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Standard Test Method

Testing of Embeddable Impressed Current Anodes for Use in Cathodic Protection of Atmospherically Exposed Steel-Reinforced Concrete

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NACE International
15385 Park Ten Place
Houston, Texas 77084-5145
+1 281-228-6200
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Foreword

This NACE International test method has been prepared to provide users and manufacturers of embeddable anodes with a test method for evaluating the anode material to an expected lifetime criterion. It is applicable to embeddable anode materials, such as titanium (Ti) mesh, commonly used for cathodic protection (CP) of atmospherically exposed steel-reinforced concrete.

This test method presents two methods for evaluating the anode material; Test Method Part A is intended to evaluate whether an embeddable anode material complies with minimum required specifications of design life expectancy at rated current output. Test Method Part B is a quicker test to ensure that a sample from a particular batch of material is suitable. Test Method Part B shall only be conducted on samples of a product that has passed Test Method Part A for the required design life. The test methods are not applicable to surface-mounted anodes or conductive coating materials.

The test method was originally prepared in 1994 by Task Group (TG) T-3K-6, "Test Procedure for Anodes Used in Concrete," a component of Unit Committee T-3K, "Corrosion and Other Deterioration Phenomena Associated with Concrete." It was reviewed by TG 045, "Anodes Test Procedures" and reaffirmed in 2001 by Specific Technology Group (STG) 01, "Concrete and Rebar." It was revised by TG 045 in 2007 and in 2015 by TG 472 (new designation). TG 472 is administered by STG 01, "Reinforced Concrete"; and sponsored by STG 05, "Cathodic/Anodic Protection." This standard is issued by NACE under the auspices of STG 01.

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.* The terms *shall* and *must* are used to state a requirement, and are considered mandatory. The term *should* is used to state something good and is recommended, but is not considered mandatory. The term *may* is used to state something considered optional.

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Contents

Section 1: General

1.1 Accelerated testing of anodes for use in concrete is intended to provide an indication of an anode's ability to perform satisfactorily for a specific number of years. Unfortunately, accelerated life testing cannot be conducted in concrete because testing at high-current levels results in premature failure of the concrete as the test electrolyte. Accelerated life testing must therefore be conducted in an aqueous solution.

1.2 Test Method Part A is designed to evaluate the anode material to an expected lifetime criterion, and is conducted over a period of at least 180 days. (See Section 3.)

1.3 Test Method Part B uses accelerated life testing to verify that anodes comprised of a Ti substrate, to which a mixed metal oxide (MMO) catalytic coating has been applied, meet minimum service-life requirements in accordance with the expected design life. The test is operated at higher current densities than the application's design to accelerate the time to failure. (See Section 8.)

1.3.1 The minimum test period is 65 hours for anodes with an expected design life of 100 years at a maximum current density of 108 mA/m^2 (10 mA/ft^2).

1.3.2 The minimum test period is 78 hours for anodes with an expected design life of 120 years at a maximum current density of 108 mA/m^2 (10 mA/ft^2).

Section 2: Definitions

Accelerated life: The lifetime of an MMO anode under accelerated testing condition, usually in the specific electrolyte applied with large current density. The total period of testing until the deactivation of the MMO anode is taken as the accelerated life.

Cell voltage: Voltage between anode and cathode in a single cell.

Charge density: The product of applied current density multiplied by operating time.

Mixed metal oxide (MMO) anode: An impressed current anode for cathodic protection consisting of conductive coating of MMO formed on titanium substrate.

Luggin Probe: A device used in measuring the potential of an electrode with a significant current density imposed on its surface. (The probe minimizes the IR drop that would otherwise be included in the measurement and without significantly disturbing the current distribution on that electrode.)

Ripple: The alternating current (AC) component in the output of a direct current (DC) power supply, arising within the power supply from incomplete filtering or from commutator action in a DC generator.