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

GB/T 17925-2024

**Practice for X-ray digital radioscopic examination of cylinder
weld**

气瓶对接焊缝X射线数字成像检测

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1 Scope

GB/T 17925-2024 governs the X-ray digital radiographic examination of the butt welds of gas cylinders. A cylinder is a pressure vessel that will be filled and emptied thousands of times and carried around by people, so its longitudinal and circumferential welds are examined on every unit rather than by sampling, and the examination has moved from film to flat panel detectors. Digital radiography is faster and leaves an image that can be stored and re-examined, but it introduces its own variables - detector pixel pitch, magnification, grey level and image processing - which have to be controlled or the sensitivity claimed for the technique is not achieved. The standard sets the technique, the equipment, the process and the image quality requirements: the general requirements, the testing environment and working conditions, the timing of the examination and the surface preparation, the examination technique and process, the marking of image information, the measurement of the image quality indicator and the limits on it, the observation, processing and dimensional

measurement of the image, the quality classification of the cylinder butt weld, and the storage of the images. It replaces the 2011 edition and takes effect on 1 July 2025.

This document specifies the flat panel detector X-ray digital radioscopic (DR) examination technology, equipment, process and image quality requirements for fusion welded butt joints of gas cylinders during manufacturing. This document is applicable to DR examination of cylinder weld made of steel and nonferrous metal materials with a nominal thickness of 16.0 mm and a nominal diameter of 100 mm ~ 1 200 mm. This document can be used as a reference for DR examination of other gas cylinders of similar specifications, sizes, and materials, as well as fusion-welded butt joints of in-use gas cylinders.

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.

GB/T 12604.11, Non-destructive testing - Terminology - Terms used in X-ray digital radioscopic testing

GB/T 23901.1, Non-destructive testing - Image quality of radiographs - Part 1. Determination of the image quality value using wire-type image quality indicators

GB/T 23901.5, Non-destructive testing - Image quality of radiographs - Part 5. Determination of the image unsharpness and basic spatial resolution value using duplex wire-type image quality indicators NB/T 47013.1, Nondestructive testing of pressure equipments - Part

1.General requirements NB/T 47013.2, Nondestructive testing of pressure equipments - Part 2. Radiographic testing

JB/T 7902, Non-destructive testing - Specification for wire-type image quality indicators

3 Terms and definitions

For the purpose of this document, terms and definitions given in GB/T 12604.11, NB/T 47013.1 and NB/T 47013.2, as well as the following apply.

3.1 system resolution ratio The measured value of a duplex wire image quality indicator placed directly on the detector surface.

3.2 image resolution ratio The measured value of a duplex wire image quality indicator placed on the base material on the source side of the weld being inspected.

3.3 total unsharpness The image unsharpness composed of the inherent unsharpness of

the detector and the geometric unsharpness.

3.4 normalized signal-to-noise ratio Normalized signal-to-noise ratio based on resolution ratio.

3.5 amount of exposure during single frame The product of tube current and the time of exposure during single frame.

3.6 multiframe superposition The signal processing process of superimposing and averaging the gray-scale values of multiple images collected while keeping the relative positions of the radiation source, workpiece and imaging plate unchanged.

3.7 accumulated exposure

5.1.1 X-ray machine

5.1.1.1 High-frequency constant-voltage small-focus X-ray machine should be selected. The operating frequency of its high-voltage generator shall not be less than 20 kHz; the ripple factor (the peak-to-peak value of the AC component in the DC voltage output by the high-voltage generator of the X-ray machine) shall be less than 1%; the effective focal spot size shall not be greater than

5.1.1.2 The energy range of the X-ray machine shall be selected based on the material, penetrated thickness and arrangement of the gas cylinder being inspected, combined with the process requirements of high-voltage transillumination.

5.1.2 Flat panel detector

5.1.2.1 A flat panel detector shall be used.

5.1.2.2 The array element size of the detector should not be larger than 160 μm .

5.1.2.3 The analog-to-digital conversion bit number of the detector shall be no less than 12 bits, and the exposure-grayscale linear range should be no less than 75% of the full grayscale.

5.1.3 Computer system

5.1.3.1 The configuration of the computer host shall be compatible with the flat panel detector, X-ray machine control system and control system of the inspection tooling used.

5.1.3.2 The computer system shall be equipped with a large memory and hard disk, and shall have a data backup system.

5.1.3.3 The computer system shall be equipped with a high-brightness and high-resolution display and shall meet the following requirements.

a) Brightness not less than 250 cd/m^2 ;

- b) Capable of displaying at least 256 gray levels;
- c) Capable of displaying at least 2 million pixels, with a pixel size of less than 0.3 mm;
- d) The minimum displayable light intensity ratio is 1.250.

5.1.4 System software

5.1.4.1 The system software shall have the functions of image acquisition, image processing, image measurement and annotation, and image storage.

5.1.4.2 The image acquisition function shall include the adjustment and control of the X-ray machine, detector, and inspection tooling.

5.1.4.3 The image processing function shall include various noise reduction functions as well as image scaling, rotation, mirroring, contrast and brightness adjustment functions.

5.1.4.4 The image measurement and annotation function shall include grayscale measurement, resolution measurement, signal-to-noise ratio and normalized signal-to-noise ratio measurement, geometric dimension measurement and defect marking, and position annotation functions.

5.1.4.5 The image storage function shall include the establishment and classification management of image libraries, as well as browsing, retrieval and search functions.

5.1.5 Inspection tooling

5.1.5.1 The inspection tooling shall include an X-ray machine-detector tooling, a gas cylinder conveyor and a gas cylinder inspection platform.

5.1.5.2 The X-ray machine-detector tooling and the gas cylinder inspection platform shall be able to achieve relative movement in multiple dimensions, such as front and back, up and down, left and right rotation, and deflection, to achieve the following functions.

- a) Carry out testing on any designated part or range;
- b) Adjust the transillumination arrangement according to the needs, such as selecting appropriate F and b;
- c) Adjust the illumination angle for detection.

5.1.5.3 Inspection tooling with automatic position tracking function and positioning marking function shall meet the following requirements.

- b) Testing equipment (X-ray machine, detector, inspection tooling, image quality indicator, scattered radiation protection equipment, marking, system software, display, etc.);
- c) Testing process (illumination parameters, geometric parameters, acquisition parameters,