Title	**CORROSION PROTECTION - guideline** **Execution Guidelines (KAR)** **Quality Assurance Plan (QAP) &** **Packaging, cover and storage specification**		
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Design

1. Applicable standards and regulations

DIN EN ISO 12944	Paints and varnishes - Corrosion protection of steel structures by protective paint systems 1-8
DIN EN ISO 12944-3	Corrosion protection of steel structures by protective paint systems - Design considerations.
DIN EN ISO 8501	Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness, incl. processing with laser technology rounding off / braking edges 1-4, < 2 mm.
DIN EN ISO 8503	Preparation of steel substrates before application of paints and related products - Surface roughness characteristics of blast-cleaned steel substrates 1-5
DIN 18364	German construction contract procedures (VOB) - Part C: General technical specifications in construction contracts (ATV) - Corrosion protection of steel structures, with corresponding DIN EN ISO 14713 Zinc and aluminium coatings - Guidelines and recommendations for the protection against corrosion of iron and steel in structures and the DSTV directive "Corrosion protection of steel structures in ambient atmospheric conditions by coating systems".
DIN EN ISO 1460	Hot-dip galvanized coatings on ferrous materials - Gravimetric determination of the mass per unit area.
DIN EN ISO 1461	Hot-dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods.
DIN EN ISO 14713	Zinc coatings - Guidelines and recommendations for the protection against corrosion of iron and steel in structures - Part 1 - 2: Hot-dip galvanizing
DIN EN 55633:2009	Paints and varnishes - Corrosion protection of steel structures by powder coating systems (not permissible with silicone and wax proportions)
DIN EN 55634	Paints, varnishes and coatings - Corrosion protection of supporting thin-walled building components made of steel (April 2010) nominal plate thickness < 3 mm.
DIN EN 10025-2	Hot rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels; German version EN 10025-2:2004
DIN EN 10204: 2005-01	Metallic products – Types of inspection documents German version EN 10204:2004
ISO 19840	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Measurement of, and acceptance criteria for, the thickness of dry films on rough surfaces; First edition 01.11.2004.
DIN 50978	Testing of metallic coatings; adherence of hot-dip zinc coatings.

DIN EN ISO 2178	Non-magnetic coatings on magnetic substrates - Measurement of coating thickness - Magnetic method (ISO 2178:1982); German version EN ISO 2178:1995.
DIN EN 10025-2	Hot rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels; German version EN 10025-2:2004
DIN EN 10204: 2005-01	Metallic products – Types of inspection documents
DIN EN 1090-2:2011-10	Execution of steel structures and aluminium structures - Part 2; German version EN 1090-2:2008+A1:2011
AGI - worksheet: K 20	Corrosion protection of steel by duplex systems (hot-dip galvanizing + coating); 2011-1
AGI - worksheet: K 151	Corrosion protection under heat and cold insulation in operating facilities. (CUI – Corrosion Under Insulation)

In addition, standards and conditions have to be observed or used:

DIN 55530:2011-05 (PE-LD)	Barrier materials made of low density polyethylene
DIN 55531-1 2011-05	Composite aluminium films (TL 8135-0)
DIN 55474:2015-3	Seaworthy packaging (barrier foils)
	Martin " Double APRON SEAL " Skirting System " in separate execution guideline according to the safety data and their data sheets
	Provisions of coating material manufacturers and their safety data and product data sheets

Abbreviations:

AN – Contractor
AG – Client
KAR– Corrosion Protection Execution Guidelines
QSP– Quality Assurance Plan

2. General

2.1 Scope

These CORROSION PROTECTION Execution Guidelines (KAR) and the Quality Assurance Plan (QSP) apply to all steel parts of the existing KNAUF plants to be coated, to new plants under construction as well as to any reconstruction of existing plants.

The Execution Guidelines and Quality Assurance Plan are binding for all system parts to be delivered by the Contractor.

The packaging, cover and storage specifications according to the additional standards, guidelines and conditions of KNAUF Engineering are binding as well.

The CORROSION PROTECTION Execution Guidelines and Quality Assurance Plan apply to the atmospheric corrosion protection, ambient conditions of steel components according to DIN EN ISO 12944-1 and DIN EN ISO 12944-2.

Delivery by the Contractor (AN):
Regardless of the listed CORROSION PROTECTION Execution Guidelines (KAR) and Quality Assurance Plan (QSP) as well as storage specification, the manufacturer is liable for the delivery quality of the goods up to the handover to the client.

2.2 Execution Guidelines

The Contractor bears the full responsibility for the corrosion protection work. The contractor shall ensure the use of qualified staff, the compliance with the quality assurance, the compliance with the coating preparation specification of the manufacturer and the creation of the required documentation.

The Contractor is furthermore responsible for the proper use of the specified coating materials, the execution guidelines, equipment, auxiliary materials and logistics taking into account the relevant provisions, in particular the relevant national and international safety regulations and environmental requirements.

The Contractor has to ensure that subcontractors receive the necessary specifications and comply with the specified coating systems.

Basically, only coating materials from one manufacturer may be used within a coating system (primer, sealer and top coating). Deviations are not allowed.

The provisions regarding relative air humidity and object temperature of the steel components comply with ***Table 01*** and 3K above the dew point temperature of the ambient air must be strictly observed. The maximum object temperature must not exceed the maximum permissible temperature specified by the manufacturer of the coating material. During the coating works on the construction site, the dew point and temperature measurements have to be performed on a continuous basis and fully recorded.

If required, the Contractor can use the electrical heater blowers; oil- and gas-fired fans are not allowed. The explosion and fire protection when using heating devices for coating works must be observed by the Contractor.
During blasting and coating works, the climatic conditions temperature (LF), rel. air humidity (RL), object temperature (OT) and in particular the dew point value (T) must be measured in temporary facilities and on the construction site.

Coating materials must not be applied to damp surfaces (e.g. as a result of rain, fog or condensation moisture).

Dust residues and surface roughness (Rz) must also be checked. The determined data must be documented by photographs. The relevant measuring devices shall be provided by the Contractor.

All assembly and welding works as well as the removal of welding residues, e.g. welding beads, burrs, etc., must be done before the beginning of the coating works.

Pipes shall be thoroughly blown off before leaving the blasting area. The pipe ends must be closed according to project-specific requirements.

Pipe ends must be closed with plastic caps at the manufacturer and secured with adhesive tape. Pipes without plastic caps may not be delivered to and stored at the construction site. Tube caps may be removed only immediately before installation.

Exposed system components such as platforms, pipe bridges, pipes etc., must be covered with UV-resistant coating materials.

The corrosion protection design of the steel construction must be observed.

Edges and welding points must meet the requirements of EN ISO DIN 12944-3 (Section 5.4, Annex D, Fig. D5).

After the surface preparation and/or after the blasting or manual derusting and before coating at the manufacturer, assembly welding edges in the impact area shall be masked with about 50 mm adhesive tape.

Bulb plates, etc. must not be covered with tape, but must be coated with strippable varnish with a dry film thickness of at least 150 µm.

The readability of all markings on steel and pipe components (e.g.: Material and pipe identification no.) must be ensured after the surface preparation and coating.

The system parts, equipment, piping, cable trays, grating, wall and floor surfaces, etc. which are already installed shall be covered by the Contractor with paper and foil during the coating works. In particular, electrical control devices, etc. shall be wrapped and masked with foil.

The client reserves the right to have the specified corrosion protection, in temporary facilities and on the construction site, checked by a "paint inspector".

Components provided with fire protective coating according to DIN EN ISO 4102 require only one primer coating approved by the coating material manufacturer for fire protection coating. The safety and product data sheets must be strictly observed.

Cutting edges shall be coated with zinc dust paint, "zinc sprays" must not be used.

Stainless austenitic steel (CrNiMO) type 316 containing molybdenum (Mo) (material no.1.4401) and type 316 L (material no.1.4404) shall be coated only in case of corrosiveness category C5-M (sea).

The drying times and the complete hardening of the corresponding applied coating materials must be observed according to the technical data sheet of the coating material manufacturer.

2.3 Climatic and atmospheric conditions (on site) for coating materials

At the manufacturer and on the construction site, the following climate parameters, as well as the technical data sheet of the respective coating material manufacturer, must be strictly observed:

Table 01: Climatic conditions for coating materials

Climatic conditions	min. Temperature	max. Temperature	Coating materials
Ambient temperatures	≥ 5°C		Solvent-free coating materials
Ambient temperatures	≥ 10°C		Waterborne coating materials
Object temperature	≥ 5°C		Solvent-containing coating materials
Object temperature	≥ 10°C		Waterborne coating materials
relative air humidity	≤ 80 %		
Dew point distance	≤ 3 K	≤ 3 K	

Note: The object temperature must be at least 3K (3°C) above the dew point temperature, i.e.: LT 20°C / RL 70% = 14.4°C + 3K = 17.4°C TT.

2.4 Colouring

Single coatings laid on top each other must have different colours.
Each coating must have a clearly different colour from previous coating.

For the top coating, the specified colourings shall be used in accordance with Table 02.

Table 02: Colour concept

Description	Colouring	Note
Outer surfaces	RAL 1015 light ivory, silk-matt	
Insulated outer surfaces	RAL 7035 light grey	
Equipment	RAL 9006 white aluminium	
protective device [1])	RAL 1003 signal yellow, silk-matt	
Protective fences, frame [1])	RAL 1003 signal yellow, silk-matt	
Protective fences, grating [1])	RAL 9005 black, silk-matt	
Stainless steel parts	Etched and passivated	

Legend: [1]) Safety colours according to DIN 4844-1:2012-06 yellow/black contrast

2.5 Corrosiveness category for atmospheric influences

When selecting the coating systems, the local ambient conditions with the different corrosion loads covered by the corrosiveness categories C1 to C5 have to be taken into account.

The corrosiveness categories for atmospheric pollution and typical environments, are divided into six categories in accordance with DIN EN ISO 12944:

Table 03 Corrosiveness classification

Corrosiveness category	**Indoor area** Typical environment	**Outdoor area** Typical environment	Corrosion load
C1	Only indoor areas insulated buildings		►insignificant
C2	Unheated buildings	Atmospheres with low , Contamination mostly rural areas	► low
C3	Rooms with high humidity and low air contamination	City and industry atmosphere with moderate S02 load	► moderate
C4	Chemical plants, Swimming pools	Industrial and coastal atmosphere with moderate Salt level	► strong
C5 I	Areas with almost constant condensation and high contamination	Industrial areas with high humidity and aggressive atmosphere	► very strong (industry)
C5-M	Buildings or areas with almost constant Condensation	Coasts and offshore with High salt levels	► very strong (Sea)

3. Surface preparation

3.1 Surface preparation (blasting) at the manufacturer

The surface preparation is to be carried out according to DIN EN ISO 12 944-4, ISO 8501-1 / SSPC- SP 10.

The surface to be coated must be checked before surface preparation for visible and not visible contamination, according to DIN EN ISO 12 944-4, section 4.10.2. In particular, oils, greases, waxes, various types of dissolving salts, sulphates and chlorides, as well as dust residues and condensation, must be completely removed before blasting.

The components are to be blasted through blast derusting, coating system, after the surface preparation factor Sa2½ according to DIN EN ISO 12 944-4. The roughness (Rz) of the blasted surfaces is 60 to 100 µm (Rz) and corresponds to the roughness "medium" (G) ISO 8503-1.

Table 04: Surface preparation, national and international standards

Germany 12944-4 ISO 8501-1	England BS 7079 A 1	England BS 4232	Sweden SIS 055900	USA SSPC SP	USA NACE	Canada CGSB	Japan SPSS	China GB 8923
Blasting Sa 1	SA 1	Light blast to bruch off	SA 1	SSPC SP 7	NACE 4	31 GP 404 Type 3		SA 1 (?)
Blasting Sa 2	Sa 2	Third Quality	Sa 2	SSPC SP 6	NACE 3	31 GP 404 Type 2	JASh1/r JASd1/r	Sa 2
Blasting Sa 2 ½	Sa 2 ½	Second Quality	Sa 2 ½	SSPC SP 10	NACE 3		JASh2/r JASd2/r	Sa 2 ½
Blasting Sa 3	Sa 3	First Quality	Sa 3	SSPC SP 5	NACE 1	31 GP 404 Type 1	JASh3/r JASd3/r	Sa 3
St 2 PMa *)	St 2		St 2	SSPC SP 2				St 2
St 3 PMa *)	St 3		St 3	SSPC SP 3				St 3

Note: SIS 055900 Swedish Standart Institution (1967 Schweden) replaced by DIN EN ISO 8501-1
*) PMa = Partial machine manual rust removal

Only angular blasting abrasives according to DIN EN ISO 11127-1:2011 are permitted: Steel shot (GS); Garnet, electrocorundum (MKE) (ISO 11126-7:1995, copper slag (MCU) melted coal slag (MSK) according to ISO 11126-6:1993 and glass beads (MGL) according to DIN 8201-7, July 1985. The use of quartz sand is not permissible due to danger of silicosis.

Blasted surfaces must be free of contaminants, such as blasting material and welding splashes (welding beads) and must be ***immediately (within 4 hours) primed after the end of blasting.***

When processing steel surfaces with laser technology, the deburring, rounding off, and breaking of edges 1-4, < 2 mm according to DIN EN ISO 8501 is to be adhered to.

Moving parts, such as shafts, spindles of fittings as well as sealing surfaces of flanges must not be blasted. Machines and other components whose function can be impaired by blasting must not be blasted. If blasting is carried out near machines, motors, valves, level indicators, measurement and control equipment or similar sensitive equipment at the construction site, parts are to be protected against the ingress of blasting material or blasting dust residues.

3.2 Surface preparation (blasting) on the construction site

Secondary (partial) surface preparation is carried out on the construction site depending on the coating system.

Basically, only the ***"bristle blasting method"*** can used on the construction site for the subsequent removal of rust or preparation of steel surfaces, as well as for the removal of rust from welding seams etc.. Particularly because the surface preparation is comparable with the surface finish of Sa 2½ and approved in accordance with DIN EN ISO 8501-1. (Manufacturer: MONTI Industrial)

Basically, the contractor has to carry out a salt test (Brestle test) and dew point distance measurement (≥ 3K) on the coatings after surface treatment (blasting) in the coastal and sea area or similar atmosphere. The measured values are to be verifiably recorded with digital photos as a proof.

- Brestle test (soluble salt test) recommended according to ISO 8502-6 & 9, maximum salt content up to 20 mg/m² according to ISO 8502-3 (NaCl), unless otherwise recommended by coating manufacturer.
- Dust residues, dust content according to ISO 8502-3 <2; size <2
- Condensation, dew point distance of ≥ 3K are to be strictly observed.

Degree of purity, according to SA 2½, with roughness measurement Rz 100 µm, "Bristle Blasting method" with "Testex Press-O-Film Kit" according to ISO 8503-3

3.3 Surface preparation for powder coating

In case of powder coating the steel surfaces are to be prepared by degreasing or phosphatizing, galvanized steel surfaces by pickling through chromatizing (chromium-free), aluminium surfaces by anodizing.

In the case of surface preparation with the "Laser Technology" particular care is to be taken to ensure that the rounding off / breaking of edges 1-4, < 2 mm is carried out in accordance with DIN EN ISO 8501.

3.4 Surface preparation of hot-dip galvanized surfaces

Execution only in consultation with the client (AG)

If hot-dip galvanized plant components are to be coated, the surface is basically to be roughen up by "Sweeping".

For "sweeping" as well as for galvanized surfaces with "white rust", suitable, mineral (ferrite- and chrome-free) blasting abrasives are to be used with low pressure according to DIN EN ISO 12 944-4. The roughness (RZ) of galvanized surfaces has to be 20 to 30 µm (RZ).

A surface preparation and/or pretreatment of the zinc coating is usually required to ensure the adhesion of a coating after hot-dip galvanizing. Any typical (e.g. white rust) and atypical product impurities (e.g. dirt, oil, grease, waxes, etc.) must be completely removed beforehand. The execution of the proper surface preparation lies within the responsibility of the contractor.

3.5 Surface preparation of stainless austenitic steel

(Only for corrosiveness category CM5)

The surface preparation on stainless austenitic steel is to be roughened up by "sweeping". The roughness (RZ) has to be 20 to 30 µm (RZ).

3.6 Intermediate cleaning before on site coating (TOP coat)

Impurities such as salt deposits, waxes, greases and oils must be completely removed or washed out before blast derusting, with HDW high pressure water washing with minimum 500 bar pressure, water temperature of ≤ 70°C and at least 15 Mpa, (ph value 6-8).

3.7 Surface preparation of stainless steel

Steam degreasing with chlorinated solvents and mechanical surface preparation on the construction site, generally depending on the coating system.

4. Application of coating systems

The coating systems must be in accordance with DIN EN ISO 12 944-5, (NDFT = nominal dry film thickness).

4.1 Coating at the manufacturer / construction site

The coating materials and coating systems are to be selected in accordance with DIN EN ISO 12944-2 for the exposure according to corrosiveness category CI to C5-M with the protection duration "HIGH-(H)".

Corrosiveness category C5-M is present if the plant is located less than 1 km from the sea.

The protection duration of a coating system is defined as the expected lifetime of a coating system until the first partial replacement. DIN EN ISO 12944 defines five time periods for the protection duration:

Abbreviations: ***VL*** *= very low (protection duration 0 to < 2 years);* ***L*** *= low, (protection duration 2 to < 5 years);* ***M*** *= medium (protection duration 5 to < 10 years);* ***H*** *= high , (protection duration 10 to < 20 years);* ***VH*** ***=*** *very high (protection duration ≥ 20 years).* The protection duration is not a guarantee period.

Steel construction parts to be coated, immediately after the surface treatment, are provided the required primer (sealer) and top coating, according to the execution guidelines, depending on the coating system.

Only products of coating material manufacturers may be used, which meet the recent directives of 01.01.2007. V.O.C. emissions (Volatile Organic Componds) EU Directives 199/12 EC, 31.BlmSchV (Federal Emission Control Act), the EU Directive 2004/42/EC, Chem.VOVFarbV (Decopaint Directive)

For the storage and processing of the 1-component good or 2-component coating materials, hardeners and dilutions, the corresponding legal provisions (safety container) as well as the safety and product data sheets of the coating manufacturer must be observed.

The application of coating has to be carried out at the manufacturer by means of airless spraying technique, on the construction site basically with a brush, a short-pile lambskin roller.

The application of sealer and top coating with the roller / brush is allowed only if the coating material is suitable for this, according to the data sheet of the coating manufacturer.

In case of hot-dip galvanized surfaces and stainless austenitic steels, the top coating may only be applied with the roller / brush.

After the final assembly on the construction site, touch up works are carried out, after required manual or machine derusting, depending on the respective coating structure, according to the execution guidelines.

Joints with joint insulation - or sealing - before the last top coating, are basically to be sealed using manual compressed air or cordless gun (Skiaflex 11 FC or equivalent).

Following application procedures are allowed by the manufacturer:

- Coatings: Airless – spraying technique
- Hardly accessible places such as notches, angle sections, corners, etc. must be pretreated with the brush; holes must be pretreated
- Top coatings and touch ups with short-pile roller and brush.

4.1.1 Machines, motors, valves, shafts, spindles, etc.

Before subsequent coating of fittings, machines, motors, etc. the type of the selected coating as well as the rated temperature, the respective equipment parts are to be checked by the contractor.

4.1.2 Connections and counterflange connections and pipes, etc.

All sealing surfaces of spools, flanges, spindles and packing glands of fittings, etc. are to be carefully protected before blasting with plastic caps, etc.

The marking for the identification of the supplied pipe parts to be coated shall be carried out by the contractor for the pipe assembly.

4.2 Coating in the mounting field (construction site)

Coating of steel components, such as steel structures, tanks, containers, pipes, connection flanges, apparatuses, etc.

4.2.1 Steel containers (containers welded at the assembly site)

After the assembly of steel tanks or silos with connection flanges, etc., delivered with a prime coat, the welding seams and welding edges are to be processed by partial blasting or subsequent machine derusting, i.e., roughening up (surface preparation factor PSa 2½ or PMa according to EN ISO 8501-2/SSPC-SP 10). The prime coat is to be applied immediately. In case of the PMa, subsequent roughening up with a grain size of 60 to 80 is mandatory before coating. The further coating is carried out according to the applicable coating system depending on the corrosiveness.

4.2.2 Bolted steel structures

In case of primed bolted steel structures, the joints in the flange connections are to be insulated and sealed after the assembly on all sides with a 1K plasto-elastic joint sealing compound or an acrylic resin-based compound. Silicone joint seals are not permitted.

4.2.3 Screw connections

Ferritic nuts and bolts are processed by a manual rust removal and provided with the complete coating system. The screw connections prepared with industrial lubricant (Molykote®) must be carefully cleaned with a suitable solvent and completely coated.

4.2.4 Steel structures, stairs, walkways, platforms and pipes, etc.

For stairs, walkways and platforms, it has to be ensured that the complete coating system was applied to the bearing surfaces of the steel structure and cured appropriately before inserting the gratings.

Note: Gratings are to be reinstalled correctly after dismantling in accordance with the safety regulations.

4.3 Steel components and pipelines, heat- resistant coating 600°C

Steel components, pipelines and pipe supports with a rated temperature of up to 600°C shall be provided with the primary (sealer) and top coating at the manufacturer or on site, according to the heat-resistant coating system.

Plant parts to be isolated shall be provided with a primer coat.

Parts and related steel components protruding from the installation shall be coated with a corresponding colour.

Note: Coated and bundled pipes of heat tracing must not be bent.

4.4 Powder coating (hot-dip galvanized) steel

The application of the powder coating shall be carried out according to DIN 55633:2009-04**,** as well as the technical data sheet of the coating material manufacturer.

An adhesion test of the test coating is to be carried out and documented.

Powder coating with wax or silicone resin components is not allowed.

In powder coatings there can have different versions. Most of them can be easily overcoated with a 2K PUR, while other powder coatings contain wax components which can cause adhesion problems.

4.5 Coating on stainless steel

Stainless steel parts are coated only with corrosiveness category C5-M (sea) according to coating system 5.1 and 5.2.

Stainless steel parts pickling and passivating at the manufacturer

Stainless steel parts, depending on process class or corrosiveness category as well as depending on the atmospheric and heat exposure, are to be pickled and passivated, or passivated according to DIN EN 2516.

Table 07: Stainless steel parts pickling and passivating, according to ISO 16048

	Process class
Material type and name	Corrosiveness category
austenitic precipitation hardening steels	C1
austenitic stainless steels and ferritic steels	C3
ferritic and martensitic chromium steels	C4
martensitic precipitation hardening steels	C4

Table 08: Stainless steel parts pickling and passivating, according to DIN EN 2516

	Process class
Material type and name	Corrosiveness category
austenitic precipitation hardening steels	C1
austenitic stainless steels and austenitic / ferritic steels	C1 or C2
high-temperature resistant nickel alloys	C1 or C2
ferritic and martensitic chromium steels	C4
martensitic precipitation hardening steels	C4

5. Measures at the mounting site

Form of delivery (FCA):
Manufacturer's coating is to be tested at the entry to the construction site for scope of damage and documented with digital photos. The copy of this documentation is to be sent to the project management of KNAUF Engineering without request.

In case of delivery "free site" by the contractor (CIP):
Components with the manufacturer's coating delivered by the manufacturer to the construction site shall be checked immediately after arrival to the construction site for the actual condition of the coating and documented.

Surfaces damaged by transport and assembly as well as corroded points shall be touched up by the contractor depending on the applicable coating structure.

Touch up of coatings:
After assembly the corresponding coating systems shall be checked visually and if necessary the required cleaning and touch up measures, must be defined by the client (AG). The required cleaning is to be carried out by means of a high pressure water unit (HDW).

If a blast derusting is not feasible, the surface preparation of some part surfaces shall be the carried out by mechanical sanding. To do this, a permit with written confirmation of the client is mandatory.

The prepared secondary derusting areas are to be coated with a 2K epoxy resin zinc dust or a 1K polyurethane zinc coating. The top coating is carried out depending on the respective coating system or the execution guidelines.

Hot-dip galvanized surfaces are prepared according to DIN EN ISO 12944-4 Psa 2½ in damaged areas.

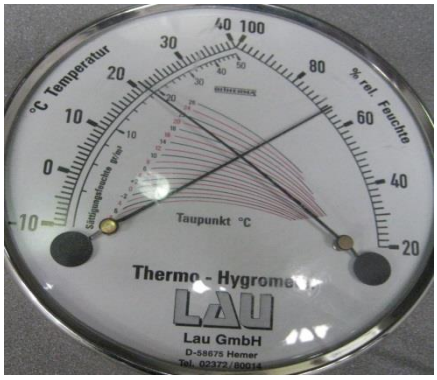
6. Quality monitoring of blasting and coating works at the manufacturer or on the construction site

For tests & inspections, the calibrated test equipment is to be used in accordance with the Table 11.

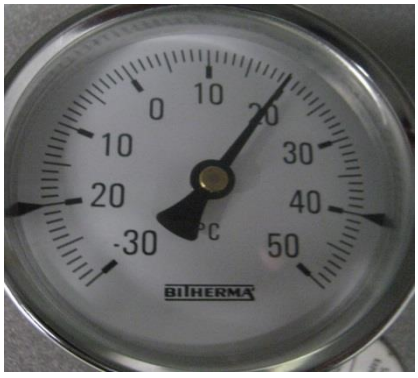
6.1 Test and measurement of the climatic conditions

Measurement data climatic conditions:
The specified ambient temperatures are to be strictly adhered to during the blasting and coating.

Ambient temperature	21,0 °C
Relative humidity	68 %
Object temperature	20.0 °C
Dew point (see dew points table)	14.9 °C



Measurement using a hygrometer for Ambient temperature, the relative Air temperature (RL) and dew point determination ≤ 3K



object temperature measurement (magnetic adhesive thermometer)

Initial state is rust grade A 8501-1 and surface preparation Sa 2½ blasted according to DIN EN ISO 12944-4, section 4.10.2, rust degree A ISO 8501-1, average roughness Rz 40-60 µm.

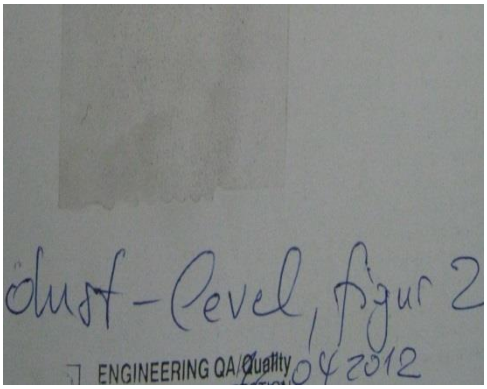
6.2 Test methods of blasting work

6.2.1 Examination of the degree of purity, visual inspection

Degree of purity, according to Sa 2½, Rz 40-60 µm ISO 8503-1

6.2.2 Examination of visual condition of surface preparation

Visual inspection of the condition of the surface for errors, such as welding error (welding beads) dust and salt residues, etc.



Dust content quantity < 2

6.2.3 Measurements of the roughness examination

Visual inspection of roughness and roughness management, according to ISO 8503-3 and examination of the degree of purity, particularly on welds and dust residue on the blasted and cleaned steel surface according to ISO 8502-3:2014-06

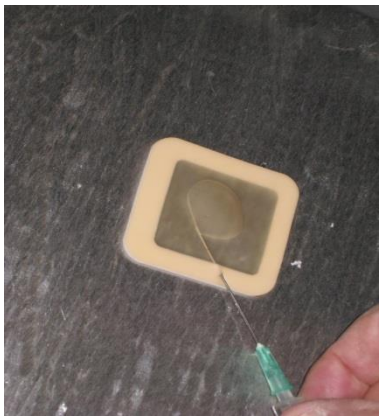
Blast profile of the surface after
Sa 2½, Rz 40-60 µm

roughness measurement of blasted surfaces
"Testex Press-O-Film Kit"

6.2.4 Test and measurements of the salt test (Brestle test)

The measurement of salt content "salt test (Brestle test)" shall be carried out in accordance with ISO 8502-6 and ISO 8502-9 after blasting the steel surface and the visual inspection of the surface preparation.

Maximum acceptable salt concentration is 20 mg / m² according to the quality level of ISO 8502-3 (NaCl). The quality level must be agreed with the coating material manufacturer.



Bresle test sampler with injection
of deionized water

conductivity meter
measurement result: 12.4 mg/m² (NaCl)

6.2.5 Crack checks on processing of thin-walled components with wall thickness of ≤ 3 mm

Thin-walled components with a wall thickness of ≤ 3 mm after surface treatment, especially after blasting, check for cracks according to DIN EN ISO 12944-4 /
EN ISO 1519 und EN ISO 4618-2

6.3 Test methods of coatings

6.3.1 Test and measurement of the wet film comb and dry film thickness measurement at the manufacturer and at the construction site:

The wet film comb measurement (µm thicknesses) is carried out by means of the wet film comb and dry layer thickness measurement by means of a digital LCD Qnix®1500 measuring device according to DIN EN ISO 2808, DIN 50984, ISO 2178 and documented in the control surface protocol.

To determine the average value, the individual measurements are added and divided by the number of measurements, see Annex Individual measurements.

Wet film comb, film thickness measurement (stainless steel comb)

Test of coating materials by digital dry film measurement

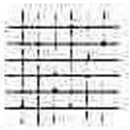
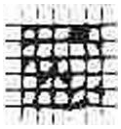
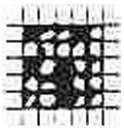
Determination of the coating materials according to DIN EN ISO 2808 - (ISO 2808:2007)
DIN 50981, DIN 50984, ISO 2178, BS 5411 (3 & 11), BS 3900 - C5, ASTM B 499, ISO 2360, ASTM D 1400, ASTM D 1186, ASTM D 7091

Dry film thickness measurement by means of a digital LCD Qnix®1500 measuring device

6.3.2 Test of coating materials – cross-cut test (Gt) and X-cut test (Kt) according to DIN EN ISO 2409:2013 (ASTM D 3359) on the construction site:

The 5 cross-cut tests (values Gt 0 to Gt 5) is used to determine the adhesion of single and multilayer coatings with the undercoat from good to very bad.

Table 09: Cross-cut values Gt 0 to Gt 5

Cross-cut values	Description	Surface in the area of the cross-cut in which the flaking off has occurred (example for 6 parallel cuts)
0	The cut edges are completely smooth, none of the squares of the grid is flaked off	—
1	At the intersection points of the grid lines, no cuts of the coating have flaked off. Flaked off surface is not larger than 5% of the cross-cut surface.	
2	The coating is flaked off along cutting edges or the at the intersection points of the grid lines. Flaked off surface is significantly larger than 5% but not larger than 15% of the cross-cut surface.	
3	The coating has flaked off along the cutting edges or partially in width stripes, and/or some squares have completely or partially flaked off. A cross-cut area which is significantly larger than 15% but not substantially larger than 35% is affected.	
4	The coating along the cutting edges has flaked off in width stripes, and/or some squares have completely or partially flaked off. A cross-cut area which is significantly larger than 35 % but not substantially larger than 65 % is affected.	
5	Any flaking off that can no longer as be considered cross-cut-value 4.	

Test of adhesion of coatings according to DIN EN ISO 2409 (with 6 cutting edges)

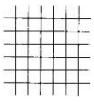
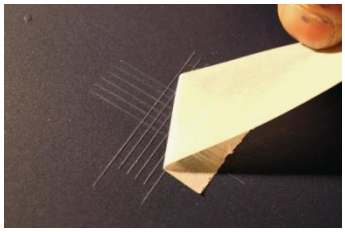




Table 10: Grid spacing in different layer thickness

Standard	Layer thickness (µm)	Multi-blade knife Quantity	Grid spacing (mm)
DIN EN ISO 2409	< 60 µm	1 x 6	1 mm
	60 and 120 µm	1 x 6	2 mm
	120 to 250 µm	1 x 6	3 mm
ASTM D 3359	< 50 µm	1 x 11	1 mm
	50 and 125 µm	1 x 6	2 mm

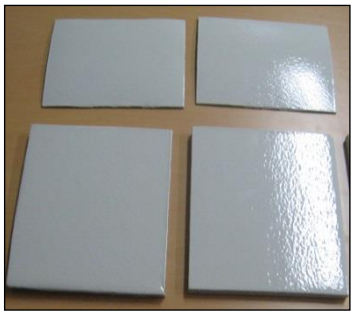
***X-cut tests** are carried out from > 250 µm film thickness*

Table 11: Characteristic value from KT 0 to KT 5

Description	Characteristic values
No peeling or flaking	Kt 0
Traces of peeling or flaking along the cuts or their intersection point	Kt 1
Serrated flaking along the cuts of up to 1.5 mm on each side.	Kt 2
Serrated flaking along the cuts of up to 3.0 mm on each side.	Kt 3
Peeling almost over the entire surface at the X under the tape	Kt 4
Flaking over the surface at the X and beyond,	Kt 5

6.3.3 Test and measurement of adhesive strength

Coated test plates for testing the adhesion for the adhesion and cohesion failure measurement, in accordance with ISO 4624.



Coated test plates

Test of adhesive strength = 7.13 MPa
Hydraulic pull off tester (manual)

Permissible limits:

- Adhesion failure measurement to the undercoat ≤ 5 MPa (≤ 5.0 N/mm²)
- Cohesion failure measurement under ≤ 3 MPa (≤ 3.0 N/mm²)

6.3.4 Pore examination, execution after consultation with the client.

100% pore examination of the required coating systems,
Defects after coating

100% pore examination of coating,
according to ISO 2746 (ASTM D 5162)

marking the open pores
"pinhole"

7. Quality assurance – requirements at the manufacturer/construction site

7.1 Layer thickness measurements

For coating thickness measurements only approved measuring instruments may be used in accordance with the DIN EN ISO 2808. The required nominal dry film thickness (NDFT) must be achieved at every point of the component.

7.1.1 The following definitions are given in the standard as acceptance criteria for the dry film thickness (NDFT):

- The average value of all measurements must be at least equal to or greater than the agreed layer thicknesses.
- All individual values of the dry film thickness must equal to or be greater than 80% the nominal layer thickness measurements.
- A maximum of 20% of the measured values must fall below the nominal layer thickness.
- No value may fall below the maximum specified layers thickness.

This means that no individual value must fall below 80 µm (NDFT) with a nominal thickness of 100 µm (NDFT) and that the average value of all measurements must equal to or be greater than 100 µm (NDFT). With 100 measurements, no more than 20 individual values may fall below 100 µm (NDFT).

7.1.2 The maximum layer thickness must not be greater than three times the nominal coating. Special arrangements can be made upon consultation with the coating material manufacturer.

7.1.3 The adhesion to the substrate surface and between individual coating systems, on average of 5 cross-cut values, must not be worse than Gt1.

7.1.4 Appropriate lifting accessories are to be used for transportation / sea transport and for the assembly of coated parts.

7.1.5 The coated parts may be transported only if the coating materials are hardened completely, in accordance with the coating material manufacturer.

An exception here is an unavoidable turning of parts during the coating process or a stacking at the location suitable for drying.

7.1.6 Coating by galvanizing:

Manufacturer / construction site – welding points and – cutting edges are to be touched up on all steel components, pipes, mounts, etc. with zinc dust coating ≤ 90% zinc.

***Note*: Zinc sprays or other coating materials are not allowed.**

7.2 Creating control surfaces

To determine possible causes of coating damage, the client, before the coating process and during the coating process, in consultation with the client, applicator and the coating material manufacturer, has to create control surfaces.

The client, however, reserves the right to a random check and to check the daily documentation.

The control surfaces are to be created in accordance with DIN EN ISO 12944-7 and to be identified in corresponding as-built drawings of the components. The as-built drawings of the components shall be made available to the contractor by the client for marking.

The number of control surfaces depends on the size of the object and the number of the applicable coating systems. Objects > 100 to 500 m² require one control surface, objects > 501 to 2,000 m² require 2 or 3 control surfaces.

7.3 Intermediate and final acceptance

The contractor provides a short description of its quality assurance system, the implementation of the request in accordance with DIN EN ISO 12 944-7 (execution and monitoring of the coating process) is to be described.

The contractor has to ensure quality assurance and construction-accompanying quality control of surface preparation and the application of coating materials and the inspections and tests with appropriate test instruments and to document them. The quality controls are to be carried out by qualified personnel (paint inspector).

Destructive test methods must not be used to ensure the quality of the coating of steel components, i.e.
► test plates are to be applied with the component to be coated.

Particular attention is to be paid to zinc dust coatings to ensure that - because of the danger of not sufficient adhesive strength - a thickness of 120 µm (DFT) on average is not exceeded. The product data sheets of the coating material manufacturer are to be observed.

7.4 Report & digital photo documentation

The contractor shall provide the measurement results with a complete report & digital photo documentation, with regular update (date and ongoing report no.), in accordance with table 6: Tests & examinations and the table 7: Carry out tests and measurements.

These are to be sent regularly without request via e-mail to the project management of Knauf Engineering.

The tests and measurements are to be documented in writing completely before and during surface preparation and before, during, and after the application and digital photos are to be made, in accordance with the "Coating Work Report" and the "Acceptance report" for the inspection at the manufacturer and construction site.

8. Warranty

The guarantee period for warranty claims for corrosion protection is determined by the client:

The contractor (AN) guarantees for the total corrosion protection, with the packaging, cover and appropriate storage, that

- During the warranty period, no changes of the undercoat to be protected and the surface treatment shall be detected.
- The required property values with the dry film shall not be changed.
- The coating system, as well as the final coat shall have no colour deviation and yellowing as a result of lack of resistance to UV or heat.
- Contaminants have been removed during the surface preparation and have not left any remaining marks.
- Coatings shall not be damaged by bacteria, algae and oil.
- Coatings and solvents contain no toxic or carcinogenic substances.

The coating material manufacturer has to confirm in writing that the respective corrosion protection coating systems meet the requirements for these objects and are suitable and with proper application according the coating material manufacturer's instructions meet the warranty requirements.

9. Execution guidelines for coating systems 1-6 (see Annex)

9.1 System 01 Finished coating systems at the manufacturer, construction site (topcoat)

9.2 System 02 Unalloyed, low-alloy steel at the manufacturer, construction site (topcoat)

9.3 System 03 Finished coating systems at the manufacturer, construction site (topcoat)

9.4 System 04 Heat-resistant coating systems for periodically alternating and highly corrosive atmosphere at the manufacturer, construction site (topcoat)

9.5 System 05 Sea transport, unalloyed, low-alloy steel at the manufacturer, construction site (topcoat)

9.6 System 06 Stainless ferritic and austenitic steel at the manufacturer, construction site (topcoat)

10. Technical data. Data sheets, inspection sheets and data safety sheets

- Product and safety data sheets of the coating material manufacturer
- Manufacturer documentation B&L Rivolta K.S.P. or KLÜBER Contractor Fluid H1
- Product and safety data sheets corrosion X HD
- Product data sheets for foil bags, shrink film wrapping or bag foil and fabric foil with mounting eyelets.

11. Corrosion protection of bare machine and steel parts

Machine parts, which have no coating, are to be provided with TECTYL 846-K-19 for corrosion protection for transport and storage.

The processing instructions of the manufacturer must be strictly observed.

Before the application of corrosion protection, surface preparations described in Chapter 3 are to be carried out.

12. Preservation

General
All steel components, machines and machine parts, pipes (spools), etc. as well as purchased parts shall be protected during transportation, storage and handling against atmospheric conditions. The safety and product data sheets of the corrosion inhibitor must be strictly observed.

Waxy or silicone-containing and similar preservatives are not permitted.

Exceptions are non-wetted parts, which are also protected against media by appropriate fixtures.

12.1 Preservation classes

K0 ► no preservation

K1 ► thin-film preservation
Preservation with all bare and not coated components
Preservatives with low-viscosity highly effective corrosion protection oil (V.O.C.-free)
Fabricate: B&L Revolt K.S.P. or KLÜBER Contractor Fluid H1

K2 ► Corrosion X HD heavy duty corrosion protection oil (silicone-free)
Lubricants for bearings, chains, hinges and rails, etc.

13. Packaging, cover and storage of coated plant parts

- During transportation, storage and handling (site), all steel and machine components must be protected against direct atmospheric influences.
- The packaging, cover and storage specification for uncoated and/or coated parts are to be strictly observed by the client (AG).
- Large contact points of foils and packaging are to be avoided or lined with suitable materials.
- All contact points to a wooden support must be provided with an impermeable barrier.
- Not permitted are packaging materials with corrugated cardboard, paper, etc. due to strong absorption of moisture.

- Polyethylene base barrier films, according to DIN 55530, and aluminium – composite foil according to DIN 55531 are permitted.
- Waxy and similar preservatives are absolutely prohibited.
- Closed film packaging, such as shrink film (*V2*) and boxes with foil lining (*V3*) are to be provided with appropriate sufficient desiccant.
- Polyethylene barrier films, in accordance with DIN 55530:2011-05 (PE-LD).
- Aluminium - composite film, in accordance with DIN 55531-1 2011-05 and TL 8135-0.
- Seaworthy packaging (barrier films) DIN 55474:2015-3.

Closed polyethylene film packaging must be provided with sufficient desiccant such as:

V1 ► foil bag open below, foil hood
Foil thickness min. 100 µm open to diffusion from the inside to the outside

V2 ► shrink film wrapping or bag foil closed
Open to diffusion from the inside to the outside

V3 ► boxes on the inside, lined with appropriate foil

V4 ► cover the parts with fabric foil with mounting eyelets as
Mounting material or equivalent.

14. Storage conditions (A to D at the manufacturer/construction site)

► **A** free storage
► **B** covered storage
► **C** in closed hall
► **D** in closed heated hall, min. + 8°C

15. Transport and storage matrix

	Storage	Modes of transport			
		Trucks covered by tarpaulin	Railway covered by tarpaulin	Sea	Sea container
Corrosion-resistant materials	A, B, C, D	K0	K0	K6	K6
Corrosion-sensitive materials	A, B, C, D	K6	K6	K6	K6
Corrosion-sensitive small parts	A, B, C, D	K1 + K4	K1 + K4	K6	K6

For storage type **A** always use additionally **K5**!!!

Explanation:
AK = 1K solvent-based and waterborne alkyd resins
AY = 1K solvent-based and waterborne acrylic resins
PVC = 1K-solvent-based vinyl chloride - copolymers
EP = 2K - low-solvent epoxy resins combination, with or without the addition of micaceous iron ore (EG)
EP (Zn) = 2K chromate-free zinc phosphate epoxy resin - prime coat / 2K - EP Zn (R) zinc dust primer
PUR = 1K, 2K- low-solvent polyurethane, with or without the addition of micaceous iron ore (EG)

9.1 - System 1.0 - complete coating of unalloyed and low-alloy steel at the manufacturer / touch up on the construction site

Coating systems for plant components at the manufacturer or temporary blasting and coating halls							*coating of the system parts, areas on the construction site*				
		Inner surfaces	***Outer surfaces***								
Paint system No	Type of substrate		Surface preparation	Primer coat	Sealer coat	Top coat	Surface preparation	Prime coat	Sealer coat	Top coat	Total NDFT µm Complete system Colour
System 1.1 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category up to **C1**	► unalloyed / low-alloy C-steels	Surface preparation ▲ Blasting Sa 2½ ¹) DIN EN ISO 12944-4 SSPC-SP10 Prime coat ▲ 1 K synthetic resin combination NDFT 40 µm airless process	►blasting Sa 2½ ¹) DIN EN ISO 12944-4 SSPC-SP10	► 1 K synthetic resin combination NDFT 40 µm Airless proc.		► 1 K synthetic resin combination NDFT 40 µm Airless proc.	► partial HE / manual rust removal St3, PMa	► touch up		► touch up	Colour concept **NDFT 80 µm** (nominal dry film thickness)
System 1.2 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category up to **C2**	► unalloyed / low-alloy C-steels		►blasting Sa 2½ ¹) DIN EN ISO 12944-4 SSPC-SP10	► 1 K PUR zinc polyurethane NDFT 80 µm Airless proc.		► 2 K PUR Polyurethane NDFT 80 µm Airless proc.	► partial HE / manual rust removal St3, PMa	► touch up		► touch up	Colour concept **NDFT 160 µm** (nominal dry film thickness)
System 1.3 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category up to **C3**	► unalloyed / low-alloy C-steels		►blasting Sa 2½ ¹) DIN EN ISO 12944-4 SSPC-SP10	► 2 K EP Primer NDFT 100 µm Airless proc.		► 2 K PUR Polyurethane NDFT 80 µm Airless proc.	► partial HE / manual rust removal St3, PMa	► touch up		► touch up	Colour concept **NDFT 180 µm** (nominal dry film thickness)
System 1.4 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category up to **C4**	► unalloyed / low-alloy C-steels		►blasting Sa 2½ ¹) DIN EN ISO 12944-4 SSPC-SP10	► 2 K EP Zinc phosphate NDFT 80 µm Airless proc.	► 2 K EP Micaceous iron ore NDFT 80 µm Airless proc.	► 2 K PUR Polyurethane NDFT 80 µm Airless proc.	► partial HE / manual rust removal St3, PMa	► touch up	► touch up	► touch up	Colour concept **NDFT 240 µm** (nominal dry film thickness)
System 1.5 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► Corrosiveness category up to **C5-I (M)**	► unalloyed / low-alloy C-steels		►blasting Sa 2½ ¹) DIN EN ISO 12944-4 SSPC-SP10	► 2 K EP zinc dust NDFT 80 µm Airless proc.	► 2 K EP Micaceous iron ore NDFT 80 µm Airless proc.	► 2 K PUR Polyurethane NDFT 80 µm Airless proc.	► partial HE / manual rust removal St3, PMa	► touch up	► touch up	► touch up	Colour concept **NDFT 240 µm** (nominal dry film thickness)
System 1.6 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► Corrosiveness category up to **C5-M (M)**	► unalloyed / low-alloy		►blasting Sa 2½ ¹) DIN EN ISO 12944-4 SSPC-SP10	► 2 K EP Zinc phosphate NDFT 120 µm Airless proc.	► 2 K EP Micaceous iron ore NDFT 80 µm Airless proc.	► 2 K PUR Polyurethane NDFT 80 µm Airless proc.	► partial HE / manual rust removal St3, PMa	► touch up	► touch up	► touch up	Colour concept **NDFT 280 µm** (nominal dry film thickness)
System 1.7 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category up to **C5-M(H)**	► unalloyed / low-alloy		►blasting Sa 2½ ¹) DIN EN ISO 12944-4 SSPC-SP10	► 2 K EP Zinc phosphate NDFT 120 µm Airless proc.	► 2 K EP Micaceous iron ore NDFT 120 µm Airless proc.	► 2 K PUR Polyurethane NDFT 80 µm Airless proc.	► partial HE / manual rust removal St3, PMa	► touch up	► touch up	► touch up	Colour concept **NDFT 320 µm** (nominal dry film thickness)

¹) Note: If the "blasting" cannot be applied, use other coating systems. The corrosion protection is reduced.

9.2 - System 2.0 - complete coating of unalloyed and low-alloy steel at the manufacturer / touch up on the construction site - water-based coatings

Coating systems for plant components at the manufacturer or temporary blasting and coating halls							*coating of the system parts, areas on the construction site*				
		Inner surfaces	***Outer surfaces***								
Paint system No	Type of Substrate		Surface preparation	Primer coat	Sealer coat	Top coat	Surface preparation	Prime coat	Sealer coat	Top coat	Total NDFT µm Complete system colouring
System 2.1 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category up to **C1**	► unalloyed / low-alloy C-steels	Surface preparation ▲ Blasting Sa 2½ [1]) DIN EN ISO 12944-4 SSPC-SP10 Prime coat ▲ 1 K synthetic resin combination NDFT 40 µm airless process	►blasting Sa 2½ [1]) DIN EN ISO 12944-4 SSPC-SP10	► 1 K acrylic-hydro zinc phosphate Sheet 92 NDFT 40 µm		► 1 K acrylic-hydro sheet 92 NDFT 40 µm	► partial HE / manual rust removal St3, PMa	► touch up		► touch up	Colour concept **NDFT 80 µm** (nominal dry film thickness)
System 2.2 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category up to **C2**	► unalloyed / low-alloy C-steels		►blasting Sa 2½ [1]) DIN EN ISO 12944-4 SSPC-SP10	► 1 K acrylic-hydro zinc phosphate Sheet 92 NDFT 80 µm		► 1 K acrylic-hydro sheet 92 NDFT 80 µm	► partial HE / manual rust removal St3, PMa	► touch up		► touch up	Colour concept **NDFT 160 µm** (nominal dry film thickness)
System 2.3 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category up to **C3**	► unalloyed / low-alloy C-steels		►blasting Sa 2½ [1]) DIN EN ISO 12944-4 SSPC-SP10	► 1 K acrylic-hydro zinc phosphate Sheet 92 NDFT 100 µm		► 1 K acrylic-hydro sheet 92 NDFT 80 µm	► partial HE / manual rust removal St3, PMa	► touch up		► touch up	Colour concept **NDFT 180 µm** (nominal dry film thickness)
System 2.4 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category up to **C4**	► unalloyed / low-alloy C-steels		►blasting Sa 2½ [1]) DIN EN ISO 12944-4 SSPC-SP10	► 2 K-epoxy hydro zinc phosphate NDFT 80 µm	► 2 K-epoxy hydro NDFT 80 µm	► 2 K-polyurethane hydro NDFT 80 µm	► partial HE / manual rust removal St3, PMa	► touch up	► touch up	► touch up	Colour concept **NDFT 240 µm** (nominal dry film thickness)
System 2.5 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► Corrosiveness category up to **C5-I (M)**	► unalloyed / low-alloy		►blasting Sa 2½ [1]) DIN EN ISO 12944-4 SSPC-SP10	► 2 K-epoxy hydro zinc phosphate NDFT 80 µm	► 2 K-epoxy hydro NDFT 2 x 80 µm	► 2 K-polyurethane hydro NDFT 80 µm	► partial HE / manual rust removal St3, PMa	► touch up	► touch up	► touch up	Colour concept **NDFT 320 µm** (nominal dry film thickness)
System 2.6 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► Corrosiveness category up to **C5-M (M)**	► unalloyed / low-alloy		►blasting Sa 2½ [1]) DIN EN ISO 12944-4 SSPC-SP10	► 2 K-epoxy hydro zinc phosphate NDFT 80 µm	► 2 K-epoxy hydro NDFT 2 x 80 µm	► 2 K-polyurethane hydro NDFT 80 µm	► partial HE / manual rust removal St3, PMa	► touch up	► touch up	► touch up	Colour concept **NDFT 320 µm** (nominal dry film thickness)

[1]) Note: If the "blasting" cannot be applied, use other coating systems. The corrosion protection is reduced.

9.3 - System 3.0 - Powder coating according to DIN 55633, complete coating at the manufacturer

Coating systems for plant components at the manufacturer or temporary blasting and coating halls					*coating of the system parts, areas on the construction site*				
Paint system No	Type of substrate	Surface preparation	GB powder coating DIN 55633	DB powder coating DIN 55633	Surface preparation	GB powder coating DIN 55633	Sealer coat	DB powder coating DIN 55633	Total NDFT µm Complete system colouring
System 3.1 ►operating temperature (T) -20°C ≤ T ≤ + 200°C ► corrosiveness category up to **C1**	► unalloyed / low alloyed C-steels galvanized surfaces Aluminium	►Blasting SA 2½ degreasing / phosphatizing, chromatizing Anodizing		►2 components SP. PUR NDFT 80 µm Powder spraying process					Colour concept **NDFT 80 µm** (nominal dry film thickness)
System 3.2 ►operating temperature (T) -20°C ≤ T ≤ + 200°C ► corrosiveness category up to **C2**	► unalloyed / low alloyed C-steels galvanized surfaces Aluminium	►Blasting SA 2½ degreasing / phosphatizing, chromatizing Anodizing		►2 components SP. PUR NDFT 80 µm Powder spraying process					Colour concept **NDFT 80 µm** (nominal dry film thickness)
System 3.3 ►operating temperature (T) -20°C ≤ T ≤ + 200°C ► corrosiveness category up to **C3**	► unalloyed / low alloyed C-steels galvanized surfaces Aluminium	►Blasting SA 2½ degreasing / phosphatizing, chromatizing Anodizing		►2 components SP. PUR NDFT 80 µm Powder spraying process					Colour concept **NDFT 80 µm** (nominal dry film thickness)
System 3.4 ►operating temperature (T) -20°C ≤ T ≤ + 200°C ► corrosiveness category up to **C4**	► unalloyed / low alloyed C-steels galvanized surfaces Aluminium	►Blasting SA 2½ degreasing / phosphatizing, chromatizing Anodizing	►2 components SP. PUR Primer NDFT 60 µm Powder process	►2 components SP. PUR NDFT 60 µm Powder spraying process					Colour concept **NDFT 120 µm** (nominal dry film thickness)
System 3.5 ►operating temperature (T) -20°C ≤ T ≤ + 200°C ► Corrosiveness category up to **C5-I (M)**	► unalloyed / low alloyed C-steels galvanized surfaces Aluminium	►Blasting SA 2½ degreasing / phosphatizing, chromatizing Anodizing	►2 components SP. PUR Primer NDFT 80 µm Powder process	►2 components SP. PUR NDFT 80 µm Powder spraying process					Colour concept **NDFT 160 µm** (nominal dry film thickness)

[1]) Note: If the "blasting" cannot be applied, use other coating systems. The corrosion protection is reduced.

9.4 - System 4.0 - coating of unalloyed and low-alloy steel at the manufacturer / touch up or top coating on the construction site

Coating systems for plant components at the manufacturer or temporary blasting and coating halls							*coating of the system parts, areas on the construction site*				
		Inner surfaces	***Outer surfaces***								
Paint system No	Type of Substrate		Surface preparation	Primer coat	Sealer coat	Top coat	Surface preparation	Prime coat	Sealer coat	Top coat	Total NDFT µm Complete system colouring
System 4.1 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category up to **C1**	► unalloyed / low-alloy C-steels	Surface preparation ▲ Blasting Sa 2½ [1]) DIN EN ISO 12944-4 SSPC-SP10 Prime coat ▲ 1 K synthetic resin combination NDFT 40 µm airless process	►blasting Sa 2½ [1]) DIN EN ISO 12944-4 SSPC-SP10	► 1 K synthetic resin combination NDFT 40 µm Airless proc.			► partial HE / mach. derusting St3, PMa SSPC SP3	► touch up		► 1 K synthetic resin combination NDFT 40 µm Airless proc. ► touch up	Colour concept **NDFT 80 µm** (nominal dry film thickness)
System 4.2 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category up to **C2**	► unalloyed / low-alloy C-steels		►blasting Sa 2½ [1]) DIN EN ISO 12944-4 SSPC-SP10	► 1 K PUR zinc polyurethane NDFT 80 µm Airless proc.			► partial HE / mach. derusting St3, PMa SSPC SP3	► touch up		► 2 K PUR Acrylic-polyurethane NDFT 80 µm Airless proc. ► touch up	Colour concept **NDFT 160 µm** (nominal dry film thickness)
System 4.3 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category up to **C3**	► unalloyed / low-alloy C-steels		►blasting Sa 2½ [1]) DIN EN ISO 12944-4 SSPC-SP10	► 2 K EP Primer NDFT 100 µm Airless proc.			► partial HE / mach. derusting St3, PMa SSPC SP3	► touch up		► 2 K PUR Acrylic-polyurethane NDFT 80 µm Airless proc. ► touch up	Colour concept **NDFT 180 µm** (nominal dry film thickness)
System 4.4 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category up to **C4**	► unalloyed / low-alloy C-steels		►blasting Sa 2½ [1]) DIN EN ISO 12944-4 SSPC-SP10	► 2 K zinc phosphate NDFT 80 µm Airless proc.	► 2 K EP Acrylic-polyurethane NDFT 80 µm Airless proc.		► partial HE / mach. derusting St3, PMa SSPC SP3	► touch up	► touch up	► 2 K PUR Acrylic-polyurethane NDFT 80 µm Brush / roller	Colour concept **NDFT 240 µm** (nominal dry film thickness)
System 4.5 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► Corrosiveness category up to **C5-I (M)**	► unalloyed / low-alloy C-steels		►blasting Sa 2½ [1]) DIN EN ISO 12944-4 SSPC-SP10	► 2 K EP zinc dust NDFT 80 µm Airless proc.	► 2 K EP Micaceous iron ore NDFT 80 µm Airless proc.		► partial HE / mach. derusting St3, PMa SSPC SP3	► touch up	► touch up	► 2 K PUR Acrylic-polyurethane NDFT 80 µm Brush / roller	Colour concept **NDFT 240 µm** (nominal dry film thickness)
System 4.6 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► Corrosiveness category up to **C5-M (M)**	► unalloyed / low-alloy		►blasting Sa 2½ [1]) DIN EN ISO 12944-4 SSPC-SP10	► 2 K zinc phosphate NDFT 120 µm Airless proc.	► 2 K PUR Acrylic-polyurethane NDFT 80 µm Airless proc.		► partial HE / mach. derusting St3, PMa SSPC SP3	► touch up	► touch up	► 2 K PUR Acrylic-polyurethane NDFT 80 µm Brush / roller	Colour concept **NDFT 280 µm** (nominal dry film thickness)
System 4.7 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category up to **C5-M(H)**	► unalloyed / low-alloy		►blasting Sa 2½ [1]) DIN EN ISO 12944-4 SSPC-SP10	► 2 K EP zinc dust NDFT 80 µm Airless proc.	► 2 K EP Epoxy resin EG NDFT 80 µm Airless proc.	►2 K PUR (1.DB) Acrylic-polyurethane NDFT 80 µm Airless proc.	► partial HE / mach. derusting St3, PMa SSPC SP3	► touch up	► touch up	►2 K PUR (2.DB) Acrylic-polyurethane NDFT 80 µm Brush / roller	Colour concept **NDFT 320 µm** (nominal dry film thickness)

[1]) Note: If the "blasting" cannot be applied, use other coating systems. The corrosion protection is reduced.

9.5 - System 5.0 - hot-dip galvanizing and coating of hot-dip galvanized steel at the manufacturer / touch up on the construction site

Coating systems for plant components at the manufacturer or temporary blasting and coating halls						*coating of the system parts, areas on the construction site*			
Paint system No	Type of substrate	Surface preparation [1])	Zinc coating	Primer coat	Top coat	Surface preparation	Prime coat	Top coat	Total NDFT µm Complete system colouring
System 5.1 ►operating temperature (T) -20°C ≤ T ≤ + 200°C ► corrosiveness category **C1 / C2**	► unalloyed / low-alloy C-steels	► Surface preparation is part of the galvanizing process	min. 50 µm						
System 5.2 ►operating temperature (T) -20°C ≤ T ≤ + 200°C ► corrosiveness category **C3 / C4**	► unalloyed / low-alloy C-steels	► Surface preparation is part of the galvanizing process	min. 60 µm						
System 5.3 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category **C5 I (M) / C5 M (H)**	► unalloyed / low-alloy C-steels	► Surface preparation is part of the galvanizing process	min. 60 µm	► 2 K EP Zinc phosphate NDFT 120 µm Airless proc.	► 2 K PUR Acrylic-polyurethane NDFT 80 µm Airless proc.	► partial HE / rust removal St3, PMa SSPC SP3	► touch up	► touch up	Colour concept **NDFT 180 µm** (nominal dry film thickness)

[1]) Note: If the "Sweep blasting" cannot be applied, use other coating systems. The corrosion protection is reduced.

9.6 - System 6.0 - heat-resistant coating systems for periodic changing temperatures at the manufacturer / construction site

Coating systems for plant components at the manufacturer or temporary blasting and coating halls							*coating of the system parts, areas on the construction site*				
		Inner surfaces	***Outer surfaces***								
Paint system No	Type of substrate	Surface preparation ▲ Blasting Sa 2½ ¹) DIN EN ISO 12944-4 SSPC-SP10 Prime coat 1 K synthetic resin combination NDFT 40 µm airless process ▲	Surface preparation	Primer coat	Sealer coat	Top coat	Surface preparation	Prime coat	Sealer coat	Top coat	Total NDFT µm Complete system colouring
System 6.1 **Completely at the manufacturer** ► operating temperature (T)	► unalloyed / low-alloy C-steels		►blasting Sa 3 ¹) DIN EN ISO 12944-4 SSPC-SP5	► 1 K ESI (*) ethyl silicate-zinc dust NDFT 40 µm Airless proc.	► 1 K silicone resin NDFT 30 µm Airless proc.	► 1 K silicone resin NDFT 30 µm Airless proc.					Colour concept **NDFT 100 µm** (nominal dry film thickness)
System 6.2 **Completely at the manufacturer** ► operating temperature (T)	► unalloyed / low-alloy C-steels		►blasting Sa 3 ¹) DIN EN ISO 12944-4 SSPC-SP5	► 1 K silicone resin NDFT 30 µm Airless proc.	► 1 K silicone resin NDFT 30 µm Airless proc.	► 1 K silicone resin NDFT 30 µm Airless proc.					Colour concept **NDFT 90 µm** (nominal dry film thickness)
System 6.3 **Complete on the construction site** ► operating temperature (T)	► unalloyed / low-alloy C-steels						► partial mach. " Bristle Blasting method" St3, PMa	► 1 K silicone resin NDFT 30 µm Brush / roller	► 1 K silicone resin NDFT 30 µm Brush / roller	► 1 K silicone resin NDFT 30 µm Brush / roller	Colour concept **NDFT 90 µm** (nominal dry film thickness)
System 6.4 **Topcoat on the construction site** ► operating temperature (T) + 400°C ≤ T + 600°C	► unalloyed / low-alloy C-steels		►blasting Sa 3 ¹) DIN EN ISO 12944-4 SSPC-SP5	► SI - Al silicone-Alu NDFT 30 µm Airless proc.	► SI - Al silicone-Alu NDFT 30 µm Airless proc.		► partial mach. " Bristle Blasting method" St3, PMa	► touch up	► touch up	► SI - Al silicone-Alu NDFT 30 µm Brush / roller	Colour concept **NDFT 90 µm** (nominal dry film thickness)

(*): Alternatively 1K - silicone resin (system 6.2)

¹) Note: If the "Sweep blasting" cannot be applied, use other coating systems. The corrosion protection is reduced. Greater than > 600 ° C no coating possible

Attention:

- With a small number of starting and return cycles / year (e.g. continuous operation with a maintenance shift / week) can be omitted for the top coat.
- Frequent starting and return cycles / year, the top paint should be applied because strong condensation can be expected.
- Isolated plant parts shall be provided with a primer coat

9.7 - System 7.0 - coating of stainless austenitic steel at the manufacturer / touch up and top coating on site

Coating systems for plant components at the manufacturer or temporary blasting and coating halls						*coating of the system parts, areas on the construction site*				
Paint system No	Type of substrate	Surface preparation [1])	Primer coat	Sealer coat	Top coat	Surface preparation	Prime coat	Sealer coat	Top coat	Total NDFT µm Complete system colouring
System 7.1 Manufacturer ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category **C5-M (M)**	►Stainless austenitic steel	►sweep-Strahlen sweep-Blasting 12944-4 ISO 8501-1	► 2 K EP Zinc phosphate NDFT 80 µm Airless proc.	► 2 K EP Micaceous iron ore NDFT 80 µm Airless proc.	► 2 K PUR Acrylic-polyurethane NDFT 80 µm Airless proc.					Colour concept **NDFT 240 µm** (nominal dry film thickness)
System 7.2 ►operating temperature (T) -20°C ≤ T ≤ + 150°C ► corrosiveness category **C5-M (H)**	►Stainless austenitic steel	►sweep-Strahlen sweep-Blasting 12944-4 ISO 8501-1	► 2 K EP Zinc phosphate NDFT 80 µm Airless proc.	► 2 K EP Micaceous iron ore NDFT 80 µm Airless proc.	► 2 K PUR Acrylic-polyurethane NDFT 80 µm Airless proc.	► partial HE / rust removal St3, PMa SSPC SP3	► touch up	► touch up	► 2 K PUR Acrylic-polyurethane NDFT 80 µm Brush / roller	Colour concept **NDFT 320 µm** (nominal dry film thickness)

[1]) Note: If the "Sweep blasting" cannot be applied, use other coating systems. The corrosion protection is reduced.