TECHNICAL SPECIFICATION

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Plain bearings — Surface modification by press fitting solid lubricants combined with micro dimple processing

Paliers lisses — Modification de la surface par fixation par pression de lubrifiants solides combinée à un traitement par micro-cavités

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Foreword

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This document was prepared by Technical Committee ISO/TC 123, *Plain bearings*, Subcommittee SC 7, *Special types of plain bearings*.

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 a general surface modification method, heat treatment such as carburizing or nitriding, hard film coating by chemical vapour deposition (CVD) or physical vapour deposition (PVD), solid lubricant coating using a resin binder, etc. are used. However, these conventional surface modification methods have problems such as the need for a special device, insufficient adhesion strength of the coating film, etc. Therefore, the purpose of this document is to provide a method for forming a lubricating film firmly bonded to the base metal by a simple method.

This document specifies surface modification method by a combination of processes capable of quickly processing with general purpose equipment in order to obtain excellent friction characteristics by a method excellent in mass production.

Plain bearings — Surface modification by press fitting solid lubricants combined with micro dimple processing

1 Scope

This document specifies the method of surface modification that improves the friction characteristics of plain bearings, by press fitting a solid lubricant onto the bearing metal surface mechanically in combination with processing a lot of micro dimples on the surface.

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 terminology 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
hybrid media
shot media having a surface modifying material attached to the media surface

Note 1 to entry: A shot media coated by carbon black is described in A.2 as an example of hybrid media.

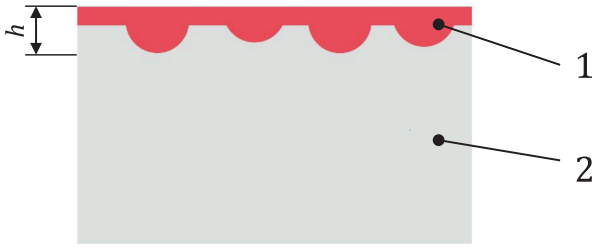
3.2
Almen strip
rectangular metal strip used for evaluating the shot peening intensity

3.3
arc height
height of the arched deformation of an Almen strip

Note 1 to entry: An arc height shows the intensity of the shot peening and is expressed in millimetres.

4 Structure

The structure of the surface modified layer obtained by the surface modification method specified in this document is shown in Figure 1. The thickness of the surface modified layer is several micro meters. Dimensions such as the thickness of the surface modified layer and the diameter/depth/area ratio of dimples are determined by the application and its operating conditions.



Key

1 modified layer

2 target material

h thickness of the surface modified layer

Figure 1 — Structure of surface modified layer

5 Materials

5.1 Target materials

The materials to be surface-modified by the method specified in this document shall be metal materials. In particular, materials having high work hardening property are suitable. Typical such materials include steel, aluminium alloy, titanium alloy, etc.

5.2 Solid lubricants

Typical solid lubricants used for the surface modification specified in this document are molybdenum disulfide, graphite, carbon black, etc. Table 1 shows a typical combination of solid lubricant and target material with their applications.

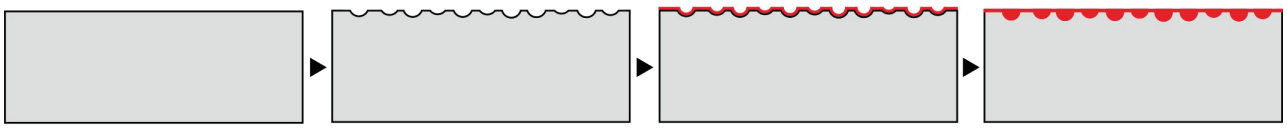
Table 1 — Typical combination of solid lubricant and target material, and their applications

Solid lubricant	Target material	Application
Molybdenum disulfide	Steel, Aluminium alloy, etc.	High load, vacuum
Graphite	Steel, etc.	High temperature
Carbon black	Steel, Titanium alloy, etc.	Dry condition, low humidity

6 Process

6.1 General

The surface modification process specified in this document should be based on a combination of formation of dimples on the surface, supply of solid lubricant to the surface and press fitting of solid lubricant to the surface. General process steps of surface modification are shown in Figure 2.



a) Initial surface **b) Formation of dimples** **c) Supply of solid lubricant** **d) Press fitting of solid lubricant**

Figure 2 — General process steps of surface modification

Examples of friction test results of samples obtained by the surface modification method specified in this document is shown in Annex A.

6.2 Formation of dimples

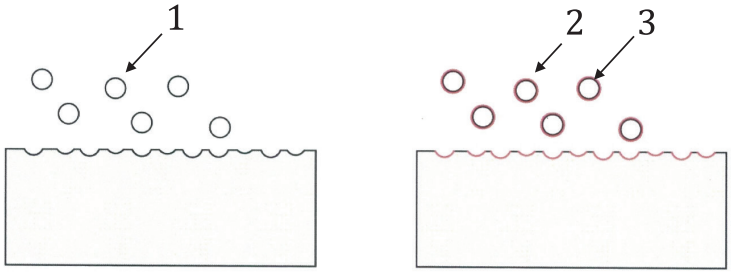
6.2.1 General

Typical examples of the method of dimple formation are described below. However, the method is not limited to them. Other methods can be used if the required dimples are obtained.

6.2.2 Shot peening

Shot peening, by applying out at high speed media (hard particles) nearly spherical surface of the material, is a cold working method for work hardening the target material surface by providing compressive residual stress. By this method, fatigue strength and stress corrosion cracking resistance can be improved. In the surface modification of bearings specified in this document, it is mainly used as a pre-treatment before "press fitting" the solid lubricants on the surface. By using hybrid media having a surface modifying material attached to the media surface, it is possible to adhere the modifying material to the target material surface simultaneously with formation of dimples. In this case, the dimple formation process, the solid lubricant supplying process and part of the press fitting process specified in this document are done simultaneously.

A schematic diagram of surface modification by shot peening process is shown in Figure 3.



Key

1 raw shot media

2 hybrid shot media

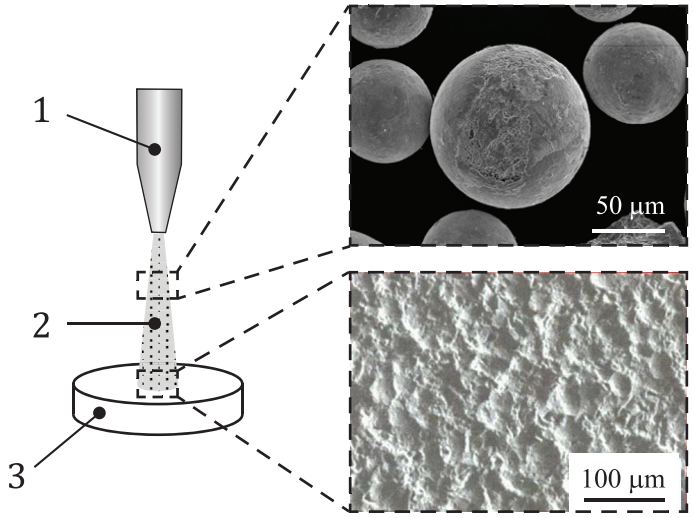
3 surface modifying material attached to the media surface

Figure 3 — Formation of dimples by shot peening process

Because of its aim for formation of dimples, unlike in the case of shot peening for the purpose of general surface hardening, the diameter of media should be about five times the expected dimple diameter and the hardness should be about 70 % as compared with the target material. A projection flow rate of

about 5 g/s and a projection pressure of about 0,3 MPa are suitable. It is recommended to measure the arc height beforehand using Almen strips in order to evaluate the shot peening conditions. A schematic diagram of the shot peening process is shown in Figure 4.

General shot peening procedures and conditions are defined in ISO 12686 and ISO 26910-1.



Key

1 nozzle

2 compressed gas containing shot media

3 target material

NOTE The upper photo is the enlarged view of shot media and the lower photo is the enlarged view of the shot peened surface of the target material.

Figure 4 — Shot peening process

6.2.3 Interrupted micro cutting

Like shot peening, interrupted micro cutting is a processing method for making dimples on the surface. Since cutting is performed with a rotating tool, it is useful when processing dimple with pattern property. An arbitrary pattern can be generated by controlling the combination of the shape of the cutting edge, the feed speed, and the rotation speed. The feature of this processing method is that it can control the pitch, size and depth of the dimple, so that it is superior in terms of homogeneity of the surface properties. It is also suitable for processing in places where shot peening processing is difficult, such as the inside of a cylinder. A schematic diagram of the interrupted micro cutting process is shown in Figure 5.