

ICS 27.200
CCS J 73



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 46756-2025

Liquid helium-free dilution refrigerator

无液氦稀释制冷机

Issued on: December 2, 2025

Implemented on: July 1, 2026

**Issued by: State Administration for Market Regulation;
Standardization Administration of the PRC**

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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 National Light Industry Council. This document is under the jurisdiction of the National Technical Committee on Refrigeration Standardization (SAC/TC119). This document was drafted by: the 16th Research Institute of China Electronics Technology Group Corporation, the Yangtze River Delta Quantum Technology Industry Innovation Center, and Shanghai Quantum Technology. Technology Co., Ltd., China Electronics

Technology Standardization Institute, CSSC Pengli (Nanjing) Ultra-Low Temperature Technology Co., Ltd., QuantumCTek Joint-stock company, China Electronics Technology Group Corporation Electronic Science Research Institute, Institute of Physics, Chinese Academy of Sciences, Institute of Physics and Chemistry, Chinese Academy of Sciences Technology Research Institute, University of Electronic Science and Technology of China, Hydrogen Technology (Guangzhou) Co., Ltd., Hefei Zhileng Cryogenic Technology Co., Ltd., Chinese Association of Refrigeration. The main drafters of this document are. Xu Youping, Yang Hong, Luo Gaoqiao, Luo Ercang, He Yulong, Wu Ming, Man Changcai, Shen Fangda, Xie Lei, and Li Yangmu. Dai Wei, Li Xiaoyu, Luan Tian, Cheng Xuan, Yuan Yuliang, Li Xu, Lu Peiyong, Jia Li, Zhao Haiqiu, Zhang Chi, Chao Wei, Zhu Qinsheng, Du Xiyang, Zheng Xinbi, Zhang Qingnan, Chen Geng, and Yu Lianhui. Liquid helium dilution refrigerator

1 Scope

GB/T 46756-2025 is the Chinese national standard covering the cryogen-free dilution refrigerator - the machine that reaches a few millikelvin on a pulse tube instead of a helium bath, with its cooling power at 100 mK, its base temperature, its vibration and its wiring, which is what quantum computing hardware is built inside. First edition. It was issued on 2 December 2025 and has been in force since 1 July 2026, as a first edition. The document is under the responsibility of the China National Light Industry Council. This page is published from the official record of the 2025 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 specifies the product classification and model naming, technical requirements, and inspection procedures for liquid helium-free dilution refrigerators (hereinafter referred to as "refrigeration units"). The rules, marking, packaging, transportation and storage, and the corresponding test methods are described. This document applies to the design, production, and application of refrigeration machines.

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 151 Heat Exchangers

GB/T 2829 Periodic inspection sampling procedures and tables (applicable to the inspection of process stability)

GB/T 4798.1 Classification of Environmental Conditions - Classification of Environmental Parameter Groups and Grading of Severity - Part

3 Terms and Definitions

The following terms and definitions apply to this document.

3.1 A refrigerator that uses superfluid 4He to dilute 3He without precooling with liquid helium to obtain milliKelvin-level low temperatures.

Note. The mixture of 3He and 4He is separated into a concentrated 3He phase and a diluted 3He phase. 3He atoms in the concentrated phase enter the diluted phase through the phase interface. The dilution process is accompanied by... It absorbs heat to achieve a cooling effect, generating a milliKelvin-level low-temperature environment in the mixing chamber.

3.2 mixing chamber Components containing the 3He and 4He dilution phase interfaces.

3.3 Mixing chamber plate A thin-plate planar component used to install the cooled device at the lowest temperature point of the mixing chamber in a dilution refrigeration unit.

3.4 effective cooling capacity The cooling capacity provided to the load by the mixed chamber cold plate at a temperature of 100mK .