



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

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**Non-destructive testing of steel tubes - Magnetic particle
inspection of seamless and welded ferromagnetic steel tubes
for the detection of surface imperfections**

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1 Scope

This document specifies the requirements for magnetic particle inspection of seamless and welded ferromagnetic steel tubes for surface imperfections on the tube body and imperfections on the end face/bevel at the tube ends.

This document specifies the requirements for the detection of imperfections on the outer surface of all or part of steel tubes. Upon negotiation and agreement between the purchaser and the manufacturer, it can be applied to the detection of the inner surface over a limited length from the tube end (depending on the diameter of the steel tube).

When applicable, this document can be used to locate the position of the external surface imperfections detected by other non-destructive testing (such as ultrasonic)

methods before grinding, and to confirm that the imperfections have been completely removed after grinding.

This document specifies the requirements for the detection of laminar imperfections on the end face/bevel at both ends of plain-end tubes and beveled-end tubes that may affect subsequent manufacturing and testing (such as welding and ultrasonic testing of welds).

This document applies to the detection of laminar imperfections and other imperfections on the end face/bevel. In this case, the direction of the magnetic field shall be as perpendicular to the direction of the imperfection being detected as possible.

This document also applies to the inspection of hollow parts.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9712 Non-destructive testing - Qualification and certification of personnel

NOTE: GB/T 9445-2015 Non-destructive testing - Qualification and certification of personnel (ISO 9712:2012, IDT)

ISO 9934-1 Non-destructive testing - Magnetic particle inspection - Part 1: General principles

NOTE: GB/T 15822.1-2005 Non-destructive testing - Magnetic particle inspection - Part 1: General principles (ISO 9934-1:2001, IDT)

ISO 9934-2 Non-destructive testing - Magnetic particle inspection - Part 2: Detection media

NOTE: GB/T 15822.2-2005 Non-destructive testing - Magnetic particle inspection - Part 2: Detection media (ISO 9934-2:2002, IDT)

ISO 9934-3 Non-destructive testing - Magnetic particle inspection - Part 3:

Equipment

NOTE: GB/T 15822.3-2005 Non-destructive testing - Magnetic particle inspection - Part 3: Equipment (ISO 9934-3:2002, IDT)

ISO 10893-8 Non-destructive testing of steel tubes - Part 8: Automated ultrasonic testing of seamless and welded steel tubes for the detection of laminar imperfections

ISO 11484 Steel products - Employer's qualification system for non-destructive testing (NDT) personnel

3 Terms and definitions

For the purpose of this document, the terms and definitions defined in ISO 9934-1 and ISO 11484 and the following apply.

3.1 tube A long hollow product with open ends and a cross-section of any shape.

3.2 seamless tube A hollow tube made by piercing a solid material, which is further hot or cold processed into final dimensions.

3.3 welded tube A hollow tube made from a strip by crimping and then welding, which may be further hot and cold processed into final dimensions.

5.1.1 Inspection area (tube body or end face/bevel) and inspection direction (longitudinal or transverse) shall be carried out in accordance with the product standards or contract

requirements.

5.1.2 As necessary, the entire outside surface of each tube or part of it shall be inspected using the magnetic particle method. For the detection of longitudinal and/or transverse surface imperfections, DC or DC magnetization shall be used, depending on the magnetic particle technique used. When testing end face/bevel, dry magnetic particle inspection can be used after negotiation and agreement between the supplier and the purchaser. Otherwise, follow the requirements of ISO 9934-1, ISO 9934-2, and ISO 9934-3.

5.1.3 In order to detect surface imperfections, the detection medium shall be applied simultaneously with magnetization, and the illumination shall not be less than 500 lx.

Only after negotiation and agreement between the supply and demand parties, can the residual magnetism method be used, that is, magnetic powder is applied after the steel tube is magnetized. The residual magnetism method is generally not allowed to be used for the inspection of end face/bevel.

In the case of insufficient detection sensitivity in certain areas (for example, the contrast between the detection medium and the surface of the steel tube being inspected is small)

or due to the magnetization technique used, a contrast enhancer shall be applied to the steel tube area being inspected before detection to enhance the contrast. Alternatively, fluorescent magnetic powder shall be used to detect in a dark area through a UV-A radiation source. The background white light intensity during detection shall not exceed 20 lx, and the black light intensity shall be at least 10 W/m².

5.1.4 This document does not specify the magnetization intensity required to detect unacceptable surface imperfections, nor the current intensity required to achieve this intensity. In this case, the magnetization requirements and detection media shall be implemented in accordance with the requirements of ISO 9934-1, ISO 9934-2, and ISO 9934-3 (except those required in 5.1.2).

5.1.5 In the production testing of steel tubes, the magnetization intensity achieved by the technique and equipment used shall be confirmed regularly, generally not more than

4 h, and a magnetic field strength meter can be used. When inspecting the end face/bevel, a comparison sample tube containing an artificial simulated imperfection or a natural laminar imperfection on the end face/bevel can be used. The manufacturer shall be able to prove the existence of these imperfections.

5.2 Inspection of tube body

5.2.1 General When conducting production inspection of steel tubes, circumferential magnetization shall be used to detect longitudinal surface imperfections, and magnetization parallel to the main axis of the steel tube shall be used to detect transverse surface imperfections.

5.2.2 Magnetization method To inspect the tube body, one of the following magnetization methods shall be used.

a) Method A: Current flow method The current flows through the two contact areas on the surface of the steel tube, and the current is provided by an external DC, AC or full-wave/half-wave rectified AC power source. This method is used to detect imperfections approximately parallel to the main axis of the steel tube.

b) Method B: Threaded bar method/cable method The current (as in Method A) is passed through a rigid bar or flexible cable placed within the steel tube and approximately concentric with it. This method is used to detect imperfections approximately parallel to the main axis of the steel tube.

c) Method C: Encircling coil method A rigid or semi-rigid current-carrying coil is wound around the steel tube. The surface of the steel tube is axially magnetized under the action of the coil. This method is used to detect approximately transverse imperfections.

d) Method D: Magnetic flux method The steel tube or part of the steel tube forms part of the magnetic circuit of an electromagnet, which receives current from an external power source (as in Method A). This method is useful for detecting imperfections that are at right angles to the line connecting the electromagnet poles.

Other magnetization techniques or combinations of the techniques given in 5.2.2 a) to 5.2.2 d) may be used as long as the requirement for the magnetic field strength and direction are met.

5.3 Inspection of end face/bevel

5.3.1 During the production inspection of the end face/bevel at both ends, the manufacturer may decide to magnetize parallel to the main axis of the steel tube or through the radial thickness direction of the steel tube. At the same time, the detection medium shall be applied to the end face/bevel of the steel tube to detect laminar imperfections.

5.3.2 When using magnetization parallel to the main axis of the tube, a rigid concentric coil around or within the tube shall be used for magnetization, positioned close to the Steel tubes or steel tube components showing indications exceed the corresponding acceptance level shall be deemed as suspect steel tubes.

For suspect steel tubes, one or more of the following measures shall be taken:

a) grind the suspect area or use appropriate methods to detect it; after grinding, confirm that the remaining wall thickness is within the allowable tolerance range, and the steel tube shall be re-inspected according to the previously specified method; if no indication greater than or equal to the acceptance level is produced, the steel tube shall be deemed to have passed the inspection;

Upon negotiation and agreement between the purchaser and the manufacturer, other