

## Technical Requirements for Paintwork

### Procedure

This Standard replaces and cancels its previous revision.

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 sections, subsections and enumerates 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 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 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 section, subsection and enumerate to be revised, the proposed text, and technical/economic justification for revision. The proposals are evaluated during the work for alteration of this Standard.

***"This Standard is exclusive property of Petróleo Brasileiro S. A. - PETROBRAS, internal application and PETROBRAS Subsidiaries and shall be used by its suppliers of goods and services under contracts or similar under the conditions established in Bidding, Contract, Agreement or similar.***

***The use of this Standard by other companies / organizations / government agencies and individuals is the sole responsibility of the users.."***

### CONTEC

Comissão de Normalização  
Técnica

### SC - 14

Painting and Anticorrosive  
Coatings

### Introduction

PETROBRAS Technical Standards are prepared by Working Groups - WG (consisting specialized of Technical Collaborators from Company and its Subsidiaries), are commented by Company Units and its Subsidiaries, are approved by the Authoring Subcommittees - SCs (consisting of technicians from the same specialty, representing the various Company Units and its Subsidiaries), and ratified by the Executive Nucleus (consisting of representatives of the Company Units and its Subsidiaries). A PETROBRAS Technical Standard is subject to revision at any time by its Authoring Subcommittee and shall be reviewed every 5 years to be revalidated, revised or cancelled. PETROBRAS Technical Standards are prepared in accordance with PETROBRAS Technical Standard [N-1](#). For complete information about PETROBRAS Technical Standards see PETROBRAS Technical Standards Catalog.

**Summary**

|                                                                                                     |    |
|-----------------------------------------------------------------------------------------------------|----|
| Foreword.....                                                                                       | 4  |
| 1 Scope.....                                                                                        | 4  |
| 2 Normative References.....                                                                         | 4  |
| 3 Terms and Definitions.....                                                                        | 6  |
| 4 General Conditions.....                                                                           | 6  |
| 4.1 Training Plan of the Work Force .....                                                           | 6  |
| 4.2 Paint Application Procedure of Executing Agent .....                                            | 7  |
| 4.3 Inspection Procedure .....                                                                      | 8  |
| 4.4 Plan for Calibration Instruments.....                                                           | 8  |
| 4.5 Storage.....                                                                                    | 8  |
| 4.6 Shelf Life and Paint Revalidation Criteria .....                                                | 8  |
| 4.7 Surface Preparation .....                                                                       | 9  |
| 4.8 Mixing, Homogenization and Dilution of Paints.....                                              | 9  |
| 4.9 Paint Application.....                                                                          | 10 |
| 5 Specific Conditions .....                                                                         | 13 |
| 5.1 Paints .....                                                                                    | 13 |
| 5.1.1 Zinc-Rich Paints (PETROBRAS N-1277, N-1661, N-1841 and N-2231).....                           | 13 |
| 5.1.2 Solvent-Free Epoxy Finish Paint (PETROBRAS N-2629, N-2680 and N-2912, Types II and III) ..... | 14 |
| 5.2 Application Process.....                                                                        | 14 |
| 5.2.1 Air Less Gun .....                                                                            | 14 |
| 5.2.2 Conventional Gun .....                                                                        | 15 |
| 5.2.3 Brush.....                                                                                    | 15 |
| 5.2.4 Electrostatic Gun.....                                                                        | 16 |
| 5.2.5 Roller.....                                                                                   | 16 |
| 6 Inspection .....                                                                                  | 16 |
| 6.1 Receipt of Paints and Thinners .....                                                            | 16 |
| 6.2 Surface Preparation .....                                                                       | 17 |
| 6.3 Roughness Profile .....                                                                         | 17 |



|                                                         |    |
|---------------------------------------------------------|----|
| 6.4 Relative Humidity and Temperature.....              | 17 |
| 6.5 Film.....                                           | 17 |
| 6.6 Wet Film Thickness (WFT).....                       | 18 |
| 6.7 Dry Film Thickness (DFT) .....                      | 18 |
| 6.8 Holidays.....                                       | 18 |
| 6.9 Adhesion (Pull-Off Test).....                       | 19 |
| 6.9.1 General Criteria.....                             | 19 |
| 6.9.2 Description of Tests .....                        | 19 |
| 7 Acceptance and Rejection Criteria .....               | 20 |
| 7.1 Recept of Paints and Thinners.....                  | 20 |
| 7.2 Surface Preparation .....                           | 20 |
| 7.3 Relative Humidity and Temperature.....              | 20 |
| 7.4 Film.....                                           | 20 |
| 7.5 Adhesion (Pull off Test).....                       | 20 |
| 7.6 Wet Film Thickness (WFT).....                       | 21 |
| 7.7 Dry Film Thickness (DFT) .....                      | 21 |
| 7.8 Holidays.....                                       | 22 |
| 8 Safety/Collection, Storage and Disposal of Waste..... | 22 |
| Annex A - Table .....                                   | 23 |

## Figure

|                                            |    |
|--------------------------------------------|----|
| Figure 1 - Types of Adhesion Failure ..... | 21 |
|--------------------------------------------|----|

## Tables

|                                                         |    |
|---------------------------------------------------------|----|
| Table 1 - Training Plan of the Work Force .....         | 6  |
| Table A.1 - Acceptance Criteria for Pull-Off Test ..... | 23 |

## Foreword

This Standard is the English version (issued in 12/2016) of PETROBRAS N-13 REV. L 03/2016. In case of doubt, the Portuguese version, which is the valid document for all intents and purposes, shall be used.

## 1 Scope

1.1 This Standard settles the conditions required for application and quality control of paint systems for industrial equipment (see PETROBRAS [N-2](#)), piping and pipeline systems (see PETROBRAS [N-442](#) and [N-2843](#)), painting of galvanized surfaces, ferrous and nonferrous alloys, composite and polymeric materials (see PETROBRAS [N-1021](#)), offshore exploration and production units (see PETROBRAS [N-1374](#)) steel structures (see PETROBRAS [N-1550](#)), ships (see PETROBRAS [N-1192](#)), machinery, electrical equipment, and instruments (see PETROBRAS [N-1735](#)), painting of equipment submerged in seawater (see PETROBRAS [N-2037](#)), terrestrial probe painting (see PETROBRAS [N-2104](#)), galvanized tower (see PETROBRAS [N-2441](#)), powder coatings (see PETROBRAS [N-2841](#)) and tanks, spheres and cylinders (see PETROBRAS [N-2913](#)).

1.2 This Standard also covers conditions for storage and receiving of paints, thinners and safety requirements.

1.3 It is forbidden the use of chromate, sulfates and molybdates based pigments, as well as, the sulfochromate lead and any other substances containing lead and chromate (chromium VI).

1.4 This Standard is to be applied to procedures started from its issue date.

1.5 This Standard contains Technical Requirements and Recommended Practices.

## 2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies.

PETROBRAS [N-2](#) - Revestimento Anticorrosivo de Equipamento Industrial;

PETROBRAS [N-9](#) - Tratamento de Superfícies de Aço com Jato Abrasivo e Hidrojateamento;

PETROBRAS [N-442](#) - Pintura Externa de Tubulação em Instalações Terrestres;

PETROBRAS [N-1021](#) - Pintura de Superfícies Galvanizadas, Ligas Ferrosas e não Ferrosas, Materiais Compósitos e Poliméricos;

PETROBRAS [N-1192](#) - Pintura de Embarcações;

PETROBRAS [N-1277](#) - Tinta de Fundo Epóxi-Zinco Poliamida;

PETROBRAS [N-1374](#) - Revestimentos Anticorrosivos para Unidades Marítimas de Exploração e de Produção;

PETROBRAS [N-1550](#) - Pintura de Estrutura Metálica;

PETROBRAS [N-1661](#) - Tinta de Zinco Etil-Silicato;

PETROBRAS [N-1735](#) - Pintura de Máquinas, Equipamentos Elétricos e Instrumentos;

- PETROBRAS [N-1841](#) - "Shop Primer" de Zinco Etil-Silicato;
- PETROBRAS [N-2037](#) - Pintura de Equipamentos Submersos em Água do Mar;
- PETROBRAS [N-2104](#) - Pintura de Sonda Terrestre;
- PETROBRAS [N-2231](#) - Tinta de Etil - Silicato de Zinco - Alumínio;
- PETROBRAS [N-2288](#) - Tinta de Fundo Epóxi Pigmentada com Alumínio;
- PETROBRAS [N-2441](#) - Pintura para Torre Galvanizada;
- PETROBRAS [N-2628](#) - Tinta Epóxi Poliamida de Alta Espessura;
- PETROBRAS [N-2629](#) - Tinta de Acabamento Epóxi sem Solvente;
- PETROBRAS [N-2630](#) - Tinta Epóxi - Fosfato de Zinco de Alta Espessura;
- PETROBRAS [N-2677](#) - Tinta de Poliuretano Acrílico;
- PETROBRAS [N-2680](#) - Tinta Epóxi, sem Solventes, Tolerante a Superfícies Molhadas;
- PETROBRAS [N-2841](#) - Qualificação e Aplicação de Revestimentos Anticorrosivos, à Base de Tintas em Pó;
- PETROBRAS [N-2843](#) - Revestimento Interno de Tubos;
- PETROBRAS [N-2912](#) - Tinta Epóxi "Novolac";
- PETROBRAS [N-2913](#) - Revestimentos Anticorrosivos para Tanque, Esfera e Cilindro de Armazenamento;
- ABNT [NBR 10443](#) - Tintas e Vernizes - Determinação da Espessura da Película Seca sobre Superfícies Rugosas;
- ABNT [NBR 15156](#) - Pintura Industrial;
- ABNT [NBR 15218](#) - Critérios para Qualificação e Certificação de Inspetores de Pintura Industrial;
- ABNT [NBR 15442](#) - Pintura Industrial - Inspeção de Recebimento de Recipientes Fechados;
- ABNT [NBR 15488](#) - Pintura Industrial - Superfície Metálica para Aplicação de Tinta - Determinação do Perfil de Rugosidade;
- ABNT [NBR 15877:2010](#) - Pintura Industrial - Ensaio de Aderência por Tração;
- ABNT [NBR 16172](#) - Revestimentos Anticorrosivos - Determinação de Descontinuidades em Revestimentos Anticorrosivos Aplicados sobre Substratos Metálicos;
- ISO [8501-1](#) - Preparation of Steel Substrates before Application of Paints and Related Products - Visual Assessment of Surface Cleanliness - Part 1: Rust Grades and Preparation Grades of Uncoated Steel Substrates and of Steel Substrates after Overall Removal of Previous Coatings;
- ASTM [D4541:2009](#) - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers;
- SSPC-VIS 4/[NACE VIS 7](#) - Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting.
- NACE [WJ-1/SSPC-SP WJ 1](#) - Waterjet Cleaning of Metals-Clean to Bare Substrate (W-1)

NACE [WJ-2/SSPC-SP WJ 2](#) - Waterjet Cleaning of Metals-Very Thorough Cleaning (WJ-2);

NACE [WJ-3/SSPC-SP WJ 3](#) - Waterjet Cleaning of Metals-Thorough Cleaning (WJ-3);

NACE [WJ-4/SSPC-SP WJ 4](#) - Waterjet Cleaning of Metals-Light Cleaning (WJ-4);

SSPC-[SP 11](#) - Power Tool Cleaning to Bare Metal.

NOTE For documents referred in this Standard and for which only the Portuguese version is available, the PETROBRAS department that uses this Standard should be consulted for any information required for the specific application.

### 3 Terms and Definitions

For the purposes of this document, the terms and definitions indicated in ABNT [NBR 15156](#) are applied.

### 4 General Conditions

#### 4.1 Training Plan of the Work Force

4.1.1 Before the start of services, the coating inspector level 2 or renowned professional in industrial painting area shall develop and implement a training plan with evaluation criteria to the entire work force involved in painting services, containing at least the topics of Table 1.

4.1.2 Other equivalent theoretical trainings are accepted replacing the theoretical part of Table 1, at the discretion of PETROBRAS, through theoretical and practical assessment.

**Table 1 - Training Plan of the Work Force**

| Course program                                                                                                         | Hours (h) |         |         |
|------------------------------------------------------------------------------------------------------------------------|-----------|---------|---------|
|                                                                                                                        | Foreman   | Blaster | Painter |
| <b>Theoretical part</b>                                                                                                |           |         |         |
| - Paint purpose;<br>- Activity and responsibility of painter;<br>- Concepts of corrosion: rust grades.                 | 2         | 2       | 2       |
| - Environmental conditions: ambient temperature, relative humidity, dew point, substrate temperature.                  | 2         | 2       | 2       |
| - Surface preparation: cleaning with solvents, manual cleaning, mechanical cleaning, abrasive blasting, water jetting. | 4         | 4       | 4       |

Table 1 - Training Plan of the Work Force (Continuation)

| Course program                                                                                                                                                                                                                                                                                                      | Hours (h) |         |         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------|---------|
|                                                                                                                                                                                                                                                                                                                     | Foreman   | Blaster | Painter |
| <b>Theoretical part</b>                                                                                                                                                                                                                                                                                             |           |         |         |
| - Types of abrasives, preparation grades of steel surfaces and roughness profile.                                                                                                                                                                                                                                   | 2         | 2       | 1       |
| - Types of paints and main characteristics, according to the service to be performed.                                                                                                                                                                                                                               | 2         | 2       | 2       |
| - Paint preparation: homogenization, dilution, shelf life, induction time, pot-life, mixing ratio.                                                                                                                                                                                                                  | 2         | 2       | 2       |
| - Paint systems: paint to be used, application methods, dry film thickness, number of coats, interval between coats.                                                                                                                                                                                                | 4         | 4       | 4       |
| - Application methods: roller, brush, conventional gun and air less gun;<br>- Good practices: stripe coat, wet film measurement, chloride content measurement at the surface.                                                                                                                                       | 4         | 4       | 4       |
| - Main failures and defects: prevention and correction.                                                                                                                                                                                                                                                             | 4         | 4       | 4       |
| - General requirements of safety, environment, energy efficiency and health (SMES, with its abbreviature in Portuguese): security services, product disposal, personal protective equipment (EPI, with its abbreviature in Portuguese), collective protection equipment (EPC, with its abbreviature in Portuguese). | 2         | 2       | 2       |
| - Execution Procedure.                                                                                                                                                                                                                                                                                              | 4         | 2       | 2       |
| <b>Practical Part</b>                                                                                                                                                                                                                                                                                               |           |         |         |
| - Rust grades of steel surfaces.                                                                                                                                                                                                                                                                                    | 1         | 1       | 1       |
| - Identification of surface preparation grades: manual, mechanical, abrasive blasting and water jetting.                                                                                                                                                                                                            | 1         | 1       | 1       |
| - Application techniques according to the service to be performed: roller, brush, conventional gun and air less gun.                                                                                                                                                                                                | 4         | 4       | 4       |
| - Good practices: stripe coat: wet film measurement, chloride content measurement at the surface.                                                                                                                                                                                                                   | 2         | 2       | 2       |

## 4.2 Paint Application Procedure of Executing Agent

4.2.1 The procedure for application of paint systems for equipment and parts to be painted shall contain, at least, the following information:

- purpose for which the procedure is intended;
- specification of paint system to be used;
- applicable standards;
- instructions for receipt and storage of paints, thinners, and related products;
- paint system execution sequence;
- paint application process;
- specification of paints to be used, including suppliers and respective commercial references;
- instructions for touchups on the paint system;
- quality control plan.

4.2.2 The entire workforce shall be trained by a coating inspector Level 1 (with proven experience of 24 months) or Level 2 on the execution procedure of painting service to be performed.

4.2.3 The periodicity of training on execution procedure of painting shall be annual or at the discretion of PETROBRAS.

### **4.3 Inspection Procedure**

The paint system inspection procedure shall contain, at least, the following information:

- a) objective;
- b) reference standards;
- c) criteria for sampling and inspections to be performed;
- d) apparatus and instruments;
- e) acceptance or rejection criteria;
- f) forms used for recording results.

### **4.4 Plan for Calibration Instruments**

4.4.1 The instruments used in the inspections should have calibration certificate issued by laboratories accredited by INMETRO.

4.4.2 It should be prepared a plan for calibration of instruments, which must contain, at least, the following information:

- a) identification of the instrument;
- b) date of calibration;
- c) number of calibration certificate;
- d) frequency of calibration;
- e) validity of calibration;
- f) date of next calibration.

### **4.5 Storage**

4.5.1 The places for storing paints, varnishes, solvents, and thinners shall be covered, well ventilated, not subject to excessive heat, protected against sparks, lightning discharges and direct sunlight. These places shall be exclusive and provided with fire-fighting systems.

4.5.2 Maximum stacking of containers shall be as follows:

- a) 20 gallons;
- b) 5 buckets;
- c) 3 drums (200 L).

4.5.3 Warehouse storage shall be undertaken based on a first in, first out (FIFO) system and items shall be handled in such a manner as to prevent damages.

### **4.6 Shelf Life and Paint Revalidation Criteria**

4.6.1 Paints with an expired shelf life and which have not been revalidated shall not be used.

4.6.2 Revalidated paints must not be used for painting interior surfaces, as well as the exterior surfaces subject to high temperatures (above 80 °C) or condensation and paintwork on surfaces operating immersed (interior and exterior paintwork).

4.6.3 For painting surfaces not falling into the cases specified in 4.6.2, paints may be revalidated twice, if it is previously authorized in writing by PETROBRAS. The revalidation is the responsibility of the paint manufacturer, which must emit a new certificate of analysis specific for revalidation, containing as a minimum the following information:

- a) identification of lot;
- b) date of fabrication;
- c) original data of validity;
- d) date and validity of the first revalidation;
- e) date and validity of the second revalidation;
- f) identification of the professional responsible for revalidation.

## **4.7 Surface Preparation**

4.7.1 Surfaces shall be prepared according to PETROBRAS [N-9](#), and [SSPC-SP11](#).

4.7.2 The degrees of cleanliness of metal surfaces are those specified in the PETROBRAS Standards. Specific degrees are assigned to each paint system.

4.7.3 Machined surfaces of flanges and connections shall be protected from abrasive blasting by means of a wooden cover or a plastic sheet.

4.7.4 Blasting near the newly painted surface shall only be performed when the paint film is dry to touch, so that there is no possibility of impregnation of abrasive.

4.7.5 The abrasives to be used shall be approved according to PETROBRAS [N-9](#).

## **4.8 Mixing, Homogenization and Dilution of Paints**

4.8.1 Every paint shall be homogenized before and during application so as to keep the pigment suspended. Paints comprised of 2 or more components, they shall be separately homogenized before mixing. After mixing, no streaks or strips of different colors shall be observed and the appearance shall be uniform.

4.8.2 Homogenization shall occur in the original container, and the paint shall not be removed from it before all the settled pigment has been incorporated into the vehicle. However, part of the paint not sedimented may be temporarily removed to facilitate the homogenizing process. If difficulties arise in the dispersion of the settled pigment, the paint shall not be used. **[Recommended Practice]**