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

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**Non-destructive testing - Industrial endoscopy visual testing -
Part 1: General requirements**

无损检测 工业内窥镜目视检测 第1部分：方法

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1 Scope

Part 1 of China's national standard for industrial endoscopic visual testing, giving the general requirements. Visual inspection is the oldest non-destructive method and the only one that identifies a defect directly rather than inferring it from a signal, and the endoscope extends it into places a person cannot see: inside an engine without removing the head, along a heat exchanger tube, into a turbine's gas path, through a weld's bore. The requirements have to address what determines whether the inspection means anything - the resolution and the illumination at the working distance, the field of view and the distortion, the ability to measure a defect rather than merely see it, and the qualification of the person interpreting the image. That last is why this is a formal method rather than looking: an endoscopic image is distorted, oddly lit and hard to scale, and two inspectors can reach opposite conclusions from the same view.

This document specifies the method principle, environmental requirements, personnel requirements, testing system, testing, result evaluation, and testing report of industrial endoscopy (hereinafter referred to as endoscopy) visual testing. This document is applicable to the testing and evaluation of the inner surface state and internal structure of metal or non-metal parts and assembly components of industrial products.

2 Normative references

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

GB/T 9445 Non-destructive testing - Qualification and certification of NDT personnel

GB/T 20737 Non-destructive testing - General terms and definitions

GB/T 41856.2 Non-destructive testing - Industrial endoscopy visual testing - Part 2: Atlas

3 Terms and definitions

The terms and definitions defined in GB/T 20737 apply to this document.

4 Method principle

Without damaging the tested part or the operation of in-service equipment, for the parts or inner surface conditions that are difficult to be observed by direct visual testing, endoscopy visual testing uses an endoscopy testing system to test and evaluate them by means of optical images or photoelectric conversion video images. By changing different endoscopy probes (also known as scope bodies); changing the viewing direction or improving the field of view; and applying optical or photoelectric principles, FIND defects clearly, intuitively and effectively. Compare the measured image with the typical atlas; analyze and evaluate the real situation of the tested area or structure.

5 Environmental requirements

5.1 The ambient temperature and humidity of the testing site shall meet the requirements of the testing system.

5.2 There shall be no electromagnetic interference affecting the testing around the testing site.

5.3 The endoscopy testing system should have its own grounding protection power supply or be grounded independently. It shall be equipped with a voltage stabilizing device, to ensure that there is no static electricity accumulation during the working process. The grounding resistance should not be greater than 4 Ω .

5.4 When testing, it is advisable to avoid strong light or direct sunlight; choose a soft and quiet environment.

6 Personnel requirements

The personnel, who carry out the testing, shall be subject to qualification and certification according to GB/T 9445 or the system recognized by the parties to the contract; it shall obtain relevant qualification certificates for visual testing. Or the employer shall provide job training and operation authorization for them.

7.1 Composition

7.1.1 The basic configuration of the endoscopy testing system is mainly composed of endoscopy probe, lighting source, control system, and display system.

7.1.2 Auxiliary functions such as manipulator, image recording transmission system, and video converter can be configured.

7.2 Classification Endoscopy testing systems are classified according to imaging principles and light guide materials as follows:

a) Optical straight-rod endoscopy (rigid scope or straight-rod scope). Use the principle of optical imaging. Use the objective lens to generate the image signal. Use a medium to transmit the image. Use the eyepiece to directly observe. It can

7.4 Lighting source

7.4.1 In order to ensure the testing resolution ability of the endoscopy AND truly reflect the state of the inner surface of the tested part, a white light illumination source should be used.

7.4.2 According to the material and inner surface state of the tested part, adjust the illumination and the depth of field and angle of the endoscopy probe, to avoid reflection and glare.

7.5 Control system The endoscopy testing system should have the function of adjusting focus and illumination. There are automatic and manual adjustments.

7.6 Display system

7.6.1 The resolution of the display system should not be lower than that of the endoscopy testing system.

7.6.2 The imaging quality of the endoscopy testing system should be tested using a resolution test card, to judge the imaging clarity, resolution, barrel-shaped distortion, color distortion, etc.

7.7 Measurement mode The measurement mode of the endoscopy testing system is divided into two types: comparative measurement and absolute measurement. According to the testing requirements of the tested part, select a measurement mode. See Appendix B.

7.8 Testing software The testing software should have functions such as image

freeze-frame photography, video recording, zoom-in, comparison, etc.; and can perform color setting, brightness adjustment, file naming, image storage and recall, video/video playback, deletion, formatting, lighting color white balance, etc.

7.9 Auxiliary functions Fiber optic or electronic video endoscopy shall have the following auxiliary functions - such as tool auxiliary channels and externally attached auxiliary tools, etc. - for operations such as foreign objects grasping, deburring, chamfering, diversion, and cleaning. When grasping foreign objects, according to the material and shape of the excess objects, auxiliary grasping tools can be selected. The length is generally longer than the length of the insertion tube of endoscopy probe. When grabbing excess objects, it is advisable to avoid the auxiliary tools from scratching the surface of the tested part. When the grasping tool enters the working channel of the endoscopy, it shall be in a straightened and tightened state to facilitate grasping. If burrs are found in the inner hole and inner cavity OR chamfering is required, the endoscopic electric grinding device with built-in tool channel can be selected for visual operation.

8.1 Testing preparation

8.1.1 Before testing, it is advisable to remove impurities and corrosive objects on the surface of the tested part; remove redundant objects that affect the testing and evaluation; so as to ensure the true state of the surface of the tested part.

8.1.2 According to the internal structure characteristics of the inspected part and the testing requirements, select the model and specification of the endoscopy probe. According to the testing steps, unfold and connect the testing system. Check the reliable grounding of the power supply, the stable placement of the instrument, and the normal start-up function of the instrument.

8.1.3 Before testing, the following elements should be paid attention to:

- a) Avoid dropping, colliding and crushing the lens of the endoscopy probe;
- b) Avoid cable crushing or sharp object cuts of the endoscopy probe;
- c) Before testing, check whether the connection of the endoscopy probe is firm AND whether the surface of the endoscopy probe is intact;
- d) Avoid damage or jamming of the endoscopy probe caused by foreign objects, obstacles or edge burrs in the tested part.

8.2 Testing process specification Before testing, it shall prepare the corresponding testing process specification or testing operation documents. The contents shall at least include:

- a) Information of the tested part and the tested range (testing area, location and orientation);
- b) Reference to this document and acceptance requirements;