

Test Methods to Evaluate Thermal Properties and Performance of Insulative Coatings

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ABSTRACT

New NACE TEST METHOD! The purpose of this NACE International standard test method is to specify test methods and test conditions used to evaluate thermal properties, insulation values, and performance/integrity before and after thermal aging of insulative coatings. Testing for corrosion resistance is not included in this test method.

The primary intent of this standard is to specify test conditions that would provide a baseline evaluation – one that would allow direct performance comparisons between different insulative coatings. This standard is designed to have practical test procedures and limited test conditions. It also includes five mandatory appendixes that describe hot plate designs and thermal test setups, all of which are used in this standard test method.

This standard test method introduces new test methods to determine if, and at what rate, an insulative coating's properties deteriorate with thermal aging. Test methods are given for both organic and inorganic based coatings. This standard test method is intended for use by facility owners, engineers, coating manufacturers, and other interested parties.

KEYWORDS

adhesion pull tests, blister resistance, corrosion under insulation (CUI), delamination, disbondment, emissivity, flame spread index, hot plate design, infrared thermometer (IR Meter), inorganic insulative coatings, insulating coating, insulative coatings, insulation values, organic insulative coatings, percent mass loss, proportional-integral-derivative (PID) controller, smoke development index, solar absorptance, TG 525, thermal aging, thermal conductivity, thermocouple wire, thermal efficiency, thermal properties, thermal test, test panel, STG 02.

Foreword

The purpose of this NACE International standard test method is to specify test methods and test conditions used to evaluate thermal properties, insulation values, and performance/integrity before and after thermal aging of insulative coatings. Testing for corrosion resistance is not included in this test method as that topic falls under the testing of the corrosion-resistant primers typically used with these coatings.

The primary intent of this standard is to specify test conditions that would give a baseline evaluation—one that would allow direct performance comparisons between different insulative coatings. This standard is designed to have practical test procedures and limited test conditions. It also includes Appendixes A–C (mandatory), which describe hot plate designs; and Appendixes D and E (mandatory) that describe thermal test setups, all of which are used in this standard test method.

The performance of insulative coatings varies considerably depending on the temperatures of the metallic substrate and ambient air, the thickness of the coating, etc. A more complete evaluation would include a matrix of test conditions at various substrate temperatures and coating thicknesses. Increasing the thermal aging durations would also provide a more complete characterization of the coating's resistance to thermal aging.

However, this additional testing would make the standard more complicated and less practical. Users of this standard are encouraged to consider expanding the test conditions for the specified tests to other test temperatures and thicknesses and test durations if a more complete characterization is needed. The test conditions specified in this standard are mandatory, and any tests with alternate sets of conditions shall be performed in addition to the mandatory tests in this standard.

Insulative coatings are often used to provide thermal insulation and personnel protection against burns to skin, and to improve process stability during rapid changes in weather conditions. Since they are liquid coatings, they can easily be applied onto irregular shaped objects used in hot services. In combination with an anticorrosive primer, these coatings also provide corrosion protection and minimize corrosion under insulation (CUI), because the insulative coating bonds directly to the primed metallic substrate.

Numerous test methods have been used to characterize their performance. Some of these test methods are a take-off from test methods used for traditional bulk insulation products and for coatings in atmospheric services at ambient temperatures. Their relevance to insulative coatings may be questionable. It has been difficult for facility owners and engineers to compare coating performance using these different test methods, which provide no standardization of the test conditions. A standardized test method can validate the thermal characteristics of these coatings and enable direct comparison of the coating's performance. This standard selects only those test methods that are most relevant to insulative coatings in high-temperature services.

There are currently no test methods to evaluate thermal aging of insulative coatings. This standard introduces new test methods to determine if, and at what rate, an insulative coating's properties deteriorate with thermal aging.

Test methods are given for both organic- and inorganic-based coatings. The maximum service temperature limit for the organic-based coatings may be approximately 177 °C (350 °F). For inorganic coatings, the limit is significantly higher. In addition, thicknesses can range from 1 to 5 mm (40 – 200 mil) for organic coatings and may be significantly thicker for inorganic coatings.

This standard test method is intended for use by facility owners, engineers, coating manufacturers, and other interested parties.

This NACE standard test method was prepared in 2020 by Task Group (TG) 525, "Determining the True Insulative Value of Liquid Insulative Materials Applied on Steel Surfaces." This TG is administered by Specific Technology Group (STG) 02, "Coatings and Linings, Protective—Atmospheric." This standard is issued by NACE under the auspices of STG 02.

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