

# Control of External Corrosion on Underground or Submerged Metallic Piping Systems

© 2024 Association for Materials Protection and Performance (AMPP). All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise) without the prior written permission of AMPP.

# Control of External Corrosion on Underground or Submerged Metallic Piping Systems

This AMPP standard represents a consensus of those individual members who have reviewed this document, its scope, and provisions. Its acceptance does not in any respect preclude anyone, whether he or she has adopted the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not in conformance with this standard. Nothing contained in this AMPP standard is to be construed as granting any right, by implication or otherwise, to manufacture, sell, or use in connection with any method, apparatus, or product covered by Letters Patent or as indemnifying or protecting anyone against liability for infringement of Letters Patent. This standard represents minimum requirements and should in no way be interpreted as a restriction on the use of better procedures or materials. Neither is this standard intended to apply in all cases relating to the subject. Unpredictable circumstances may negate the usefulness of this standard in specific instances. AMPP assumes no responsibility for the interpretation or use of this standard by other parties and accepts responsibility for only those official AMPP interpretations issued by AMPP in accordance with its governing procedures and policies which preclude the issuance of interpretations by individual volunteers.

Users of this AMPP standard are responsible for reviewing appropriate health, safety, environmental, and regulatory documents and for determining their applicability in relation to this standard prior to its use. This AMPP standard may not necessarily address all potential health and safety problems, or environmental hazards associated with the use of materials, equipment, and/or operations detailed or referred to within this standard. Users of this AMPP standard are also responsible for establishing appropriate health, safety, and environmental protection practices, in consultation with appropriate regulatory authorities, if necessary, to achieve compliance with any existing applicable regulatory requirements prior to the use of this standard.

CAUTIONARY NOTICE: AMPP standards are subject to periodic review and may be revised or withdrawn at any time in accordance with AMPP technical committee procedures. AMPP requires that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of initial publication and subsequently from the date of each reaffirmation or revision. The user is cautioned to obtain the latest edition. Purchasers of AMPP standards may receive current information on all standards and other AMPP/NACE/SSPC publications by contacting AMPP Customer Support, 15835 Park Ten Place, Houston, Texas 77084-5145 (Tel. +1-281-228-6200, email: [customersupport@ampp.org](mailto:customersupport@ampp.org)).

## Document History:

2024-05-08: Revised by AMPP Standards Committee (SC) 15, Pipelines and Tanks

2013-10-04: Revised as SP0169 by NACE Task Group (TG) 360, "Piping Systems: Review of SP0169-2007 (formerly RP0169), 'Control of External Corrosion on Underground or Submerged Metallic Piping'"

2007-03-15: Reaffirmed by NACE Specific Technology Group (STG) 35, "Pipelines, Tanks, and Well Casings"

2002-09-11: Reaffirmed by NACE STG 35, "Pipelines, Tanks, and Well Casings"

1996-09-10: Reaffirmed by NACE Unit Committee T-10A, "Cathodic Protection"

April 1992: Revised by NACE TG T-10-1

January 1983: Revised by NACE TG T-10-1

September 1976: Revised by NACE TG T-10-1

January 1972: Revised by NACE TG T-10-1

April 1969: Approved as RP0169 by NACE TG T-10-1

AMPP values your input. To provide feedback on this standard, please contact: [standards@ampp.org](mailto:standards@ampp.org)

NACE SP0169-2024

©2024 Association for Materials Protection and Performance (AMPP). All rights reserved.

# Control of External Corrosion on Underground or Submerged Metallic Piping Systems

Format, Scope, Rationale.....	5
Section 1 General .....	6
Section 2 Definitions, Abbreviations, and Acronyms.....	6
Section 3 Determination of Need for External Corrosion Control.....	12
Section 4 Piping System Design.....	15
4.1 Introduction .....	15
4.2 External Corrosion Control.....	15
4.3 Electrical Isolation .....	15
4.4 Electrical Continuity.....	16
4.5 Corrosion Control Test Stations .....	17
Section 5 External Coatings.....	19
Section 6 Criteria and Other Considerations for Cathodic Protection .....	23
6.1 Introduction .....	23
6.2 Criteria.....	23
6.3 Relevant Considerations .....	29
6.4 Target Potentials .....	31
6.5 Alternative Reference Electrode .....	31
Section 7 Design of Cathodic Protection Systems.....	31
7.1 Introduction .....	31
7.2 Major Objectives of CP Systems.....	31
7.3 CP Design Considerations .....	32
7.4 Information useful for CP Design.....	32
7.5 Types of CP Systems.....	33
7.6 Considerations Influencing Selection of the Type of CP System .....	34
7.7 Factors Influencing Design of CP Systems.....	34
7.8 Estimating Percentage Bare .....	36
7.9 Design Drawings and Specifications.....	36
Section 8 Installation of Cathodic Protection Systems.....	37
8.1 Introduction .....	37
8.2 Construction Specifications.....	37
8.3 Construction Supervision .....	37
8.4 Galvanic Anode Systems.....	37
8.5 Impressed Current Systems.....	38

	8.6	Corrosion Control Test Stations, Connections, and Bonds .....	39
	8.7	Electrical Isolation .....	40
Section 9		Control of Stray Current Interference .....	40
	9.1	Introduction .....	40
	9.2	Typical Sources of Stray Current .....	40
	9.3	New Construction .....	40
	9.4	Personnel Safety .....	41
	9.5	DC Interference .....	41
	9.6	AC Interference .....	44
	9.7	Telluric Currents .....	45
Section 10		Commissioning, Operating, Monitoring, and Maintaining of CP Systems .....	46
Section 11		External Corrosion Control Records .....	48
References		.....	49
Bibliography		.....	56
Appendix A		External Coatings Tables .....	63
Appendix B		List of International Standards (Nonmandatory) .....	68
FIGURES			
Figure 1		Residual Corrosion Rate of Carbon Steel Specimens as a Function of AC and CP Current Density. Laboratory Tests Performed in Simulated Soil Conditions .....	24
Figure 2		Potential Range as a Function of Temperature for High pH SCC Based on Slow Strain Rate Tests Performed in Simulant of Field Electrolyte (p. 9.1) .....	27
Figure 3		Typical Conductance versus Bare Area Normalized for a Soil Resistivity of 1,000 $\Omega$ cm .....	36
TABLES			
Table 1		Estimating Coating Quality Based on Electrical Parameters .....	35
Table 2		AC Corrosion Major Risk Factors .....	45
Table A1		Generic External Coating Systems for Carbon Steel Pipe with Material Requirements and Reference Standards for Application, Inspection, Physical Characteristics, and Test Performance Criteria for Underground Piping .....	63
Table A2		Generic External Coating Systems for Ductile Iron Pipe with Material Requirements and Reference Standards for Application, Inspection, Physical Characteristics, and Test Performance Criteria for Underground Piping .....	66
Table A3		Methods for Evaluating Field Performance of In-Situ, or Newly Plant-Applied and Field-Applied External Coatings .....	67
Table B1		List of International Standards .....	68

## Foreword

This standard presents methods and practices for achieving effective control of external corrosion on underground or submerged metallic piping systems and is intended for use by corrosion control personnel concerned with piping used for the transport of oil, gas, water, and other fluids. It is applicable to underground structures and piping buried on land, or submerged in water bodies such as lakes, rivers, bayous, and creeks.

This standard describes the use of electrically insulating coatings, electrical isolation, and cathodic protection (CP) as they relate to external corrosion control. This standard does not include corrosion control methods based on injection of chemicals into the environment, on the use of electrically conductive coatings, or on the use of non-adhered polyethylene encasement (refer to NACE Publication 10A292).<sup>1</sup> The standard contains specific provisions for the application of CP to existing uncoated, existing coated, and new piping systems. Also included are methods for control of stray currents on pipelines.

For accurate and correct application, this standard must be used in its entirety. Using or citing only specific paragraphs or sections can lead to misinterpretation and misapplication of the practices contained in this standard. This standard does not designate practices for every specific situation because of the complexity of conditions to which underground or submerged piping systems are exposed.

This standard should be used in conjunction with the practices described in the following AMPP standards and publications, when appropriate (use latest revisions):

SP0572<sup>2</sup> Design, Installation, Operation, and Maintenance of Impressed Current Deep Anode Beds

SP21424<sup>37</sup> Alternating Current Corrosion on Cathodically Protected Pipelines: Risk Assessment, Mitigation, and Monitoring

SP0285<sup>4</sup> Corrosion Control of Underground Storage Tank Systems by Cathodic Protection

SP0286<sup>5</sup> The Electrical Isolation of Cathodically Protected Pipelines

SP0188<sup>6</sup> Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

TM0497<sup>7</sup> Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems

This standard is not intended to apply to offshore pipelines and structures. For these facilities, the recommended AMPP standards are ANSI/NACE SP0115/ISO 15049<sup>8</sup> for offshore pipelines and SP0176<sup>9</sup> for offshore structures. Although definitions of onshore and offshore may vary, it is the responsibility of the user to determine which of the above standards apply to pipelines across coastal boundaries.

## Scope

This standard provides methods and practices for achieving effective control of external corrosion on underground or submerged metallic piping systems.

## Rationale

This AMPP standard provides general corrosion control guidelines for underground or submerged metallic piping systems.

In accordance with AMPP's standards review policy, this document is to be updated every 5 years to reflect current industry trends and regulations.

In all AMPP standards, the terms *shall* and *must* are used to state requirements and are considered mandatory. The term *should* is used to state something that is recommended, but is not considered mandatory. The term *may* is used to state something considered optional.