Unipetrol RPA, s.r.o. Technical Services Section	**Surface protection of metal structures and equipment**	N 10 051

The standard is binding for all departments of the company and external organizations that provide surface protection in the territory and facilities owned and/or operated by UNIPETROL RPA, s.r.o. The standard does not apply to subsidiaries of UNIPETROL RPA, s.r.o. Furthermore, it does not apply to the Litvínov and Kralupy Refineries either.

The responsible departments (user, operator or maintainer) are obliged to acquaint all external companies that conduct these activities for them with the standard. The standard shall be also binding for these external companies.

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Replaces:	**Standard administrator:**	**Valid from:**
N 10 051 dated 01/10/2001	Maintenance Support Section	21. 11. 2018

1. General stipulations

1.1 Scope of validity

This standard applies to the design, implementation and inspection of surface protection of structures and equipment.

1.2 Introduction

There are various options for protecting structures. This standard focuses on the protection by means of paints, with different parts dealing with aspects that are relevant to achieving adequate corrosion protection. The purpose of this standard is to provide information in the form of rules. It is intended for workers with certain technical knowledge in the field. Knowledge of related international and national standards is expected. For these reasons, it cannot be considered as a comprehensive guide for the selection of corrosion protection.

It does not deal with economic provisions and contractual relations. However, it should be noted that a failure to comply with the requirements and recommendations of this standard may have economic and legal consequences.

2. Terminology, definitions, terms

User	– production or operation unit (or department) manager, to whom the device (fixed tangible assets) has been entrusted to use
Operator	– the unit manager or plant manager designated with overall responsibility for fixed tangible assets. In the production unit, the user is the production director
Care taker	– a designated employee who is responsible for the technical condition of various groups of fixed tangible assets, including maintenance and repairs
Proposing party*	– a worker authorized to prescribe technological procedures for surface protection
Investor's representative *	– a worker authorized to carry out surface protection checks
Approver*	– a worker authorized to approve technological processes
Applicator	– a worker or an organization providing surface protection according to the prescribed technological process
TP	– technological process; a guideline for making surface protection, containing all particulars;
SP	– surface protection; protection of the base material of the structure or equipment from the effects of corrosive loads (especially atmospheric loads);
PS	– paint system; one or more layers of paint, each of which meets the desired function
coat layer	– a continuous layer formed by applying one coat of paint onto the surface of the object to be protected
combined coating	– surface protection consisting of one or more metal layers provided with a single or multi-layer paint system
inspection surface	– (also called "inspection area"); a designated part of the surface protection where, in order to avoid any doubt as to the observance of the technological process, the coating was carried out with the participation of representatives of all interested parties;
DFT	– Dry Film Thickness
NDFT	- Nominal Dry Film Thickness
TDFT	– Total Dry Film Thickness = a thickness of the entire paint system
WFT	– Wet Film Thickness = a thickness of non-cured or wet coating
T_D	– Lower limit = minimum allowed film thickness, usually 80% of TDFT
workshop base	– a paint layer which allows later welding.

* – This person is a head of the Corrosion Laboratory of the Material Testing and Defectoscopy Department in UNIPETROL RPA, s.r.o., or a person authorized by him.

3. Corrosion factory and corrosion protection

3.1 Corrosivity of atmospheres

The corrosivity of atmospheres is determined by a number of climatic agents causing corrosion of metals. Quantitative evaluation of corrosivity depends on the time of surface wetting, atmospheric pollution by corrosive active substances, the value of solar ultraviolet radiation, air temperature, the amount and composition of solid fallout.

3.1.1 Corrosivity of atmospheres is divided into six levels according to ČSN ISO 9223: 2012 (03 8203).

Class of corrosivity of the atmosphere		
Designation	Naming	Steady corrosion rate (μm/year)*
C1	Very low	≤ 1,3
C2	Low	1,3 – 25
C3	Medium	25 – 50
C4	High	50 – 80
C5	Very high	80 –200
CX	Extreme	200 – 700

* - values for unprotected carbon steel

According to ČSN EN ISO 12944-2, extended designation C5-I (industrial) or C5-M (marine) can be used for class C5.

These standards assess the corrosivity of the atmosphere at the site of the company by class C4 – C5 and C5 – CX at external areas in the territory of the company and by C3 – C4 in the interior of buildings and closed warehouses.

3.2 Corrosivity of water and soil

3.2.1 Classes of corrosivity are very difficult to define as corrosion is usually local.

3.2.2 Classes of corrosivity of water and soil

Grade	Environment	Examples of environment
Im1	Fresh water	Water constructions, hydro power plants
Im2	Sea or brackish water	Port constructions
Im3	Soil	Tanks, pipes placed in the ground

3.3 Depending on the class of corrosivity of the atmosphere, water or soil and other factors, the nominal coating thickness and number of layers are determined (EN ISO 12944).

4. Conditions for corrosion protection application

4.1 The surface of the material to be protected must be free of scale, corrosion products (according to the specified degree of cleaning), impurities (dust, salts, grease, etc.), water (moisture, dew, icing), slag and flux residues after welding, residues of old non-stick coatings (depending on the nature and degree of cleaning), sharp protrusions and burrs. The surface temperature must be at least 3°C above the dew point of the ambient air (see 7.4). The surface may be damp (not wet) only if special paints are used. The temperature of the surface to be coated must be between +5 to + 40°C, unless otherwise specified by the paint manufacturer.

4.1.1 When making coatings, it is necessary to observe technological regulations for the processing of paints which are stated on the packaging labels, material data sheets, catalogues, etc. Paints after the use-by date, paints from damaged packaging or paints that has been stored under conditions other than those specified by the manufacturer must not be used.

4.2 Roofed workplaces

For the production of protective coatings, the dry relative humidity of the air must not exceed 70% (unless the manufacturer of the paints requires otherwise), with a temperature of +5 to + 30°C, adequately lit and ventilated, spacious, dust-free, and fire-safe.

4.3 Open spaces

The temperature during application and drying must be between +5 to + 35°C and the air relative humidity shall mot exceed 70% for spraying and 80% for brushing, unless otherwise specified by the paint manufacturer.

4.3.1 The coating must not be applied in frost, rain, snow, fog, strong wind, etc. The surface must not be contaminated during its implementation. These climatic conditions must not occur during drying and curing either.

4.3.2 Surfaces exposed to direct sunlight should be painted when away from the sun, or they must be shaded.

5. Principles of surface protection application

5.1 Surface preparation

The principles of surface treatment before making surface protection are set by ČSN ISO 8504-2 and 3 (03 8224). The class of surface preparation and surface roughness (if required by the paint system) must be part of the technological

process. Surface preparation must only be carried out under the conditions specified in points 4.2 – 4.3.1.

Surface preparation is divided into:

– blasting (action of a concentrated jet of a high-kinetic energy blasting agent);

– manual cleaning (a method of preparing steel substrates by hand without using force, e.g. chipping hammers, brushes, sandpaper etc.);

– manual mechanized cleaning (a method of preparing steel substrates using manual mechanized aids except for blasting, e.g. rotary brushes or grinders, rotary wheels with sandpaper, etc.);

– water (pressure) or steam cleaning;

– solvent cleaning (a method for removing visible oils, grease, fats and other soluble impurities);

– acid pickling (especially small parts);

– flame cleaning.

5.2 Surface preparation grade

Dry surface blasting to grade Sa 2 ½ is considered standard surface preparation.

Other methods of surface preparation must be considered to be of poor quality, having a significant effect on the lower quality and durability of surface protection. They **must not be used** for painting new structures and equipment.

Standards of surface preparation grades

Grade	Method	Basic surface features
Sa 1	Blasting	Non-stick scales, rust, coating layers are removed
Sa 2		Most scales, rust, coatings are removed. All residues are firmly adherent
Sa 2 ½		**Scales, rust, and old coatings are removed. The remaining traces of dirt are only shadows in the form of spots or strips**
Sa3		Scales, rust, and old coatings are removed. The surface must have a uniform metallic appearance
Grade 2	Manual or mechanized cleaning	Non-stick scales, rust, coating layers are removed
Grade 3		Non-stick scales, rust, coating layers are removed more thoroughly than in grade 2. It must have a metallic shade given by the substrate.
Fl	Flame cleaning	Scales, rust, coating layers are removed. All residues can only appear as a change in the colour shade of the surface

The original state of the unpainted steel surface is marked as:

A – new product, scaled surface;

B – scaled surface, partially corroded;

C – surface completely corroded, without signs of uneven corrosion;

D – surface completely corroded, attacked by uneven corrosion.

In the case of surface preparation of previously painted surfaces, the letter P is added before the surface preparation grade (e.g. PSa 2 ½)

If the surface has been exposed to contamination (salt, fallout, grease, etc.), it must be washed with clean water, preferably under pressure, possibly with a suitable solvent, before preparation of the surface.

Before preparing the surface, all oil, grease and dirt must be removed with a suitable solvent, steam or water jet, if necessary with a suitable alkaline detergent.

Before preparing the surface, all spatter of weld metal, sharp edges, laps, etc. must be removed.

Compressed air used for blasting must be free of water and oil and its temperature must not exceed 110°C.

After preparation of the area, all cleaning waste, dust, etc. must be disposed of.

Tests for the evaluation of surface cleanliness by iron, chlorides and dust etc. are given in individual parts of ČSN ISO 8502 (03 8222).

Another type and grade of surface preparation can only be used for repairing and restoring surface protection on existing equipment and is subject to approval by the Approver after submitting reasons that prevent the use of the standard procedure (e.g. work safety, zone with explosion hazard, presence of rotary machines, etc.). The use of a lower quality type or a lower grade of surface preparation has a significant effect on the resulting life of the surface protection.

It is absolutely inadmissible that scales remain on the surface after the surface preparation has been carried out!

Galvanized surfaces shall be thoroughly degreased, in case of salt contamination, rinsing and light blasting to Sa 1 or manual roughing shall be carried out to improve paint adhesion.

5.3 Paint system application

5.3.1 The conditions for the paint system application are given in clause 4 of this standard.

5.3.2 The primer must be made within 4 hours after cleaning the surface. Under favorable conditions (dry, windless weather, etc.) this interval can be extended up to 8 hours. On the contrary, under unfavorable conditions, it is necessary to shorten the interval or stop work.

5.3.3 The primer is applied by brush manually only (unless the manufacturer specifies otherwise) and must cover the roughness of the substrate profile. It is not allowed to use a roller for the primer application!

5.3.4 Other layers are preferably applied by spraying. The use of a brush or roller is possible in the case of material (large losses) or environmental reasons and also for local repairs. Individual layers must be colour-coded for possible inspection!

5.3.5 Each coating must be applied evenly at the specified thickness to avoid occurrence of unpainted surfaces.

5.3.6 The minimum and maximum intervals between paints are specified by the manufacturer for each paint. If the subsequent coat has not been applied within 1 month after the application of the previous coat, the previous coat must be prepared for the application of the subsequent coat, i.e. cleaned, repaired or renewed.

5.3.7 If the specified layer thickness is damaged or not adhered to during application, the damaged areas must be repaired or the unfinished layer must be painted up to the specified thickness immediately.

5.3.8 Coatings must not be applied if the available illumination does not reach a minimum of 500 lux, and if there is a likelihood of adverse weather changes within 2 hours after finishing the painting.

5.3.9 In the case of subsequent welding work, the surface protection shall end at a distance of 50 – 150 mm (depending on the thickness of the material to be welded) from the welded edges. Finishing is done by strapping and this area is protected by a suitable workshop base after the primer application. These areas must be identified before painting.

5.3.10 If increased protection of edges, welds and other critical points is prescribed, a strip coat (approximately 25 mm) is applied on both sides of the edge before applying the primer.

5.3.11 In metallization, the maximum interval between blasting and metallization is 4 hours, 30 minutes under wet conditions (under a shelter), and less than 30 minutes at a relative humidity above 80%. The first sealing coat on the metallized surface should be applied as soon as possible after metallization.

5.3.12 It is not permissible to mount or handle structures or equipment whose surface protection is not sufficiently dried or cured. Drying and curing times are specified in the paint material data sheet.

6. Prescribing paint system

The use of many paint systems is widespread in the corrosion protection of structures and equipment. Various examples of paint systems with proven properties can be given, but this review will never be exhaustive in terms of acceptance of all the parameters and influences listed below. In addition, new technologies are constantly being developed and legislative changes are underway, which are either desirable or necessary to be incorporated into new technological processes.

Therefore, it is always necessary to work closely with the relevant specialized workplace when selecting the appropriate corrosion protection.

6. 1 Default parameters

When prescribing a paint system, the following parameters should be taken into account:

- corrosivity of the environment;
- climatic conditions and microclimate (local specific conditions);
- type of structure or equipment;
- type and condition of the surface to be coated;
- possible method of surface preparation;
- availability and accessibility;
- required lifetime * – low (L) up to 5 years
  - medium (M) 5 – 15 years
  - high (H) more than 15 years
- equipment life expectancy;
- method of application of individual layers;
- type and properties of the coatings used, their compatibility;

* – the lifetime of the surface protection should ideally be the same as the lifetime of the equipment; however, in most cases this cannot be achieved and it is therefore necessary to select the lifetime of the surface protection so that this term forms the x^{th} part of the lifetime of the equipment, where X is an integer.

– lifetime is not a warranty period! Lifetime is a technical prerequisite, while a warranty period is a legal term. There are no rules for determining the correlation of these terms.

6.2 General specification preparation

For the purposes of this standard, it is best to specify the paint system specification. This specification shall preferably include points which unambiguously identify and establish all parameters necessary to provide high quality surface protection.

- Customer;
- project, contract title;
- nature of work (new protection, maintenance, renewal);
- location, place and environmental conditions;
- type and condition of the substrate;
- existing paint system (for maintenance and renewal)
- working parameters and conditions (temperature, insulation, heating, etc.);
- surface protection technological process (point 6.3);

- notes, warnings, comments affecting the quality of workmanship;
- name of the author.

6.3 Elaboration of paint system specification

The established practice in the company is that the general and paint system specifications are elaborated in one common separate document which serves as an annex to the higher level documentation (project, order, etc.). For this reason, the paint system specification does not contain all the elements listed in the international standard and is therefore simpler and easier to understand:

- surface pretreatment (cleaning, degreasing, etc.);
- surface preparation including grade of cleanliness (e.g. Sa 2 ½);
- surface profile (roughness), if required;
- completion of surface preparation (dusting, vacuuming, sweeping, etc.);
- increased protection (strip coating);
- weld protection (workshop base)
- primer = manufacturer, paint name, shade, NDFT);
- intermediate coat(s) = manufacturer, paint name, shade, NDFT);
- top coat = manufacturer, paint name, shade **, NDFT);
- TDFT – total dry film thickness;
- minimum dry film thickness (usually 80% TDFT), in some cases also the maximum dry film thickness.

** – shade of the last layer is not usually specified, the choice is left to the user, unless specified by law (media identification, security, etc.)

If any parameters do not have to be determined, they are not given.

6.4 Specimen paint system specification

As mentioned above, it is not possible to comprehensively cover all variants of paint systems for individual conditions. Therefore, this is only an example given herein that takes into account the most common tender conditions:

New structure; outdoor exposure with C-5I atmosphere aggressiveness at ambient temperature (max. 120°C); uninsulated, unheated; required maximum lifetime (H) = approx. 15 years.

Example of technological procedure:

- clean the surface and degrease, if necessary;
- blast the surface to grade Sa 2.5; de-dust;
- 1 x Hempadur 45880 with a dry film thickness of 80 µm;
- 2 x Hempadur 45880 with a dry film thickness 2 x 80 µm;
- 1 x Hempathane Topcoat HS 55610 with a dry film thickness of 60 µm.

Total dry film thickness of 300 µm, T_D = 240 µm.

In the case of welded parts it is necessary to apply a Hempel`s Shopprimer E 15280 workshop base with a dry film thickness of approx. 25 µm within a distance of approx. 100 – 150 mm from the weld. After assembly and welding grind using the Bristle blaster method and clean to the grade close to Sa 2.5, and apply the prescribed paint system.

Given the operating conditions, I recommend applying the entire paint system in the workshop and taking appropriate precautions to avoid damage during transport. Perform repairs after assembly.

Colour marking of piping according to flowing substances is addressed by N 13 700. I leave the shade of other surfaces at the user's discretion.

Observe the provisions of N 10 051 and S 317 when carrying out the procedure.

Timely inspections of surface protections (after individual operations) must be ensured by the implementer in cooperation with the application company (failure to perform all inspections may result in non-acceptance of surface protections!).

Note: The specified technological procedure applies only to this contract!
The thickness gauge will be calibrated on a smooth plate.

Date *Prepared by*

6.5 Paint systems

These paint systems are intended only for protection against atmospheric corrosion of carbon steel surfaces during outdoor exposure. If protection of other surfaces or against other media is necessary, surface protection must be consulted with a corrosion laboratory worker of the CHPL material testing laboratory.
Coatings are specified for corrosion aggressiveness C-5I and lifetime H (at least 15 years).
Surface preparation Sa 2 ½, for repairs, manual cleaning St3 or PSt3.

Table of temperature applicability of paint systems

	← -196°C	← -50°C	← 120°C	← 150°C	← 200°C	← 400°C	← 600°C
	insulated	**surfaces**					
PS 1		300 µm					
PS 2			3 layers (240 µm)				
PS 3							
PS 4							
	uninsulated	**surfaces**					
PS 5							
PS 6							
	manual	**surface**	**preparation**				
PS 7							
PS 8			3 layers (240 µm)				
PS 9							

Paint systems for insulated surfaces

Paint System No. 1 (PS 1)

– clean the surface and degrease, if necessary;
– blast the surface to grade Sa 2 ½, roughness BN10a according to Rugotest No. 3, de-dust;
– 2 x VERSILINE CUI 56990, dry film thickness 2 x 100 µm;

Total dry film thickness of 200 µm, T_D = 160 µm.

Paint System No. 2 (PS 2)

- clean the surface and degrease, if necessary;
- blast the surface to grade Sa 2 ½; de-dust;
- 4 x Hempadur 45141/3 (19000 and 19870), dry film thickness 4 x 80 µm.

Total dry film thickness of 320 µm, T_D = 280 µm.

Note: Paint 45141 is intended for application at higher temperatures (15 – 30°C)
Paint 45143 is intended for application at lower temperatures (-10 – +15°C)

Paint System No. 3 (PS 3)

– clean the surface and degrease, if necessary;
– blast the surface to grade Sa 2 ½, roughness BN10a according to Rugotest No. 3, de-dust;
– 2 x Hempadur 85671, dry film thickness 2 x 100 µm.

Total dry film thickness of 200 µm, T_D = 160 µm.

Paint System No. 4 (PS 4)

– clean the surface and degrease, if necessary;
– blast the surface to grade Sa 2 1/2; de-dust;
– 1 x Hempel`s Silicone Zinc 16990, dry film thickness 50 µm;
– 1 x Hempel`s Silicone Acrylic 56940, thickness 25 µm.

Total dry film thickness of 75 µm, T_D = 50 µm, the maximum thickness of 90 µm.

Note: Paint 56940 for aluminium shades only!!

Paint systems for non-insulated surfaces (if different from insulated surfaces)

Paint System No. 5 (PS 5)

– clean the surface and degrease, if necessary;

– blast the surface to grade Sa 2 1/2, roughness N 10a according to Rugotest No. 3, de-dust;
– 2 x Hempadur 85671, dry film thickness 2 x 100 µm.

Total dry film thickness of 200 µm, T_D = 160 µm.

Paint System No. 6 (PS 6)

– clean the surface and degrease, if necessary;
– blast the surface to grade Sa 2 ½, roughness BN10a according to Rugotest No. 3, de-dust;
– 3 x Hempadur 45880, dry film thickness 3 x 80 µm.
– 1 x Hempathane Topcoat 55610, dry film thickness 60 µm.

Total dry film thickness of 300 µm, T_D = 240 µm.

Paint systems for manually (mechanically) prepared surface

Paint system No. 7 (PS 7) – insulated and non-insulated surfaces

– clean the surface of non-stick paint residues, corrosive fumes and deposits, degrease;
– pressure water cleaning;
– clean the surface to grade St 3 (PSt3), de-dust, degrease if necessary;
– 2 x VERSILINE CUI 56990, dry film thickness 2 x 100 µm.

Total dry film thickness of 200 µm, T_D = 160 µm.

Paint system No. 8 (PS 8) – insulated surfaces

– clean the surface of non-stick paint residues, corrosive fumes and deposits, degrease;
– pressure water cleaning;
– clean the surface to grade St 3 (PSt3), de-dust, degrease if necessary;
– 4 x Hempadur 45141/3 (19000 and 19870), dry film thickness 4 x 80 µm.

Total dry film thickness of 320 µm, T_D = 280 µm.

Paint system No. 9 (PS 9) – non-insulated surfaces

– clean the surface of non-stick paint residues, corrosive fumes and deposits, degrease;
– pressure water cleaning;
– clean the surface to grade St 3 (PSt3), de-dust, degrease if necessary;
– 3 x Hempadur 45880, dry film thickness 3 x 80 µm.
– 1 x Hempathane Topcoat 55610, dry film thickness 60 µm.

Total dry film thickness of 300 µm, T_D = 240 µm.

7. Quality control and testing of surface protection

7.1 The surface protection technological procedure must be submitted and approved in good time in advance by the investor's approver. The investor’s representative has

the right to supervise the work at all stages and to refuse all tools, instruments, materials, procedures and activities that are not in accordance with the technological procedure and other related standards, regulations, etc. Any deviation from the technological procedure shall be immediately notified to the investor's representative, who shall decide on the further procedure.
The investor's representative shall be informed in good time of the commencement of work and of the schedule for each operation. If the investor's representative so requests, the applicator is obliged to ensure his participation in the inspection of each stage of surface protection performance and ensure the availability of all painted surfaces.

7.2 The applicator is responsible for:

– the design and quality of the surface protection to be carried out in accordance with the technological procedure and other related documents;
– ensuring professional supervision and prescribed inspections (including inspections of the investor's representative) during the application of surface protections;
– timely delivery according to agreed deadlines (taking into account climatic conditions);
– keeping a logbook with all the requisites;
– protection of the entire equipment, structures and all other areas during work against mechanical damage, environmental damage, damage, pollution, etc .;
– providing the necessary material for surface protection performance;
– the appropriate properties of paints and other materials as specified by the manufacturer's material data sheets (including viscosity adjustment);
– safe and reliable operation of all equipment, machinery and aids used for surface protection performance;
– inspection and disposal of waste caused by its own activities.

7.3 Qualitative features of surface protection are as follows:

– prescribed surface preparation;
– prescribed number of layers;
– prescribed thicknesses of individual layers (DFT);
– prescribed total thickness (TDFT);
– adherence to the final colour shade and colour coding of individual layers;
– coatings must be evenly applied and well worked out on all parts of the painted surfaces, including corners, edges, etc., they must not be contaminated by impurities on the dried paint or in the paint;
– there shall be no cracks, blisters, craters or pores in the coating;
– the coating must not peel off and must have sufficient adhesion.

7.4 Supervision in the coating application

Generally, it is necessary to monitor climatic conditions during the whole implementation of surface protection, i.e. air temperature (Ta), relative air humidity (rh), surface temperature (Ts). The dew point (DP) and the offset of the surface temperature from the dew point (ΔT) are then determined, which must be at least + 3°C. Measurements are carried out at least 3 times a day, at the beginning, in the middle and before the end of work. It is suitable to use a device with continuous recording and the possibility of data transfer to a PC and subsequent printing for

evidence in the logbook. Furthermore, it is necessary to carefully monitor the possibility of adverse weather changes (especially rainfall and strong wind) and to terminate the work in time in order to prevent deterioration of the non-dried paint.

7.5 Surface preparation by blasting

The blasting agents must be dry (except for wet blasting), free from corrosive products and contaminants affecting adhesion. Safety and hygiene regulations must be observed when they are used.

The type of blasting agent must be chosen taking into account the required degree of cleanliness and surface roughness.

After blasting, perform:

– evaluation of the degree of surface preparation according to the image standard;

– determination of surface roughness (comparative standards, Testex tapes, profilometer);

– determination of surface cleanliness.

In case of unsatisfactory values the procedure must be repeated.

7.6 Manual cleaning

After manual cleaning, the degree of surface preparation and surface cleanliness shall be checked.

7.7 Primer

The paint must be prepared and applied according to the manufacturer's material data sheets, which must include the mixing ratio, the use of solvents, the type and permitted dilution, the method of application, applicable thickness, drying times and overcoating intervals. Material data sheets must be available.

For application, manual brushing is preferred, unless otherwise specified by the paint manufacturer. Application is carried out in two mutually perpendicular directions to obtain a smooth surface and as uniform thickness as possible. It is not permitted to use a roller to apply the paint!

The paint must be applied under the conditions specified in point 4 of this standard.

If condensation, rain, dust, or other foreign materials contaminate the surface of the coating film that is not touch-dry, the coating must be removed, the surface cleaned again, and a new paint film applied.

During application, the applicator performs wet film thickness (WFT)measurement to check for compliance with the technological procedure.

After drying, perform:

– visual inspection of the surface for inadmissible defects (cracks, blisters, veils, run-offs, orange peel, etc.);

– dry film thickness measurement. Unless otherwise specified, an individual thickness less than 80% of the nominal thickness is unacceptable. Thicknesses between 80% and 100% of the nominal thickness are acceptable if an overall arithmetic mean equal to or higher than the nominal dry film thickness is provided and the proportion of these measurements is less than 20% (**80/20 rule**);

– porosity inspection.

In case of doubt, the investor's representative is entitled to carry out destructive paint tests to the extent necessary at the expense of the applicator. These include, for example, checking the grade of surface preparation, checking adhesion, etc. For

surface protections relevant to safety and reliability of operation, these tests are the standard test method and will be performed to the extent necessary.

7.8 Intermediate coat(s) and topcoat

The same rules apply to the intermediate coat(s) as for the primer with the following differences:

– spraying is the preferred method of application;

– if the surface is contaminated during drying, the investor's representative will decide whether to proceed as in the case of primer, or to grind and fill up the film to the prescribed thickness;

– for the topcoat, a visual inspection of the colour shade shall be carried out according to the technological procedure or the relevant standards.

7.9 Final inspection

Perform:

– check of the applicator's logbook;

– visual surface inspection;

– dry film thickness measurement (TDFT), unless otherwise specified, an individual thickness less than 80% of the nominal thickness is unacceptable. Thicknesses between 80% and 100% of the nominal thickness are acceptable if an overall arithmetic mean equal to or higher than the nominal dry film thickness is provided and the proportion of these measurements is less than 20% (**80/20 rule**);

– random check for non-porosity, if any is required.

In case of doubt about the quality of the surface protection, further inspections, including destructive ones, can be ordered and performed. The type and scope are determined by the investor's representative.

It is unacceptable to carry out work before final inspection of individual parts of the equipment, which would make the inspection impossible! These mainly concern dismantling of scaffolding, insulation, construction work, etc.

7.10 Inspection area

In certain cases it is appropriate to establish inspection areas. This especially applies to larger investment projects, equipment and structures that are important for safe and reliable operation.

Inspection areas are suitable locations on the structure or equipment used to determine the lowest acceptable level, to assess that the manufacturer's or supplier's data is correct, and to assess the state of surface protection at any time after completion. Inspection areas are not normally used for warranty purposes, but may be used for this purpose if the parties concerned agree so.

Inspection areas must be made in areas with typical corrosion loads for the construction work. Surface preparation and application of surface protection on inspection areas must be carried out at the presence of representatives of the parties concerned. The approval that the areas have been carried out in accordance with the technological procedure must be made in writing. All inspection areas must be accurately documented and permanently marked. The records shall contain all relevant data and be confirmed by the parties concerned.

The number of inspection areas must be proportional, practically and economically, to the total area of surface protection.

Surface protection on the inspection area shall be evaluated by methods agreed by the parties concerned, preferably using international or national standards.

Defects can be detected at the following locations:

– on a structure or equipment but not on inspection areas;

– on a structure or equipment as well as on inspection areas;

– only on the inspection area(s).

If inspection areas are used for warranty purposes, possible causes of defects must be determined by a qualified and experienced expert approved by the parties concerned.

In case of damage to the inspection areas, the defects must be carefully repaired, but the repaired areas are no longer considered as inspection areas.

8. List of quoted and related standards and documents

ČSN

ČSN EN ISO 3882 (03 8180)	– Metallic and other inorganic coatings – Review of methods of measurement of thickness
ČSN ISO 2178 (03 8181)	– Non-magnetic coatings on magnetic substrates. – Measurement of coating thickness. Magnetic method
ČSN EN ISO 2360 (03 8185)	– Non-conductive coatings on non-magnetic base metals – Measurement of coating thickness – Amplitude-sensitive eddy current method
ČSN EN ISO 9223 (03 8203)	– Corrosion of metals and alloys. Corrosivity of atmospheres. Classification, determination and estimation
ČSN EN ISO 8501-1 (03 8221)	– 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
ČSN ISO 8501-2 (03 8221)	Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 2: Preparation grades of previously coated steel substrates after localized removal of previous coatings
ČSN ISO 8502-2 (03 8222)	– Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 2: Laboratory determination of chloride on cleaned surfaces
ČSN ISO 8502-3 (03 8222)	– Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)
ČSN ISO 8502- 4 (03 8222)	– Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 4: Guidance on the estimation of the probability of condensation prior to paint application
ČSN ISO 8502-6 (03 8222)	– Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 6: Extraction of soluble contaminants for analysis – The Bresle method

ČSN ISO 8502-9 (03 8222)	– Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 9: Field method for the conductometric determination of water-soluble salts
ČSN EN ISO 8503-1 (03 8223)	– Preparation of steel substrates before application of paints and related products – Surface roughness characteristics of blast-cleaned steel substrates – Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces
ČSN EN ISO 8503-2 (03 8223)	– Preparation of steel substrates before application of paints and related products – Surface roughness characteristics of blast-cleaned steel substrates – Part 2: Method for the grading of surface profile of abrasive blast-cleaned steel – Comparator procedure
ČSN EN ISO 8503-3 (03 8223)	– Preparation of steel substrates before application of paints and related products – Surface roughness characteristics of blast-cleaned steel substrates – Part 3: Method for the calibration of ISO surface profile comparators and for the determination of surface profile – Focusing microscope procedure
ČSN EN ISO 8503-4 (03 8223)	– Preparation of steel substrates before application of paints and related products – Surface roughness characteristics of blast-cleaned steel substrates – Part 4: Method of calibration of ISO surface profile comparators and for the determination of surface profile – Stylus instrument procedure
ČSN EN ISO 8504-1 (03 8224)	– Preparation of steel substrates before application of paints and related products – Surface preparation methods – Part 1: General principles
ČSN EN ISO 8504-2 (03 8224)	– Preparation of steel substrates before application of paints and related products – Surface preparation methods – Part 2: Blasting
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ČSN EN ISO 12944-1 (03 8241)	– Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 1: General introduction
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ČSN EN ISO 14713-3 (03 8261)	– Zinc coatings – Guidelines and recommendations for the protection against corrosion of iron and steel in structures – Part 3: Sherardizing
ČSN EN ISO 2063 (03 8734)	– Thermal spraying – Metallic and other inorganic coatings – Zinc, aluminium and their alloys
ČSN EN ISO 1461 (03 8560)	– Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods
ČSN EN ISO 14922-1 (03 8711)	– Thermal spraying – Quality requirements of thermally sprayed structures – Part 1: Guidance for selection and use

ČSN EN ISO 14922-2 (03 8711)	– Thermal spraying – Quality requirements of thermally sprayed structures – Part 2: Comprehensive quality requirements
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ČSN EN ISO 14922-4 (03 8711)	– Thermal spraying – Quality requirements of thermally sprayed structures – Part 4: Basic quality requirements
ČSN 13 0072	– Piping. Marking of pipelines in plants according to the flowing liquids
ČSN EN ISO 2808 (67 3061)	– Paints and varnishes – Determination of film thickness
ČSN EN ISO 4624 (67 3077)	– Paints and varnishes - Pull-off test for adhesion
ČSN ISO 2409 (67 3085)	– Paints and varnishes. Cross-cut test

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S 317	– Principles of corrosion protection of machine and technological equipment
N 13 700	– Marking of piping according to the flowing liquids