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Biomimetics — Biomimetic materials, structures and components

Biomimétisme — Matériaux, structures et composants biomimétiques

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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.

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The committee responsible for this document is ISO/TC 266, *Biomimetics*.

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Introduction

The increasing complexity of technical solutions and products requires new approaches. Classic research and development methods and innovation approaches often reach their limits, especially in the development and optimization of materials, structures, and components. The identification of suitable biological principles and their transfer to technical applications in the sense of biomimetics, therefore, can make an important contribution to the development of functional, adaptive, efficient (in terms of resources), and safe (in terms of toxicity to humans and the environment) materials, structures, components and manufacturing techniques.

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Biomimetics — Biomimetic materials, structures and components

1 Scope

This International Standard provides a framework of biomimetics for the development of materials, structures, surfaces, components, and manufacturing technologies.

This International Standard specifies the principles of biological systems, and especially the performance of biological materials, structures, surfaces, components, and manufacturing technologies that provide the motivation and reasons for biomimetic approaches. It specifies the methodology based on analysis of biological systems, which lead to analogies, and abstractions. The transfer process from biology to technology is described based on examples of biomimetic materials, structures, surfaces, components, and manufacturing technologies. This International Standard describes measurement methods and parameters for the characterization of properties of biomimetic materials. This International Standard provides information on the relevance of biomimetic materials, structures, surfaces, components, and manufacturing technologies for industry.

This International Standard also links to other subareas in biomimetics because fundamental developments in materials, structures, surfaces, components, and manufacturing technologies often form the basis for a wide variety of additional innovations. It provides guidance and support for all those who develop, design, process, or use biomimetic materials, structures, surfaces, components, and manufacturing technologies. This International Standard can also serve for those who want to learn about and investigate these topics.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 18458, *Biomimetics — Terminology, concepts and methodology*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18458 and the following apply.

3.1
adaptivity
ability to adapt to variable environmental conditions

3.2
efficiency
relationship between the useful outputs to all inputs of a system

3.3
generative manufacturing process
manufacturing process in which three-dimensional components are produced, for instance, by applying material layer-by-layer

Note 1 to entry: These technologies can be used in four different levels of manufacturing:

— Concept model (additive manufacturing): A mechanical load cannot be applied to these models and they only serve to provide a three-dimensional view.

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— Functional models (additive manufacturing): These models have properties similar to those available in the components manufactured later on in mass-production.

— Tools (rapid tooling): Tools are created that can be combined with other manufacturing processes.

— Low volume production (rapid manufacturing): The properties of the geometries manufactured correspond to those desired in actual use.

3.4
gradient transition
gradual transition
direction-dependent, continuous change of a chemical, physical, or mechanical property

Note 1 to entry: Biological materials are often characterized by gradual transitions in terms of their physical and mechanical properties, which are achieved through structural changes at various hierarchical levels, among other things.

3.5
compatibility
recyclability and adaptability of a material flow or a technology in the environment

3.6
modularity
composition of an overall system from individual modules

3.7
multifunctionality
structure and properties of a material and component allowing several functions necessary for the organism or technically desired to be realized at a high level and in equilibrium

3.8
redundancy
existence of functionally comparable systems, whereby one system alone is sufficient to maintain the corresponding function (multiplicity in systems)

3.9
resilience
fault tolerance
tolerance of a system to malfunctions or capacity to recover functionality after stress

3.10
Self-X property
property and information existing in a material or on a surface proceed processes autonomously without requiring special control

Note 1 to entry: Self-X properties are widespread in biological materials and surfaces and are of great interest for transfer to technical products. Examples include self-organization, self-assembly, self-repair, self-healing, self-cleaning, and self-sharpening.

3.11
stereoregularity
tacticity
certain geometric regularity in the molecular structure of polymer chains

Note 1 to entry: Macromolecular materials with identical chemical compositions can have significantly different mechanical properties due to differences in the spatial arrangement of their atoms and groups of atoms. In chemical production techniques, the molecular geometry of polymer chains is determined during polymerization by the reaction temperature selected and the catalyst used.

Note 2 to entry: A classic example from nature is polyisoprene, which can be elastic (natural rubber), as well as hard (balata, gutta-percha).

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