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**Corrosion of Metals and Alloys - Potentiostatic
Test and Evaluation Method for Determination of
Susceptibility to Grooving Corrosion of High
Frequency Electric Resistance Welded Steel Pipes**

金属和合金的腐蚀

高频电阻焊焊管沟槽腐蚀性能恒电位试验与评价方法

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Corrosion of Metals and Alloys - Potentiostatic Test and Evaluation Method for Determination of Susceptibility to Grooving Corrosion of High Frequency Electric Resistance Welded Steel Pipes

1 Scope

This Standard specifies a method for evaluating the grooving corrosion of high-frequency electric resistance welded steel pipes by using the constant potential anodic polarization method in a 3.5% NaCl solution.

This Standard is applicable to the test of grooving corrosion for carbon steel high-frequency electric resistance welded pipes.

2 Normative References

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) are applicable to this document.

GB/T 16545 Corrosion of Metals and Alloys - Removal of Corrosion Products from Corrosion Test Specimens

GB/T 18590-2001 Corrosion of Metals and Alloys - Evaluation of Pitting Corrosion

JB/T 10579-2006 Standard Practice for Applying Statistics of Corrosion Data

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1 Grooving corrosion

The corrosion state that occurs at the weld junction and forms a deep-valley or horseshoe-shaped narrow groove.

3.2 Grooving corrosion sensitivity coefficient

The ratio of the maximum corrosion depth (the sum of the average corrosion depth of the specimen and the maximum grooving corrosion depth) and the average corrosion depth of the specimen at the junction.

4 Principle

Since the difference in composition, structure and residual stress BETWEEN the high-frequency electric resistance steel pipes weld-seam AND the base metal, the welded steel pipes may form the corrosion groove at the weld junction during the serving process. Such difference can be highlighted by applying appropriate anode potential to the welded steel pipe weld-seam for polarization, and further rapidly characterize the resistance of grooving corrosion of the high-frequency electric resistance welded steel pipe weld-seam.

5 Devices and Materials

5.1 Potentiostat

The potentiostat shall meet the following requirements:

- Voltage range: $-2V \sim +2V$;
- Current range: $-1A \sim +1A$;
- Voltage resolution shall be no less than $1mV$;
- Current resolution shall be no less than $0.01mA$.

5.2 Tested electrolytic cell

The tested electrolytic cell shall contain a working electrode (specimen), one is used as the reference electrode for measuring the electrode potential; and one or two auxiliary electrodes. The tested electrolytic cell shall have a gas inlet and a gas outlet. The auxiliary electrode shall be placed reasonably so that the current on the sample can evenly distributed. In order to minimize the solution resistance between the reference electrode and the working electrode; the front end of the capillary shall be placed approximately 2 times the capillary diameter away from the working electrode, but no close than the position of 2 times the capillary diameter. The tested electrolytic cell shall be made of a material that is inert under the test temperature environment. The solution volume on the sample surface is greater than $500mL/cm^2$. The composition and installation of the tested electrolytic cell can refer to Figure 1.

Key:

- | | |
|---------------------------|---------------|
| 1 – original surface; | 4 – junction; |
| 2 – measurement baseline; | 5 – groove. |
| 3 – heat affected zone; | |

Figure 3 – Metallographic Photo of Corroded Groove Section of a High-Frequency Electric Resistance Welded Steel Pipe Products

8 Evaluation of Test Results

At least measure 3 parallel specimens; use the measured maximum Value- α to evaluate the groove corrosion. The parallel samples and data statistical analysis shall conform to the provisions of JB/T 10579-2006. The groove corrosion sensitivity increases as the increase of groove corrosion sensitivity coefficient, α . The larger the Value- α means that the groove corrosion is more likely to occur.

9 Test Report

The test report shall at least contain the following contents:

- This Standard number;
- Test laboratory;
- Relevant information of sample;
- Test environmental conditions;
- Instrument types for test;
- Value- α .

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