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

GB/T 45523.4-2025

**Remote handling devices for radioactive materials - Part 4:
Power manipulator**

放射性物质远程操作装置 第4部分：动力机械手
(English Translation)

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Foreword

This document is in accordance with the provisions of GB/T 1.1-2020 "Guidelines for standardization work Part 1: Structure and drafting rules for standardization documents" Drafting.

This document is part 4 of GB/T 45523 "Remote Operation Devices for Radioactive Material". GB/T 45523 has been published for the following part.

--- Part 1: General requirements;

--- Part 2: Mechanical master-slave manipulators;

--- Part 3: Electric follow-up master-slave manipulator;

--- Part 4: Power manipulator;

--- Part 5: Sword-type manipulator.

Introduction

Remote control devices for radioactive materials play a key role in the fields of nuclear energy and nuclear technology, and have a profound impact on the safe operation and environmental protection of the nuclear industry.

Its core function is to perform maintenance, dismantling, and operation tasks in a high-radiation environment, effectively isolating operators from radioactive materials.

This device not only ensures the safety and health of the workers, but also improves the work efficiency and reduces the risk of radiation exposure.

It reduces production and operation costs and is an important tool that is indispensable for the safe and efficient operation of the nuclear industry.

GB/T 45523 "Remote Operation Device for Radioactive Materials" focuses on mechanical master-slave manipulators, electric follow-up master-slave manipulators, power machinery these types of manipulators meet various needs with their respective control flexibility, load capacity and applicable scenarios.

The scientific and reasonable selection, deployment and continuous maintenance of these remote operation devices can effectively reduce the operator's Radiation exposure level, effectively control production and operation costs, and improve operating efficiency and overall system safety. This is not only a technological advancement it is an important contribution to human health, environmental protection and sustainable development. Therefore, we continue to optimize the design of the device and improve the automation level.

The key to promoting the sustainable development of remote operation technology of radioactive materials is to strengthen personnel training and management.

GB/T 45523 "Remote Operation Devices for Radioactive Materials" is planned to consist of five parts.

--- Part 1: General requirements. The purpose is to specify the requirements that need to be met by the design, manufacture and application of remote operation devices for radioactive materials.

General requirements.

--- Part 2: Mechanical master-slave manipulators. The purpose is to specify the design, manufacture and application of mechanical master-slave manipulators that need to meet

Specific requirements on structure and function, technical indicators, inspection, etc.

--- Part 3: Electric follower master-slave manipulator. The purpose is to specify the design, manufacture and application of electric follower master-slave manipulators that need to meet Specific requirements on structure and function, technical indicators, inspection, etc.

--- Part 4: Power manipulator. The purpose is to specify the structure and function of the power manipulator that needs to be designed, manufactured and applied.

Specific requirements in terms of performance, technical indicators, inspection, etc.

--- Part 5: Sword-type manipulator. The purpose is to specify the structure and function of the sword-type manipulator that needs to be designed, manufactured and applied.

Specific requirements in terms of performance, technical indicators, inspection, etc.

Radioactive Material Remote Control Device Part 4: Power manipulators

1 Scope

This document specifies the structure and function, technical requirements and inspection requirements of power manipulators.

This document applies to the design, manufacture and application of teleoperated powered manipulators for use in ionizing radiation environments.

2 Normative references

The contents of the following documents constitute essential clauses of this document through normative references in this document.

For referenced documents without a date, only the version corresponding to that date applies to this document; for referenced documents without a date, the latest version (including all amendments) applies to this document.

GB/T 1804 General tolerances Tolerances of linear and angular dimensions without tolerance indication GB/T 45523.1 Remote control devices for radioactive materials Part 1: General requirements EJ/T 1175.5 Sealed chamber components Part 5: Electrical and fluid pipeline penetrations for sealed chambers without shielding EJ/T 1175.6 Sealed chamber components Part 6: Common penetration parts for shielded sealed chambers

3 Terms and definitions

The terms and definitions defined in GB/T 45523.1 apply to this document.

4 Structure and function

4.1

Power manipulators are usually installed in a bridge-type configuration, with the manipulator arm mounted on a rail-supported carrier or a remotely controlled carrier.

The carrier running on the guide rail usually consists of a movable large vehicle bridge frame, a small vehicle frame and a telescopic tube, and its layout diagram is shown in Figure 1.

The manipulator can also be mounted on a rail carrier on the hot chamber floor.

4.2

The power manipulator is electrically driven and its movement speed is controlled by switching devices or potentiometers and traditional analog control or digital control.

The robot arm consists of a shoulder joint and a wrist joint, mounted on a carrier that achieves positioning motion (see Figure 1).

4.3

A robotic arm is usually equipped with a clamp with parallel movable jaws that can be used to manipulate objects and apply forces and torques.

The end effector can be remotely replaced with other types of end effectors, such as grabbers or other mechanical or electric tools, by means of a replacement tool set up in the hot chamber.

Shoulder hook allows lifting of heavier objects.

4.4

The transport devices used in the hot chamber generally include a mobile bridge (trolley), a transverse crane (trolley) and a multi-layer vertical extension crane with a lifting function.

The telescopic tube lifting mechanism can be used to replace the lifting function of a light crane. Other different designs can also be used, such as cantilever installation Mobile brackets installed on the side walls, mobile gantry installed on the bottom plate, rotating machine base and other special tooling.

4.5

Depending on the model of the power manipulator, the speed of each movement can be fixed, controlled in steps or continuously adjusted.

Direct feedback of operating force, but its clamping force can be transmitted to the operator in an appropriate way. Several large and small gears or pre-selected limits can be set the size of the clamping force is indicated by sound and light.