Australian Standard®

METHODS OF TEST FOR VITREOUS ENAMEL COATINGS

PART 1.1: CHEMICAL TESTS—

DETERMINATION OF RESISTANCE OF VITREOUS ENAMEL COATINGS TO HOT SODIUM HYDROXIDE

The following scientific, industrial and governmental organizations and departments were officially represented on the committee entrusted with the preparation of these standard methods:

Australian Electrical Manufacturers Association

Australian Gas Association

Australian Vitreous Enamellers Institute

Bureau of Steel Manufacturers of Australia

Confederation of Australian Industry

Department of Science

Electricity Supply Association of Australia

Gas Appliance Manufacturers Association of Australia

Health Commission of N.S.W.

Metal Trades Industry Association of Australia

Australian Standard®

METHODS OF TEST FOR VITREOUS ENAMEL COATINGS

PART 1.1: CHEMICAL TESTS—

DETERMINATION OF RESISTANCE OF VITREOUS ENAMEL COATINGS TO HOT SODIUM HYDROXIDE

PUBLISHED BY STANDARDS AUSTRALIA
(STANDARDS ASSOCIATION OF AUSTRALIA)
1 THE CRESCENT, HOMEBUSH, NSW 2140

PREFACE

These standard methods were prepared by the Association's Committee on Vitreous Enamel Finishes as the revision, metrication and extension of the methods in AS K95—1961 which they accordingly supersede.

During its work on these standard methods, the committee took particular note of ISO/TC 107/SC 7 published documents and standards, and accordingly has introduced test methods and equipment which have been adopted as international standards. These include:

ISO 2722	Vitreous and Porcelain Enamels— Determination of Resistance to Citric Acid at Room Temperature
ISO 2723	Vitreous and Porcelain Enamels for Sheet Steel— Production of Specimens for Testing
ISO 2724	Vitreous and Porcelain Enamels for Cast Iron— Production of Specimens for Testing
ISO 2733	Vitreous and Porcelain Enamels— Apparatus for Testing with Acid and Neutral Liquids and their Vapours
ISO 2734	Vitreous and Porcelain Enamels— Apparatus for Testing with Alkaline Liquids
ISO 2742	Vitreous and Porcelain Enamels— Determination of Resistance to Boiling Citric Acid
ISO 2743	Vitreous and Porcelain Enamels— Determination of Resistance to Boiling Hydrochloric Acid
ISO 2744	Vitreous and Porcelain Enamels— Determination of Resistance to Boiling Water and Water Vapour
ISO 2745	Vitreous and Porcelain Enamels— Determination of Resistance to Hot Sodium Hydroxide
ISO 2746	Vitreous and Porcelain Enamels— Enamelled Articles for Service under Highly Corrosive Conditions—High Voltage Test

International tests for the determination of abrasion resistance have not yet been finalized; accordingly, this standard relies on the test developed by the Porcelain Enamel Institute in America as specified in ASTM C448—1964.

The introduction of continuous cleaning enamels on the commercial market has necessitated the inclusion of a test method to test their efficacy.

These standard methods may require reference to the following standards:

AS 1580	Methods of Test for Paints, Varnishes, Lacquers and Related Materials (Metric Units)— Method 602.2, Specular Gloss
AS 1914	Glossary of Terms Relating to Vitreous Enamel Coatings
BS 1041	Code for Temperature Measurement

LIST OF METHODS

Number	Title
PART 1— CHEMICAL TESTS	
AS 2219.1.1—1978	Determination of resistance of vitreous enamel coatings to hot sodium hydroxide
AS 2219.1.2—1978	Determination of resistance of vitreous enamel coatings to boiling water and water vapour
AS 2219.1.3—1978	Determination of resistance of vitreous enamel coatings to boiling hydrochloric acid
AS 2219.1.4—1978	Determination of resistance of vitreous enamel coatings to boiling citric acid
AS 2219.1.5—1978	Determination of resistance of vitreous enamel coatings to citric acid at room temperature
PART 2— PHYSICAL TESTS	
AS 2219.2.1—1978	Determination of resistance of vitreous enamel coatings on steel to thermal shock
AS 2219.2.2—1978	Determination of the heat resistance of vitreous enamel coatings on cast iron
AS 2219.2.3—1978	Determination of abrasion resistance of vitreous enamel coatings
PART 3— MISCELLANEOUS TESTS	
AS 2219.3.1—1978	Determination of the performance of continuous cleaning vitreous enamel coatings

STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard

METHODS OF TEST FOR VITREOUS ENAMEL COATINGS

PART 1—CHEMICAL TESTS

AS 2219.1.1
DETERMINATION OF RESISTANCE OF VITREOUS ENAMEL COATINGS TO HOT SODIUM HYDROXIDE

FOREWORD

This test method has the characteristics of good repeatability and reproducibility of the test results obtained.

Although the specified test solution and test temperature are normally essential to this method, it is possible in particular cases to run the test with an alkaline attacking agent other than sodium hydroxide (1 mol/L) and at temperatures below 80°C (see Note in Clause 1). Any deviations from the procedure given in this method should be stated in the test report.

Testing the resistance of enamels to alkaline liquids involves more difficulties than testing their resistance to acids or water. This fact is mainly due to differences in the formation on the surface of the test panel, of deposits of insoluble salts which retard the attack in an uncontrollable way, and to the very strong dependence of the alkaline corrosion on temperature.

Testing at temperatures above 80°C impairs the reproducibility of the results due to deposits of insoluble salts on the enamel surface. Test temperatures below 80°C impair the reproducibility because of the slight attack.

A test with sodium hydroxide solution (1 mol/L) at 80°C over 48 h results in sufficiently high corrosion for all enamels in question. A deviation of 10°C, as shown in Fig. 1, results in doubling or halving the corrosion speed. Thus, a deviation of only 1°C means an error of 10 percent. This fact makes it necessary to control the test temperature at 80 ± 0.1°C, which can only be guaranteed in an agitated, thermostatically controlled liquid bath.

The immersion of the whole test equipment in a thermostatically controlled liquid bath makes it necessary to protect the edge as well as the back of the test panel against corrosion by means of a rubber envelope that is both heat-resistant and alkali-resistant. The rubber envelope also serves as a sealing unit for the test equipment.

ISBN 0 7262 1573 2

The alkaline attack is always more severe in the liquid phase. Therefore, a test panel subjected to the vapour phase could be discarded in favour of two panels subjected to the liquid phase.

Glass or another enamel in contact with the test solution sometimes impairs the test results considerably. Therefore, it is neither permissible to use a test cylinder of glass or ceramic instead of stainless steel, nor to test two different enamelled test panels in the same cylinder.

The determination of loss in mass has proved superior to any other method of evaluation, especially after considerably high alkaline attack.

The alkaline corrosion test leaves, on the enamel surface, residues partly acid-soluble and more or less removable by washing or by rubbing. Therefore, the procedure given in this method should be followed exactly in order to prevent diversified cleaning procedures from impairing the test result.

Edge chipping is frequently the cause of a considerably high corrosion speed and can be seen, with the naked eye, on the edge of a test panel and inside the protective rubber envelope.

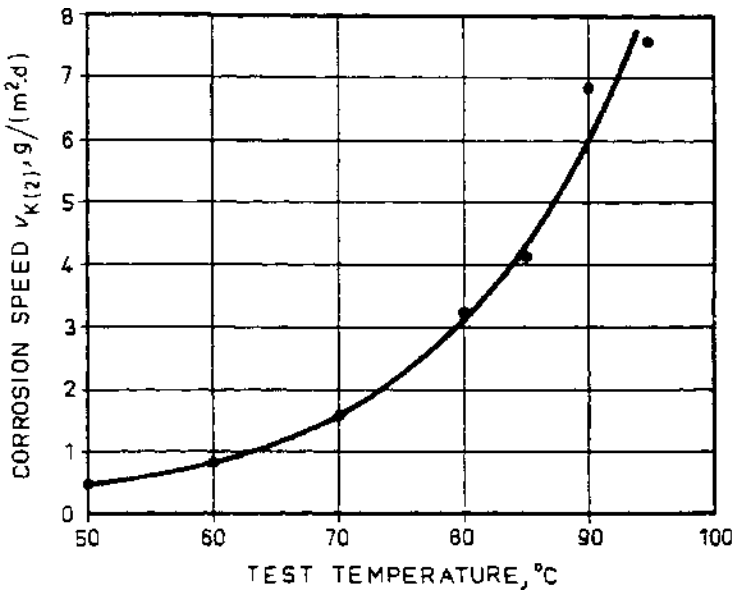

Fig. 1. GRAPH SHOWING THE DEPENDENCE OF THE ALKALI RESISTANCE OF A TANK ENAMEL ON THE TEST TEMPERATURE

METHOD

1 SCOPE. This standard describes the procedure for determining the resistance of flat surfaces of vitreous and porcelain enamels to a hot solution of sodium hydroxide.

NOTE: The method is also suitable for determining the resistance of enamels to other alkaline reagents.

2 PRINCIPLE. Enamelled test panels are exposed to attack by a hot solution of sodium hydroxide. The rate of corrosion is then calculated from the loss in mass.

3 DEFINITIONS. For the purpose of this standard, the following definitions apply:

Test sample—a portion of material or a group of items selected from a batch or consignment by a sampling procedure.

Test specimen—a portion of material or a single item taken from the sample for the purpose of applying a particular test.

Test panel—a panel prepared for testing and made from a test specimen by some mechanical operation.

4 REAGENTS. Chemicals used for testing purposes shall be free from impurities which could influence the outcome of the test. The following reagents are required:

(a) *Sodium hydroxide solution.* Dissolve 40.00 g of NaOH in distilled water and make up to 1 L.

NOTES:

1. The solution is to be kept sealed to prevent the absorption of carbon dioxide.
2. A fresh solution is required for each test.

(b) *Acetic acid,* 5 percent (*m/m*) solution.

(c) *Distilled or demineralized water.*

(d) *Solvent cleaner,* such as trichloroethylene or acetone.

5 APPARATUS. The following apparatus is required:

(a) Test apparatus (see Appendix A).

(b) Temperature controlled water bath.

NOTES:

1. The bath should be fitted with a stirring device and be capable of being sealed against loss by evaporation.
2. In order to prevent corrosion it is recommended that a solution of sodium nitrite (approximately 1 percent m/m) be used as the heating liquid.

(c) Thermometer, graduated and accurate to 0.1°C.

(d) Hot air oven capable of maintaining a temperature of at least 130 ± 5°C.

(e) Desiccator (internal diameter approximately 200 mm).