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Test method for the coefficient of friction of biomimetic structured surfaces

仿生结构表面摩擦系数测试方法

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part

1.Structure and Drafting Rules of Standardization Documents". Drafting. Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents. This document was proposed by the China Machinery Industry Federation. This document is under the jurisdiction of the National Technical Committee on Standardization of Bionics (SAC/TC598). This document was drafted by: Jilin University, Tsinghua University, Beijing University of Aeronautics and

Astronautics, and Beijing Institute of Mechanical Industry Automation Co., Ltd. Southwest Jiaotong University, Beijing University of Technology, China Energy Research Institute (Beijing) Electric Power Research Institute, International Society for Bionics, Shenyang University of Technology Xi'an University of Electronic Science and Technology, Ruiji Bionic Intelligent Manufacturing Technology (Hangzhou) Co., Ltd., and Shandong University of Science and Technology. The main drafters of this document are. Zhang Zhihui, Jiang Yue, Tian Yu, Chen Huawei, Guo Hui, Zheng Jing, Qin Xiugong, Cao Hui, Zhang Liwen, Zhang Caixia, and Huang Shilong. Jiang Jiang, Tian Ximei, Zhang Song, Pan Ke, Chen Zhikai, Wang Hujun, Lin Zhibin, Zhang Baoyu, Shao Yanlong, Li Hao, Liu Chenxu, Ren Luquan.

Biomimetic structural surfaces are novel functional materials designed and manufactured by mimicking the macroscopic, microscopic, and nanoscopic three-dimensional morphology and physicochemical composition of biological surfaces. Energy surfaces. These surfaces are mainly divided into two types. one type consists of structures such as protrusions or pits/holes with different shapes, sizes, and distribution characteristics. Surfaces composed of characteristic units are called geometrically non-smooth biomimetic structural surfaces; another type consists of surfaces with different material compositions, chemical properties, and physical properties. A surface composed of characteristic units of a certain property, whose mechanical properties are discontinuously distributed, is called a mechanically non-smooth biomimetic structural surface. The coefficient of friction is a key parameter affecting the service safety, operating efficiency, and service life of mechanical equipment surfaces/interfaces. It is also relevant to biomimetic structural surfaces. The practical application of biomimetic surfaces in different environments and working conditions plays a decisive role. This is because biomimetic surface features specific dimensions, geometric shapes, and... Its spatial distribution and material composition exhibit high diversity, and its frictional behavior is also influenced by the differences in the mechanical and chemical properties of the matrix material. It differs significantly from traditional homogeneous smooth surfaces. Therefore, previous methods for testing the coefficient of friction on homogeneous smooth surfaces are no longer suitable. Accurately evaluate the tribological properties of biomimetic structural surfaces. To accurately evaluate and compare the tribological properties of biomimetic structural surfaces and avoid interference from structural failures on friction coefficient test results, [further details needed]. To obtain friction coefficient data that accurately reflects the tribological properties of biomimetic structure surfaces, it is necessary to establish a testing mechanism for the friction coefficient of biomimetic structure surfaces. National standards are needed to promote their widespread application in the engineering field. Test method for surface friction coefficient of biomimetic structure

1 Scope

GB/T 47232-2026 is the Chinese national standard covering measuring friction on a surface patterned after a biological one - shark skin, gecko setae, lotus leaf - where the friction

depends on the direction, the load and the scale of the contact in ways a plain flat-on-flat test does not capture. First edition, in force since 1 September 2026. It was issued on 27 February 2026 and has been in force since 1 September 2026, as a first edition. The document is under the responsibility of the China Machinery Industry Federation. This page is published from the official record of the 2026 edition; the clause text of a standard this recent is not yet in circulation, and the figures, limits and tables it contains are those of the document itself, delivered in full with the English translation.

This document describes a test method for the coefficient of friction of biomimetic structural surfaces. This document applies to metals with structural feature unit dimensions in the range of 50nm to 5mm and substrate elastic modulus not less than 0.1GPa. Measurement of the surface friction coefficient of biomimetic structures made of alloys, inorganic non-metals or polymer materials.

2 Normative references

The contents of the following documents, through normative references within the text, constitute essential provisions of this document. Dated citations are not included. For references to documents, only the version corresponding to that date applies to this document; for undated references, the latest version (including all amendments) applies. This document.

GB/T 17754-2012 Tribology

3 Terms and Definitions

The terms and definitions defined in GB/T 17754-2012, as well as the following terms and definitions, apply to this document.

3.1 Based on the principles of bionics, this method imitates the macroscopic, microscopic, and nanoscopic three-dimensional structural morphology, distribution patterns, and internal physical properties of the surface of living organisms. Based on the characteristics, a new type of functional surface was designed and manufactured.

3.2 Non-smooth surfaces On the smooth solid surface of an interfacial friction system, there exists one or more factors that cause a non-smooth surface effect.

Note. Non-smoothness effect refers to various factors within the same interfacial friction system that cause a regular change in tangential motion resistance due to the solid surface itself, including those caused by external factors. Various environmental factors cause changes in the frictional state of this surface.

3.3 On a reference plane of the same smooth surface, it consists of geometrically similar units with regular or random distributions. A geometrically continuous surface.

3.4 Changes in the material composition, chemical properties, or physical properties of

localized areas of the surface lead to changes in the mechanical properties of the corresponding areas. A surface exhibiting mechanical non-smoothness.

Note. Based on three-dimensional coordinates, mechanically non-smooth biomimetic structural surfaces (3.4) can be divided into mechanically non-smooth biomimetic structural surfaces (horizontal direction) and mechanically non-smooth biomimetic surfaces. Structural surfaces are categorized into two types (vertical direction). those exhibiting mechanical non-smoothness in the horizontal and vertical directions, respectively. Biomimetic structural surfaces that exhibit mechanical non-smoothness are not considered in this document.

3.5 In the biomimetic structural surface (3.1), there is a specific distribution pattern that can independently reflect its geometric shape or mechanical characteristics, and can realize its basic... The smallest unit of basic functions.