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Partie n° 4 : Qualité et acceptation des travaux de mise en oeuvre

ENGLISH TITLE: Paint systems for military ships

Part no. 4: Quality and acceptance of paint works

ANALYSIS:

This document defines the general and specific requirements for controlling the execution and acceptance of painting work for military ships, both new build and during maintenance.

It describes the principles and requirements relating to the control of the quality of work and the associated inspections for the application of paints.

KEY WORDS:

Paint systems – Ship - Surface ship –Submarine – Location – Execution work – Acceptance – Inspection

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Issue	Date	Nature of the change
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FOREWORD

A ship is made up of a juxtaposition of areas with structures of varying levels of complexity and specific uses or functions called “locations”. These locations are on the inside or outside of the ship and all their surfaces are subject to severe environments with various levels of atmospheric or immersion corrosiveness, as referred to in NF EN ISO 12 944-2.

All these surfaces are coated with paint systems which have a **twofold purpose**:

- **corrosion control**,
- **specific function** (visual stealth, ergonomics, anti-fouling, non-slip, anti-static, food, aesthetic, etc.).

Extensive maintenance is carried out on these protective coatings and where necessary they are completely repainted after a period of 15 years, corresponding approximately to half a ship’s lifetime. In the meantime, these protective coatings require routine maintenance in order to touch up areas which have suffered accidental deterioration of a mechanical, thermal or other nature. This keeps the specific function associated with the relevant location up to standard. It is carried out at frequencies considerably higher than those corresponding to the expected durability of the corrosion protection function (> 15 years).

The corrosion protection durability required for the paint systems as a whole for the protection of the various locations of a military ship is **High Durability**, as defined in the NF EN ISO 12 944-1 standard.

In addition to corrosion control for operational and cost targets, high durability is also crucial in limiting the frequency of health and safety, VOC and environmental risks and the production of waste resulting from maintenance over the lifetime of a ship.

The expected in-service performance of the protection afforded by a paint system will depend on two essential factors, which are:

- the appropriate selection of a paint system that is fit for purpose, this selection is covered by the first three parts of NORMDEF 0002:
  - Part no. 1 – General requirements for new build,
  - Part no. 2 – Performance requirements for the locations of newly built ships,
  - Part no. 3 – Requirements and qualification of paint systems for maintenance.
- the control of application work. This application phase is covered by the last part of NORMDEF 0002:
  - Part no. 4 – Quality and acceptance of application work.

The application of paint comes within those procedures known as "special" for which inspection of the final product cannot guarantee the expected performance.

That is why it is essential that the work is done and supervised by qualified personnel within the framework of a quality process comprising the different stages associated with the inspections. That is the subject of this document.

CONTENTS

1. PURPOSE

a) This "Defence" standard describes the **principles and requirements related to the control of the quality of painting work and the associated inspections for the protective systems applied on ships of the French Navy**.

b) ***Annexe I*** sets out the minimum requirements in terms of inspection and acceptance of paint protection systems for the different locations of the ship.

c) ***Annexe II*** specifies the expected surface preparation criteria before starting to paint the different locations of the ship.

2. SCOPE

a) This document concerns both new build work and that done during maintenance.

b) The requirements set by this document cover the ship's critical locations as defined in NORMDEF 0002-1. They remain applicable for all of the ship's locations.

c) The requirements set by this document should be integrated into the Quality Assurance Plan (QAP) drawn up by the Industrial Prime Contractor (IPC) and/or any contractors.

3. REFERENCES TO STANDARDS

The standards referred to below are those that should be taken into account when applying this document. The texts of these references have been identified by critical choices as being the most appropriate for the application of this standard.

. NORMDEF 0001 "National defence colours".

. NORMDEF 0002-1 "Paint systems for military ships – Part 1: General requirements for new build"

. NORMDEF 0002-2 "Paint systems for military ships – Part 2: Performance requirements for locations on newly built ships"

. NORMDEF 0002-3 "Paint systems for military ships – Part 3: Paint systems for maintenance – requirements and qualification"

. Fascicule n° 56: Public works contracts - General technical specifications – "Protection of metal works against corrosion" (NOR decree: ECOM0400013A of the 12th February 2004)

. NATO / AEP 59: "Application process for optimum paint and coatings systems' performance"

. NF C 26-215 "Test methods for insulating materials. Methods for measuring the transverse resistivity and surface resistivity of solid electrically insulating materials"

. NF P 62-001 "Resilient floor coverings. Electrostatic behaviour Classification"

. NF T 30-124 "Paints and varnishes. Measuring the dry film thickness. Non-destructive magnetic flow method"

. NF T 34-554-2 "Paints and varnishes. Corrosion protection paint systems – Permanency over time and colorimetric properties Part 2: Determination of works in service"

. NF T 35-506 "Paints and varnishes. Zinc rich workshop primer paints Definition of the degrees of secondary surface preparation"

. NF T 35-520 "Paints and varnishes. Surface preparation of already coated steel. Cleaning with high pressure water"

. NF T 36-005 "Paints and varnishes. Classification of paints, varnishes and related products"

. NF X 08-002 "Limited collection of colours. Designation and catalogue of CCR colours Secondary standards"

. NF EN ISO 2813 "Paints and varnishes. Determination of specular gloss of non-metallic paint films at 20 degrees, 60 degrees and 85 degrees"

. NF EN ISO 4618 "Paints and varnishes. Terms and definitions"

. NF EN ISO 4628 "Paints and varnishes. Evaluation of the degradation of coatings. Designation of quantity and size of defects and of intensity of uniform changes in appearance"

. NF EN ISO 7724 "Paints and varnishes. Colorimetry"

. NF EN ISO 8501 "Preparation of steel substrates before the application of paints and derived products" Visual assessment of surface cleanliness"

. NF EN ISO 8502 "Preparation of steel substrates before the application of paints and derived products" Tests to assess the cleanness of a surface"

. NF EN ISO 8503 "Preparation of steel substrates before the application of paints and derived products" Surface roughness characteristics of blast-cleaned steel substrates"

. NF EN ISO 12944 "Paints and varnishes. Corrosion protection of steel structures by protective paint systems"

- Part 7 – Execution and supervision of paint work

- Part 8 – Development of specifications for new work and maintenance

. ASTM D 4752 "Standard Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub"

. IRCN 3.3 06/95 "Preparation standard for sheet steel before application of paints"

. STANAG 1278 "Standard for the Required Level and Measurement of the Coefficient of Friction on Flight Decks"

4. TERMINOLOGY, SYMBOLS AND ABBREVIATIONS

The definitions and abbreviations specific to the technical field of paint are given by the NF EN ISO 4618 and NF T 36-005 standards.

ACQPA: Association for the Certification and Qualification of Corrosion Protection Paint

AEP: Allied Engineering Publication

CA: Contracting Authority

IMC: Industrial Main Contractor

NATO: North Atlantic Treaty Organization

NBC: Nuclear, Radiological and Chemical

EPST: Extreme Pressure Steam Turbine

The definitions below apply to this document.

Quality Assurance Plan (QAP) in accordance with fascicule n° 56: the QAP concerning the protection of metal works against corrosion includes:

- general organisation provisions and documents,
- execution provisions resulting in the drawing up of documents prior to this execution,
- execution monitoring provisions resulting in the creation of monitoring documents that are kept available.

Paint work: all the operations, from the making available of the surfaces to the acceptance of the latter by the Contracting Authority (CA). This includes, in particular, the acceptance of the surfaces to be protected, the surface preparation, the supply, storage and application of the products, along with the supervision. All of these stages are the subject of descriptions in the NF EN ISO and AEP 59 series of standards.

Inspections – external inspection – internal inspection (internal and external), in accordance with fascicule n° 56:

- the **external inspection** is performed by:
  - on the one hand, the industrial main contractor,
  - and, on the other, the contracting authority.
- the **internal inspection** is the company's responsibility. We distinguish two levels:
  - the **internal inspection** performed by the painters themselves, whatever their rank or their line management,
  - the **external inspection** performed by an ad hoc body that may or may not belong to the company and has no responsibility for the execution.

5. REQUIREMENTS FOR PAINT WORK

5.1 Quality assurance plan

The industrial main contractor must draw up a quality assurance plan (QAP) specific to the operation and submit it to the contracting authority for approval.

This QAP includes:

- general organisation provisions and documents,
- execution provisions resulting in the drawing up of documents prior to that execution,
- execution monitoring provisions resulting in the creation of monitoring documents that are kept available.

The provisions of the general organisation documents deal with the points defined below:

- identification of the parties concerned: contracting authority, industrial main contractor, contract holder company, subcontractors and main suppliers,
- organisation diagram and management responsible for the operation, with indication of its qualification and professional references,
- designation of a person responsible for each inspection task,

– principles and organisational conditions of the inspection with definition of halt points.

The execution provisions and documents (procedures, operating methods, instructions, etc.) include, mainly:

– the list of the resources used (products, personnel and equipment),
– the description of the methods and operating modes for executing the work,
– the list and methods of the inspection and checking operations to be performed.

These provisions and documents should be produced before any work.

The execution monitoring provisions and documents (certificates, reports, acceptance files, results of measurements and tests, forms/readings/monitoring log, etc.) are documents that physically record the inspections and checks performed or provide proof of the qualifications and certificates relating to the resources used.

They should be kept available for the contracting authority but are not the subject of systematic circulation except for the documents about the halt points and the reference surfaces.

The models of execution monitoring documents are submitted to the contracting authority before the corresponding execution phases. These models, which are the company's responsibility, should include the headings as indicated in AEP 59 and the NF EN ISO 12944-8 standard.

5.2 Specific requirements to be introduced in the QAP

a) The description of the paint system to be applied is given according to the model document indicated in NORMDEF 0002-1 (sequence sheets [G] and instructions for use [C]). Furthermore, as demanded in parts 1, 2 and 3 of NORMDEF 0002, these systems are certified by a third party.

b) The minimum qualification levels of operators and inspectors are specified in the table below:

Type of player	Certification and level required
Responsible for the execution of protection work (team or site leader) Responsible for internal inspection	ACQPA - Operator L2* or equivalent
Painters (SP - Surface Preparation / PA – Paint Application)	ACQPA - Operator N1 or N2 (SP / PA)* or equivalent
Responsible for external inspection	ACQPA / FROSIO* inspector or equivalent
Responsible for exterior inspection	ACQPA / FROSIO* inspector or equivalent

* See the ACQPA site www.acqpa.com for the definitions

c) In the case of a complete or significant repainting of a critical location of the ship (see the list of locations in annexe I of NORMDEF 0002-1), a reference surface complying with the NF EN ISO 12944-7 standard is made. It corresponds to an area representative of the location to be treated and is created in the presence of the parties (at least in the presence of representatives of the painting company, the paint manufacturer and the industrial main contractor). This surface is used to:

– set a minimum acceptable level for the execution of the work,
– check that those carrying out the work have a good understanding of the specification to be respected,
– check the accuracy of the data provided by a manufacturer or painting company,
– assess the performances of paint systems once the work has been done,

– serve as an item for expert appraisal, if need be.

Any reference surface should be the subject of specific document (see **NF EN ISO 12944-8**) that is sent to the contracting authority.

d) In the case of the inspection plan, a minimum of two halt points are necessary: the first at the end of the surface preparation and immediately before starting to paint and the second after the complete application of the paint system. An additional halt point is added for the under works and the decks between the application of the corrosion protection system and the anti-fouling or non-slip system (see ***point 2 of annexe I)***.

e) ***Annexe I*** sets out the minimum requirements in terms of inspection and acceptance of paint protection systems for the different locations of the ship.

f) The compliance requirements are generally given in the ships' own specifications combined with those mentioned in the sequence sheets. If there is no indication concerning the state of surfaces before painting (preparation of steel sheets, surface preparation, roughness, level of cleanliness, etc.), the criteria to use are those found in ***annexe II***.

ANNEXE I - *(NORMATIVE)*

MINIMUM REQUIREMENTS IN TERMS OF INSPECTION AND ACCEPTANCE OF PAINT PROTECTION SYSTEMS FOR THE DIFFERENT LOCATIONS OF THE SHIP

1 – REQUIREMENTS COMMON TO ALL OF THE SHIP'S LOCATIONS

Two halt points are created for the paint protection system of all of the ship's locations:

① - After completion of the substrate preparation phase and just before application of the first coat of the paint system,

② - After application of the paint system and its complete drying.

The minimum inspections are the following:

Nature of the operation	Type of inspection	Conformity	Standard reference
Halt point 1: Preparation of the substrate *(these inspections are performed just before application of the first coat of the paint system).*	Level of preparation of the sheet steel	Conforms to the specification	IRCN 3.3 06/95 or NF EN ISO 8501-3
	Level of visual cleanliness of the substrate	Conforms to the specification	NF EN ISO 8501-1 or -2 or NF T 35-506 or NF T 35-520
	Dust (intensity and size)	< 2	NF EN ISO 8502-3
	Soluble salts (≡ Chlorides)	Conforms to the specification	NF EN ISO 8502-6/-9
	Ferrous oxides	Conforms to the specification	(1)
	Oils and grease	None	(1)
	Roughness	Conforms to the specification	NF EN ISO 8503 series
	Temperature/humidity	Conforms to the manufacturer's technical data sheet	NF EN ISO 8502-4
	Probability of condensation	Temp. of substrate ≥ dew point +3°C,	NF EN ISO 8502-4
Halt point 2: After application of the complete paint system	Paint defects (Runs and over-thickness, Mottling, Differences in gloss and colour, Over spray, Egg-shell finish, Fish eye, Amine separation, After-tack, Lifting, Curling, Pin hole, Lack, Porosity, Bleeding, etc.)	No visually perceptible defect	NF EN ISO 4628, NF EN ISO 4618
	Dry thickness measurement	Conforms to the	NF T 30-124

		specification	level A

(1) – Not defined at present

2 – ADDITIONAL REQUIREMENTS SPECIFIC TO CERTAIN LOCATIONS

The additional halt points for certain locations are described in the table below:

Location	Type of the requirement and inspections	Conformity	Standard reference
Under works – *Additional halt point between the application of the corrosion protection system and that of the anti-fouling system*	Measurement of the dry thickness of the corrosion protection system	Conforms to the specification	NF T 30-124 level A
	Determination of the dry thickness of the anti-fouling system: Th. AF = Total Th. – Th. CP	Conforms to the specification	NF T 30-124 level A
	Roughness of the anti-fouling system	≤ 150 µm	Measured using the BSRA apparatus
Upper works and superstructures – *Additional inspections at halt point 2 (see §1 – annexe I)*	Colour measurement: - Global deviation / reference standard A625 - Uniformity of colour between 2 surfaces belonging to a global visual perception area of the structure (NF T 34-554-2)	 ΔE* < 2 ΔE* < 2	NF EN ISO 7724 series
	Specular gloss measurement: - Level of specular gloss - Uniformity of specular gloss between 2 surfaces belonging to a global visual perception area of the structure (NF T 34-554-2)	 45 < SG ≤ 70 ± 7	NF EN ISO 2813
Conventional deck – *Additional halt point between the application of the corrosion protection system and that of the nonslip system*	Measurement of the dry thickness of the corrosion protection system	Conforms to the specification	NF T 30-124 level A
	Nonslip property	Visually uniform	
RAS area deck – *Additional halt point between the application of the corrosion protection system and that of the nonslip system*	Measurement of the dry thickness of the corrosion protection system	Conforms to the specification	NF T 30-124 level A
	Nonslip property	Visually uniform	
	Friction coefficient: - Dry - Wet	 > 0,90 > 0,80	STANAG 1278
Flight deck – *Additional halt point between the application of the corrosion protection system and that of the*	Measurement of the dry thickness of the corrosion protection system	Conforms to the specification	NF T 30-124 level A
	Nonslip property	Visually uniform	

nonslip system	Friction coefficient: - Dry - Wet	 > 0,90 > 0,80	STANAG 1278
Ammunition area – *Additional inspections at halt point 2 (see §1 – annexe I)*	Walker test	< 1 kV	NF P 62-001

Location	Type of the requirement and inspections	Conformity	Standard reference
Batteries room – *Additional inspections at halt point 2 (see §1 – annexe I)*	Surface resistivity	$10^6 – 10^8$ Ω . square mesh	NF C 26-215
	Walker test	< 1 kV	NF P 62-001
NBC rooms (liquid danger and steam danger areas) – *Additional inspections at halt point 2 (see §1 – annexe I)*	Colour measurement: - Global deviation / reference standards A110 and A330 - Uniformity of colour between 2 surfaces belonging to a global visual perception area of the structure (NF T 34-554-2)	 ΔE* < 4 ΔE* < 8 ΔE* < 2	NF EN ISO 7724 series
	Specular gloss measurement: - Level of specular gloss - Uniformity of specular gloss between 2 surfaces belonging to a global visual perception area of the structure (NF T 34-554-2)	 > 70 ± 5	NF EN ISO 2813
	Cross-linking	No defect (change of appearance, curling, after-tack)	ASTM D 4752

ANNEXE II - *(NORMATIVE)*

SURFACE PREPARATION CRITERIA BEFORE PAINTING FOR THE DIFFERENT LOCATIONS OF THE SHIP

		PREPARATION of the SUBSTRATE in NEW BUILD					***MAINTENANCE of the PAINT SYSTEM***			
Location	**Critical nature of the location [1]**	**Sheet metal preparation** **IRCN 3.3 - 06/95** **NF EN ISO 8501-3**	**Primer surface preparation** **NF EN ISO 8501-1**	**Secondary surface preparation** **NF EN ISO 8501-1 or** **NF T 35-506**	**Roughness** **NF EN ISO 8503**	**Contamination with soluble salts [2]** **NF EN ISO 8502**	**Complete repainting** **NF EN ISO 8501-1** **NF T 35-520**	**Contamination with soluble salts [3]** **NF EN ISO 8502**	**Local repainting** **NF EN ISO 8501-2** **NF T 35-520**	**Application of finishing coat**
Under works	C	PT 2	A Sa 2½	A Sa 2½	MG	5 µg/cm²	Sa 2½ or DHP4 ≤ OF1 ([Fe 2+] ≤ 1g/m²)	5 µg/cm²	P Sa 2½ or DHP4 ≤ OF1 (on spot) P St3 or PMa	Wash with fresh water 140 bars
Upper works and Superstructures	C	PT 2	A Sa 2½	PS 4	MG	7 µg/cm²	Sa 2½ or DHP4 ≤ OF1 ([Fe 2+] ≤ 1g/m²)	7 µg/cm²	P Sa 2½ or DHP4 ≤ OF1 (on spot) P St3 or PMa	Wash with fresh water 250 bars or washing for repainting
External decks	C	PT 2	A Sa 2½	A Sa 2½	MG	5 µg/cm²	Sa 2½ or DHP4 ≤ OF1 ([Fe 2+] ≤ 1g/m²)	5 µg/cm²	P Sa 2½ or DHP4 ≤ OF1 (on spot) P St3 or PMa	Wash with fresh water 250 bars or washing for repainting
RAS, personnel safety and work areas	C	PT 2	A Sa 2½	A Sa 2½	MG	5 µg/cm²	Sa 2½ or DHP4 ≤ OF1 ([Fe 2+] ≤ 1g/m²)	5 µg/cm²	P Sa 2½ or DHP4 ≤ OF1 (on spot) P St3 or PMa	Not applicable
Landing areas *(steel)*	C	PT 2	A Sa 2½	A Sa 2½	MG	5 µg/cm²	Sa 2½ or DHP4 ≤ OF1 ([Fe 2+] ≤ 1g/m²)	5 µg/cm²	P Sa 2½ or DHP4 ≤ OF1 (on spot) P St3 or PMa	Not applicable
Nuclear quality water tank and neutron pools	C	PT 4	A Sa 2½	A Sa 2½	MG/GG	3 µg/cm²	Sa 2½	3 µg/cm²	P Sa 2½	Not applicable
Miscellaneous tanks [4]	C	PT 3	A Sa 2½	A Sa 2½	MG	3 µg/cm²	Sa 2½	3 µg/cm²	P Sa 2½	Not applicable

		PREPARATION of the SUBSTRATE in NEW BUILD					MAINTENANCE of the PAINT SYSTEM			
Location	**Critical nature of the location [1]**	**Sheet metal preparation IRCN 3.3 - 06/95 NF EN ISO 8501-3**	**Primer surface preparation NF EN ISO 8501-1**	**Secondary surface preparation NF EN ISO 8501-1 or NF T 35-506**	**Roughness NF EN ISO 8503**	**Contamination with soluble salts [2] NF EN ISO 8502**	**Complete repainting NF EN ISO 8501-1 NF T 35-520**	**Contamination with soluble salts [3] NF EN ISO 8502**	**Local repainting NF EN ISO 8501-2 NF T 35-520**	**Application of finishing coat**
Sea water tanks [5]	C	PT 3	A Sa 2½	PS 4	MG	5 µg/cm²	Sa 2½	5 µg/cm²	P Sa 2½	Not applicable
Oil tanks	-	PT 1	A Sa 2½	PS 1	MG	-	Not applicable	Not applicable	Not applicable	Not applicable
Open mesh	C	PT 2	A Sa 2½	PS 4	MG	7 µg/cm²	Sa 2½	7 µg/cm²	P Sa 2½ P St 3 or PMa	Not applicable
Hidden surfaces	NC	PT 2	A Sa 2½	PS 3	MG	15 µg/cm²	Not applicable	Not applicable	P St3 or PMa	Not applicable
Bottoms	C	PT 3	A Sa 2½	PS 4	MG	5 µg/cm²	Sa 2½	5 µg/cm²	P Sa 2½ P St 3 or PMa	Degreasing sanding
internal decks	NC	PT 2	A Sa 2½	PS 2	MG	10 µg/cm²	Sa 2½ St 3	10 µg/cm²	P St 3 or PMa	Degreasing washing
Ammunition preparation area	C	PT2	A Sa 2½	PS 3	MG	10 µg/cm²	Sa 2½	10 µg/cm²	P Sa 2½ P St 3 or PMa	Not applicable
Dry rooms with specific shade: **- operations rooms** **- living quarters**	NC	PT 1 PT 1	A Sa 2½ A Sa 2½	PS 2 PS 2	MG MG	15 µg/cm² 15 µg/cm²	St 3 St 3	- -	P St 3 or PMa P St 3 or PMa	Degreasing washing Degreasing washing
Dry rooms without specific shade requirement	NC	PT 2	A Sa 2½	PS 3	MG	15 µg/cm²	St 3	-	P St 3 or PMa	Degreasing washing
Wet rooms (without specific shade requirement)	NC	PT 2	A Sa 2½	PS 3	MG	10 µg/cm²	St 3	-	P St 3 or PMa	Degreasing washing
NBC decontamination room	C	PT 3	A Sa 2½	A Sa 2½	MG	3 µg/cm²	Sa 2½	3 µg/cm²	P Sa 2½ P St 3 or PMa	Degreasing sanding
Reactor Exchanger Compartment	C	PT 3	A Sa 2½	A Sa 2½	MG	3 µg/cm²	Sa 2½	3 µg/cm²	P Sa 2½ P St 3 or PMa	Degreasing sanding

[1] C: Critical – NC: Non critical
[2] Values given in the Eurocoat 99 paper
[3] This criteria is applicable in the context of complete and local repainting.
[4] Drinking, distilled and demineralised water, diesel, TR5, TH and TVEP oil.
[5] Sea water, wastes and miscellaneous