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Chemical conversion coatings - Black oxide coating on iron and steel - Specification and test methods

化学转化膜 钢铁黑色氧化膜 规范和试验方法

(ISO 11408:1999, MOD)

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1 Scope

This standard specifies the requirements for black oxide films on iron and steel (including cast iron, wrought iron, carbon steel, low alloy steel and stainless steel). Black oxide film can be used to reduce friction between sliding surfaces or bearing surfaces, or for decoration, or to reduce light reflection. This film can be used wherever a black surface is required, with or without additional anti-corrosion treatment; even with additional anti-corrosion treatment, it can only achieve very limited corrosion protection under mildly corrosive conditions.

This standard does not specify the state, processing, surface roughness of the substrate before black oxidation.

2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For the dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this Standard; however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 10125 Corrosion tests in artificial atmospheres - Salt spray tests

GB/T 12334 Metallic and other inorganic coatings - Definitions and conventions concerning the measurement of thickness (idt ISO 2064)

GB/T 12609 Electrodeposited metallic coatings and related finishes- Sampling procedures for inspection by attributes (eqv ISO 4519)

ISO 9587 Metallic and other inorganic coatings - Pretreatments of iron or steel to reduce the risk of hydrogen embrittlement

ISO 9588 Metallic and other inorganic coatings - Post-coating treatments of iron or steel to reduce the risk of hydrogen embrittlement

c) Any requirements for additional anticorrosive treatments (such as oil film, wax film or paint film) and wet heat test after such treatment;

d) Any requirements for heat treatment before and/or after black oxidation (see Chapter 6);

e) Any requirements for oxalic acid resistance tests (see 7.2);

f) Any requirements for abrasion resistance and its testing;

g) The coefficient of friction and any requirements for its testing;

h) Any requirements for test of resistance to neutral salt spray (see 7.3);

i) Any requirements for adhesion of thicker black oxide film.

5 Substrate

The surface roughness of the film depends on the original surface roughness of the substrate, so it shall not be the cause of rejection of the black oxide film.

6 Heat treatment of steel

6.1 Overview

Heat treatment of certain steel types may be required to reduce the risk of cracking due to hydrogen or alkali embrittlement.

Note: High-strength steels with a tensile strength Rm ≥ 1000 MPa may suffer from alkali embrittlement, resulting in spontaneous cracking during the black oxidation process under internal or external stress.

6.2 Heat treatment before black oxidation

The heat treatment before black oxidation shall be performed in accordance with ISO 9587. The heat treatment shall be performed before any pretreatment or cleaning process using an aqueous solution is started.

6.3 Heat treatment after black oxidation

Heat treatment after black oxidation shall be performed in accordance with ISO 9588. Surface-hardened workpieces shall be heat treated at 190 °C ~ 220 °C for not less than 2 h.

7 Requirements

7.1 Appearance and surface quality

The film layer should be free of red oxidation spots; the entire film layer shall not be reddish brown. Before any additional anticorrosive treatment is applied, the portion wiped by a clean Whatman40 filter paper (or other filter paper of the same quality) shall be free of reddish brown or green dirt.

Note: Partial strengthening, welding, bonding, riveting or other types of mechanical treatment are allowed to have uneven color and fogging.

7.2 Oxalic acid resistance test

7.2.1 Before using any additional anticorrosive treatment, when testing in accordance with 7.2.2, the black oxide film on the workpiece shall conform to Figure 3.

7.2.2 Dissolve 50 g of oxalic acid in 1 L of distilled or deionized water. Add 3 drops (about 0.2 mL) of this solution on a flat surface which is covered with the black oxide film at room temperature. The reaction shall occur within 8 minutes after 30 seconds. After 8 minutes, wash and dry the surface and compare it with Figure 1 to Figure 3.

7.3 Test of austenitic stainless steel's resistance to neutral salt spray

The neutral salt spray test (NSS test) is performed in accordance with GB/T 10125. The significant surface without any additional anticorrosive treatment shall be subjected to the 96 h test without obvious signs of corrosion (rust spots).

8 Sampling

Samples shall be randomly selected from the inspection lot according to the sample size as specified in GB/T 12609. Each sample shall be checked for compliance with this standard; the lot shall be judged as meeting or not meeting the requirements in accordance with the rules of the sampling plan in GB/T 11609.

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