force-feed lubrication

3.3.3.2

mechanical force-feed lubrication

method of lubrication (3.1.2) in which the lubricant is supplied between the interacting surfaces in relative motion by force applied externally through the movement of machine components

Note 1 to entry: See [Figure 2](#).



Key

- 1 force-feed lubricant
- 2 check valve
- 3 piston
- 4 oil

Figure 2 — Mechanical force-feed lubrication

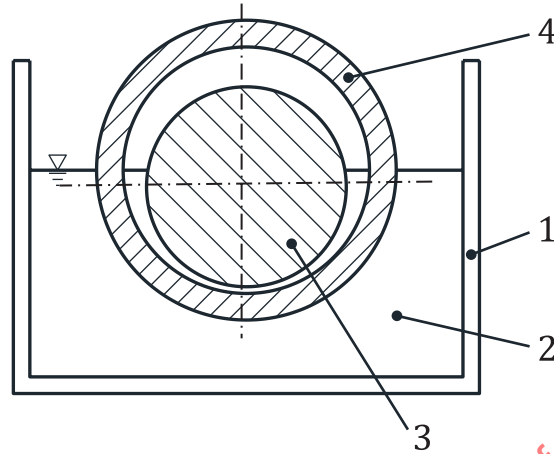
3.3.3.3

dip-feed lubrication

oil-bath lubrication

method of lubrication (3.1.2) in which the interacting surfaces in relative motion are partially, permanently or periodically submerged in a bath of liquid lubricant

Note 1 to entry: See [Figure 3](#).



Key

- 1 oil bath
- 2 oil
- 3 shaft
- 4 bearing

Figure 3 — Dip-feed lubrication

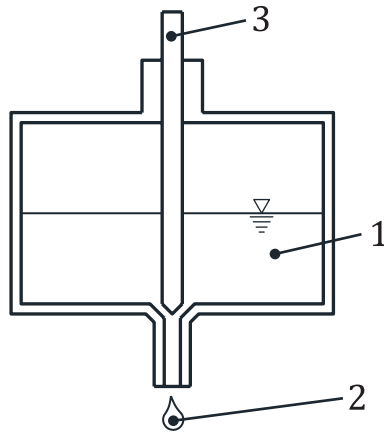
3.3.3.4

drop-feed lubrication

drip-feed lubrication

method of lubrication (3.1.2) in which the lubricant is supplied between the interacting surfaces in relative motion in the form of drops at regular intervals

Note 1 to entry: See [Figure 4](#).



Key

- 1 oil
- 2 oil drop
- 3 controller

Figure 4 — Drop-feed lubrication

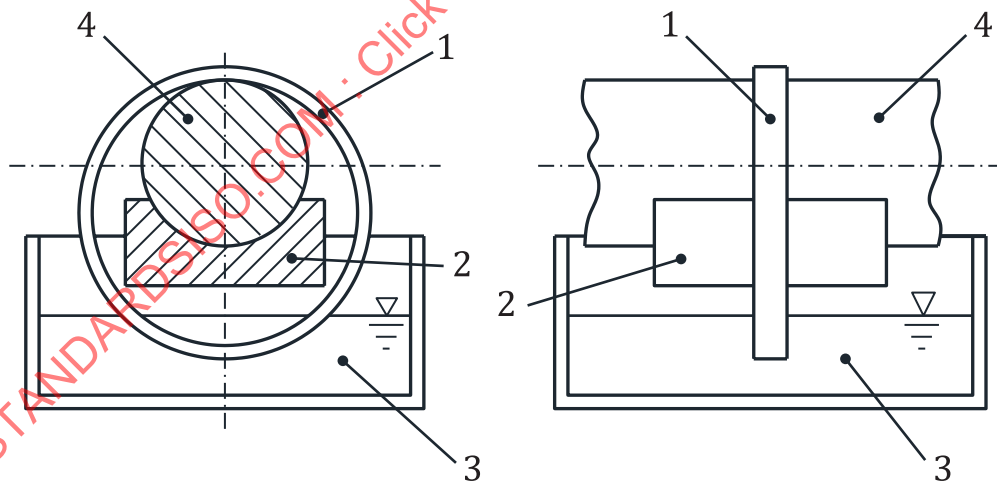
**3.3.3.5
ring lubrication**

method of lubrication (3.1.2) in which a ring is arranged over the shaft in such manner that a portion of the ring is immersed in the lubricant and thus supplies the lubricant to the sliding surface

Note 1 to entry: See [Figure 5](#).

Note 2 to entry: For reference, the ring is either fixed or not fixed onto the shaft.

Note 3 to entry: In the case of a low-speed application, a chain is used for the same purpose.



Key

- 1 oil ring
- 2 bearing
- 3 oil
- 4 shaft

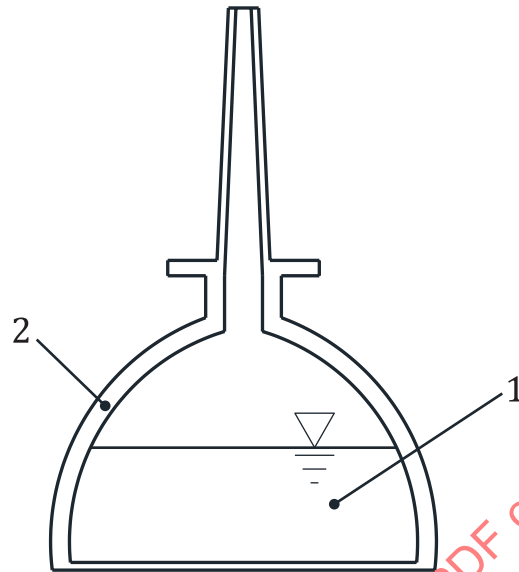
Figure 5 — Ring lubrication

3.3.3.6

hand lubrication

method of lubrication (3.1.2) in which the lubricant is supplied to the interacting surfaces in relative motion by human handling using an oil can, e.g. an oiler

Note 1 to entry: See [Figure 6](#).



Key

- 1 oil
- 2 oil can

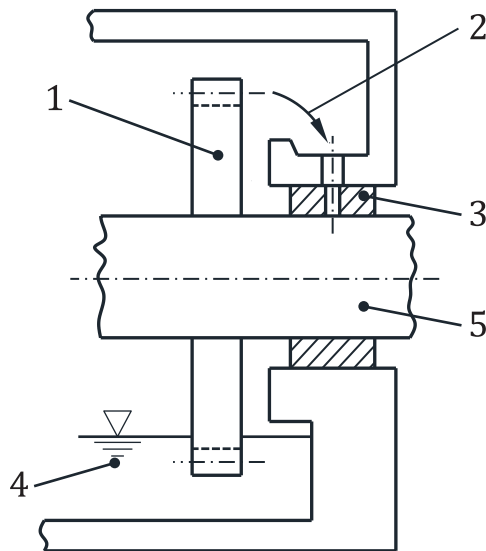
Figure 6 — Oiler

3.3.3.7

splash lubrication

method of lubrication (3.1.2) in which the lubricant is supplied to the interacting surfaces in relative motion by hitting and splashing the lubricant with a mechanical moving part

Note 1 to entry: See [Figure 7](#).



Key

- 1 gear
- 2 splashed oil
- 3 bearing
- 4 oil
- 5 shaft

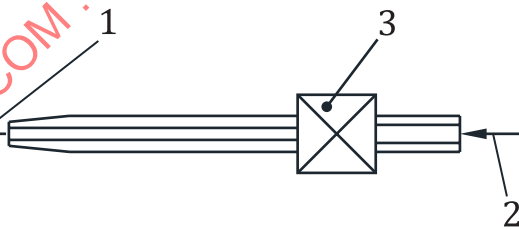
Figure 7 — Splash lubrication

3.3.3.8

oil jet lubrication

method of lubrication (3.1.2) in which the lubricant is supplied to the interacting surfaces in relative motion by a jet of oil mixed gas

Note 1 to entry: See [Figure 8](#).



Key

- 1 jet of oil mixed gas
- 2 oil mixed gas
- 3 control valve

Figure 8 — Oil jet lubrication

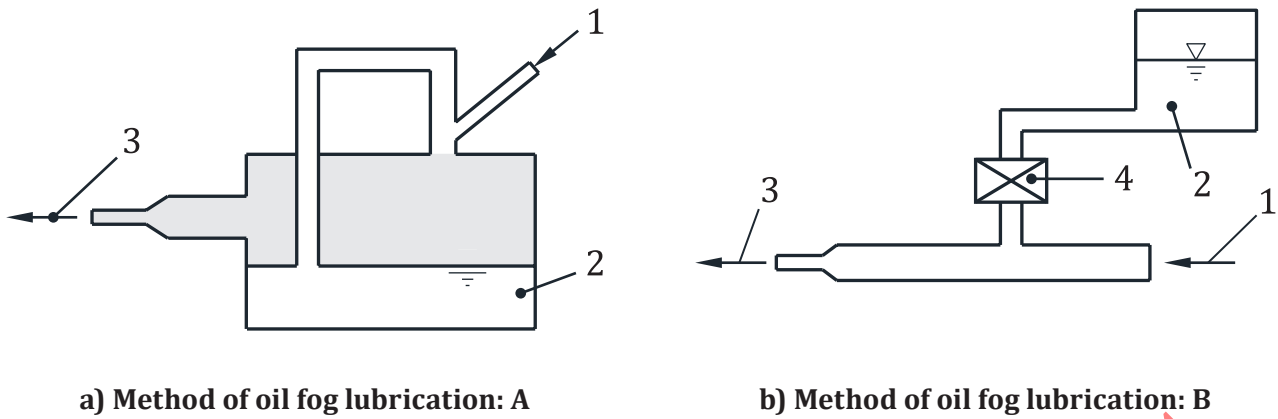
3.3.3.9

oil fog lubrication

oil mist lubrication

method of lubrication (3.1.2) in which the lubricant is supplied to the interacting surfaces in relative motion as mist or fog produced by injecting the lubricant with a stream of air or other gas

Note 1 to entry: See [Figure 9](#).



Key

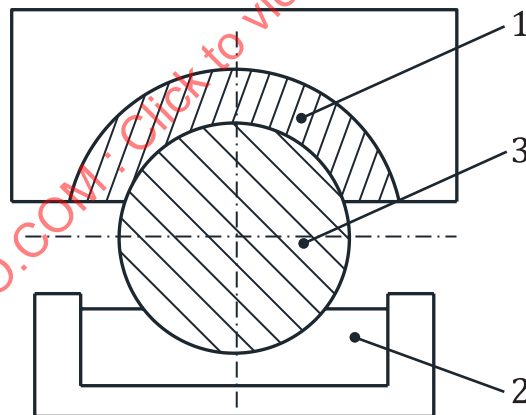
- 1 air or other gas
- 2 oil
- 3 oil fog or oil mist
- 4 mixing valve

Figure 9 — Oil fog lubrication

**3.3.3.10
pad lubrication**

method of lubrication (3.1.2) in which the liquid lubricant is supplied to the interacting surfaces in relative motion by a contacting pad of a lubricant-moistened material possessing capillary properties

Note 1 to entry: See [Figure 10](#).



Key

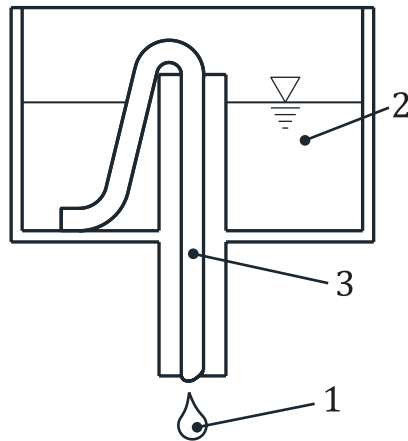
- 1 bearing
- 2 oil pad
- 3 shaft

Figure 10 — Pad lubrication

**3.3.3.11
wick lubrication**

method of lubrication (3.1.2) in which a wick is used to supply lubricant to the sliding surface by capillary action

Note 1 to entry: See [Figure 11](#).



Key

- 1 oil drop
- 2 oil
- 3 wick

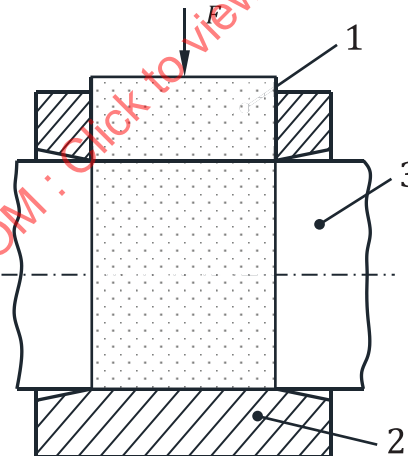
Figure 11 — Wick lubrication

3.3.3.12

rotaprint lubrication

method of lubrication (3.1.2) in which the surface of the body is supplied with the *solid lubricant* (3.4.1.4) detaching from a special lubricating solid body pressed to the surface

Note 1 to entry: See [Figure 12](#).



Key

- 1 solid lubricant
- 2 bearing
- 3 shaft
- F* load

Figure 12 — Rotaprint lubrication

3.3.3.13

solid-film coating lubrication

method of lubrication (3.1.2) in which the interacting surface in relative motion is coated with a solid film before the part is put into operation

3.3.3.14

directed lubrication

method of lubrication (3.1.2) in which the lubricant is supplied directly to a part of the friction surfaces to be lubricated

Note 1 to entry: A typical directed lubrication is that used for industrial tilting pad bearings, in which the *lubricating oil* (3.4.1.1) is sprayed onto the interacting surfaces in relative motion from nozzles.

3.3.3.15

leading-edge groove lubrication

method of lubrication (3.1.2) in which the lubricant is supplied to a groove located at the leading edge of the friction surfaces to be lubricated

Note 1 to entry: This is a typical lubricating method used for industrial tilting pad bearings, in which the *lubricating oil* (3.4.1.1) is supplied to a groove of each pad.

3.4 Terms related to lubricants, their components and types

3.4.1 Terms related to type according to the physical state of lubricant

3.4.1.1

lubricating oil

liquid lubricant used mainly for reduction of friction and wear on the interacting surfaces in relative motion and heat removal

Note 1 to entry: Ordinarily, refined oils are used.

3.4.1.2

aqueous lubricant

lubricant that contains 10 % or more water

3.4.1.3

grease

semi-solid or *solid lubricant* (3.4.1.4) consisting essentially of a stabilized mixture of *mineral oil* (3.4.3.1) or synthetic oil, with soaps or other thickeners

Note 1 to entry: Grease can contain other ingredients.

3.4.1.4

solid lubricant

lubricant having firm shape, which is not in a liquid or gaseous state

3.4.1.5

coated type solid lubricant

type of *solid lubricant* (3.4.1.4) that is coated with a sliding material on the surface of a bearing or shaft

3.4.1.6

embedded type solid lubricant

type of *solid lubricant* (3.4.1.4) that is mechanically embedded in the bearing body

3.4.1.7

dispersed type solid lubricant

type of *solid lubricant* (3.4.1.4) that is dispersed and contained in the bearing body

3.4.2 Terms related to type according to the presence of additive

3.4.2.1

base oil

refined oil without any *additive* (3.4.4.1)

3.4.2.2

lubricant with additive

lubricant which includes material added for the purpose of imparting new properties or enhancing existing properties of the lubricant

3.4.3 Terms related to type according to the origin of lubricant

3.4.3.1

mineral oil

oil consisting of a mixture of hydrocarbons, either naturally found or obtained by treatment of materials of mineral origin

3.4.3.2

petroleum oil

lubricating oil ([3.4.1.1](#)) refined from crude petroleum

3.4.3.3

vegetable oil

oil consisting of a mixture of glycerides of fatty acids, obtained by treatment of materials of plant origin

3.4.3.4

animal oil

oil consisting of a mixture of glycerides of fatty acids, obtained by treatment of materials of animal origin

3.4.3.5

synthetic lubricant

lubricant obtained by chemical process and treatment, combining different artificial substances

3.4.3.6

**solid lubricant binder
binder**

substance which promotes adhesion of particles of a *solid lubricant* ([3.4.1.4](#)) to each other and to the surfaces of the bodies to be lubricated

3.4.4 Terms related to type according to the type of additive

3.4.4.1

additive

material added to the lubricant for the purpose of imparting new properties or enhancing existing properties

3.4.4.2

additive package

mixture of several *additives* ([3.4.4.1](#)) ready to be added to a lubricant

3.4.4.3

multifunctional additive

additive ([3.4.4.1](#)) improving simultaneously several properties of the lubricant

3.4.4.4

anti-corrosion additive

additive ([3.4.4.1](#)) which prevents, retards or limits the rate of corrosion of lubricated metallic surfaces

3.4.4.5

anti-oxidant additive

additive ([3.4.4.1](#)) which prevents, retards or limits the rate of oxidation of a lubricant

3.4.4.6

rust-preventive additive

additive ([3.4.4.1](#)) which prevents, retards or limits the rate of rust occurring on the surfaces made of ferrous alloys

3.4.4.7

friction modifier

additive (3.4.4.1) to modify the friction characteristics of a lubricant as desired

3.4.4.8

anti-wear additive

additive (3.4.4.1) which prevents or reduces the rate or intensity of wear of the interacting surfaces in relative motion

3.4.4.9

anti-scoring additive

additive (3.4.4.1) which prevents, limits or retards the rate or intensity of scoring of the interacting surfaces in relative motion

Note 1 to entry: This *additive* (3.4.4.1) is also known as an *extreme pressure (EP) additive* (3.4.4.10).

3.4.4.10

extreme pressure additive

EP additive

chemical compound used in severe lubricating conditions, such as high-contact pressure and/or high sliding speed between interacting surfaces, to reduce friction and wear and prevent seizure, whereby it undergoes chemical reaction and produces lubricating substances

Note 1 to entry: For reference, this *additive* (3.4.4.1) is also known as an *anti-scoring additive* (3.4.4.9).

3.4.4.11

pour-point depressant

additive (3.4.4.1) which decreases the pour point of a liquid lubricant

3.4.4.12

viscosity index improver

additive (3.4.4.1), usually a polymer, which reduces the degree of *viscosity* (3.5.1) variation with temperature, thus increasing the *viscosity index* (3.5.3) of a lubricant

Note 1 to entry: A high *viscosity index* (3.5.3) indicates a relatively small variation of *viscosity* (3.5.1) with temperature and vice versa.

3.4.4.13

anti-foam additive

additive (3.4.4.1) preventing or reducing foaming of a liquid lubricant

3.4.4.14

detergent additive

surface-active *additive* (3.4.4.1) which helps to keep solid particles in suspension in a lubricant

3.4.4.15

dispersant additive

additive (3.4.4.1) to a liquid lubricant which increases dispersion or scattering of insoluble impurities and stability of suspension mostly at low temperature

3.4.4.16

detergent dispersant

additive (3.4.4.1) which has the effect of dispersing solid particles in the lubricant to prevent them from becoming deposits and of neutralizing the sulphuric acid produced by combustion of sulphur in the lubricant

3.4.4.17

emulsifier

surface-active agent which is especially suitable for emulsification of oil and water