

Control of Internal Corrosion in Steel Pipelines and Piping Systems

This NACE International 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 NACE 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. NACE assumes no responsibility for the interpretation or use of this standard by other parties and accepts responsibility for only those official NACE interpretations issued by NACE in accordance with its governing procedures and policies which preclude the issuance of interpretations by individual volunteers.

Users of this NACE 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 NACE 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 NACE 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CAUTIONARY NOTICE: NACE standards are subject to periodic review, and may be revised or withdrawn at any time in accordance with NACE technical committee procedures. NACE 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 NACE standards may receive current information on all standards and other NACE publications by contacting the NACE FirstService Department, 15835 Park Ten Place, Houston, Texas 77084-5145 (telephone +1 281-228-6200).

ABSTRACT

This standard presents recommended practices for the control of internal corrosion in steel pipelines and piping systems used to gather, transport, or distribute crude oil, petroleum products, or gas. It is meant to serve as a guide for establishing minimum requirements for control of internal corrosion in crude oil gathering and flow lines, crude oil transmission, hydrocarbon products, gas gathering and flow lines, gas transmission, and gas distribution. This standard is maintained by Task Group 038.

KEYWORDS

Pipelines, internal corrosion, corrosion control.

Foreword

The purpose of this NACE standard practice is to describe procedures and practices for achieving effective control of internal corrosion in carbon steel pipe and piping systems used to gather, transport, or distribute crude oil, petroleum products, and gas, including produced water and water injection pipe. Certain constituents that are found in the gas and liquid transported in these systems (e.g., oxygen, carbon dioxide, hydrogen sulfide, bacteria, etc.) can cause corrosion. Additionally, the complex nature and interaction between constituents in the pipeline may affect whether a corrosive condition exists or increase the severity of a corrosive condition. These corrosive conditions can lead to localized pitting corrosion, underdeposit corrosion, microbiologically influenced corrosion and general corrosion. The predominant failures occur by localized pitting mechanism; therefore controlling pitting corrosion is paramount. Identification of potentially corrosive gas and liquid in a pipeline can only be achieved by analysis of operating conditions, fluid composition, physical monitoring and/or inspection results, or other considerations. There are many mitigation methods that can be implemented in systems where corrosive conditions exist. This standard presents general practices in regard to control of internal corrosion in steel pipeline systems. This standard is intended for use by pipeline operators, pipeline service providers, government agencies, and any other persons or companies involved in planning, designing, or managing pipeline integrity.

This standard was prepared by Task Group (TG) 038 on Control of Internal Corrosion in Steel Pipelines and Piping Systems. It was revised in 2018 by TG 038. TG 038 is administered by Specific Technology Group (STG) 35 on Pipeline, Tanks, and Well Casings. This standard is issued by NACE International 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.

Control of Internal Corrosion in Steel Pipelines and Piping Systems

| | | |
|----|---|----|
| 1. | General | 4 |
| 2. | Definitions | 4 |
| 3. | Internal Corrosion Threat Assessment..... | 6 |
| 4. | Internal Corrosion Management Plan | 9 |
| 5. | System Design | 10 |
| 6. | Internal Corrosion and Related Parameter Measurement | 13 |
| 7. | Methods for Controlling Internal Corrosion | 15 |
| 8. | Feedback and Continuous Improvement | 18 |
| 9. | Corrosion Control Records..... | 19 |
| | References..... | 20 |
| | Appendix A: Typical Gas Quality Specification (Nonmandatory)..... | 22 |
| | Appendix B: Publications Providing Test Methods for Constituents Associated with Corrosion (Mandatory)..... | 23 |
| | Appendix C: Impacts of Common Impurities (Nonmandatory)..... | 24 |

Section 1: General

- 1.1 This standard presents recommended practices for the control of internal corrosion in steel pipelines and piping systems used to gather, transport, or distribute crude oil, petroleum products, or natural gas.
- 1.2 This standard serves as a guide for establishing minimum requirements for management of internal corrosion in the following systems:
- (a) Crude oil gathering and flow lines
 - (b) Crude oil transmission
 - (c) Hydrocarbon products
 - (d) Gas gathering and flow lines
 - (e) Gas transmission
 - (f) Gas distribution
 - (g) Storage systems
 - (h) Produced water lines
 - (i) Injection water lines
- 1.3 This standard does not designate specific practices for every situation because the complexity of systems precludes standardizing internal corrosion control practices.
- 1.4 This document does not cover internal cracking mechanisms, nor does it address steam ...
- 1.5 Corrosion control of equipment such as tanks, vessels, processing units, valves etc. is outside the scope of this document.
- 1.6 This document does not specifically address corrosion resistant alloys (CRAs) or well tubulars. Although many of the same principles could be applied to these materials and environments, there will be exceptions.
- 1.7 The internal corrosion control process described in this document is a continual feedback loop. It begins with performing an internal corrosion threat assessment to identify relevant internal corrosion mechanisms and contributing factors for the pipeline/system, creating a corrosion control plan to evaluate, mitigate and monitor those threats, and utilizing information obtained from monitoring, inspection and other activities (e.g., maintenance) as feedback to update the identified threats and corrosion control plan.
- 1.8 Local government regulations or permits may dictate particular requirements related to implementation of various sections of this standard.
- 1.9 The provisions of this standard should be applied under the direction of competent persons who, by reason of knowledge of the physical sciences and the principles of engineering and mathematics acquired by education or related practical experience, are qualified to engage in the practice of corrosion control on carbon steel piping systems. Such persons may be registered professional engineers or persons recognized as corrosion specialists by organizations such as NACE, or engineers, scientists or technicians with suitable levels of experience, and their professional activities include internal corrosion control of buried carbon steel piping and pipeline systems.

Section 2: Definitions

Archaea: Unicellular microorganisms that are generally distinct from bacteria, which often inhabit extreme environmental conditions.

Atomization: Turning a chemical to fine particles or spray.

Biocide: A chemical product that is intended to kill biological microorganisms or render them harmless.

Biofilm: Microbial growth at an interface in which individual cells are bound within a matrix of extracellular polymeric materials.

Cavitation: The formation and rapid collapse of cavities or bubbles of vapor or gas within a liquid resulting from mechanical or hydrodynamic forces.

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