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**Requirements for three-dimensional model simplification
and lightweight of mechanical products**

机械产品三维模型简化与轻量化要求

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Requirements for three-dimensional model simplification and lightweight of mechanical products

1 Scope

This document specifies the requirements for simplification and lightweight of three-dimensional models of mechanical products.

This document is suitable for three-dimensional model construction of mechanical products and simplification and lightweight processing in application scenarios such as simulation, visualization, data sharing and exchange.

2 Normative references

The following referenced documents are indispensable for the application 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.

GB/T 24734.11, *Technical product documentation -- Digital product definition data practices -- Part 11: Levels of geometrical detail*

GB/T 26099.1, *General principles of three-dimensional modeling for mechanical products -- Part 1: General requirements*

GB/T 26099.2, *General principles of three-dimensional modeling for mechanical products -- Part 2: Part modeling*

GB/T 26099.3, *General principles of three-dimensional modeling for mechanical products -- Part 3: Assembly modeling*

GB/T 26100, *General principles of digital mock-up for mechanical products*

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 26099.1, GB/T 26099.2, GB/T 26099.3, GB/T 26100 as well as the followings apply.

3.1 simplification

A three-dimensional model construction or processing method that allows certain features not to be constructed, certain parts or components not to be assembled,

- f) Name the simplified model file in accordance with the provisions of GB/T 26099.1. Consider the inheritance with the original model name.

5.2 Simplification requirements in part modeling

5.2.1 Three-dimensional model simplification in part modeling meets the following requirements:

- a) The external interface of the model shall not be simplified and its assembly shall not be affected;
- b) Some features related to manufacturing, such as internal threads, external threads, undercuts, etc., are allowed to be omitted or simplified in expression. However, when the simplified model is used for projection to generate two-dimensional engineering drawings, it shall meet the relevant regulations of mechanical drawing;
- c) For several groups of holes with the same diameter and distributed in a certain regular pattern, only one feature can be constructed. Other similar features can be simplified by the center line;
- d) Features such as printing, engraving, and knurling allow simplified expression in the form of stickers. When necessary, it can also be accompanied by comments;
- e) When modeling standard parts and purchased parts, the internal structure unrelated to installation is allowed to be simplified, but basic information that affects the model assembly design such as the maximum geometric outline, installation interface, extreme position, and mass attributes shall be included;
- f) Under the conditions that meet the usage requirements, low-order surfaces can be used instead of high-order surfaces.

5.2.2 See Figure A.1 in Annex A for a simplification example in part modeling.

5.3 Simplification requirements for assembly model applications

5.3.1 Three-dimensional model simplification for assembly model applications meets the following requirements.

- a) When assembly models are used for visual display, such as in digital factories or digital production line visual display applications, for assembly models of production lines, machine tools, logistics and other equipment, if the internal details do not need to be displayed, a simplified method without assembly can be used. If some external subtle features do not affect the display effect, simple shapes (cylinder, cube, etc.) can be used instead of the simplified method of complex shapes.

- b) Generally, it is advisable to remove the modeling history information in the original model and base it on the business needs of different application scenarios in a). Choose to retain, partially remove or completely remove assembly structure, annotations, attributes, views, colors and other information;
- c) The lightweight model formed after surface processing can reduce the size of the model file through surface reduction, merging primitives, deleting invisible surfaces, patching or deleting holes, etc., so as to meet the requirements of the visualization software and hardware system;
- d) For point cloud models obtained by reverse engineering methods, it is advisable to convert mesh surfaces into NURBS surfaces or other parameter expressions to reduce model file size;
- e) For a large number of repeated parts, only the geometric data of one part can be recorded, but the position information of all parts shall be saved to reduce the amount of data. At the same time, the recorded geometric data information of the parts and all parts shall be used during the visualization process. location information to reconstruct all parts and position them correctly;
- f) Multiple LOD level representations shall be provided to meet visualization and accuracy requirements;
- g) The lightweight model file naming shall be in accordance with the provisions of GB/T 26099.1. Consider inheritance from the original model's name.

6.2 Lightweight requirements for collaborative research and development

The lightweight of three-dimensional models in collaborative R&D applications meets the following requirements:

- a) It shall be based on the needs of product data sharing and exchange, browsing and circle reading in collaborative R&D applications. Determine the lightweight model file format. Choose lightweight processing tools;
- b) The lightweight model file format, unit system and scale shall be consistent. Model accuracy shall meet the requirements of all parties involved in collaborative R&D;
- c) The assembly structure information in the original model shall be included;
- d) Annotations and marking information shall be saved in lightweight model files.

6.3 Lightweight requirements for assembly simulation

The lightweight three-dimensional model for assembly simulation applications shall

meet the following requirements:

- a) According to the assembly process simulation in assembly simulation applications, as well as the interference inspection and simulation requirements between components, between components and tooling, determine the lightweight model file format and select lightweight processing tools;
- b) Contain assembly structure and assembly relative position information in the original model.

6.4 Lightweight requirements for three-dimensional processes

Three-dimensional model lightweight for three-dimensional processes shall meet the following requirements:

- a) According to the process model visual display and human-computer interaction requirements in three-dimensional process visualization publishing applications, the lightweight model file format is determined. Choose lightweight processing tools;
- b) Contain assembly structure, annotations, attributes, views, colors and other information in the original model.

6.5 Lightweight requirements for three-dimensional electronic interactive publications

The lightweight three-dimensional model for three-dimensional electronic interactive publications shall meet the following requirements:

- a) The lightweight model file format is determined based on the model-based product installation, use, repair and maintenance interaction requirements and the type of interactive display platform in the three-dimensional electronic interactive publication application. Choose lightweight processing tools;
- b) Contain assembly structure, annotations, attributes, views, colors and other information in the original model.

6.6 Lightweight requirements for visual display

The lightweight three-dimensional model for visual display shall meet the following requirements:

- a) According to the purpose of visual display, such as concept display before product manufacturing, publicity display after product manufacturing, and training display such as operation/maintenance, as well as the software and hardware

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