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Standard
Recommended Practice

Metallurgical and Inspection Requirements for Offshore Pipeline Bracelet Anodes

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Foreword

The purpose of this standard recommended practice is to set minimum physical quality and inspection requirements for cast galvanic anodes for offshore pipeline applications. The objectives are to standardize an industry-wide practice that can be used by consultants, manufacturers, and users to define the physical requirements of anodes; and to be sufficiently specific to assist inspection authorities in their task of confirming that anodes comply with the physical requirements. This standard is applicable to typical half-shell or segmented bracelet-type anodes.

This standard was originally prepared in 1992 by Task Group T-7L-9, a component of Unit Committee T-7L on Cathodic Protection. It was reaffirmed by T-7L in 1999 and is published under the auspices of Group Committee T-7 on Corrosion by Waters.

In NACE standards, the terms *shall*, *must*, *should*, and *may* are used in accordance with the definitions of these terms in the *NACE Publications Style Manual*, 3rd. ed., Paragraph 8.4.1.8. *Shall* and *must* are used to state mandatory requirements. *Should* is used to state that which is considered good and is recommended but is not absolutely mandatory. *May* is used to state that which is considered optional.

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Section 1: General

1.1 This standard defines minimum physical quality and inspection requirements for bracelet galvanic anodes for offshore pipeline applications, including risers and J-tubes.

1.2 This standard is applicable to the majority of bracelet-type anodes used on offshore pipelines, i.e., anodes of half-shell or segmented configurations. For other anode designs, such as semi-cylindrical segments with cast-in longitudinal notches, an experienced corrosion specialist should be responsible for defining the acceptance criteria.

1.3 This standard does not specify particular anode alloy compositions or define short- or long-term performance tests.

1.4 This standard does not specify particular anode or anode insert designs. An experienced corrosion specialist should be responsible for anode and anode insert design.

1.5 Although some aspects of this standard may be relevant to other types of galvanic anodes, it is not intended to apply to platform, hull, tank, or extruded-type anodes.

1.6 This standard does not address electrochemical or other anode performance test procedures. NACE Standard TM0190[1] gives a standardized short-term potential and capacity determination test procedure for quality control purposes in international laboratories.

1.7 The manufacturer is responsible for meeting the quality levels specified in this standard. The purchaser shall determine the extent of inspection to be conducted by the purchasing organization to prove compliance with the quality specified.

Section 2: Definitions

Bracelet Anodes: Anodes with geometry suitable for direct attachment around the circumference of a pipeline. These may be half-shell bracelets consisting of two semi-circular sections or segmented bracelets consisting of a large number of individual anodes.

Certificate of Conformity: A statement from the manufacturer's representative (executive) and endorsed by a representative of the purchaser affirming that the anodes listed comply with the requirements of the order.

Cold Lap: Horizontal discontinuity caused by solidification of the meniscus of a partially cast anode as a result of interrupted flow of the casting stream. The solidified meniscus is covered with metal when the flow resumes. Cold laps can occur along the length of an anode.

Cold Shut: Horizontal surface discontinuity caused by solidification of a portion of a meniscus during the progressive filling of a mold, which is later covered with more solidifying metal as the molten metal level rises. Cold shuts generally occur at corners remote from the point of pour.

Cracking: Fracture of metal along an irregular path producing a discontinuity similar to a ragged edge. It can occur during the solidification of the anode (hot cracking), during the contraction of the anode after solidification, or under externally applied loads. Hot cracking may be associated with the shrinkage depression that can occur in open-topped molds.

Dulling of Steels: Deterioration in the appearance of shot-blasted inserts due to oxidation that causes darkening of the surface but not rust discoloration (see *Rust Discoloration*).

Electrochemical Properties: Those properties of potential and current capacity that characterize a sacrificial anode and can be assessed by quantitative tests.

Gas Holes: Evidence of bubbles within the solidifying metal. The holes can indicate that moisture was on the mold or insert prior to casting or that the liquid metal contained a high level of hydrogen that formed bubbles during cooling of the metal.

Heat: Also called a *melt* or *cast*, it is the unit that defines molten metal and identifies the anodes cast from it. A heat is the product that is cast to a planned procedure in one melting operation in one furnace, without significant interruption. If the casting sequence is interrupted, the anodes produced before, between, and after the interruption constitute *batches*.

Insert: The form over which the anode is cast. This is sometimes referred to as a *core*.

Low-Carbon Steel: Steel having less than 0.30% carbon and no intentional alloying additions.

Nonmetallic Inclusions: Particles of oxides and other refractory materials entrapped in liquid metal during the melting or casting sequences.