INTERNATIONAL STANDARD

ISO 4821

First edition
2022-05

Plain bearings — Dynamic adhesion test method for DLC coated parts under lubricated condition

Paliers lisses - Méthode d'essai d'adhérence dynamique sur des composants revêtus de DLC dans des conditions de lubrification

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Reference number
ISO 4821:2022(E)

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Published in Switzerland

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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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For an explanation of 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 www.iso.org/iso/foreword.html.

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.

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Introduction

Reducing the mechanical loss in engines is one of the effective ways to improve the fuel efficiency of automobiles. To reduce the friction coefficient between engine parts, diamond-like carbon (DLC) coatings can be applied for plain bearings as well as other sliding parts such as valve lifters and piston rings.

Since DLC hard coatings have high internal stress due to its coating process under high temperature and the difference of the coefficient of thermal expansion between DLC and engine parts, the quality control of the adhesion strength between coatings and base materials of specific parts after the coating process is very important. As there is no appropriate official test, automobile manufacturers or part suppliers must validate the adhesion strength by using a specially designed test facility using actual engine parts. In order to further spread the DLC coatings to mechanical parts of engines in the future, a test method can be used to easily evaluate the adhesion strength of the coatings.

The purpose of this document is to provide a test method for evaluating adhesion strength of DLC coatings. The test method specified in this document is a test apparatus equipped with a simple ball-on-disk that has a correlation with conventional engine evaluation results and a relatively inexpensive acoustic emission measurement machine without using actual parts.

The positioning of this test method in the process of parts evaluation performed by automobile manufacturers or part suppliers is shown in Annex A. The correlation between results obtained by the test method specified in this document and results obtained by the test method using conventional engine parts is described in Annex B.

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1 Scope

This document specifies a procedure to measure the adhesion strength of diamond-like carbon (DLC) coatings specified in ISO 20523 by detecting acoustic emission signals using ball-on-disk method under the lubricated condition. DLC is normally coated on metal or ceramic.

The test results are not applicable when the DLC coated parts operate in an unlubricated environment.

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.

ISO 683-17, *Heat-treated steels, alloy steels and free-cutting steels — Part 17: Ball and roller bearing steels*

ISO 1101, *Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ISO 21920-2, *Geometrical product specifications (GPS) — Surface texture: Profile— Part 2: Terms, definitions and surface texture parameters*

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
ball-on-disk method
test method in which the sliding contact between fixed balls and rotating disk specimen

3.2
acoustic emission
AE
physical vibration caused by sudden movement within a material subjected to physical stress, often symptomatic of a defect

3.3
adhesion strength
load of diamond-like carbon (DLC) coating delamination detected by sharp signal increment of *acoustic emission* (3.2)

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