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NATIONAL STANDARD OF THE
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ICS 25.160.20

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GB/T 1954-2008

Replacing GB/T 1954-1980

**Methods of Measurement for Ferrite Content in
Austenitic Cr-Ni Stainless Steel Weld Metals**

铬镍奥氏体不锈钢焊缝铁素体含量测量方法

(ISO 8249:2000, Welding - Determination of Ferrite Number (FN) in
Austenitic and Duplex Ferrite-austenitic Cr-Ni Stainless Steel Weld
Metals, MOD)

Issued on: June 26, 2008

Implemented on: January 1, 2009

**Issued by: General Administration of Quality Supervision, Inspection and
Quarantine;**

**Standardization Administration of the People's Republic of
China.**

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Foreword

The modification of this Standard adopts international standard ISO 8249:2000 *Welding - Determination of Ferrite Number (FN) in Austenitic and Duplex Ferritic-austenitic Cr-Ni Stainless Steel Weld Metals* (English version).

In order to guarantee the applicability of this Standard, the following modifications in technical content are made when ISO 8249:2000 is adopted:

- The content of standard magnet, standard magnetic instrument and calibration curve in the international standard is not quoted; relevant definitions and stipulations are directly adopted;
- Relevant stipulation of product measurement is added;
- Metallographic method in GB/T 1954-1980 is retained.

This Standard is amendment of GB/T 1954-1980 *Determination of the Welding Seam Iron Element Content in Chromium, Nickel Austenitic Stainless Steel*. In comparison with GB/T 1954-1980, the main technical changes are as follows:

- The stipulations of sample preparation and product measurement in magnetic method part are added;
- The stipulations of instrument calibration are modified;
- The content of Austenitic-ferritic stainless steel is added;
- The stipulation of test report is added; the chapter of arbitration test is deleted;
- Appendix A provides a reference format of test data.

Since the date of implementation, this Standard shall serve as a replacement of GB/T 1954-1980.

In this Standard, Appendix A is informative.

This Standard was proposed by and shall be under the jurisdiction of National Technical Committee 55 on Welding of Standardization Administration of China (SAC/TC 55).

The drafting organizations of this Standard: Harbin Welding Institute Limited Company; Tianjin Bridge Welding Materials Group Co., Ltd.; Tianjin Golden Bridge Welding Materials Group International Trading Co., Ltd.; Advanced Technology & Materials Co., Ltd. (AT&M).

The main drafters of this Standard: Sun Shaofan, Song Yuying, Hou Laichang, Li Jifu.

Methods of Measurement for Ferrite Content in Austenitic Cr-Ni Stainless Steel Weld Metals

1 Scope

This Standard stipulates the measurement method for ferrite content.

This Standard is applicable to Austenitic, Austenitic-ferritic chromium nickel stainless steel welded metals.

The magnetic method stipulated in this Standard is not applicable to Austenitic stainless steel castings and forgings.

2 Normative References

Through the reference in this Standard, clauses of the following documents become clauses of this Standard. In terms of references with a specific date, all the subsequent modification sheets (excluding the corrected content) or the revised editions are not applicable to this Standard. However, all parties that reach an agreement in accordance with this Standard are encouraged to explore the possibility of adopting the latest version of these documents. In terms of references without a specific date, the latest version is applicable to this Standard.

GB/T 20878 *Stainless and Heat-resisting Steels - Designation and Chemical Composition*

3 Terms

The following terms and definitions are applicable to this Standard.

3.1 Ferrite

Ferrite refers to high-temperature ferrite which is formed directly through the solidification and crystallization of liquid metal; it is retained to room temperature.

3.2 Ferrite Number (FN)

Ferrite number refers to standardized numerical value, which is artificially selected to express ferrite content in Austenitic stainless steel, and ferritic-Austenitic stainless steel weld metals.

3.3 Primary Standard

Primary standard refers to a layer of accurate non-magnetic coating standard sample that is produced on carbon steel matrix with the carbon content of less than 0.18%. The non-magnetic coating is made of copper; plated with hard chromium, and polished. Each standard sample marks FN value of a certain equivalent magnetic weld metal that is internationally universal. It is applicable to the calibration of measurement instrument under standard magnetic attraction principle, for example, Mange-Gage.

3.4 Secondary Standard

Secondary standard refers to weld surfacing metal sample or sample with similar surfacing metal structure that is produced in accordance with standard procedures. Use Mange-Gage, which is calibrated through primary standard, to determine FN value of each sample. It is applied to periodic calibration of ferrite measurement instrument under magnetic method.

4 Magnetic Method

4.1 General Principles

Ferrite measurement instrument, which takes magnetic attraction or magnetic permeability as the principle, shall be adopted for measurement. The measured ferrite number (FN) shall be used to express ferrite content in Austenitic stainless steel, Austenitic-ferritic stainless steel weld metals.

4.2 Measurement of Surfacing metal of Welding Rod Electric Arc Welding

4.2.1 Sample preparation

- a) In accordance with the shape and dimensions shown in Figure 1, use test welding rods to overlay a sample on the substrate. During the overlaying, two copper plates may be parallelly placed on the substrate.
- b) The overlaying layer's minimum height H is 13 mm (see NOTE b in Figure 1). When the diameter of welding rod is ≥ 4.0 mm, each overlaying layer shall be constituted of single weld bead. When the diameter of welding rod is < 4.0 mm, the width of weld bead shall be not more than 3 times of the diameter of welding core; each overlaying layer shall be constituted of two or more weld beads. During the welding, electric arc is not allowed to contact the copper plates.
- c) Welding current shall comply with the stipulations in Table 1; arc initiation and arc extinction shall be on the head end and the tail end of the welding layer. After the welding of a weld bead is completed, alter the welding direction.
- d) 20 s after the welding of each weld bead is completed, use water-cooling; the temperature between the beads shall be not more than 100 °C. Before water-cooling, the top weld bead shall firstly be air-cooled to below 425 °C.

welding samples shall be as close to the stipulations in 4.2 as possible.

4.4 Measurement of Product Weld

4.4.1 In the measurement of product weld and weld metals, samples may be taken, or, measurement may be directly conducted from the welding test piece provided for product inspection. Or, measurement may be directly conducted on product weld or overlaying layer. Measurement instrument shall comply with the stipulations in 4.5. Measurement process shall comply with the stipulations in 4.2.

4.4.2 In the measurement of product weld and weld metals, the measuring parts shall comply with the stipulations of product technical conditions, or, be determined by both parties through negotiation. Generally speaking, the surface being measured shall be polished. If the machining of the weld surface may trigger changes of anti-corrosion property or other specific properties, and further affect product quality, then, in the measurement of this type of welds (including overlaying metal), whether the surface shall be polished shall be determined by both parties through negotiation. In the select measurement location, in every 5 mm ~ 10 mm, take 1 measurement point. The measurement shall comply with the stipulations in 4.2.2.

4.4.3 In terms of long weld and large-area of overlaying, conduct spot measurement in accordance with a certain proportion. The proportion and part of spot measurement shall be determined by both parties through negotiation. The part of spot measurement shall be representative. Measurement points shall be uniformly distributed within the range of the measurement part. When welding operators are replaced, welding parameters are changed, plate thickness or cooling conditions are changed, re-measurement shall be conducted in time.

4.4.4 When the transition layer is measured in accordance with the requirements of technical conditions, the overlapped area of the two outermost weld beads shall be considered as the measurement part.

4.4.5 During the measurement process, if ferrite distribution is found to be extremely asymmetrical, the average value, the highest value, the lowest value and its part shall be respectively provided in the measurement result.

4.4.6 During the measurement, it shall be guaranteed that the influence of strong magnetic substance (for example, low carbon steel or cast iron, etc.) near the instrument on the measurement result is eliminated. In terms of standard magnetic instrument, during the measurement, the distance from surrounding ferromagnetic substance to the measuring head shall be beyond 18 mm. Other types of probe-type instruments shall be operated in accordance with the requested minimum distance from ferromagnetic substance.

Please be cautious in the measurement of the stainless steel weld of composite board and relatively thin stainless steel overlaying layer (layer thickness < 5 mm). The

5.2.3 In terms of surfacing metal, the central cross section of the outermost layer shall be considered as the measurement part (as it is shown in Figure 5).

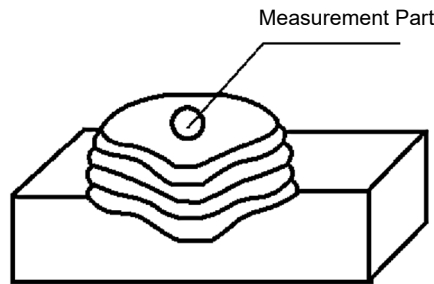


Figure 5 -- Surfacing Metal Measurement Part

When large-area overlaying has transition layer, the transition layer's ferrite content is measured in accordance with the technical conditions, then, the junction of the two outermost weld beads shall be considered as the measurement part.

If necessary, through the negotiation between both parties, measurement may be conducted on a certain layer, a certain part, or layer-by-layer.

5.2.4 Under general circumstances, take 3 metallographic samples. In terms of each sample, measure above 10 representative fields of view; take the average value as the measurement result of the sample. Then, take the average value of the measurement result of 3 samples as the final result.

5.2.5 In terms of double-sided weld, take the average value of two large surfaces as the measurement result. If there are special demands, the average content of each large surface may be listed.

5.2.6 When it is determined through an agreement between both parties that measurement shall be conducted on a certain layer, a certain part or layer-by-layer, the average value of above 10 representative fields of view shall be taken as the measurement result.

5.2.7 If it is found during the measurement process that ferrite distribution is extremely asymmetrical, then, the measurement result shall provide the average content, the highest content and the lowest content, and add certain explanation.

5.3 Metallographic Standard Map

5.3.1 Metallographic standard map belongs to approximate or semi-quantitative metallographic method, which can only provide a rough range of ferrite content. This Standard attaches two groups of metallographic standard maps (respectively 500 times and 1,000 times of welding rod electric arc weld) for the purposes of comparative screening test, intermediate approximate measurement and other semi-quantitative tests (see Figure 6 and Figure 7).

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