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**Anti-corrosion Technical Specification for Marine
Steel Structures by High Velocity Arc Spraying**

海洋用钢结构高速电弧喷涂

耐蚀作业技术规范

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Anti-corrosion Technical Specification for Marine Steel Structures by High Velocity Arc Spraying

1 Scope

This Standard specifies the classification, spraying system, spraying materials, operation and test methods of anti-corrosion coating for marine steel structures by high velocity arc spraying.

This Standard applies to thermal-sprayed zinc-aluminum and zinc-aluminum-magnesium rare-earth coatings on the steel surface of marine steel structures.

This Standard does not apply to the repair of damaged surfaces and other metal coatings.

2 Normative references

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

GB/T 3190-2008, Wrought aluminum and aluminum alloy. Chemical composition

GB/T 4956, Non-magnetic coatings on magnetic substrates - Measurement of coating thickness - Magnetic method

GB/T 6462, Metallic and oxide coatings. Measurement of coating thickness - Microscopical method

GB/T 8923.1-2011, Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings

GB/T 9793, Thermal spraying. Metallic and other inorganic coatings. Zinc, aluminum and their alloys

GB/T 11373-2017, Thermal spraying. Pre-treatment of surfaces of metallic parts and components

GB/T 11374, Thermal spraying coating. Nondestructive methods for

alloy that contains 5% of Mg, which is codenamed Al-Mg5 or LF5.

6.2 Operation

6.2.1 Workpiece surface pretreatment

6.2.1.1 General rules

For the to-be-sprayed surface which is heavily polluted, before sandblasting, the workpiece shall be cleaned, and special methods shall be used to remove deposits such as oil stains; for the to-be-sprayed surface which is lightly contaminated, sandblasting pretreatment can be performed directly. For workpieces which are locally sprayed, not only the dirt at the spraying site, but also the contaminants in the adjacent spraying area, shall be removed, so as to prevent the contaminants from being sprayed into the spraying area during the spraying process. The workpiece surface which has been pretreated shall be a metal surface that has an off-white homogeneity, on which, there is neither oil, nor rust, nor other contaminants.

6.2.1.2 Sandblasting pretreatment

Sandblasting pretreatment uses sands, of which the particle size is 10 mesh ~ 20 mesh, and which is dry, high-hardness and multi-angle, such as brown corundum sand, copper ore or steel sand. When a thinner metal substrate is sprayed, the pressure shall be 0.3 MPa ~ 0.4 MPa; when a thicker substrate is sprayed, the pressure shall be ≥ 0.6 MPa, the sandblasting angle shall usually be 70° , and the sandblasting time shall not be too long. After the sandblasting pretreatment, the oil stain and rust layer on the surface of the substrate shall be removed, and the de-rusting quality shall reach level-Sa2.5.

6.2.1.3 Inspection of surface roughness

The surface roughness of the workpiece, after sandblasting, shall meet the requirements of $R_z\ 25\ \mu\text{m} \sim 100\ \mu\text{m}$ in GB/T 11373-2017.

6.2.1.4 Surface cleanliness

The surface cleanliness of the workpiece, after sandblasting, shall comply with level-Sa2.5 in GB/T 8923.1-2011.

6.2.1.5 Sandblasting roughening treatment

The workpiece surface after sandblasting roughening treatment is easily contaminated by the outside; therefore, it is necessary to avoid touching by hand and blowing. The treated surface shall be sprayed within 2h ~ 3h. If the spraying cannot be performed on time, it's necessary to use a clean plastic film to cover and protect it. If it is to be moved, avoid secondary pollution on the surface.

firstly be used to pretreat the coating. Frequently-used sealing agents include paraffin, vinyl, silicone resin, phenolic, modified boxwood phenolic, polyurethane, titanium nano-polymer coatings and so on. When sealing, different sealing agents shall be selected according to different ambient temperatures.

6.2.3.1.3.2 Spraying of zinc-aluminum-magnesium-rare earth alloy coating plays a role of self-sealing, which leaves out manual sealing.

6.2.3.2 Coating

The coating, through sealing treatment, can be coated for its aesthetic appearance or extended life.

6.2.3.3 Compatibility

Whether the metal coating is sealed or not shall be resolved by mutual agreement. The coating system shall be compatible with the metal coating or the sealant; when needed, perform a test to confirm the compatibility between the metal coating and the material.

7 Test method

7.1 Thickness measurement

7.1.1 Magnetic measurement

Magnetic measurement has the advantage of non-destructive, fast and being capable to directly measure any part of any to-be-test surface. In addition, both the properties and the standard thickness values of the coating (Zn, Al) which is sprayed on the steel substrate are beneficial to achieve a satisfactory measurement accuracy for the method. Therefore, for a given sample, as long as the magnetic thickness gauge is properly calibrated according to the standard regulations and the agreement between the supplier and the buyer, the magnetic measurement can provide an effective and accurate acceptance check result. Perform the specific method according to the requirements of GB/T 4956.

7.1.2 Cross-section microscopy

Cross-section microscopy refers to the measurement of the coating thickness on the cross-section under a microscope, which is also a method that is used to examine the thickness of a metal coating. The sample preparation method is specified in GB/T 6462. In order to prevent the coating from peeling off from the substrate and the edges, use a plastic or a low-melting-point alloy to fix the sample, and use a polishing agent to inspect the surface. The specific

Appendix A

(Normative)

Test method of the coating thickness -- cross-section microscopy

A.1 Thickness test

A.1.1 Coating of which the area is 1 m^2

When the coating area is within 1 cm^2 , the local thickness at any given point shall be the coating thickness that is measured on the base level of 1 cm^2 .

Since various methods which are suitable for the measurement of coating thickness are performed on measuring surfaces of different sizes; therefore, the following methods are used to determine the local thickness of any part of the coating (see Table A.1):

- When the measuring surface is not less than 1 cm^2 , only one measurement shall be performed;
- When a microscope is used to perform a straight-line or a curve measurement on the cross-section of the coating, 10 measurements shall be performed within the distance of $1\text{ cm} \sim 2\text{ cm}$, and the arithmetic mean shall be taken;
- When the diameter of the measuring surface is larger than 5 mm , only one measurement shall be performed.
- When the diameter of the measuring surface is $3\text{ mm} \sim 5\text{ mm}$, 2 measurements shall be performed within 1 cm^2 , and the arithmetic mean shall be taken;
- When the diameter of the measuring surface is smaller than 3 mm , 3 measurements shall be performed within 1 cm^2 , and the arithmetic mean shall be taken;
- When the point-measurement method is used, 5 measurements shall be performed within 1 cm^2 and the arithmetic mean shall be taken.

Appendix B

(Normative)

Test method of bond strength

B.1 Stretching test

B.1.1 Use a cutting tool to cut the circular coating to the base metal; the diameter of the circle shall be the same as the diameter of the cylinder which is used for the test.

B.1.2 Clean the test surface; use bonding agent to adhere the cylinder to the coating, of which, the bonding force shall be greater than the bonding force between the coating and the substrate; before the bonding agent is applied, firstly use wash primer to cover the coating to permeate it into the coating holes, so as to prevent the bonding agent from permeating into the matrix; after the bonding agent is fixed, remove the excess bonding agent around the periphery of the cylinder.

B.1.3 In the direction perpendicular to the cylinder, gradually increase the force until the cylinder is released from the coating, and measure the tensile force of the peeling of the coating. For specific test method, see GB/T 9793.

B.2 Test piece

Every set shall have at least 5 test pieces.

B.3 Result

The following five situations occur:

- a) The sample substrate and the sprayed layer are completely separated at the interface;
- b) The inner layers of the coating are completely separated;
- c) The coating and the adhesive interface are completely separated
- d) The layers of the bonding agent itself are completely separated;
- e) Multiple separation states which are comprehensively generated from the above several situations.

B.4 Judgment

In the above five cases, if the result is a), or b), or both a) and b) at the same

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