

SURFACE TOLERANT SOLVENT FREE EPOXY PAINT FOR WET SURFACES

Specification

The CONTEC - Authoring Subcommittee provides guidance on the interpretation of this Standard when questions arise regarding its contents. The Department of PETROBRAS that uses this Standard is responsible for adopting and applying the clauses thereof.

Technical Requirement: a provision established as the most adequate and which shall be used strictly in accordance with this Standard. If a decision is taken not to follow the requirement ("non-conformity" to this Standard) it shall be based on well-founded economic and management reasons, and be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by the verb forms "shall," "it is necessary...", "is required to...", "it is required that...", "is to...", "has to...", "only ... is permitted," and other equivalent expressions having an imperative nature.

Recommended Practice: a provision that may be adopted under the conditions of this Standard, but which admits (and draws attention to) the possibility of there being a more adequate alternative (not written in this Standard) to the particular application. The alternative adopted shall be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by the verbal form "should" and equivalent expressions such as "it is recommended that..." and "ought to..." (verbs of a nonmandatory nature). It is indicated by the expression: **[Recommended Practice]**.

Copies of the registered "non-conformities" to this Standard that may contribute to the improvement thereof shall be submitted to the CONTEC - Authoring Subcommittee.

Proposed revisions to this Standard shall be submitted to the CONTEC - Authoring Subcommittee, indicating the alphanumeric identification and revision of the Standard, the clause(s) to be revised, the proposed text, and technical/economic justification for revision. The proposals are evaluated during the work for alteration of this Standard.

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Foreword

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CONTEC

Comissão de Normalização
Técnica

SC - 14

Paintwork and Anticorrosive
Coatings

FOREWORD

This Standard is the English version (issued in DECEMBER/2020) of PETROBRAS N-2680 Rev. A standard SET/2020.

1 SCOPE

1.1 This Standard establishes the characteristics, verifiable in the laboratory, required for surface tolerant solvent free epoxy paint for wet surfaces, supplied in 2 containers: one containing the epoxy resin (component A) and the other containing the polyamine-based curing agent (component B).

1.2 The paint mentioned in the item 1.1 shall be used to paint steel surfaces and can be applied on dry surfaces, surfaces with residual humidity and wet surfaces, in ambients without restriction to relative humidity and dew point.

1.3 If there is conflicts between the Technical Requirements and Recommended Practices established in this Standard and in other standards mentioned in the Chapter 2, the requirements of this Standard shall prevail.

1.4 This Standard is applied to specifications started as of its date of issuance.

1.5 This Standard contains Technical Requirements and Recommended Practices.

2 Normatives References

The following documents are cited in the text in such a way that their contents, total or partial, are requirements for this document. For dated references, only the mentioned editions apply. For undated references, the most recent editions of that document (including amendments) apply.

PETROBRAS [N-13](#) - Requisitos Técnicos para Serviços de Pintura;

PETROBRAS [N-1219](#) - Cores;

ABNT [NBR 12103](#) - Tintas - Determinação do Descaimento;

ABNT [NBR 15442](#) - Pintura Industrial - Inspeção de Recebimento de Recipientes Fechados;

ABNT [NBR 15742](#) - Tintas e Vernizes - Avaliação do Tempo de Vida Útil da Mistura (pot life);

ABNT [NBR 15877](#) - Pintura Industrial - Determinação da Resistência à Tração em Sistemas de Pintura e Outros Revestimentos Anticorrosivos ;

ISO [2808](#) - Paints and Varnishes - Determination of Film Thickness;

ISO [3679](#) - Determination of Flash No-Flash and Flash Point - Rapid Equilibrium Closed Cup Method;

ISO [8501-1](#) - Preparation of Steel Substrates Before Application of Paints and Related Products - Visual Assessment of Surface Cleanliness;

ISO [9227](#) - Corrosion Tests in Artificial Atmospheres - Salt Spray Tests;

ISO [12944-9](#) - Paints and Varnishes - Corrosion Protection of Steel Structures by Protective Paint Systems - Part 9: Protective paint systems and laboratory performance test methods for offshore and related structures;

ISO [16474-3](#) - Paints and Varnishes - Methods of Exposure to Laboratory Light Sources - Part 3: Fluorescent UV Lamps;

ASTM [D56](#) - Standard Test Method for Flash Point by Tag Closed Cup Tester;

ASTM [D523](#) - Standard Test Method for Specular Gloss;

ASTM [D562](#) - Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer;

ASTM [D1141](#) - Standard Practice for the Preparation of Substitute Ocean Water;

ASTM [D1308](#) - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes;

ASTM [D1475](#) - Standard Test Method for Density of Liquid Coatings, Inks, and Related Products;

ASTM [D1640](#) - Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings;

ASTM [D2369](#) - Standard Test Method for Volatile Content of Coatings;

ASTM [D4214](#) - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films;

ASTM [D4541](#) - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers;

ASTM [D6943](#) - Standard Practice for Immersion Testing of Industrial Protective Coatings and Linings;

ASTM [G8](#) - Standard Test Methods for Cathodic Disbonding of Pipeline Coatings;

3 General Conditions

3.1 Appearance of Components A and B

Components A and B shall be homogeneous and show no skinning and thickening in a freshly-opened can.

3.2 Packaging

3.2.1 Containers shall be straight circular cylindrical in shape.

3.2.2 For sealing packaging, any material capable of causing degradation or contamination of the paint shall not be used.

3.3 Conditions and Filling of Containers

3.3.1 The containers holding the components of the surface tolerant solvent free epoxy paint for wet surfaces shall be in good conditions and duly labeled or marked on the side, in accordance with the requirements of this Standard and PETROBRAS [N-1288](#) standard.

3.3.2 The containers shall contain at least the quantity mentioned in the respective indicated information.

3.4 Storage Stability

3.4.1 Components A and B shall demonstrate stability during storage in a closed container at a temperature below 40 °C, ensuring their use for at least 12 months from the date of manufacture.

3.4.2 This period of use may be extended for 2 additional periods of 6 months, through repetition and prior approval of the tests performed at the time of supply, in accordance with PETROBRAS [N-13](#) standard. **[Recommended Practice]**

3.5 Dilution

The surface tolerant solvent free epoxy paint for wet surfaces paint shall not be diluted.

3.6 Mixture of Components A and B

The mixture of components shall be done in the suitable proportion recommended by the paint producer.

3.7 Total Paint Cure

The paint shall be completely cured in 7 d, at temperatures near to 25 °C.

3.8 Marking

The label or body of the containers shall bear at least the following information:

- a) PETROBRAS N-2680 standard;
- b) surface tolerant solvent free epoxy paint for wet surfaces;
- c) identification of components: A or B;
- d) quantity contained in container, in L and in kg;
- e) manufacturer's name, address and phone number;
- f) lot number or identifying signal;
- g) product expiration date;
- h) mixing ratio by mass and volume;
- i) "Munsell" notation.

3.9 Color

The surface tolerant solvent free epoxy paint for wet surfaces shall be supplied in any colours mentioned in PETROBRAS [N-1219](#) standard.

4 Specific Conditions

4.1 Requirements for Components A and B

4.1.1 Components A and B shall be homogeneous. Should they show any evidence of settling, it shall be capable of being easily homogenized (manually).

4.2 Requirements for the Ready-to-Apply Product

The requirements for the ready-to-apply product, with components A and B duly mixed, are set out in TABLE 1. The tests shall be done at 23 °C ± 2 °C.

**Table 1 - Characteristics of the Ready-To-Apply Product
(Components A And B Duly Mixed)**

Tests	Dry Film Thickness (µm)	Requirements		Standards to be Used
		Min.	Max.	
Density, g/cm ³	-	-	1,35	ASTM D 1475
Solids by mass (%)		85 (See NOTE1)		ASTM D2369 (See NOTE 2)
Pot-Life of Mixture, h	-	3	-	ABNT NBR 15742
Consistency (UK)	-	90	110	ASTM D 562
Flash-Point of Components A and B, °C	-	55	-	ASTM D56 or ISO 3679 (See NOTE 3)
Sagging, µm	-	150	-	ABNT NBR 12103
Dry to Touch, h	100 to 150	-	6	ASTM D1640
Dry Through, h	100 to 150	-	16	ASTM D1640
Dry to Recoat, h	100 to 150	100	120	ASTM D1640
<p>NOTE 1 N-2680 paint shall not contain organic solvents in its formulation. The content of volatile substances obtained from this test refers to compounds of different chemical nature</p> <p>NOTE 2 The solids by mass test shall be carried out according to the following procedure: cure at 23 °C ± 2 °C for 24 hours, followed by 2 hours in an oven at 60 °C.</p> <p>NOTE 3 In the option for ASTM D56, the determined flash point shall be greater than 55 °C. In the option for ISO 3679, procedure A should be used at a temperature of 55 °C.</p>				

4.3 Dry Film Characteristics

The dry film characteristics are established in TABLE 2 and in items 4.3.1 up to 4.3.4.

Table 2 - Dry Film Characteristics

Tests	Dry Film Thickness (μm)	Requirements		Standards to be Used
		Min.	Max.	
Cyclic Corrosion Test (Ageing Test for CX environment, Cycle (168 h))	425 to 475	25	-	ISO 12944-9 NOTE: See item 5.2.2.8
Cathodic Disbonding (30 days), mm (See Item 5.2.2.13)	425 to 475	-	10	ASTM G8
Atlas Cell @ 40 °C, h (See NOTE 1)	425 to 475	2000	-	ASTM D6943
Xylene Immersion Resistance, h	425 to 475	2 000	-	ASTM D1308
Artificial Sea Water Immersion Resistance at 40 °C, h	425 to 475	2 000	-	ASTM D1141
Initial Adhesion to substrate (Pull-Off Test), MPa (See Note 2)	425 to 475	12	-	ABNT NBR 15877 or ASTM D4541
Final Adhesion after Cyclic Corrosion Test (Pull-Off Test), MPa (See Note 3)	425 to 475	6	-	ABNT NBR 15877 or ASTM D4541
Gloss - 60°, UB	425 to 475	70	-	ASTM D523
NOTE 1 The solution to be used must have the following composition: 70 000 ppm of chloride ions, 21.0 g / L sodium acetate trihydrate, initial pH equal to 5.0, adjusted with hydrochloric acid.				
NOTE 2 The pull-off test shall be carried out on panels whose metal surface has been prepared using standard CSt3 mechanical treatment and on panels whose metal surface has been prepared by abrasive blasting up to Sa 2 ½ standard, according to ISO 8501-1. For panels submitted to mechanical treatment up to the CSt3 standard, it is acceptable that the nature of the failure, after pulling the dollies, can be adhesive type between the substrate and the coating (A / B), for values of breaking strength of at least 12 MPa. For panels submitted to abrasive blasting to Sa 2½ standard, the minimum value and acceptable failures are, respectively, 12 MPa and B, - / Y, Y or Y / Z. The test must be performed according to ABNT NBR 15877 using pneumatic or automatic hydraulic equipment, according to the figures in Annex A, or ASTM D4541, using pneumatic equipment Type IV - Test Method D or Automatic Hydraulic Equipment Type V - Test Method E.				
NOTE 3 The pull-off adhesion test shall be performed according to ABNT NBR 15877 using pneumatic or automatic hydraulic equipment, according to figures in Annex A, or ASTM D4541 , using Type IV pneumatic equipment - Test Method D or Type V Automatic Hydraulic Equipment - Test Method E. The test shall be performed after two weeks after the end of the cyclic test. The minimum value and acceptable failures are, respectively, 6 MPa and B, - / Y, Y or Y / Z for panels subjected to abrasive blasting up to the Sa 2½ standard.				

4.3.1 The notch made in the test panel for the cyclic corrosion test must be 50 mm long and 2 mm wide, as shown in Figure A.1 It must be at least 12.5 mm from the smaller edges and from at least 25 mm from one of the largest edges of the panel. It must completely cut the coating and expose the carbon steel. The depth of penetration into carbon steel should be as small as possible.

4.3.2 The notch shall be made manually with a tool that has dimensions, on the cutting tip and that directly confers 2 mm in width, according to Figure A.2, in one or more cutting passages of the organic coating. The use of a metal ruler or any accessory that serves as a guide during the cut is recommended to avoid tortuosities along the notch.

4.3.3 When observing the panels, blisters or corrosion points shall not be found on the surface, neither shall penetration in the notch exceeding 8 mm be observed after 25 cycles (4 200 h) of cyclic corrosion test type I. The maximum chalk allowable shall be correspondent to chalk rate No. 4 of ASTM D 4214 standard.

4.3.4 When observing the panels, after the immersion tests in xylene and synthetic seawater, the presence of bubbles, corrosion points and failures in the coating must not be verified

5 Inspection

5.1 Visual Inspection

Check if the conditions indicated in items 3.1, 3.2, 3.3 and 3.8 have been fulfilled and reject items supplied in disagreement therewith.

5.2 Tests

5.2.1 The tests to be performed are those contained in TABLES 1 and 2.

5.2.2 For the performance of the tests indicated in TABLES 1 and 2, the conditions established in items 5.2.2.1 up to 5.2.2.8, shall be observed.

5.2.2.1 The application of paint on the test panels shall be made, at least, 15 minutes after mixing and homogenizing the components.

5.2.2.2 The test panels shall be made in AISI-1020 carbon steel plate and the dimensions shall be 150 mm x 100 mm and at least 4 mm of thickness. Surface preparation shall be performed by abrasive blasting to near white metal (minimum), grade Sa 2 1/2 of ISO 8501-1 standard. The anchor profile shall be 50 µm to 70 µm, angular type.

5.2.2.3 Three panels for each test shall be made.

5.2.2.4 Three coats of paint, at least 150 µm of dry film thickness, shall be applied in each panel of test. The thickness measures shall be performed in each coat of paint applied and in accordance with the non-destructive suitable methods established in ISO 2808 standard (Method 10).

5.2.2.5 Panels should be painted by gun **[Recommended Practice]**

5.2.2.6 The edges of the test panels shall be suitably protected in order to prevent the premature appearance of a corrosive process at those points.

5.2.2.7 The tests in TABLE 2 shall be performed 10 days after paint is applied on the panels. During this period, the panels shall be kept at a temperature of 25 °C ± 2 °C and a relative humidity of 60 % ± 5 %.

5.2.2.8 In the cyclic corrosion test (Ageing Test) shall be performed 25 cycles, 168 h each one [according paragraphs a) to c) below], totalizing 4 200 h, exposing the test panels to the followings conditions:

- a) UV exposure and condensation of humidity for 72 hours, in accordance with ISO 16474-3, considering the following conditions:
 - method A, cycle 1 of ISO 16474-3 alternating periods of 4 h of exposure to UVA-340 lamps $(60 \pm 3)^\circ\text{C}$ and 4 h of exposure to condensation at $(50 \pm 3)^\circ\text{C}$.
- b) neutral salt spray exposure for 72 h, in accordance with ISO 9227.
- c) 24 h of exposure to the temperature of $(-20 \pm 2)^\circ\text{C}$.

5.2.2.8.1 In the test described in item 5.2.2.8, the surface preparation of the panels must be done according to the Sa 2½ standard of ISO 8501-1.

5.2.2.8.2 The test shall start with the UVA exposure stage and end with the condensation stage.

5.2.2.8.3 Between the salt spray stage and the low temperature chamber, rinse the test panels with deionized water without drying them.

5.2.2.8.4 At the beginning of the period of exposure to low temperature, the test panels must reach a temperature of $(-20 \pm 2)^\circ\text{C}$ within 30 min.

5.2.2.8.5 In the Cathodic Disbonding Test, to be carried out in accordance with ASTM G8 (Method B), the test panels must be subjected to a range of electrochemical potential between -1.45 V and -1.55 V, measured in relation to a Cu / CuSO₄ reference electrode, using a printed current system or a magnesium galvanic sacrifice anode. The test panel and the sacrificial anode must be immersed in an electrolyte with a temperature in the 21 °C to 25 °C and with the following chemical composition: 1% sodium chloride +1% sodium sulfate +1% sodium carbonate. A hole of 6.35 mm in diameter and depth equivalent to the thickness of the coating must be made in the center of the test panel. The test duration must be 30 d.

5.2.2.8.6 The notch in the coating aims to enable the evaluation of data such as: the propagation of corrosion, formation of bubbles and cracking resulting from the failure in the coating. In addition, it provides a means for assessing the corrosion protection capacity of the coating system submitted to the test.

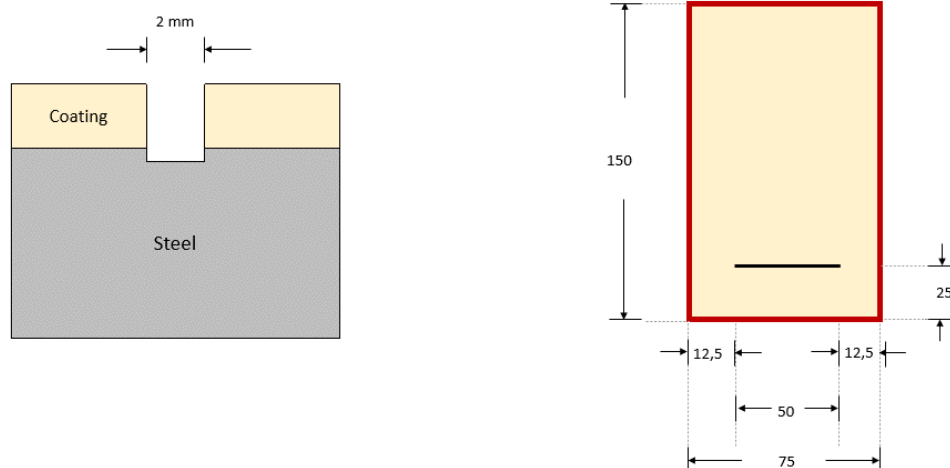


Figure A.1 – Test Panel with Notch



Figure A.2 – Example of Cutting Tool

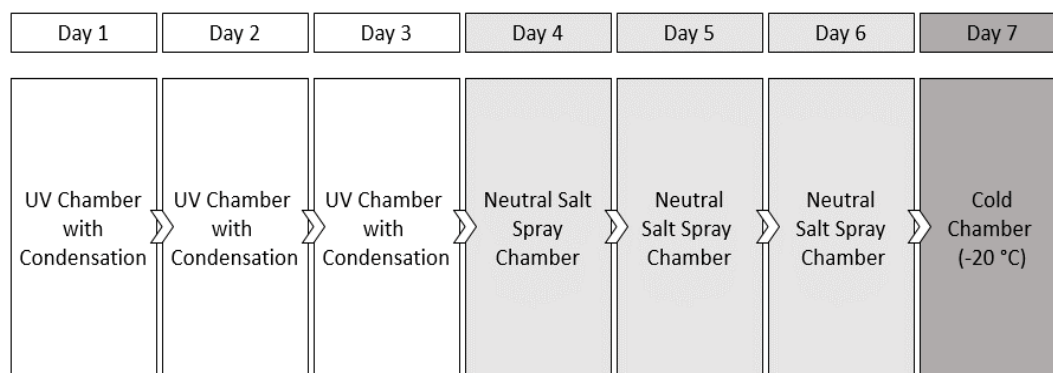


Figure A.3 – Chambers Sequence for the Ageing Cycle

REV. A

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