

Australian Standard™

Paints and related materials—Methods of test

Method 481.5: Coatings—Durability and resistance to fouling—Marine underwater paint systems

METHOD

1 SCOPE

This Standard sets out a procedure for assessing the performance of marine underwater paint systems exposed, under static conditions, to a marine environment as defined by this Standard. It provides for the determination of—

- (a) protection of the substrate from deterioration and corrosion with or without cathodic protection; and
- (b) durability and resistance to fouling of paint systems applied to the abovementioned substrates.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

- 1580 Paints and related materials—Methods of test
- 1580.101.5 Method 101.5: Conditions of test—Temperature and humidity control
- 1580.408.2 Method 408.2: Adhesion—Knife test
- 1580.505.1 Method 505.1: pH of water-based paints

3 DEFINITION

For the purpose of this Standard, the following definition applies.

3.1 Chlorinity

The chlorinity of water is equal to the total mass of dissolved chloride, bromide and iodide ions present in 1 kg of test water, expressed as grams of chloride precipitated by silver nitrate solution (see Clause 6.2.1(c)).

NOTES:

- 1 Since chlorinity includes bromide and iodide ions, its value is marginally greater than that of the chloride content alone and is really a measure of the total halide ion concentration (excluding F⁻).
- 2 For all practical purposes, the concentration of iodide ions in seawater is negligible.

4 PRINCIPLE

The paint systems to be tested are applied to prescribed test panels which are then affixed to a specified test rack and immersed at a specified depth from the test raft. The paint systems are examined periodically for permanent settlement of fouling organisms and for film integrity. The substrate is examined for signs of deterioration or corrosion where appropriate.

5 TEST RAFT

The raft consisting of a floating structure from which panels may be suspended at three depths so that the tops of the panels are between 600 mm and 2 m below the surface of the water. The design, dimensions and materials of construction of the raft* and the method of fixing the panels are at the discretion of the testing authority, provided that the following conditions are observed:

- (a) The surface of the water directly above the test panels is not covered (see Clause 6.1(e)).
- (b) The test raft may be moored in a fixed position or may be swing free.
- (c) The test panels hang vertically with at least 250 mm separation between faces of panels.
- (d) Each rack can be raised for examination of the test panels and re-immersed without damage to the panels.
- (e) The raft and its associated test equipment are secured in such a manner as to minimize the possibility of unauthorized interruption or interference to the test by actions such as vandalism.
- (f) The attachment of the frames and panels to the raft is as follows:
 - (i) *Cathodic protection* Where cathodic protection is to be applied, it shall be provided by the use of sacrificial anodes unless otherwise specified. The steel frames and the test panels are to be in direct electrical contact so that the frame and panels are maintained at a potential equivalent of from 850 mV to 950 mV negative to a silver-silver chloride half-cell over the period of test.

NOTES:

- 1 The maintenance of the required potential may be achieved, by directly attaching auxiliary anodes of zinc or zinc/aluminium alloy to the frame.
 - 2 Measurements of potential should be made at monthly intervals. For a newly installed system using sacrificial anodes, allowance of up to two months may be necessary for the system to stabilize. Where impressed current is used, three to five days should be sufficient for stabilization.
- (ii) *Non-cathodic protection* If cathodic protection is not to be applied, the test panels shall be electrically insulated from any metallic parts of the raft.

6 TEST SITE

6.1 Location of raft

The test raft shall be located at a site complying with the following requirements:

- (a) Settlement of the following four types of fouling shall be evident over a two-year period—
 - (i) macroscopic algae;
 - (ii) tubeworms;
 - (iii) bryozoans; and
 - (iv) barnacles.

In addition, for at least ten months of the year, the frequencies of at least three types of fouling that are listed in Clause 9.1.2(c) shall be greater than 10 percent when measured in accordance with Clause 9.1.2(d).

* Details of the structure and design of a suitable raft must be agreed between interested parties.

NOTE: The type and frequency of organisms settling at a particular site will be influenced by such factors as the range of diurnal and seasonal water temperature, salinity, dissolved oxygen content and pH of the water, tidal pattern and current flow rate, and the location of the site in relation to rivers, reefs, and other site features.

- (b) Temperature, chlorinity and pH of the water at the test site shall be as specified in Table 1, when measured in accordance with Clause 6.2.1(b), (c) and (d) respectively.

TABLE 1
REQUIREMENTS OF WATER AT TEST SITE

Property	Value	Period of applicability
Temperature	20°C to 30°C (tropical waters) 15°C to 25°C (temperate waters)	At least 8 months of the year
Chlorinity	≥16 g/L as Cl	At least 10 months of the year
pH	8.0 ±0.4	At least 11 months of the year

- (c) The average prevailing current at the test site shall be known and be in the range of 0.1 to 1.5 knots.
- (d) The depth of water at the site shall be such that at any minimum low tide there shall be clearance of at least 1 m between the bottom of the lowest panel and the sea bed.
- (e) The test raft shall be substantially free from shadow for at least 6 h per day.

6.2 Compliance of test site

6.2.1 Established sites

Compliance of a test site with Clause 6.1(a), (b) and (c) shall be demonstrated by monthly determinations of the following throughout the test period:

- (a) Nature and extent of settlement of fouling on at least two control panels which shall be immersed at the uppermost and lowest positions on the rack.
- (b) Water temperature, as measured 600 mm below the surface of the water.
- (c) Chlorinity, as determined on a water sample taken 600 mm below the surface of the water by any method appropriate to the typical chlorinity range of water at the test site providing that the test apparatus (if a physical test method) or the standard reagents (if a chemical test method) are calibrated, at least annually, against Standard Seawater of certified chlorinity, as prepared and determined by an oceanographic institute to a traceable international standard of measurement.

NOTES:

- The purpose of the Standard Seawater is to establish a common reference point for—
 - standardizing the results of the methods/techniques that may be used for determining chlorinity;
 - evaluating the suitability/compliance of a site with respect to the chlorinity requirements of Table 1; and
 - comparing sites with respect to their chlorinity values.
- Standard Seawater 'P series' should be used and the qualification 'P series' should be included when purchasing.

Where salinometers are used, an 'L series' standard should also be used to check the salinometer offset. However, for the accuracy required in this Standard, complex and expensive apparatus such as salinometers are unwarranted.

3 Methods in current use are many and varied and include titrimetry (specially, the argentometric (Mohr) method), electrical conductivity, hydrometry (in which density is determined and related to chlorinity via density/salinity tables), and refractometry (from which refractive index is related to the chloride concentration). Any established method may be used provided that it is calibrated against reference seawater.

- (d) pH, as determined on a water sample taken 600 mm below the surface of the water by a method appropriate to the pH range specified in Table 1 providing that the method/apparatus is calibrated against a standard buffer solution with a pH value between pH = 6.0 and pH = 10.0 (preferably, close to 8.0).

NOTE: A selection of suitable buffer solutions is given in Appendix A of AS 1580.505.1 together with a description of a procedure for calibrating a pH meter.

6.2.2 *New sites*

For new sites, the suitability shall be demonstrated by monthly determinations of the parameters specified in Clause 6.2.1 over a period of at least two years.

7 CONTROL PANELS

Any black, rigid, water-resistant and biologically inert panels of dimensions 300 mm × 150 mm shall be used. They shall be free of cracks, and be lightly abraded at the commencement of the test period. Alternatively an uncoated panel of the same substrate used in the test series may be used.

NOTES:

- 1 Acrylic or unplasticized PVC panels are recommended.
- 2 It should be ensured that the same type of panels are used in any one test series.

8 TEST PANELS

8.1 General

Test panels shall be of minimum dimensions 300 mm × 150 mm. They shall be coated in the prescribed manner with the specified paint system and dried in accordance with the specified methods.

8.2 Panel area and edges

The number of test panels shall be such that the total test area for each paint system under test is not less than 0.25 m². Each panel shall have both sides and all edges coated with the paint system under test.

8.3 Cathodically protected panels

For tests of paint systems on metallic substrates under cathodically protected conditions, a circular area of substrate (holiday) of 6 mm diameter shall be exposed 20 mm from the bottom of but on only one face of one of the panels.

NOTES: The holiday may be obtained by either—

- (a) using a drill bit modified so as to prevent perforation of the panel; or
- (b) masking off an area of appropriate size prior to application of the paint system.

9 TEST PROCEDURE

9.1 Control panels

9.1.1 *Introduction*

Control panels shall be used to determine the suitability of the test site and the continuity of settlement of fouling organisms during the period of test.