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Australian Standard™

AS 3894.3

Site testing of protective coatings

Method 3: Determination of dry film thickness

PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee CH-003, Paints and Related Materials, to supersede AS/NZS 3894.3:1993. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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FOREWORD

When determining a method of measuring the dry film thickness of a protective coating in the field, the following factors need to be taken into account:

(a) The need for an uncoated reference substrate that has a surface preparation identical to that of the work piece.

(b) Provision of standard test blocks bearing a calibrated non-magnetic coating that is traceable to a national Standard, i.e. NBS or DIN.

(c) The utilization of non-magnetic or non-metallic shims.

(d) Calibration of instruments and adjustment of instruments.

(e) Examination of coating on various faces as a sampling process.

(f) Expression of results.

The protective coating system examined here is not a separately manufactured article but one that is part of a manufactured product. There are several ways in which the concept of thickness, or its quantitative expression, differs from those criteria that usually characterize the thickness of sheets, foils, films, plates and tubes.

The durability of the protective coating system can be governed by the thickness of film, above the asperities of the substrate that is lying outside the peaks of the surface profile. Measurement of this film thickness at a large number of arbitrarily chosen spots on the test piece will commonly yield a number of readings, some of which are 50% greater than others. At the same time, on any face of the test piece, a mean value for a large number of readings will differ from the mean value of the reading observed on another face. It is the objective of this Standard to achieve uniformity of practice in dealing with such a distribution of film thickness values.

The coating surface in view may be sensibly smooth even though it has a waviness on the large scale. As well as being hidden and inaccessible to the instrument, the underside of the protective film replicates the irregularity of the surface profile, on both the small and the large scale.

Many of the methods available for examining the dry film thickness of a paint coating on a test panel are not for the use of site testing of protective coatings because of the inability to weigh the work piece, measure volume of coatings, or to mar the coating by destructive testing. It is for this reason that only non-destructive instruments, operating on magnetic or electromagnetic principles, have any practical use. The range of thicknesses of protective coatings is usually beneath the level of discrimination of acoustic instruments.

ISO 2808, and Steel Structures Painting Council Specification SSPC-PA-2 provide additional information on the determination of film thickness.

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METHOD

1 SCOPE

This Standard provides practical test methods for the on-site determination of the range of thicknesses and the mean dry film thickness of a protective coating system, or its component coats, upon a metallic structure or fabrication.

The coated fabrications to which the methods may be applied include tanks or reservoirs, bridge girders, equipment used in processing chemicals or petroleum, pipelines, and fabricated articles such as vehicles, white goods and other items of industrial production, where there is lack of uniformity of substrate thickness, metallographic character, surface condition and the film of the protective coating.

NOTES:

1 Appendix A provides a laboratory test method for the microscopic determination of the thickness of the film adhering to a substrate. This method would only be used where no other method is acceptable.

2 Appendix B provides a method for determining the thickness of a flake of the coating using an optical microscope.

3 ISO 2808 provides information on additional methods of determining film thickness.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS	
1199	Sampling procedures and tables for inspection by attributes
1399	Guide to AS 1199—Sampling procedures and tables for inspection by attributes
2483	Testing of coatings
AS/NZS	
1580	Paints and related materials—Methods of test
1580.108.2	Method 108.2: Dry film thickness—Paint inspection gauge
2310	Glossary of paint and painting terms
2312	Guide to the protection of iron and steel against exterior atmospheric corrosion
ISO	
2808	Paints and varnishes—Determination of film thickness

3 DEFINITIONS

For the purpose of this Standard, the definitions of AS/NZS 2310 and those below apply:

3.1 Dry film thickness

The thickness of the coating measured, at any location on the test surface, above the peaks of the profile (anchor pattern or surface profile) of the substrate.

3.2 Primary standards

Reference standards that are maintained and housed under controlled conditions at the principal office of the test organization.

3.3 Reference substrate

A surface used to set the instrument zero, and for comparing results obtained from the test piece.

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3.4 Secondary standards

Standards that are referenced to the primary standards and are used in the field.

4 TEST METHODS

The coating film thickness may be measured using magnetic pull-off gauges (see clause 9), or by eddy current or magnetic induction type instruments (see clause 10) of the type generally described in Table 1:

NOTES:

1 Owing to the inherent inaccuracies of some magnetic pull-off gauges, they are recommended only for process control operations, where accurate and reproducible measurements are not required.

2 Appendix C provides a method for determining the wet film thickness during application of a coating, which will assist applicators in achieving the required dry film thickness.

5 PRECAUTIONS

The accuracy of measurement of a coating thickness may be affected by a number of factors. The following precautions should be observed:

(a) *Calibration* The instrument should be calibrated in accordance with Appendix D prior to use, re-calibrated after each hour and rechecked at the end of the work period.

(b) *Substrate thickness* For each instrument, there is a critical thickness of metal substrate below which the accuracy of the instrument cannot be assured. Since this thickness depends on both the measuring frequency of the probe system and the electrical conductivity or the magnetic permeability of the substrate, its value should be determined experimentally, unless it is specified by the manufacturer of the test instrument.

(c) *Edge effects* Measurements should not be taken close to an edge, hole or inside corner of a test specimen unless the instrument is calibrated for such measurements.

(d) *Curvature* Measurements are affected by the curvature of the specimen. The influence of curvature varies considerably, depending on the make and type of instrument, but always becomes more pronounced as the radius of curvature decreases. Measurements made on curved test specimens will therefore not be valid unless the instrument is specifically calibrated for such measurements.

(e) *Surface profile and roughness* Measurements are influenced by the surface topography of the substrate and of the coating. Rough surfaces and the anchor pattern of a surface profile can cause both systematic and random errors.

(f) *Foreign particles* The probes of the coating thickness gauge need to make contact with the test surface. The instruments are therefore sensitive to any foreign material that prevents intimate contact between the probe and surface of the coating. The probe tip should be checked periodically for cleanliness and foreign particles removed using plasticine or similar material.

(g) *Soft coatings* Soft coatings may be deformed by the probe. Valid measurements on such test specimens may only be possible with the use of special probes or fixtures.

NOTE: When softness of the film is caused by the degree of cure, it may be necessary to defer testing.

(h) *Surface contamination* Sticky, greasy, tacky material, or other types of contaminants, may cause a build-up on the probe, so care should be taken that such material does not affect measurements.

NOTE: If contamination is severe, it may become necessary to defer the testing.

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