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**Plain bearings — Terms, definitions,  
classification and symbols —**

**Part 3:  
Lubrication**

*Paliers lisses — Termes, définitions, classification et symboles —  
Partie 3: Lubrification*

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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](http://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](http://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 on 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 the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

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

This third edition cancels and replaces the second edition (ISO 4378-3:2009), which has been technically revised. The following changes have been made:

- editorial revision of the document;
- addition of 12 new figures;
- revision of clause numbers.

A list of all the parts in the ISO 4378 series can be found on the ISO website.

## 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 uncertainty leads to the continuous addition of supplementary designations, which only serves to increase the misunderstanding.

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

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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. Self-explanatory terms are given without definitions.

### 2 Normative references

There are no normative references in this document.

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

#### 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 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* (3.4.1.1)

### 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* (3.4.1.2)

### 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* (3.4.1.6)

## 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

#### **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)

### 3.2.2.6

#### **hard EHL**

*elasto-hydrodynamic lubrication* (3.2.2.5) 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

### 3.2.2.7

#### **soft EHL**

*elasto-hydrodynamic lubrication* (3.2.2.5) 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

**3.2.2.8****micro EHL**

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

**3.2.2.9****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)

**3.2.2.10****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* (3.2.2.9)

**3.2.2.11****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)

**3.2.2.12****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

**3.2.2.13****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.

**3.2.2.14****non-laminar flow lubrication**

lubricating condition for which the flow is not laminar and which includes transition and *turbulent flow lubrication* (3.2.2.16)

**3.2.2.15****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.

**3.2.2.16****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 and the Taylor number is greater than a critical value

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.

**3.2.2.17**

**starved lubrication**

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

**3.2.2.18**

**non-lubrication**

condition of relative motion without *lubrication* (3.1.1)

**3.2.2.19**

**oil-free lubrication**

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

**3.2.2.20**

**grease lubrication**

*lubrication* (3.1.1) in which *grease* (3.4.1.5) is used as lubricant

**3.3 Terms related to methods of lubrication and classification**

**3.3.1 Terms related to 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 Terms related to 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

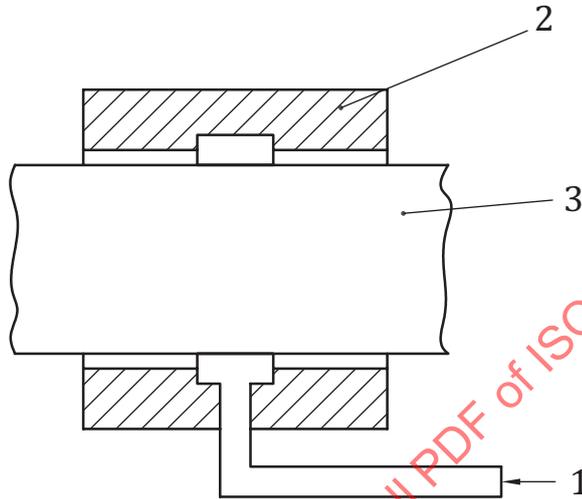
### 3.3.3 Classification according to the method of application of the lubricant to the friction surface

#### 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

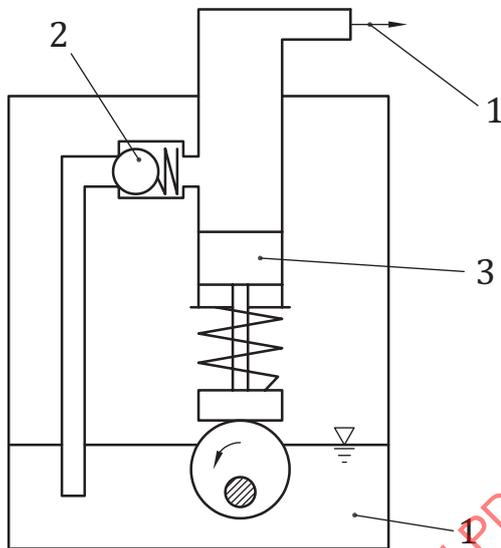
Figure 1 — Force-feed lubrication

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**

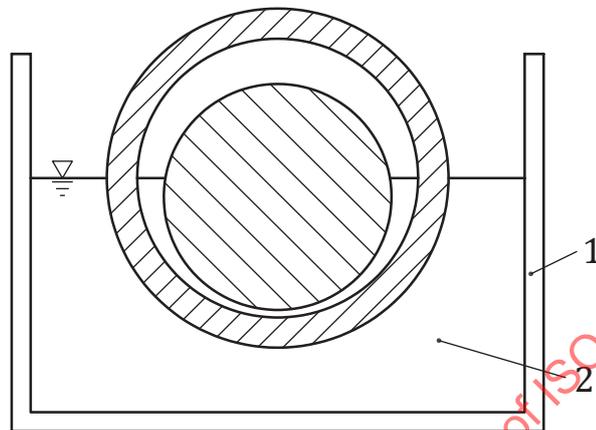
- 1 force-feed lubricant
- 2 check valve
- 3 piston

**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 (3.4.1.2)*

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



**Key**

- 1 oil bath
- 2 oil

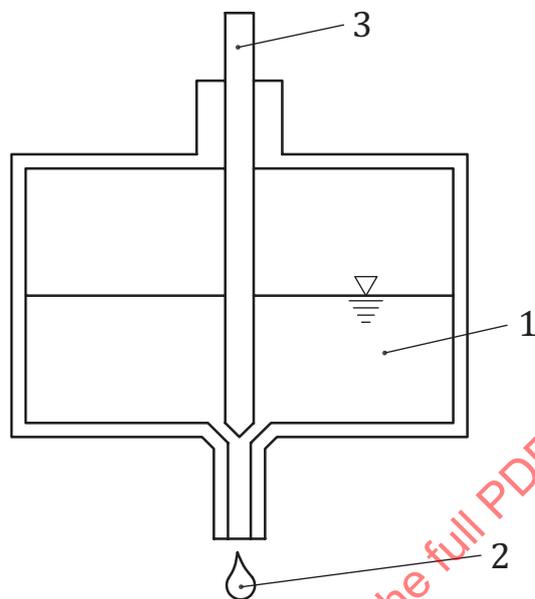
**Figure 3 — Dip-feed lubrication**

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**

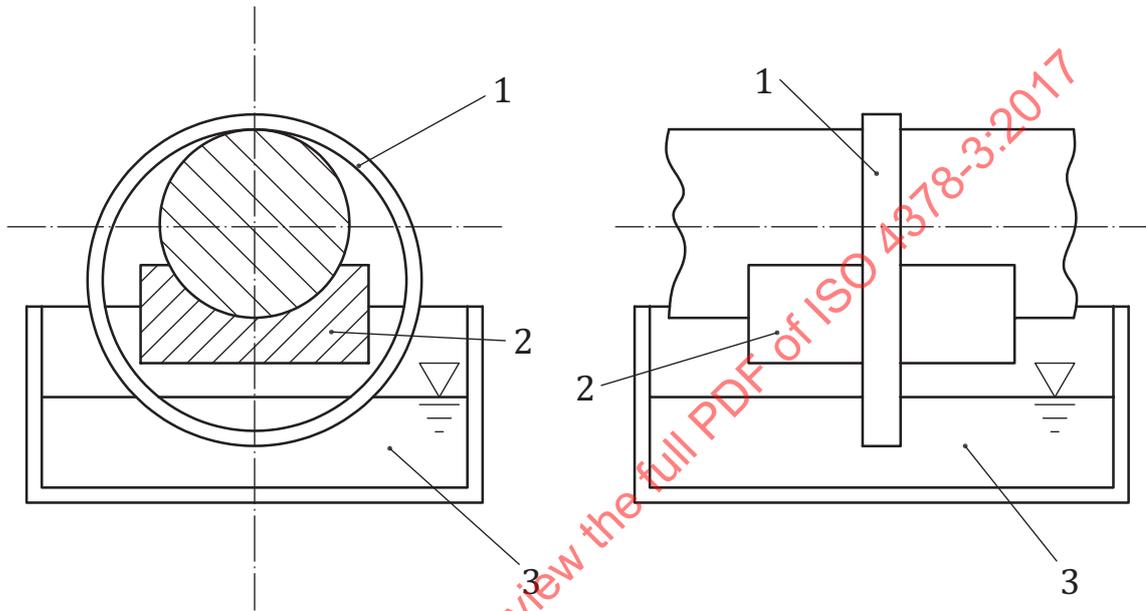
### 3.3.3.5 ring lubrication

*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: For reference, the ring is either fixed or not fixed onto the shaft.

Note 2 to entry: In the case of a low-speed application, a chain is used for the same purpose.

Note 3 to entry: See [Figure 5](#).



#### Key

- 1 oil ring
- 2 bearing
- 3 oil

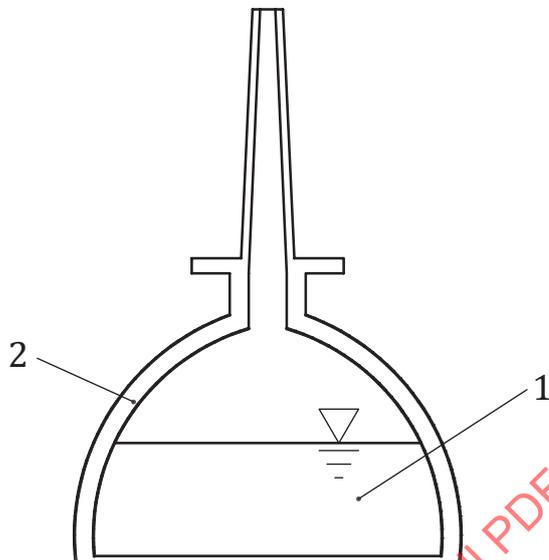
Figure 5 — Ring lubrication

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

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



**Key**

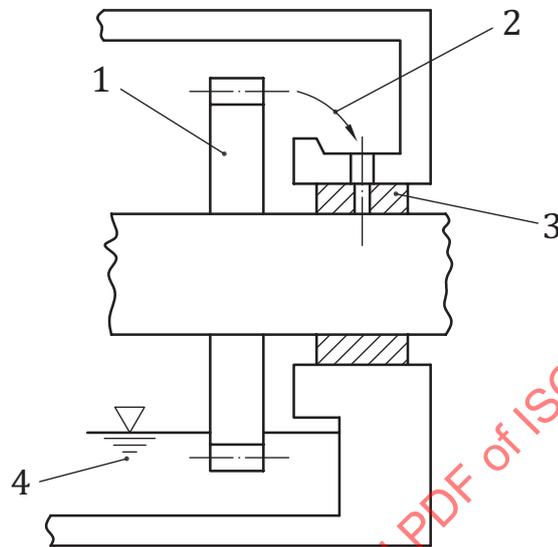
- 1 oil
- 2 oil can

**Figure 6 — Hand lubrication**

**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

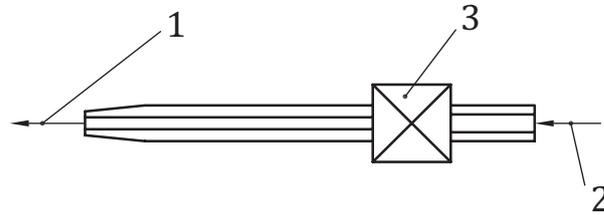
**Figure 7 — Splash lubrication**

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**

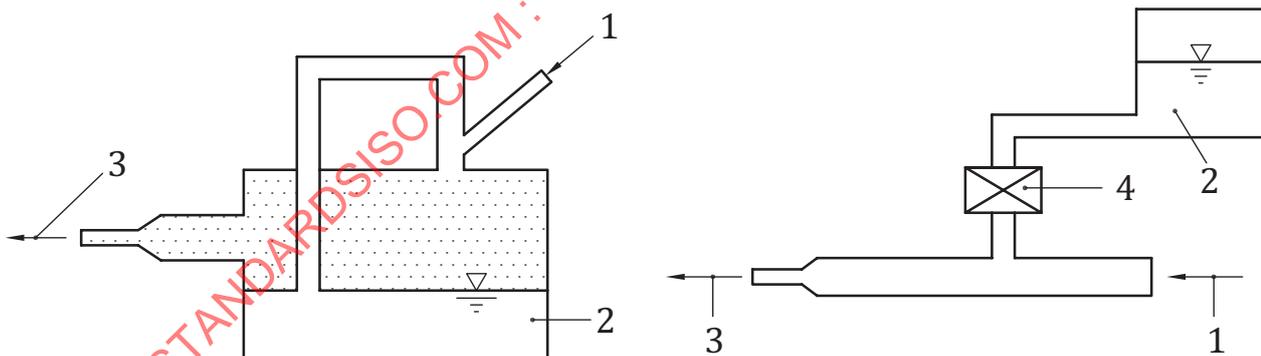
3.3.3.9

**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](#).



a)

b)

**Key**

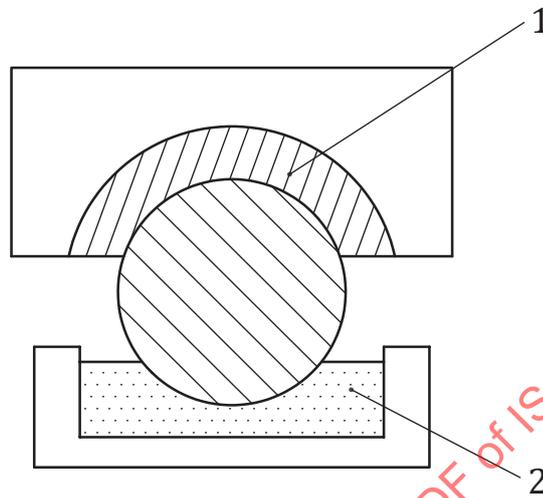
- 1 air or other gas
- 2 oil
- 3 oil fog or oil mist
- 4 mixing valve

**Figure 9 — Oil fog lubrication**

**3.3.3.10  
pad lubrication**

*method of lubrication* (3.1.2) in which the *liquid lubricant* (3.4.1.2) 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

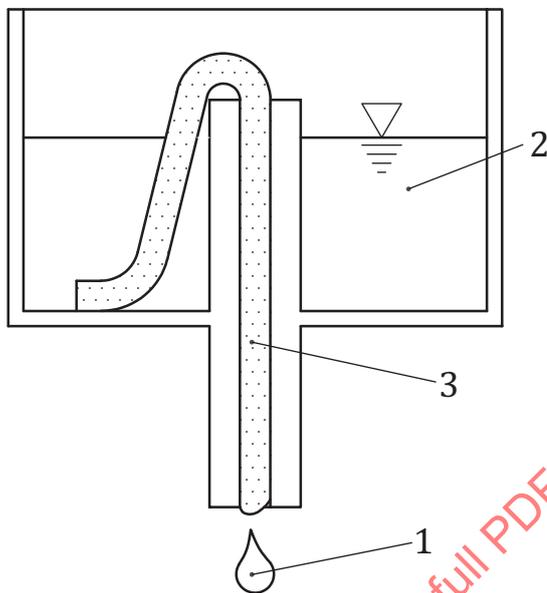
**Figure 10 — Pad lubrication**

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**

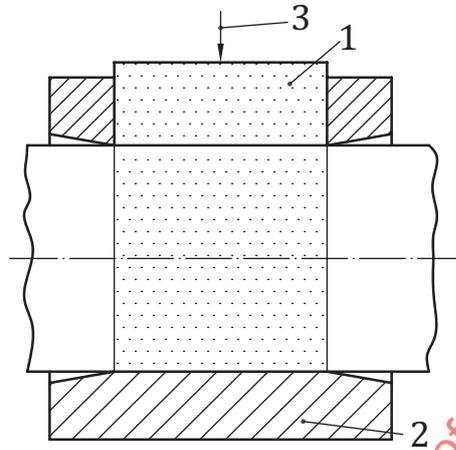
- 1 oil drop
- 2 oil
- 3 wick

**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* (3.4.1.6) 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 pressure

**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* (3.4.1.3) is sprayed onto the interacting surfaces in relative motion from nozzles.

**3.3.3.15****leading-edge grooved 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* (3.4.1.3) 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

##### **gaseous lubricant**

lubricant in gaseous state

##### 3.4.1.2

##### **liquid lubricant**

lubricant in liquid state

##### 3.4.1.3

##### **lubricating oil**

*liquid lubricant* ([3.4.1.2](#)) 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.

##### 3.4.1.4

##### **aqueous lubricant**

lubricant that contains 10 % or more water

##### 3.4.1.5

##### **grease**

semi-solid or *solid lubricant* ([3.4.1.6](#)) 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.

##### 3.4.1.6

##### **solid lubricant**

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

#### 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* ([3.4.1.3](#)) 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