



NACE Standard TM0497-2002
Item No. 21231

Standard Test Method

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

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Reaffirmed 2002-04-11
Approved 1997-12-22
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ISBN 1-57590-047-5
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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 piping to determine whether a specific criterion has been complied with at a test site. This test method includes only those measurement techniques that relate to the criteria or special conditions, such as a net protective current, contained in NACE Standard RP0169.¹ This test method is intended for use by corrosion control personnel concerned with the corrosion of buried underground or submerged piping systems, including oil, gas, water, and similar structures.

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 making pipe-to-electrolyte potential measurements and provides guidance to prevent 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 contains information on the common types, use, and maintenance of reference electrodes. Appendix B contains information for the net protective current technique, which, while not a criterion, is a useful technique to reduce corrosion. Appendix C contains information regarding the use of coupons to evaluate cathodic protection. While some engineers use these 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 on Test Methods and Measurement Techniques Related to Cathodic Protection Criteria, a component of Unit Committee T-10A on Cathodic Protection. It was reviewed by Task Group 020 and reaffirmed in 2002 by Specific Technology Group (STG) 35 on Pipelines, Tanks, and Well Casings. 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*, 4th ed., Paragraph 7.4.1.9. *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 provides testing procedures to comply with the requirements of a criterion at a test site on a buried or submerged steel, cast iron, copper, or aluminum pipeline.

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

1.3 Special conditions in which a given test technique is ineffective or only partially effective sometimes exist. Such conditions may include elevated temperatures, disbanded dielectric or thermally insulating coatings, shielding, bacterial attack, and unusual contaminants in the electrolyte. Deviation from this standard may be warranted in specific situations. In such situations corrosion control personnel should be able to demonstrate that adequate cathodic protection has been achieved.

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.

Cable: A bound or sheathed group of insulated conductors.

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

Cathodic Disbondment: The destruction of adhesion between a coating and the coated surface caused by products of a cathodic reaction.

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

Current Density: The current to or from a unit area of an electrode surface.

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 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.)

Foreign Structure: Any metallic structure that is not intended as part of a system under cathodic protection.

⁽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 the "NACE Glossary of Corrosion-Related Terms" (Houston, TX: NACE).