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Plain bearings with liquid lubrication — Lubricant supply arrangements and monitoring

Paliers lisses à lubrification fluide — Equipements de graissage et de surveillance

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Foreword

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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).

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This document was prepared by Technical Committee ISO/TC 123, *Plain bearings*, Subcommittee SC 3, *Dimensions, tolerances and construction*.

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

This document is based on German standard DIN 31692-1:1996.

Plain bearings with liquid lubrication — Lubricant supply arrangements and monitoring

1 Scope

This document provides requirements and guidance on lubricant supply arrangements and monitoring for liquid-lubricated bearings (plain bearing assemblies) such as those specified in ISO 11687 (all parts).

This document is intended to assist the design of oil-based lubrication systems for hydrodynamic plain bearings mainly to be used in large-scale rotating machinery for power generation, industry and transportation.

This document focuses on the most important requirements and characteristics of lubricant supply arrangements and monitoring for plain bearings. Additional standards such as ISO 10438-1, ISO 10438-2 and ISO 10438-3 would be needed to design complete low-pressure or high-pressure lubrication systems, along with their corresponding components.

Wherever this document specifies a particular form of solution, whether design or operation, different solutions can be selected provided they are justified by engineering assessment or reference to similar systems already in operation.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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 http://www.electropedia.org/

4 Lubrication arrangements

4.1 Self-contained bearings

The low-pressure lubrication of self-contained bearings is ensured by an internal oil reservoir and a supply mechanism, driven by the main shaft rotation. Typical self-contained bearing lubrication supply mechanisms include ring lubrication and viscosity pump lubrication. The lubrication does not require external energy or equipment. The lubricant does not leave the bearing internal reservoir.

4.2 Circulated lubrication (forced lubrication)

4.2.1 General

The oil supply of forced-lubricated bearings consists of a closed circulation system. The oil supply in these cases is provided by pumping the lubricant through the bearings. In the supply system, the oil is pumped out of the reservoir, filtered, cooled and controlled at the desired flow rate or pressure before being fed to the machine bearings. For this purpose, a complete oil supply system consists of a reservoir, pumping, filtering, cooling and controlling units. After lubricating the bearings, the oil returns to the reservoir. Some lube oil units are operated independently of the machine being supplied. Others have the main lube oil pump being driven by the shaft of the machine.

4.2.2 Oil feed and oil return

To minimize the possibility of vibrations or thermally induced tensile or compressive stresses occurring in the bearing housing, flexible compensators or connections shall be provided in the oil supply and drain piping systems if applicable.

For electrically insulated plain bearings, it is necessary to consider whether oil supply and drain pipes connected to the bearing also need insulating to prevent short circuit of the bearing insulation.

To restrict the pressure losses in the piping system to an economically justifiable amount, the oil mean flow velocity should not exceed 2 m/s in the supply lines according to experience.

The design of the return fluid flow path from the bearing to the oil reservoir shall be determined by the technical requirements of the bearing housing and the design requirements of the overall system installation.

When the return flow is driven by gravity, oil return lines shall have a slope of at least 5 %. According to ISO 10438-1, oil drains shall be sized to run no more than half full when flowing at normal drain operating temperature at maximum flow conditions and shall be arranged to ensure good drainage (recognizing the possibility of foaming conditions). Junctions and changes in the direction of pipes shall be designed so as not to impair lubricant flow. Sharp bends and down or up loops shall be avoided. Junctions in return pipes shall be located in the direction of flow. In order to prevent foaming, vertical slopes exceeding 1 m in length shall be avoided. No devices significantly impeding the flow in the return line, such as filters, etc. shall be installed.

Where more than one device (bearings, and possibly other consumers) is to be supplied with lubrication oil, the design of the oil supply and circulation system should mitigate against the potential harmful interactions in the return lines and oil reservoir caused by differential air pressure conditions.

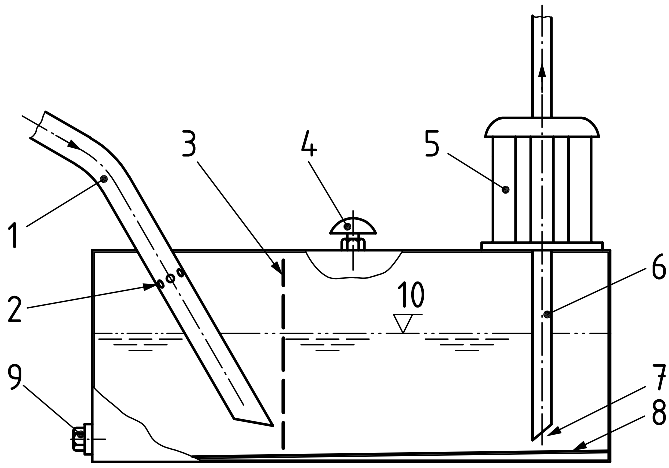
4.2.3 Oil reservoirs

The basic design requirements for oil reservoirs are given by ISO 4413 in conjunction with ISO 10438-1. Based on experience and with respect to air release and oil aging, the capacity of oil reservoirs should be approximately eight times the quantity delivered per minute. The factor eight may be reduced to three depending on the ratio of exposed surface area to volume in the oil reservoir, lubricant properties (air release additives), operating conditions, duty cycle and oil change interval. Small oil reservoirs in particular should have an internal weir or baffle plate between return and suction pipe to settle the returning oil and to permit entrained air in the oil to escape.

Oil reservoirs shall be suitably vented to allow entrained air to escape. In the – recommended – case of return pipes discharging below the reservoir oil level, vent holes shall be provided above the oil level so that the air in the reservoir is able to communicate with the air in the bearing housing via the partly filled return pipe. Oil reservoirs shall be equipped with an oil level indicator.

The suction port of the outlet line shall be chamfered to reduce the inlet flow resistance and shall be situated low relative to the fluid level in order to minimize the foam content of the fluid drawn into the outlet line. In addition, the suction port shall be positioned a sufficient distance away from the bottom of the reservoir to prevent any deposits entering the device.

The bottom of the oil reservoir shall have a slope towards the oil drain. The sloping floor of the reservoir acts to drive liquid contaminant (specifically, water) in the direction of the drain port, where it can be detected by sampling or removed.



Key

1 return pipe
2 vent holes located around the return pipe circumference
3 baffle plate
4 vent
5 pump
6 outlet line
7 chamfered suction port
8 sloping floor
9 drain port
10 oil level indicator

Figure 1 — Oil reservoir (schematic)

4.3 Hydrostatic lubrication

In both self-contained and circulating oil (forced lubricated) bearings, hydrostatic shaft lift ("jacking") using a high-pressure oil supply can be used to reduce friction and excessive bearing wear during machine start up, shutdown and periods of prolonged operation at low shaft speed. In addition, in many cases, hydrostatic jacking is specified to enable shaft rotation for maintenance purposes.

The lubricant flow rate depends on the bearing design and operating conditions. After switching on the high-pressure oil supply, the jacking pressure usually rises and peaks before falling back to a steady-state value once lift has been achieved. The required jacking pressure and flow rate should be defined by the bearing supplier (designer).

A low loss non-return valve should be installed in each high-pressure jacking supply line to prevent back flow from the bearing during normal operation.

5 Lubricants

5.1 Suitable lubricants for plain bearings

Hydrodynamic plain bearings can be operated with lubricants of different chemical bases. For the provisions given hereafter, lubrication using oils from a petroleum base (mineral oil) is assumed. Synthetic lubricants can also be used. The bearing manufacturer shall be asked for acceptable classes of lubricants (ISO 6743-99).

