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Standard
Test Method

Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems

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Foreword

This NACE International standard test method provides descriptions of the measurement techniques and cautionary measures most commonly used on underground and submerged piping other than offshore piping to determine whether a specific criterion has been met at a test site. Descriptions of measurement techniques and cautionary measures used on offshore pipelines and structures can be found in NACE SP0607/ISO 15589-2[1] for offshore pipelines, and SP0176[2] for offshore structures. This standard includes only those measurement techniques that relate to the criteria or special conditions, such as a net protective current, contained in NACE SP0169.[3] This standard is intended for use by corrosion control personnel concerned with the corrosion of underground or submerged piping systems that transport oil, gas, water, or other fluids.

The measurement techniques described require that the measurements be made in the field. Because the measurements are obtained under widely varying circumstances of field conditions and pipeline design, this standard is not as prescriptive as those NACE standard test methods that use laboratory measurements. Instead, this standard gives the user latitude to make testing decisions in the field based on the technical facts available.

This standard contains instrumentation and general measurement guidelines. It includes methods for voltage drop considerations when structure-to-electrolyte potential measurements are made and provides guidance to minimize incorrect data from being collected and used.

The measurement techniques provided in this standard were compiled from information submitted by committee members and others with expertise on the subject. Variations or other techniques not included may be equally effective. The complexity and diversity of environmental conditions may require the use of other techniques.

Appendix A (mandatory) contains information on the common types, use, and maintenance of reference electrodes. Appendix B (nonmandatory) contains information for the net protective current technique, which, while not a criterion, is a useful technique to reduce corrosion. Appendix C (nonmandatory) contains information regarding the use of coupons to evaluate cathodic protection (CP). While some engineers use these nonmandatory techniques, they are not universally accepted practices. However, there is ongoing research into their use.

The test methods in this standard were originally prepared by NACE Task Group T-10A-3, "Test Methods and Measurement Techniques Related to Cathodic Protection Criteria," a component of Unit Committee T-10A, "Cathodic Protection." It was reviewed by Task Group (TG) 020, reaffirmed in 2002 by Specific Technology Group (STG) 35, "Pipelines, Tanks, and Well Casings," and revised in 2012 by TG 020. This standard is issued by NACE under the auspices of STG 35.

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.

NACE International
Standard Practice

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Contents

Section 1: General

1.1 This standard describes and illustrates testing procedures for measuring potentials that are used to determine whether a CP criterion is achieved at a test site on underground or submerged metallic piping.

1.2 The provisions of this standard shall be applied by personnel who have the knowledge and understanding of the fundementals of cathodic protection of buried and submerged metallic piping systems acquired by education and related practical experience.

1.3 Special conditions in which a given test technique is ineffective or only partially effective sometimes exist. Refer to Paragraphs 5.9 and 6.1. Deviation from this standard may be warranted in specific situations.

Section 2: Definitions[1]

Anode: The electrode of an electrochemical cell at which oxidation occurs. Electrons flow away from the anode in the external circuit. Corrosion usually occurs and metal ions enter the solution at the anode.

Cathode: The electrode of an electrochemical cell at which reduction is the principal reaction. Electrons flow toward the cathode in the external circuit.

Cathodic Polarization: The change of electrode potential in the active (negative) direction caused by current across the electrode/electrolyte interface. See *Polarization.*

Cathodic Protection: A technique to reduce the corrosion of a metal surface by making that surface the cathode of an electrochemical cell.

Cathodic Protection Coupon: A metal sample representing the pipeline at the test site, used for cathodic protection testing, and having a chemical composition approximating that of the pipe. The coupon size should be small to avoid excessive current drain on the cathodic protection system.

Coating: A liquid, liquefiable, or mastic composition that, after application to a surface, is converted into a solid protective, decorative, or functional adherent film.

Conductor: A bare or insulated material suitable for carrying electric current.

Corrosion: The deterioration of a material, usually a metal, that results from a reaction with its environment.

Corrosion Potential (E_{corr}): The potential of a corroding surface in an electrolyte relative to a reference electrode under open-circuit conditions (also known as *Rest Potential, Open-Circuit Potential*, or *Freely Corroding Potential*).

Criterion: A standard for assessment of the effectiveness of a cathodic protection system.

Electrical Isolation: The condition of being electrically separated from other metallic structures or the environment.

Electrode: A conductor used to establish contact with an electrolyte and through which current is transferred to or from an electrolyte.

Electrode Potential: The potential of an electrode in an electrolyte as measured against a reference electrode. (The electrode potential does not include any resistance losses in potential in either the electrolyte or the external circuit. It represents the reversible work to move a unit of charge from the electrode surface through the electrolyte to the reference electrode.)

Electrolyte: A chemical substance containing ions that migrate in an electric field. For the purpose of this standard, *electrolyte* refers to the soil or liquid, including contained moisture and other chemicals, next to and in contact with a buried or submerged metallic piping system.

[1] Definitions in this section reflect common usage among practicing corrosion control personnel and apply specifically to how terms are used in this standard. As much as possible, these definitions are in accord with those in NACE/ASTM G193.[4]