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03-Structural Surface Treatment and Painting

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1 Responsibility

This Standard Technical Specification (STS) is the responsibility of the owner. The revision and date of issue are on the front page.

All deviations from the specifications must be approved in writing by the Owner.

2 Scope and Field of Application

2.1 Scope Definition

This Standard Technical Specification details the minimum technical requirements including but not limited to, the design, material quality and workmanship, applications, testing, inspection for surface treatment and coating of steel parts and steelwork.

2.2 Document Conflicts

Eventual conflicts between the referenced documents shall be reported, without delay, to the Owner in writing for resolution.

3 References and Definitions

3.1 References

All materials, workmanship, design calculation and tests shall be performed in compliance and read in conjunction with the NA-00-STS001 General Technical Standard and other relevant standards.

The relevance order of standards shall be according to NA-00-STS001.

All materials intended for use at Norðurál shall be approved by the Owner. The following referenced documents should be considered for the application of this document. For dated references, only the edition cited applies. For all references, dated and undated, the latest edition of the referenced document (including any amendments) applies.

Table 3.1- References / Standards

Standard Nr.	Subject/Name
EN ISO 12944	Paints and varnishes -- Corrosion protection of steel structures by protective paint systems
EN ISO 11124	Preparation of steel substrates before application of paints and related products -- Specifications for metallic blast-cleaning abrasives
EN ISO 11126-1	Preparation of steel substrates before application of paints and related products -- Specifications for non-metallic blast-cleaning abrasives -- Part 1: General introduction and classification
EN ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles -- Specifications and test methods
EN ISO 14713	Protection against corrosion of iron and steel in structures -- Zinc and aluminum coatings -- Guidelines
EN 10240	Internal and/or external protective coatings for steel tubes. Specification for hot dip galvanized coatings applied in automatic plants
EN ISO 10684	Fasteners -- Hot dip galvanized coatings
EN ISO 4628-2	Paints and varnishes -- Evaluation of degradation of coatings -- Designation of quantity and size of defects, and of intensity of uniform changes in appearance -- Part 2: Assessment of degree of blistering
EN ISO 4628-3	Paints and varnishes -- Evaluation of degradation of coatings -- Designation of quantity and size of defects, and of intensity of uniform changes in appearance -- Part 3: Assessment of degree of rusting
EN ISO 2063	Thermal spraying -- Metallic and other inorganic coatings -- Zinc, aluminum and their alloys
EN ISO 8501	Preparation of steel substrates before application of paints and related products -- Visual assessment of surface cleanliness
EN ISO 8503	Preparation of steel substrates before application of paints and related products -- Surface roughness characteristics of blast-cleaned steel substrates
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D 4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D4752-10	Standard Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub
ISO 19840:2012	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Measurement, and acceptance criteria for the thickness of dry films on rough surfaces.
EN ISO 2808:2007	Paints and varnishes – Determination of film thickness.
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
EN ISO 8502-3	Preparation of steel substrates before application of paint 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)

EN ISO 8502-4	Preparation of steel substrates before application of paint and related products - Tests for the assessment of surface cleanliness - Part 4: Guidance on the estimation of the probability of condensation prior to paint.
EN ISO 2409	Paints and varnishes: Cross-Cut test. (<200 microns)
EN ISO 4624	Paints and varnishes: Pull-Off test adhesion
RAL COLOR SYSTEM	http://www.ralcolor.com
NCS NATURAL COLOR SYSTEM	http://www.ncscolor.com
00/03/TS002	Structural steel
00/03/TS003	Cladding
SSPC SP 1	Solvent Cleaning

4 Corrosion considerations

4.1 Corrosion Environment

The Site weather conditions are characterized by frequently windy conditions, high humidity and low temperatures. The wind combined with briny air and debris, as well as high levels of SO₂ pollution require that steelwork be given a high degree of protection, and the treatment described in this specification has proven to be successful if correctly carried out.

The atmospheric-corrosivity category outdoors is assumed to be C5-M (very high) Marine according to EN ISO 12944-5.

Indoor environment varies throughout the factory. The potroom is characterized by high levels of dust and corrosive indoor pollutants (SO₂, HF), and low humidity. Other locations have higher humidity but lower levels of pollutants.

The atmospheric environment in indoor locations is therefore assumed to be C3 at minimum.

4.2 General design considerations to enhance corrosion protection

Access to all surfaces to provide both the initial surface treatment and subsequent maintenance painting is essential. Narrow gaps, difficult to reach corners, and hidden surfaces should be avoided wherever possible. Similarly, clearance between connecting members at junctions, and the degree of internal angles at skewed web stiffeners should allow access for coating and inspection.

Avoidance of moisture and debris traps

Details that could potentially trap moisture and debris should be avoided where possible. Measures that can be taken include:

- Grind flush weld on horizontal surfaces.
- Curtail transverse web stiffeners short of the bottom flange.
- Avoid using channels with toes upward.
- Arrange angles with the vertical leg below the horizontal.
- Avoid the use of 'T' section bearing stiffeners.
- Avoid the creation of cavities and crevices etc.
- Seal rolled hollow sections except when they are to be hot-dip galvanized.

Crevices

Crevices attract and retain water through capillary action, leading to accelerated 'crevice corrosion', so details such as lap joints should be avoided or sealed where possible.

Drainage and ventilation

Provision should be made for adequate drainage and ventilation to enable the steel surfaces to dry out, e.g. minimize the 'time of wetness'. Measures to be considered include the provision of drainage holes where necessary and the provision of free circulation of air around the structure.

For bridges, closely spaced girders should be avoided and deck run-off should be directed away from steel surfaces. In addition, the use of wide cantilevers with suitable drip details should be considered.

Contact with other materials

- Connections between dissimilar metals should be avoided where practical otherwise there is a risk of accelerated bimetallic corrosion. If this cannot be avoided, then the contact surfaces should be insulated.
- Adequate depth of cover, and the correct quality of concrete should be specified where structural steelwork is to be encased in concrete.
- Structural steel should be separated from timber by the use of coatings or sheet plastics to avoid dampness on the steel surface.

5 Warranty

The Contractor shall obtain a warranty in favor of both the Owner and the Contractor on a joint and several basis from an authorized representative of either the paint manufacturer or the applicator who shall have been approved by the manufacturer guaranteeing that the conditions of the outdoor painted surfaces shall be no worse than condition Ri 1, as defined in EN ISO 4628-3, after two years and not more blisters than defined as smaller and less dense than 1 and size 1 according to ISO 4628-2. No flaking of the paint layers is allowed for a period of two (2) years from the completion of the work. The guarantee shall contain an undertaking to carry out any treatment necessary to restore the paintwork at no cost to the Owner should the paintwork condition be worse than specified at any time during the two (2) year period.

6 Cleaning and Painting of the Work

6.1 General

- (a) Immediately following the Letter of Award or a service request, the Contractor shall submit a quality assurance program for approval by the Owner.
- (b) All paints for the outdoor equipment in the Contract shall be provided by one manufacturer and preferably manufactured in one country to ensure compatibility.
The supplier shall provide technical datasheets containing information on pre-treatment requirements, wet/dry film thickness, overpainting intervals, application recommendations/requirements and safety data sheet.
All paint products and solvents shall be stored in their original packaging and shall bear the supplier's guidelines. The manufacturing number and use-by date shall be shown on all containers.
- (c) Contractor shall strive to select a paint system and cleaning detergents that do not endanger the health and safety of the workforce or others and to minimize the effects they have on the environment.
- (d) All health and safety regulations shall be observed by the contractor, regarding use of solvents and epoxy and polyurethane products. Regulations dealing with pollution of the environment by used blast-cleaning abrasives and dust, solvents and paint shall be observed by the contractor. All activities shall minimize dust formation from dry spray and abrasive blasting. The abrasive shall not decompose to dangerous particles that can cause harm to people.

- (e) The painting of the Works shall be carried out in accordance with the appropriate standard in this Specification. The work is generally covered by the standards, but where particular items are not referred to specifically, such items shall be treated in a manner similar to other comparable items as agreed with the Owner.
- (f) The standards of surface preparations and painting are intended to give a minimum life of fifteen years in a coastal environment, with need for only minor remedial work in that period. The coating systems shall tolerate minimum 5 MPa in Pull-Off test according to EN ISO 4624 or ASTM D4541. As this test is destructive, test plates of similar surfaces are allowed when processed with the coating system.
- (g) The standards differentiate between "Treatment at Maker's Works" and "Treatment at Site after Completion of Erection" but the locations at which different stages of the treatments are carried out may be modified, always provided that each change is specifically agreed to by the Owner, and the painting is finished or made good at the Site to the Owner's satisfaction.
- (h) The standards also refer to "Indoor" and "Outdoor" locations. In this context all "Indoor" rooms and buildings without air conditioning, heating or forced ventilation shall be treated as "Outdoor".

6.2 Cleaning of surfaces

- (a) All planished and bright parts shall be coated with grease, oil or other approved rust preventative before dispatch and during erection. This protective coating shall be cleaned off and the parts polished before being handed over to the Owner.
- (b) Steel sections and plates shall be free from surface flaws and laminations prior to cleaning. Sharp edges from the fabrication process should be rounded or chamfered and burrs around holes and along cut edges should be removed.
- (c) Prior to blast cleaning all salt, greasy or oil contaminated surfaces must be degreased / washed with appropriate detergent and fulfilling SSPC SP 1. Critical areas or areas that were heavily contaminated with oil or grease shall be tested with black light to confirm that the cleaning procedure is sufficient. Salt concentration shall be measured by the Bresle method as described in ISO 8502-6 and ISO 8502-9 standards. The conductivity shall be at maximum 5.3 mS/m at 20°C or 11.2 µg NaCl/cm².
- (d) Blast cleaning shall be according to EN ISO 8501-1:2007. Surface roughness shall be within limits of the coating manufacture specification in product data sheets. The roughness shall be measured according to ISO 8503 or ASTM D 4417. Abrasive materials shall be in accordance with EN ISO 11124 and EN ISO 11126. The blasting abrasive shall be chosen so that the specified roughness and cleanness is obtained. The abrasive material shall not include or decompose to harmful particles. Compressed air used for blasting shall be without any contaminants as water and oil. The system shall include traps to capture oil and moisture. Surfaces shall be tested for dust according to EN ISO 8502-4.
- (e) Where lapped or butted joints form part of an assembly which is assembled or partly assembled before final painting, the jointed surfaces shall be cleaned, free from all scales, loose rust, dirt, salts and grease, and given one brush-applied coat of zinc phosphate primer before assembly.
- (f) All surfaces to be painted shall be free from dirt, grease, dust, salts, etc. and shall be cleaned prior to application of an additional paint layer. The surface or old coating must have a faultless binding to the under layer, which shall not be affected by the additional layer. The entire surface must be prepared by hand using appropriate detergents.

Prior to application of any new coating, the surface shall be cleaned in accordance with the most current instructions of the coating material manufacturer. If instructions are not provided, the surfaces shall be cleaned by hand and washed with hot water at a temperature of approximately 50°C, which is applied at a pressure of 100-150 bars.

It may be necessary to revise these figures according to the coating system used or the conditions of application. In all cases it is necessary to consult the instructions of the coating material manufacturer.

- (g) Hot-dip galvanized surfaces that are to be painted or powder coated shall be degreased/washed and blast cleaned very lightly with fine sand (0,2-0,5 mm) and loose particles removed.
- (h) Friction surfaces in slip-resistant connections with high strength friction grip bolts shall either be sandblasted to Sa 2.5 just before assembly or sandblasted to Sa 3.0 and metallized by thermal spraying with pure aluminum if assembly is delayed. The thickness of the metal coating shall be 50 µm to 80 µm. Friction surfaces in assembly connections shall be protected (wrapped up) during transport and storage.

6.3 Application of paint

- (a) All painting systems are subject to approval by the Owner.
- (b) Paint shall not be applied to surfaces, which are superficially or structurally damp, and condensation must be absent before the application of each coat.
- (c) Painting shall not be carried out under adverse weather conditions, such as low temperatures (below 4°C), or above 85% relative humidity, during rain or fog, or when the surface temperature is less than 3°C above the dew point. Special care should also be taken when working late on a hot day, as the relative humidity will rise fast as the temperature begins to drop in the evening.
- (d) Before priming coats of paint are applied the Owner shall be notified. He has the right to inspect the cleaned surfaces before application of priming coats of paint.
- (e) All paints shall be applied by brush or spray in accordance with the paint schedule, except for priming coats for steel floors, galleries, and stairways where dipping is permitted.
- (f) One or two stripe coats shall be applied to sharp edges, corners, crevices, holes, bolts, nuts, dents, and other areas difficult to reach with a spray gun and where there is danger of reduced paint film thickness. All visible holidays need to be covered before full application of the coat.
- (g) Where paint is to be applied by spraying, the applicator shall demonstrate that the spray technique employed does not produce paint films containing vacuoles or shadows where the paint is thin.
- (h) Porous surfaces like concrete, inorganic zinc, thermal sprayed zinc or aluminum need to be flash coated to minimize the risk of air trapping or popping. In case of pinholes, the affected surface needs to be reworked or sanded down to ensure full integrity of the coating system.
- (i) All paint film thicknesses specified refer to the dry film condition as defined in ISO 12944:2007.
The method and procedure for checking the thicknesses of dry films on rough surfaces shall be in accordance with ISO 19840, and for smooth and galvanized surfaces in accordance with ISO 2808.
The following acceptance criteria, as stated in ISO 19840, shall apply

- The arithmetic mean of all the individual dry film thicknesses shall be equal to or greater than the nominal dry film thickness (NDFT)
 - All individual dry film thicknesses shall be equal to or above 80% of the NDFT
 - Individual dry film thicknesses between 80% of the NDFT and the NDFT are acceptable provided that the number of these measurements is less than 20% of the total number of individual measurements taken.
 - All individual dry film thicknesses shall be less than or equal to the specified maximum dry film thickness, which is recommended to be no more than three times the nominal dry film thickness. This may vary depending on paint manufacturers' recommendations.
- (j) All thicknesses shall be determined by the correct use of approved commercial paint film thickness gauge. The gauge shall be calibrated every four hours in the thickness range in question. Depending on the calibration method, thickness correction values may need to be added, as is required by ISO 19840. (This corresponds to 25 µm for a substrate with "medium" roughness grade according to EN ISO 8503-1).
- (k) On sheltered or unventilated horizontal surfaces on which dew may linger, more protection is needed. To achieve this, an additional top coat of paint shall be applied that is equal in thickness and finish to the previous coat.
- (l) No consecutive coats of paint, except in the case of top coat, should be the same shade.
- (m) The Contractor shall provide finished colors in accordance with Norðurál's color codes in Appendix 1. For repainting and repairs the finished color should match, as near as is practical, the colors of similar items in the existing installation.
- (n) All outdoor and indoor painting shall be inspected in accordance with Chapter 5: "Warranty".

6.4 Metallizing by thermal spraying with zinc

- (a) Blast cleaning under metallizing shall be to Sa 3.0 according to EN ISO 8501-1. Roughness shall be Medium G, according to EN ISO 8503-1.
- (b) All thermal spraying shall proceed in accordance with EN ISO 2063:2005. Unless otherwise indicated in the special specifications, a minimum thickness of 100 µm is required. The metal layer shall be applied with the most even thickness possible. The thermal spraying shall proceed no later than 4 hours after blast cleaning.
- (c) For the specified film thicknesses of metallized coatings the same procedures apply as for paint coatings.

6.5 Hot-dip galvanizing

- (a) All galvanizing shall be carried out by the hot dip process and unless otherwise specified shall conform in all respects to EN ISO 1461, EN ISO 14713 and EN 10240:1997.
- (b) All surface defects in the steel including cracks, surface laminations, laps and folds, shall be removed. All drilling, cutting, welding, forming and final fabrications of unit members and assemblies shall be completed before the structures are galvanized. The surface of the steelwork to be galvanized shall be free from all welding slag, paint, oil, grease and similar contaminants.
- (c) Adequate provisions for filling, venting and draining shall be made for assemblies fabricated from hollow sections. Vent holes shall be suitably plugged after galvanizing.

- (d) Zinc thicknesses shall be in compliance with Table 6.1 below :

Table 6.1- Zinc thickness

Product and thickness (t) [mm]	Local coating thickness [μm] (minimum)	Average coating thickness [μm] (minimum)
Steel $t \geq 6$	100	115
Steel $3 < t \leq 6$	85	95
Steel $1 < t \leq 3$	60	70

- (e) On removal from the galvanizing bath, the resultant coating shall be smooth, continuous, free from gross surface imperfections such as bare spots, lumps, blisters, inclusions of flux, ash or dross.
- (f) Bolts, nuts and washers, including general grade high strength friction grip bolts shall be hot dip galvanized and subsequently centrifuged in accordance with EN ISO 10684:2004, to a coating thickness according to Table 1. Nuts shall be tapped up to 0.4 mm oversize after galvanizing and the threads shall be oiled to permit the nuts to be finger turned on the bolt for the full depth of the nut.
- (g) No lubricant, applied to the projecting threads of a galvanized high strength friction grip bolt after the bolt has been inserted through the steelwork, shall come into contact with the adjoining surfaces.
- (h) During off-loading and erection the use of nylon slings shall be employed. Galvanized work that is to be stored during manufacture or on the Site shall be stacked so as to provide adequate ventilation to all surfaces and to avoid wet storage staining (white rust).
- (i) Small areas of the galvanized coating damaged in any way shall be restored by the following method as approved by the Owner.

Clean the area of any weld slag and thoroughly wire brushing to give a clean surface. Wire brush damaged areas to surface quality St3 to EN ISO 8501-1.

Apply repair zinc rich paint, containing not less than 92% zinc; by weight in dry film, when not overpainted. The paint dry film thickness should be at least 50% more than the surrounding coating, but not greater than 100 μm. This should be verified with measurement.

6.6 Powder coating

The powder coating system, whether constituting a total or a part of a paint system, shall be according to corrosively category C3 (high) for indoor locations and C5-M (high) for outdoor locations as specified in respective parts 7 and 8. As powder coats only offer “barrier” corrosion protection, additional corrosion protection will be needed for outdoor locations, which may be done through hot dip galvanizing or use of appropriate corrosion protective primer.

- (a) Polyester or epoxy powder coating shall be used unless otherwise indicated. Powder coating can constitute the total or a part of a paint system. The finished colors shall be in accordance with Norðurál’s color codes in Appendix 1.
- (b) Where powder coating constitutes the finishing layers on hot-dip galvanizing the hot-dip galvanizing and powder coating shall be carried out on the same premises without transportation or interim storage out of doors or in humid conditions. Before powder coating takes place, the hot-dip galvanizing layer shall be inspected for occurrences of white rust (zinc oxide and zinc hydroxide). Prior to powder coating light blast cleaning shall be applied.

- (c) The individual work operations in the application process shall be carried out within the time frame recommended by the coating supplier.

7 Paint schedules

The paint schedule shall be as specified in the following table. Final color and paint systems are specified in tables A.1, A.2 and A.3 in appendix 1.

Table 7.1 Nordurál Paint Schedule.

No	Item	Special considerations	Paint system
0	General		Indoor Paint systems NA-1-Ch-In or NA-2-Ch-In Outdoor Paint system NA-1-Ch-Out or NA-2-Ch-Out
1	Instrument panels, control panels, junction boxes and switchgear enclosures.		Indoor Paint system NA-1-Ch-In
2	Cable ladders		Galvanized only
3	Structural steel		Indoor Paint systems NA-1-Ch-In or NA-2-Ch-In Outdoor Paint system NA-1-Ch-Out or NA-2-Ch-Out
4	Purlins and rails	Cleaned according to Part 6.2 (g) and any damaged areas repaired as specified in 6.5.	Indoor Galvanized according to Part 6.5. and painted according to Paint system NA-3-Ch-In Outdoor Galvanized according to Part 6.5 and painted according to Paint system NA-3-Ch-Out
5	Galvanized pipes		Indoor Galvanized according to Part 6.5 and painted according to Paint system NA-3-Ch-In Outdoor Galvanized according to Part 6.5 and painted according to Paint system NA-3-Ch-Out
6	Mechanical equipment		Indoor Paint system NA-1-Ch-In Outdoor Paint system NA-1-Ch-Out or Thermally sprayed according to part 6.4 and then painted according to NA-4-Ch-Out

7	Alumina storage silos	New steel shop primed according to Paint system NA-1-Ch-Shop. The surface needs to be sweep blasted if deteriorated beyond Ri 2 (EN ISO 4628-3)	Areas under high abrasion - Paint system NA-1-Ch-Im Other areas - Paint systems NA-1-Ch-Out or NA-2-Ch-Out
8	Flooring and Hand railing	Cleaned according to Part 6.2 (g) and any damaged areas repaired as specified in 6.5.	Outdoor Galvanized according to Part 6.5 and painted according to Paint system NA-3-Ch-Out
9	Carbon steel pipe flanges		Outdoor Paint system NA-1-Ch-Out or NA-2-Ch-Out
10	Galvanized pipe work	Cleaned according to Part 6.2 (g) and any damaged areas repaired as specified in 6.5.	Indoor Paint system NA-3-Ch-In Outdoor Paint system NA-3-Ch-Out
11	Galvanized items	Cleaned according to Part 6.2 (g) and any damaged areas repaired as specified in 6.5.	Indoor Paint system NA-3-Ch-In Outdoor Paint system NA-3-Ch-Out
12	Fixings	Connections between galvanized surfaces and copper, copper alloy or aluminum surfaces shall be protected by suitable tape wrapping subject to approval by the Owner	After fixing, bolt heads, washers and nuts shall receive two coats of zinc rich paint.
13	Hot surfaces: 120°C continuous temperature and 135°C peak temperature <ul style="list-style-type: none"> • Potroom ductwork • Filter compartments • Ductwork between Filters and Stack • Main Exhaust Fans • Stack 	Subject to approval by owner. When coating live equipment considerations must be taken to temperature of the coated surfaces which may be up to 140°C when coated.	Hot surfaces inside Paint system NA-1-Ch-Hot Hot surfaces outside Paint system NA-2-Ch-Hot

8 Maintenance and Touch Up of Corrosion-Protection Coatings

8.1 Cleaning of surfaces

- (a) In general for cleaning of surfaces, reference is made to Part 6.2 in this Standard.
- (b) All surfaces to be painted shall be free from dirt, grease, dust, salts, etc. and shall be cleaned prior to application of an additional paint layer. The old coating must have a faultless binding to the under layer, which shall not be affected by the additional layer. The entire surface must be prepared by hand using appropriate detergents and rinsed with clean water. The surface shall fulfill SSPC SP 1.
- (c) Where minor damages to paint are to be repaired the surfaces shall be cleaned of all corrosion products and loose and flaking paint with mechanical devices. Mechanical cleaning shall be carried out with spark free devices to St 3 according to EN ISO 8501-2.

- (d) Spot blasting which can be carried out shall be according to Sa 2.5 according to EN ISO 8501. Coatings near repairs shall be smoothen down.
- (e) All types of pre-treatment of remaining corrosion-protection coats that are to be overpainted shall be carried out cautiously to avoid damage. Transitions between bare steel and intact corrosion protection shall be gradual, and the edges must be sanded down and the area cleaned before it is re-painted with the number of coats that have been damaged.
- (f) For total repainting of structural elements blast cleaning may be used if appropriate. Blast cleaning shall be according to EN ISO 8501-1. Abrasive materials shall be in accordance with EN ISO 11124 and EN ISO 11126. The blasting abrasive shall be chosen so that the specified roughness and cleanness is obtained.
- (g) Prior to selecting paint system, the generic type of the existing coat should be tested by rubbing the surface with a cloth wet from xylene. If the existing paint is easily dissolved, the existing system is physically drying, if the cloth becomes only slightly discolored, the existing paint system is chemically hardening. Chemical curing coating cannot be applied on top of physically drying coating. In case of chemically hardening the subsequent paint systems should also be chosen from table A.2 in appendix 1; in case of physically drying system, the subsequent paint systems should be chosen from table A.3.

8.2 Application of paint

- (a) In general for application of paint, reference is made to Part 6.3 in this Standard.
- (b) Recommended painting system for painted surfaces shall in general be in accordance with table 7.1 in this standard. If the existing coat is tested to be physically curing (section 8.1(g)) then the equivalent physically curing coating system should be chosen according to table A.3 in appendix 1.
- (c) Recommended painting system for galvanized surfaces (not to be over coated) shall be according to Part 6.5 (i).
- (d) Final color shall match the original color of the undamaged surfaces of the steelwork. For larger areas the color shall be in accordance with Appendix 1.

9 Bright parts coating

- (a) **Treatment at Maker's Works:** Coat with a mixture of oil, grease or approved proprietary inhibitor.
- (b) **Treatment at Site after Completion of Erection:** Clean and polish.

10 Appendix 1

10.1 Norðurál Color Codes

Table A.1- Norðurál Color Codes

Item	Location	Color	Abbr.	Ral Color Code
Compressed air	Na	Grey	CA	RAL 7001
Fluidizing Air	Na	Light blue	FA	RAL 5012
Air Slide	Na	Blue green	SA	RAL 5021
Potable Water	Na	Blue	PW	RAL 5017
Process/Cooling Water	Na	Green	IW	RAL 6029
Diesel Fuel	Na	Grey		RAL 7001
LPG Fuel	Na	Orange	GF	RAL 2008
Hydraulic	Na	Brown	HY	RAL 8002
Virgin Alumina	Na	White	VA	RAL 9003
Reacted Alumina	Na	White w/Yellow Backslashes	RA	RAL 9003 RAL 1018
Alumina Fluoride	Na	White	AF	RAL 9003
Crushed Bath	Na	Blue Green	CB	RAL 5021
Carbon Dust	Na	Violet	DC	RAL 4001
Carbon Classified	Na	Purple	CC	RAL 4006
Fire Hydrant and Equipment	Na	Red	FI	RAL 3020
Pot Tending Machine	Potroom	Yellow Orange Blue Green	PTM	RAL 1023 RAL 2009 RAL 5017 RAL 6032
Crane	indoor	Yellow/Red		RAL 1023 RAL 2009
Alumina Storage Silos	Outdoor	Blue		NCS 4050 B10G
Structural steelwork	Indoor	Mid-Grey		RAL 7032
Structural steelwork	Outdoor	Blue		NCS 4050 B10G
Cladding of roof, walls and roof ventilators	External	Blue		NCS 4030 B30G
Cladding of roof, walls and roof ventilators	Internal	Blue		NCS 0603 G39Y
Flashings	External	Blue		NCS 4030 B30G
Flashings	Internal	Blue		NCS 0603 G39Y
Gutters	Outdoor Both Sides	Blue		NCS 4050 B10G
Galvanized Steel Doors	Outdoor Indoor	Blue		NCS 4050 B10G
Sectional Overhead Doors	Outdoor Indoor	Blue		NCS 4050 B10G
Escape Doors	Outdoor Indoor	Yellow		RAL 1018
Flooring and Hand railing	Outdoor	Yellow		RAL 1018
Steelwork, Fume Treatment Plant Hot surfaces	Na	Mid-Grey		RAL 7032
Instrument panels	Indoor	Mid-Grey		RAL 7032
Relay panels	Indoor	Mid-Grey		RAL 7032
Control panels	Indoor	Mid-Grey		RAL 7032
Junction boxes	Indoor	Mid-Grey		RAL 7032
Switchgear enclosures	Indoor	Mid-Grey		RAL 7032
Holding furnace	Cast house	Grey	HF	RAL 9006
Casting line	Cast house	Grey	CL	RAL 9006
Trough System	Cast house	Grey	TS	RAL 9006
Platforms/ hand rails	Cast house	Yellow	AP	RAL 1023
Casting line structure	Cast house	Blue	C	RAL 5013
Gear motors	Cast house	Blue	GM	RAL 5013
Strapping machine	Cast house	Yellow	SM	RAL 1023
Robot	Cast house	Yellow	RM	RAL 1004
Vehicles	Rodding shop	Yellow		RAL 1023
Machinery	Rodding shop	Grey		RAL 7038
Lower Walls	Rodding shop	Yellow		RAL 1023
Upper walls	Rodding shop	Grey		RAL9018
Access doors	Rodding shop	Blue		RAL 5015

Safety colors	Rodding shop	Yellow Green Red		RAL 1023 RAL 6018 RAL 3026
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ALTERNATIVE COLORS ARE SUBJECT TO APPROVAL BY THE OWNER

10.2 Norðurál Coating Systems

These tables show physical drying and chemical curing coatings systems for the different corrosivity categories C3 indoor and C5-M outdoor. All systems have the expected lifetime above 15 years for the given indoor and outdoor exposure. All systems require initial cleaning to fulfil SP 1. Standards referenced in tables are EN ISO 8501-1 (Cleanness) and EN ISO 8503-1 (Roughness).

10.2.1 Chemical Curing Coating Systems

Table A.2: Chemical Curing Coating System (Topcoat dissolves not in xylene thinner)

Nr	Substrate	Type of cleaning	Surface preparation	ISO 12944 Category	Expected Lifetime	Coating type (dry film thickness range)
NA-1-Ch-In	Steel	Spot repairs / Full blasting	Cleanness St 3 (spot only) / Abrasive Sa 2.5 Roughness Medium (G)	C3 A3.09	>15 years	2-3 x Surface Tolerant High build epoxy (125-150 µm) 1-2 x Polyurethane (50-75 µm). Total dft 200 µm minimum.
NA-2-Ch-In	Steel	Spot repairs / Full blasting	Cleanness Sa 2.5 Roughness Medium (G)	C3 A3.11	>15 years	1 x Epoxy zinc (50-70 µm) 1 – 2 x High build epoxy (75-100 µm) 1-2 x Polyurethane (50-75 µm). Total dft 160 µm minimum.
NA-3-Ch-In	Hot dipped galvanize d steel	Decreasing	Cleanness Mechanical or light sweeping	C3 A7.10	>15 years	1 x Surface Tolerant High build epoxy (50-70 µm) 1-2 x Polyurethane (50-75 µm). Total dft 120 µm minimum.
NA-1-Ch-Out	Steel	Spot repairs / Full blasting	Cleanness St 3 (spot only) / Sa 2.5 Roughness Medium (G)	C5-M A5M.02	>15 years	2 – 3 x Surface Tolerant High build epoxy (245-300 µm) 1-2 x Polyurethane (50-75 µm). Total dft 320 µm minimum.
NA-2-Ch-Out	Steel	Spot repairs / Full blasting	Cleanness Sa 2.5 Roughness Medium (G)	C5-M A5M.06	>15 years	1 x Epoxy zinc (50-70 µm) 2 – 3 x High build epoxy (125-175 µm) 1-2 x Polyurethane (50-75 µm). Total dft 320 µm minimum.
NA-3-Ch-Out	Hot dipped galvanize d steel	Decreasing	Cleanness Mechanical or light sweeping	C5 A7.13	>15 years	1-2 x Surface Tolerant High build epoxy (250-270 µm) 1-2 x Polyurethane (50-75 µm). Total dft 320 µm minimum.
NA-4-Ch-Out	Zinc/aluminum	Decreasing	Cleanness Mechanical or light sweeping	C5-M A8.02	>15 years	2-3 x Surface Tolerant High build epoxy (165-190 µm)

						1-2 x Polyurethane (50-75 μm). Total dft 240 μm minimum.
NA-1-Ch-Im	Steel	Full blasting	Cleaness Sa 2.5-3 Roughness Rough Medium (G)	Im A6.04(H)	>15 years	1 x Epoxy primer (50-70 μm) 2 -3 x Epoxy glass flake (430-450 μm) 1-2 x Polyurethane (50-75 μm) Total dft 560 μm minimum.
NA-1-Ch-Hot	Steel	Full blasting	Cleaness Sa 2.5-3 Roughness Rough Medium (G)	C3 A3.11	>15 years	As per suggestion subject by approval by owner
NA-2-Ch-Hot	Steel	Full blasting	Cleaness Sa 2.5 Roughness Rough Medium (G)	C5 A5M.06	>15 years	As per suggestion subject by approval by owner
NA-1-Ch-Shop	Steel	Full blasting	Cleaness Sa 2.5 Roughness Rough Medium (G)	C5 N/A	>12 months	1 x Zinc ethyl silicate shop primer (15-30 μm). Total dft 15-30 μm .

10.2.2 Physical Curing Coating Systems (Topcoat dissolves in xylene)

These specifications are only for maintenance of existing coatings that are physically drying and dissolve in xylene. Adhesion and compatibility tests need to be done to ensure full integration.

Table A.3: Physically curing coating system used in maintenance program

Nr.	Substrate	Type of cleaning	Surface preparation	ISO 12944 Category	Expected Lifetime	Coating type (dry film thickness range)
NA-1-Ph-In	Steel	Spot repairs	Cleaness Sa 2.5 or mechanical St 3	C3 A3.03	>15 years	2 x Surface Tolerant High build epoxy or acrylics (130-165 μm) 1-2 x Acrylics (40-70 μm). Total dft 200 μm minimum.
NA-2-Ph-In	Steel	Spot repairs	Cleaness Sa 2.5	C3 A3.12	>15 years	1 x epoxy zinc (50-70 μm) 1 – 2 x High build epoxy or acrylics (65-85 μm) 1-2 x Acrylics (40-70 μm). Total dft 160 μm minimum.
NA-3-Ph-In	Hot dipped galvanize d steel	Decreasing and Spot repairs	Cleaness Mechanical St 3	C3 A7.07	>15 years	1 x Surface Tolerant High build epoxy or acrylics (90-120 μm) 1-2 x Acrylics (40-70 μm). Total dft 160 μm minimum.

NA-1-Ph-Out	Steel	Spot repairs	Cleanness Sa 2.5 or mechanical St 3	C5-M A5M.02	>15 years	3– 4 x Surface Tolerant High build epoxy (320 µm) 1-2 x Acrylics (40-70 µm). Total dft 360 µm minimum.
NA-2-Ph-Out	Steel	Spot repairs	Cleanness Sa 2.5	C5-M A5M.06	>15 years	1 x epoxy zinc (50-70 µm) 2 – 3 x High build epoxy (250-270 µm) 1-2 x Acrylics (40-70 µm). Total dft 360 µm minimum.
NA-4-Ph-Out	Zinc/aluminum	Decreasing and Spot repairs	Cleanness Mechanic St 3	C5-M A8.02	>15 years	2-3 x Surface Tolerant High build epoxy (240 µm) 1-2 x Acrylics (40-70 µm). Total dft 280 µm minimum.