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Laboratory Test to Evaluate the Vapor-Inhibiting Ability of Volatile Corrosion Inhibitor Materials for Temporary Protection of Ferrous Metal Surfaces

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ABSTRACT

Volatile corrosion inhibitor (VCI) materials are widely used to provide temporary corrosion protection for the surfaces of ferrous and nonferrous metal parts. This standard test method evaluates the vapor-inhibiting ability (VIA) of various forms of VCI materials for temporary corrosion protection of ferrous metal surfaces, and is called the "VIA-Ferrous" test. It can be performed reproducibly with relatively simple and low-cost apparatus. The VIA-Ferrous test provides for standard conditions in a test jar of water-saturated, warm air without the presence of accelerating contaminants. This test method evaluates the combination of (1) vapor transport across a gap containing air, water vapor, and VCI, and (2) corrosion protection.

KEYWORDS

Volatile Corrosion Inhibitor, VCI, vapor inhibitor, ferrous, TG 215

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Foreword

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.

Volatile corrosion inhibitor (VCI) materials are used to provide temporary corrosion protection for the surfaces of ferrous and nonferrous metal parts. "Temporary" refers to conditioning the environment enclosing the metal parts for a period, usually months to years, before the parts are put to their ultimate use, or before a "permanent" coating such as paint is applied. This standard test method evaluates the vapor- inhibiting ability (VIA) of various forms of VCI materials for temporary corrosion protection of ferrous metal surfaces, which is subsequently herein called the "VIA-Ferrous" test.

VCI materials compete with alternative temporary corrosion protection methods that include oils, greases, and waxes sometimes called rust preventives or corrosion preventive compounds; various aqueous solutions and coatings; and combinations of these coatings with desiccants and "barrier" packaging. Some of these alternatives may incorporate a VCI function, and others may claim or imply VCI function in a name, but may function primarily by contact-inhibiting properties. A test of VCI function must demonstrate minimal or basic VCI effects, the combination of vapor transport and corrosion protection, from other mechanisms such as contactinhibition.

This standard test method is intended for use by VCI material manufacturers and users. It can be used for basic pass/fail qualification tests by production, quality assurance, user, or corrosion specialist laboratories to determine the VIA of VCI materials to protect ferrous metal surfaces from corrosion (rusting), including the component of ferrous metal protection afforded by multimetal VCI materials.

The VIA-Ferrous test method can be performed quickly (24 hours) and reproducibly with relatively simple and low-cost apparatus under standard conditions in a sealed jar containing a VCI test specimen, a prepared steel sample, and saturated (distilled) water vapor in warm air with no accelerating contaminants. This method evaluates the combination of (1) vapor transport across a gap containing air, water vapor, and VCI molecules, and (2) corrosion protection of a standardized steel specimen surface. This test method uses low-carbon steel as representative of the broad class of ferrous metals. An optional test is described for testing the compatibility of the VCI sample with copper. Some types of VCI chemistry in VCI-treated packaging materials (e.g., film, bags, paper) may cause corrosion or discoloration in contact with copper.

The tests described here evolved largely from U.S. MIL-STD-3010, Test Method 4031,[1] with added experience and practices over several decades by many users of the method, some with variations, and modifications, and options from related standards and practices of members of NACE Technology Exchange Group (TEG) 093X.[2–5] These practices included details of preparation of VCI material samples and steel specimens and interpretation of results. These details are reflected in several options for sample preparation, two of which are added in this revision to capture evolutionary experiences, one for higher productivity of production testing, and one for research and detailed metallographic observation. Similar VIA test methods are currently in wide use for basic qualification of VCI materials.[6–8]

This VIA-Ferrous test may be a possible basis for developing a standard test method to evaluate the VIA of VCI materials to protect representative nonferrous metal surfaces from corrosion (VIA-Nonferrous test), and another test method to include the presence of atmospheric contaminants that can accelerate corrosion.

This standard was originally prepared in 2008 by Task Group (TG) 215, "Volatile Corrosion Inhibitors (VCIs)," which is administered by Specific Technology Group (STG) 61, "Inhibition: Corrosion and Scaling." It was revised by TG 215 in 2013 and 2018. It is published by NACE International under the auspices of STG 61.

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