NACE INTERNATIONAL
THE CORROSION SOCIETY

NACE Standard RP0198-2004
Item No. 21084

Standard
Recommended Practice

The Control of Corrosion Under Thermal Insulation and Fireproofing Materials—A Systems Approach

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Reaffirmed 2004-3-31
Approved 1998-2-20
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ISBN 1-57590-049-1

Foreword

This NACE standard recommended practice provides the current technology and industry practices for mitigating corrosion under thermal insulation and fireproofing materials, a problem termed *corrosion under insulation (CUI)* in this standard. Because this corrosion problem has many facets and affects several technologies, a systems approach has been adopted. This standard is intended for use by corrosion-control personnel and others concerned with the corrosion under insulation and/or fireproofing of piping and other plant equipment. This concerns chiefly the chemical process, refining, and power generation industries.

This standard is organized into sections by function. Each section was written by specialists in that subject. These specialists are industry representatives from firms producing, specifying, designing, and using thermal insulation and fireproofing products on refinery and petrochemical equipment and piping.

This standard was originally prepared in 1998 by NACE Work Group T-5A-30a on Corrosion Protection Under Insulation, with the assistance of Task Group T-6H-31 on Coatings for Carbon and Austenitic Stainless Steel Under Insulation and ASTM[(1)] Committee C-16.40.3 on Corrosion Under Insulation. Work Group T-5A-30a supported NACE Task Group T-5A-30 on Corrosion Under Thermal Insulation, a component of NACE Unit Committee T-5A on Corrosion in Chemical Processes. The standard was reaffirmed in 2004 by Specific Technology Group (STG) 36 on Process Industry—Chemicals. This standard is issued by NACE under the auspices of STG 36.

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. The term *should* is used to state something considered good and is recommended but is not mandatory. The term *may* is used to state something considered optional.

[(1)] ASTM International (ASTM), 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959.

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Section 1: General

1.1 Corrosion under insulation (CUI) has been occurring for as long as hot or cold equipment has been insulated for thermal protection, conservation, or process stabilization. The destructive results and nature of the corrosion mechanism are not cited in the literature until the 1950s. As more problems have been experienced, concern and interest have built around this subject. Many articles and symposium papers have been published since 1983 as interest and activity in CUI have increased. The increased activity was driven largely by many occurrences of severe CUI resulting in major equipment outages, production losses, and unexpected maintenance costs in refineries, gas plants, and chemical plants.

1.2 To correct these problems, companies have developed their own criteria and approaches to the prevention of CUI. When comparing the various approaches, it is evident that there are many similarities, some differences, some new ideas, and some old ideas that have stood the test of performance. This standard incorporates the experience of many companies throughout the oil, gas, and chemical industries.

1.3 The first ASTM standard relevant to CUI was ASTM C 692,[1] adopted in 1971 and originally titled "Evaluating the Influence of Wicking Type Thermal Insulations on the Stress Corrosion Cracking Tendency of Austenitic Stainless Steels."

1.4 A symposium was held jointly by NACE, ASTM, and Materials Technology Institute (MTI)[(2)] on this subject with speakers from industries worldwide in October 1983. The papers were published in 1985 as ASTM Publication STP 880.[2]

1.5 The first NACE report on CUI was written in 1989 by Task Group T-6H-31 as publication 6H189.[3] NACE Task Group T-5A-30 was organized shortly thereafter to serve as a forum for further discussion regarding CUI. In addition to reviews of the corrosion mechanisms, perspectives on such CUI topics as methods for mitigation, insulation materials, and inspection were often exchanged. While corrosion engineers were becoming knowledgeable about CUI, ASTM Committee C-16 was preparing standards for testing insulation with a propensity to cause chloride stress corrosion cracking (SCC) of austenitic stainless steel. These two groups interacted but proceeded to develop their standards and information separately.

1.6 Although most of the attention has been focused on corrosion under thermal insulation, fireproofing materials also function, at least in part, as insulation applied between the critical steel structure and a potential fire. Other fire protection mechanisms initiated as endothermic reactions within the fireproofing material during a fire, such as sublimation, hydro-regeneration, and intumescence, are known to augment the insulating role of the fireproofing. The mechanisms also add unique considerations to the discussion of the chemistry at the wet steel interface. A discussion of corrosion mechanisms, the root cause of failure, and corrosion prevention is the same for corrosion under both insulation and fireproofing.

1.7 The consensus is that the basic solution to preventing CUI is the use of a high-quality protective coating. It is the recommendation of this committee that whenever CUI is a consideration, a protective coating should be employed to protect the equipment before it is insulated.

Section 2: Corrosion Mechanisms

2.1 Carbon Steel

Carbon steel corrodes, not because it is insulated, but because it is contacted by aerated water. The role of insulation in the CUI problem is threefold. Insulation provides:

(a) An annular space or crevice for the retention of water and other corrosive media;
(b) A material that may wick or absorb water; and
(c) A material that may contribute contaminants that increase or accelerate the corrosion rate.

The corrosion rate of carbon steel may vary because the rate is controlled largely by the metal temperature of the steel surface and contaminants present in the water. These factors and others are reviewed below.

2.1.1 Effects of Water, Contaminants, and Temperature

2.1.1.1 Sources of Water Under Insulation

The two primary water sources involved in CUI of carbon steel are:

(a) Infiltration from external sources; and
(b) Condensation.

[(2)] Materials Technology Institute (MTI), 1215 Fern Ridge Parkway, Suite 116, St. Louis, MO 63141-4401.