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**Design principle and calibration method of Chinese dummy for  
mechanical damage testing**

力学损伤测试用中国假人设计原则与标定方法

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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 be subject to patents. The publisher of this document assumes no responsibility for identifying patents. This document is proposed and coordinated by the National Ergonomics Standardization Technical Committee (SAC/TC7). This document was drafted by: Hunan University, China Institute of Standardization, Shanghai Motor Vehicle Inspection and Certification Technology Research Center Co., Ltd., China Automotive Engineering Research Institute Co., Ltd., China Astronaut Scientific Research and Training Center, China Ordnance Equipment Group Ordnance Equipment Research Institute, China Aircraft Machinery Strength Research Institute, Hangyu Lifesaving Equipment Co., Ltd. The main drafters of this document. Yan Lingbo, Cao Libo, Ran Linghua, Zhang Guanjun, Mo Fuhao, Zhang Xin, Zhu Xiaoming, Xu Wei, Ma Honglei, Wang Shu, Hu Huimin, Zhao Chaoyi, Liu Xiaochuan, Min Liwu, Wu Bin, Dong Fangdong, Wang Jianquan.

The humanoid test device is referred to as "dummy" for short. It refers to a humanoid

external form, bionic structure and function, and intelligent response to the external environment. "Human body double". Dummies are widely used in fields such as medical engineering, safety engineering, environmental engineering and military engineering. They are the national level of science and technology, comprehensive An important manifestation of national strength. The mechanical damage test dummy can simulate the damage response of a person under mechanical impact load and is directly used for testing and evaluation. Test equipment for evaluating the safety performance of manned equipment, the protective performance of wearable equipment, the performance of weapons and equipment and other equipment performance related to personnel injury. It is the core technology that supports the research and development of manned equipment and various types of equipment. Developed countries such as Europe and the United States had already begun to do so as early as the 1940s. Research on dummies for mechanical damage testing. After long-term development, dummy products for mechanical damage testing have been serialized, and their types cover It covers various groups such as men, women, children, infants, pregnant women, etc., and its uses include various forms of car crash tests, train crash tests, military Equipment protection performance testing, aerospace equipment protection performance testing and other fields. Currently, the dummies used in China are designed based on European and American human body dimensions and mechanical properties. Based on the collision test method widely used in various fields in our country Take the trial dummy as an example. This dummy was developed based on the 50th percentile human body size in the United States. The body shape difference is relatively different from that of the 50th percentile human body in China. Large; related research shows that in automobile crash tests, the damage response of Chinese human-sized dummies is consistent with the existing collision response based on European and American human-sized dummies. There were also significant differences in the damage response of the test dummies. Therefore, the existing crash test dummies based on European and American human body dimensions are directly used for automobile testing. Vehicle safety testing and evaluation will lead to the inability of the occupant restraint system to effectively protect the Chinese human body. In addition, due to the lack of corresponding experiments Basic research on dummies, lack of testing and evaluation standards for dummies that conform to Chinese human body characteristics, in my country's military industry, aerospace, rail transit and other fields In the safety test of manned equipment, only crash test dummies based on European and American human body sizes in the field of automobile collision can be generally used, which makes The development of manned equipment safety protection technology in related fields has also been greatly restricted. This document gives the design principles to be followed when designing a dummy for mechanical damage testing, the relevant human body characteristics that are key considerations, and the dummy's The test method for biomechanical performance calibration is designed to develop specialized testing methods for various complex application conditions in the fields of automobiles, military industry, aerospace, rail transit and other fields. A mechanical damage test dummy is used to

provide forward design standard support. Design principles and principles of Chinese dummies for mechanical damage testing Calibration method

## 1 Scope

GB/T 42712-2023 sets the design principles and calibration methods for a Chinese anthropomorphic test dummy. Crash test dummies were built to the anthropometry of the American population of decades ago, and the injury criteria derived from them are applied to occupants who are on average shorter, lighter and differently proportioned - which matters, because the tolerance of a body region to load depends on its dimensions and mass distribution. A dummy built to Chinese anthropometry gives injury readings that mean what they say for the people actually in the vehicles. The standard sets the design principles, covering the overall morphological design, the structural design of the body segment assemblies, the motion characteristics and the mechanical injury performance, and then the calibration method for each region in turn, from the head and neck down to the lower leg and ankle, with annexes on the centre of mass reference values and the body segment coordinate systems. It took effect on 1 March 2024.

This document stipulates the design principles of dummies for mechanical damage testing and the mechanical properties of dummies when subjected to various typical impact load conditions. Ability to calibrate test methods. This document is applicable to the safety performance testing of manned vehicles such as automobiles, armored vehicles, high-speed trains, aircraft, manned space vehicles, and amusement facilities. Development and design of dummies for mechanical damage testing in tests, wearable equipment protection performance testing, weapon equipment performance testing and other tests.

## 2 Normative reference documents

The contents of the following documents constitute essential provisions of this document through normative references in the text. Among them, the dated quotations For undated referenced documents, only the version corresponding to that date applies to this document; for undated referenced documents, the latest version (including all amendments) applies to this document.

GB/T 5703-2023 Anthropometric basic items for technical design ( ISO 7250-1.2017, MOD)

GB/T 10000 Adult human body dimensions

## 3 Terms and definitions

The terms and definitions defined in GB/T 5703-2023 and the following apply to this document.

3.1 dummy Humanoid test device for mechanical damage testing.

Note. A complete dummy consists of multiple parts assemblies that reflect various parts of the human body.

3.2 percentilepercentile The normal distribution statistical proportion obtained from the census of human physiological data (height, weight).

Note. The 5th percentile (5th), the 50th percentile (50th), and the 95th percentile (95th) are commonly used human body percentiles. For example, the 5th percentile of height Adult men means that 5% of individuals in the male population have a height parameter less than or equal to this value.

3.3 human-bodysegment The human body is divided into several segments based on bony landmarks.

3.4 The local coordinate system of each human body segment is usually used to provide a fixed reference for the position of the center of mass on each body segment.

3.5 Human body segment center of mass position positionofmasscenter The position of the center of mass of a human body segment relative to the origin of the coordinate system of the body segment.