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DUSLO CPAVOK 4  
DUSLO A.S.

## JOB DESIGN SPECIFICATION FOR PAINTING

1	06/05/2015	ISSUED FOR EXECUTION	R. MAURELLI	S. MINGARDI	S. MINGARDI/C. LUCARELLI
0	03/04/2015	ISSUED FOR EXECUTION	R. MAURELLI	S. MINGARDI	S. MINGARDI/C. LUCARELLI
A	12/02/2015	ISSUED FOR REVIEW	R. MAURELLI	S. MINGARDI	S. MINGARDI/C. LUCARELLI
REV.	DATE	STATUS	WRITTEN BY (name & visa)	CHECKED BY (name & visa)	APPROV./AUTHOR. BY (name & visa)

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**1. GENERAL**

**1.1. Scope**

Scope of this document is to define the minimum technical requirements for the selection of coating systems, surface preparation, coating application, quality assurance and control for the external corrosion protection applicable to the following categories of work in industrial facilities for DUSLO CPAVOK 4 :

- steel structures
- equipment
- machineries
- piping, valves and fittings
- instrumentation

Internal surfaces, buried or submerged, concrete materials are not part of this document.

**1.2. Contractual Definitions**

For the purpose of this specification, the following definitions shall apply. They shall be confirmed on the base of each contract.

COMPANY — The Client

CONTRACTOR — The party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of the Project.

MANUFACTURER/VENDOR — The party which manufactures and/or supplies equipment, piping for the project.

COATING MANUFACTURER — The party which manufactures and/or supplies the coating products.

SUBCONTRACTOR — The party which carries out surface preparation, application, and testing of the coatings/systems as specified by the CONTRACTOR.

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**1.3. Terms and Definitions**

Protective coating system or painting system	used as synonymous in this Specification as the sum of the total coats of paint materials applied to a substrate to provide corrosion protection
Corrosivity	the capacity of an environment to produce corrosion in a given system
Durability	expected duration time of the effectiveness of a painting system up to the first important maintenance operation
Mill scale	the oxide layer that is formed during the heat treatment or hot fabrication of metals
Surface / anchor profile	pattern left on a surface after abrasive blasting or acid treatment for the adhesion of primer coat
Primer coat	first coat/layer of a coating system
Intermediate coat	any coat/layer between the primer and the finish coat
Finishing / topcoat	final coat/layer of a coating system that normally has a specific standard colour, gloss requirements and weather resistance properties
Tie coat	coat designed to improve inter-coat adhesion and/or avoid certain phenomena and defects during spray application
Stripe coat	supplementary coat normally applied by brush or roller to ensure uniform and suitable coverage of critical and difficult areas to coat by spray such as edges, borders, rough welds, internal side of small reinforced angle bars too close to the plate, deep boxed areas, internal side of pipe sleeves, pipe penetrations, etc.
Mist coat	a thin sprayed coat of a very dilute paint providing a thin, wet layer of paint that helps the adhesion of subsequent coats, or to avoid certain phenomena. Often this spray technique replace the tie coat layer in a coating system where is not included
Overcoating time	the minimum or maximum window's time at a specific temperature to be strictly observed before to applying the subsequent layer of paint

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Wet film thickness	the thickness of coating film immediately after application to a surface
Dry film thickness (DFT)	the thickness remaining on the surface after the coating has dried / cured, specified in microns (µm)
Maximum dry film thickness	the highest acceptable DFT above which the performance of the coating could be impaired
Pot life	maximum time, at any particular temperature, during which a coating material supplied as separate components can successfully be used after they have been mixed together
Shelf life	time during which a coating material will remain in good condition when stored in its original sealed container under recommended storage conditions
Volatile organic compound (VOC)	any organic liquid and/or solid that evaporates spontaneously at the prevailing temperature and pressure of the atmosphere with which it is in contact
Carbon steel surfaces	the definition includes all carbon steel, low alloy steel, cast iron and ductile iron materials

## 2. CODES AND STANDARDS

The codes listed below are to be read in conjunction with this specification and are to be used as a minimum requirement for the supply of materials/work. For work on the job site the safe working procedures laid down by the COMPANY must be adhered to. For work carried out at VENDOR premises it may be necessary to use other specifications and codes which conform to local and/or government requirements for safe working procedures. Where this is the case these local and governmental regulations shall prevail.

All materials, workmanship and testing except as specified otherwise herein, shall be in accordance with latest editions and supplements of the following specifications and Codes of Practice.

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**Steel Structures Painting Manual**

SSPC-SP1	Steel Structures Painting Council Surface Preparation Specification – Solvent Cleaning
SSPC-SP11	Power Tool Cleaning to Bare Metal

**International Organization for Standardization (ISO)**

ISO 2409	Paints and varnishes – Cross-cut test
ISO 2178	Non-Magnetic Coating on Magnetic Substrates – Measurement of Coating Thickness – Magnetic Method
ISO 4624	Paints and varnishes – Pull Off Test for adhesion
ISO 4628-1 to 6	Paints and varnishes – Evaluation of degradation of paint coatings – Designation of intensity, quantity and size of common types of defect
ISO 8501-1	Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness. Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
ISO 8501-2	Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness. Part 2: Visual assessment of surface cleanliness
ISO 8501-3	Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness. Part 3: Preparation grades of welds, cut edges and other areas with surface imperfections
ISO 8502-2 to 3	Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness
ISO 8502-4	Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness: Guidance on the Estimation of the Probability of Condensation Prior to Paint Application
ISO 8502-6	Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness: extraction of soluble contaminants for analysis – The Bresle method
ISO 8502-9	Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness: Field method for conductometric determination of water-soluble salts

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ISO 8503-1 to 4	Preparation of steel substrates before application of paints and related products – Surface roughness characteristics of blast-cleaned surfaces
ISO 8504-1 to 3	Preparation of steel substrates before application of paints and related – Methods for surface preparation products
ISO 12944-1	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 1: General Introduction
ISO 12944-2	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 2: Classifications of environments
ISO 12944-3	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 3: Design and constructive requirements
ISO 12944-4	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 4: Surface types and preparation
ISO 12944-5	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 5: Protective paint systems
ISO 12944-7	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 7: Execution and supervision of painting work
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

**American Society for Testing and Materials (ASTM)**

ASTM D 4285	Standard test method for indicating oil or water in compressed air
ASTM D 4417	Field Measurement of Surface Profile of Blast Cleaned steel
ASTM D 4752	Measuring MEK resistance of ethyl silicate (inorganic) zinc-rich primers by solvent rub
ASTM D 5402	Assessing the solvent resistance of organic coatings using solvent rubs



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**3. REFERENCE DOCUMENTS**

The following reference documents, to the extent specified herein, form a part of this specification. When an edition date is not indicated for a document, the latest edition in force at the time of VENDOR'S proposal submittal shall apply.

**Czechoslovak State Standard**

CSN 130072	Identification of pipes conveying fluids in liquid or gaseous condition
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**Project Specifications**

2522	JSD 2200.01	Job Design Specification for Hot Insulation
2522	JSD 2200.02	Job Design Specification for Cold Insulation

**4. SCOPE**

**4.1. Selection of Painting Systems**

Painting systems are selected according to the following parameters:

- Type of substrate
- Atmosphere or environment
- Operating temperatures (minimum and maximum values)

Note:

Any severe design condition that could affect the life of protective coating will be considered for the selection of the suitable painting system (i.e. steam out or regeneration condition).

**4.2. Definition of Atmosphere or Environment**

Painting systems are selected with reference to the atmospheric-corrosivity categories C5I as per ISO 12944 - part 2 & 5, for a minimum expected durability M (medium).

**4.3. Surfaces to be coated**

- All insulated and uninsulated carbon steel and low alloy steel surfaces
- Insulated stainless steel surfaces up to 200°C.

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**4.4. Surfaces not to be coated**

- Un-insulated stainless steel surfaces
  - Other non-ferrous metal surfaces (aluminum, copper alloys, etc.), unless required for reasons of appearance or safety identification
  - Galvanized steel surfaces, unless required for reasons of appearance or safety identification
  - Nickel Alloy surfaces
  - Machined surfaces as flange faces, screw threads
  - Friction surfaces of assemblies using friction
  - Surfaces used for identifications purposes, such as nameplates, serial number plates, valve identification signs, gauge glasses and guards, gauge faces and light fixtures, valve stems and flange bolts shall not be coated
  - Galvanized steel gratings
  - Plastic and plastic coated materials when colour coding is not necessary

**5. COATING SYSTEMS**

**5.1. Standard Coating Systems**

Coating systems are described in **TABLE 1** of APPENDIX 1, for all items of the Project.

The content of TABLE 1 shall be read in conjunction with relevant NOTES on page 32.

The selection of the proper system is based on material of construction, the presence of insulation or fireproofing, and operating temperature.

**5.2. Original Manufacturer's coating systems**

Packaged equipment (including mechanical parts, pressure vessels, piping, instruments, machinery, etc.) and equipment items, such as pumps, compressors, turbines, blowers, electric motors, transformers, generators, hoists and cranes, control valves, instrumentation, fired heater burners etc. can be completely coated according to Manufacturer's standard system provided it complies with the following requirements:

- Painting procedure including description of the coating system (type and trade name of coating products, number of coating layers, dry film thickness of each layer, etc.) shall be submitted to CONTRACTOR/COMPANY for written approval, together with product technical data sheets (see para 10).
- The Manufacturer's coating system must meet the required quality of corrosion protection adapted to the climatic and the corrosive conditions of the plant.

Moreover, coating systems shall comply with the following:

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Surface preparation shall be abrasive blast cleaning to grade Sa 2.5 minimum for carbon steel surfaces and grade Sa 1 for stainless steel surfaces.

- a. For carbon steel surfaces at temperature below 100°C, the coating system shall be based on two-component products, including:
- 60 µm minimum of anticorrosive primer,
  - an intermediate coat,
  - a finishing suitable for weather exposure.

The total dry film thickness of the system shall be no less than 320 µm.

- b. For carbon steel surfaces at operating temperature above 100°C up to 400°C, the coating system shall consist of the following:
- 75 µm minimum of two-component inorganic zinc primer (zinc silicate),
  - two coats of heat resistant inorganic coating.
- c. For carbon steel surfaces at operating temperature above 400°C and up to 525°C, the coating system shall consist of two coats heat resistant silicone aluminium coating.
- d. Insulated stainless steel surfaces at operating temperature up to 100°C shall be protected with minimum 2 coats of two-component zinc-free, chloride-free, epoxy products. The total dry film thickness of the system shall be no less than 200 µm. Insulated stainless steel surfaces at operating temperature above 100°C shall receive two coats of zinc-free, chloride-free, heat resistant inorganic products (e.g. silicone-based) applied at minimum dry film thickness of 25 µm per coat.

### 5.3. Special cases

In some cases (e.g. thin steel plates on items located indoors), powder coatings based on polyester and/or epoxy resins may be allowed for uninsulated surfaces below 100°C. A minimum dry film thickness of 100 µm is then required.

For equipment items in special conditions, such as for instance immersion service, the applicable coating system will be designed for the specific fluid characteristics and service conditions.

### 5.4. Piping Supports

As a general rule, piping supports welded to pipe shall be coated with the same painting system as the supported line; for supports welded to insulated pipes, as well as protrusions through the insulation, painting system for the uninsulated portion, shall be suitable even for weather exposure.

In case of bi-metallic supports, the coating system shall be selected properly according to the base material to be coated. In addition, coating containing zinc shall not be used on stainless steel surfaces (refer to para 8.13.).

A complete guide for the selection of coating systems is shown in TABLE 3 of Appendix 3.

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**5.5. Piping Bulk Components**

Unless otherwise specified, non-itemized piping material made of carbon steel such as valves or manifolds, shall be coated by Vendor with a layer of two-component inorganic zinc silicate primer to a minimum dry film thickness of 60 µm.

Subsequent coats of the painting system shall be applied either at prefabrication shop when the material is assembled in a spool, or at site when installed as a single item, after a thorough degreasing and cleaning of the surface as per application instructions by paint Manufacturer.

Valves operators (i.e. gear, lever, hand wheel, position indicator) can be supplied with standard anticorrosive coating system by Vendor, suitable for site weather exposure.

In case of components supplied with a Vendor's temporary protection (such as phosphatizing) a proper protective coating system shall be provided at prefabrication stage or field.

Piping components made of stainless steel if delivered unpainted, shall be pickled and passivated by Vendor.

**6. COATING MATERIALS**

**6.1. Sources of Materials**

Only the materials generically specified for a given service in this specification are to be used. The fabrication and/or painting SUBCONTRACTOR shall state the name of the Coating Manufacturer and of the coating material.

Use of products from different Coating Manufacturers for the same coating system is NOT acceptable.

Subsequent coat of different Coating Manufacturer than the previous one is to be individually supported by written statements from each Coating Manufacturer involved to attest compatibility and integrity of the entire coating system.

All paint and coating materials shall be delivered to site in the Coating Manufacturer unopened original containers, in good state and correctly labelled. Label shall feature the Coating Manufacturer's name, brand name, batch number and date of manufacture.

No material shall be used after its shelf life has expired.

Technical data sheets shall also be supplied, clearly indicating all the features and requirements of the products (i.e. max/min overcoating times for the specified DFT, max/min DFT, max temperature resistance etc.).

**6.2. Coating Composition**

All coating products used in shop or on site shall meet the following requirements.

- a) All coating product formulation shall respect the local legislation of the place of application (e.g. VOC, isocyanates, etc) and to some extent they shall comply with the legislation of the country/state where the plant is built.

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- b) Coatings shall be free of heavy metals such as arsenic, barium, cadmium, lead, mercury, silver, chromium, selenium. However, zinc coatings containing barium sulphate and less than 0.02% lead are acceptable.
- c) Two-pack finish coats shall be 2K PUR with aliphatic curing agent. Where isocyanate cured products are not allowed, alternative finish products shall be submitted to CONTRACTOR for approval. Finish coat shall have good gloss retention and weather/UV resistance.
- d) Two-pack epoxy finish coatings shall be based on a polyamide or amine adduct cured two-pack epoxy media and shall be pigmented with titanium dioxide and/or light fast coloured pigments to provide the necessary opacity, film build and weather resistance. A semi-gloss finish is required.
- e) Silicone coatings shall be based on a one-pack formulation. They may comprise leafing aluminum pigment dispersed in the silicone or modified silicone media, except for application on stainless steel surfaces. The coating shall be able to dry completely at ambient temperature (no "tacky" surface).
- f) Inorganic zinc silicate primers shall be based on ethyl silicate media and shall contain not less than 85 % zinc dust by weight in the dry film. They shall be two-component products.
- g) Alternative high performance two-pack waterborne coating products shall be submitted to CONTRACTOR for approval.

**Notes:**

- 1. oil-, alkyd-, vinyl-, or acrylic-based one-component paints, and so-called "enamel", "varnishes" or "synthetic resin" are not accepted, since not suitable for heavy duty service.
- 2. nitrocellulose-based lacquers are not allowed due to high flammability.

**7. COATING APPLICATION**

**7.1. Equipment for Surface Preparation and Coating Application**

The coating SUBCONTRACTOR shall supply and transfer to site all the equipment and material necessary to carry out the cleaning, masking, priming and painting work in accordance with this specification and Coating Manufacturer's recommendations. Test equipment and devices necessary to perform inspection activities required by present specification, shall be provided by the coating SUBCONTRACTOR.

**7.2. Blasting Equipment**

All blasting equipment supplied will have a current inspection certificate from a third party independent source if required.

The pressure and volume of the compressed air supply for blast cleaning shall meet the work requirement and shall be free of oil and water contamination to ensure that the cleaning process is not impaired. Traps, separators and filters shall be emptied and cleaned regularly.

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**7.3. Hand Tools**

Chipping, scraping and steel wire brushing using manual or power driven tools shall be of a type acceptable to CONTRACTOR.

**7.4. Spray Equipment**

All spray equipment supplied will have a current inspection certificate from a third party independent source if required.

The pressure and volume of the compressed air used for spray application shall meet the work requirement and be free from oil and water contamination. Traps, separators and filters shall be emptied and cleaned regularly.

**7.5. Surface Preparation and Cleaning**

**7.5.1. General**

The following method of surface preparation shall be used as specified in TABLE 1.

In all cleaning methods the equipment and tools used shall be of suitable design and quality to properly complete the works to the specification.

Where compressed air is used, air lines shall be provided with effective, well maintained oil and water traps. Efficient well maintained air filters shall be provided to control dust.

During cleaning, all weld areas and attachments shall be given special attention to ensure all welding flux and spatter is removed by the use of solvents, files scrapers, chipping hammers, power or hand brushes or grinders fitted with flexible grinding discs.

Prior to the commencement of any of the cleaning methods detailed below, the surface to be cleaned shall have all oil, grease or wax removed by swabbing with a suitable emulsion cleaner. The surface shall then be washed down with high pressure fresh water to remove dirt, stains and residues. Where necessary, hand brushing shall be included to ensure a clean surface.

**7.5.2. Abrasive blast cleaning**

In this method, mill scale, rust and other surface contaminants shall be removed using blast or centrifugally propelled abrasives. After the specified standard has been achieved, all dust, loose materials and abrasive residues shall be removed from the cleaned surface and the surface shall be coated before contamination or flash rusting occurs.

Contaminants such as oil, greases, chemicals or soil shall be removed prior to abrasive cleaning by the use of a suitable emulsion cleaner. The surface shall be cleaned as per grade specified in TABLE 1.

The applicable standard for surface preparation shall be the latest edition or revision of the international norm ISO 8501-1.



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After blast cleaning and before application of the priming coat the surface shall be cleaned to remove dust and abrasives and in particular from pockets and corners. This can be done by vacuum cleaning or by blowing dry, oil-free compressed air.

Due care shall be exercised to prevent the abrasive grit entering inside equipment and pipe work. On completion of blasting operations, the inside of equipment and piping shall be inspected and cleaned out if the presence of abrasive grit is detected.

Any surface showing signs of handling contamination after blasting shall be solvent cleaned and re-blasted.

The use of abrasives containing silica is not permitted.

The use of Carbon steel and copper/nickel alloy abrasives on hot dip galvanized steel and austenitic steel surface is forbidden.

Abrasive media must be free from oil, grease, moisture, etc. Re-used abrasive shall be clean and reasonably sharp. They shall not be rusted or noticeably worn or dull when compared with fresh material and must be free from contaminants.

Re-used abrasive shall be approved by CONTRACTOR and shall meet the requirements as specified above.

Blast cleaning shall not commence unless a protective coating can be applied before contamination or flash rusting occur.

Blasting shall not be done outside normal daylight work hours unless authorized by CONTRACTOR.

Blasting operations shall not be carried out unless surfaces temperature to be prepared is 3°C above ambient air dew point.

**7.5.3. Protection of surfaces not to be coated**

Surfaces not requiring coating shall be protected from damage and from paint products contamination by adequate temporary coverings during all operations of surface preparations and painting. Coating that may have fallen on these surfaces e.g., valves stems, glass, adjacent equipment, flange bolts, etc. shall be removed.

In particular, stainless steel and non-ferrous surfaces shall be protected from blasting, overspray and coatings intended for carbon steel, especially coatings containing zinc.

**7.5.4. Stainless steel**

Surface shall be thoroughly degreased using an appropriate emulsion cleaner and abrasive cleaned (sweep blasting) to create a sufficient anchor profile.

Abrasive blast cleaning of stainless steel surfaces shall be performed with a suitable non-metallic abrasive such as aluminum oxide (or garnet, glass beads, olivine, not leaving inclusions or contamination on the surface).

When hand or power tool cleaning is required on stainless steel, only stainless steel wire brushes that have not been previously used on carbon steel surface must be used.

All coatings and solvents for use on stainless steel shall be free of substances such as chlorides and other halides, sulfur, and shall be free of low melting point metals (zinc, aluminum, tin and lead).

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7.5.5. Hot dip galvanized surfaces to be coated

Surface preparation shall consist of thoroughly degreasing and treating with a mordant/etching solution. After the reaction period the surfaces shall be washed down with clean water.

Sweep blast cleaning, after thorough degreasing is advisable, to roughen the surface and improve coating adhesion.

Dust from blast cleaning operation shall be removed as previously described.

**Note:** Weathered galvanized surfaces should be wire brushed first to remove all corrosion products, and washed with clean, fresh water containing detergents.

7.5.6. Weld areas and sharp edges

All weld spatters, sharp edges and surface irregularities shall be contoured and surface irregularities ground smooth as required by reference standard ISO 8501-3.

7.5.7. Anchor profile

The surface profile and anchor pattern after blast cleaning shall conform to requirements of Paint Manufacturer, for each painting product. Reference shall be made to Manufacturer's application instructions and to paint technical datasheets.

7.5.8. Manual and Mechanical (Power-Tool) Cleaning

In this process dirt, rust, mill scale and/or paint remains are removed and the metal surface prepared by hand chipping, scraping or wire brushing or preferably where possible by powered hand tools such as powered wire brushes or needle guns to achieve the specified standard.

Manual cleaning shall only be carried out when the use of power tools is prohibited and with the permission of CONTRACTOR.

The quality of surface cleanliness achieved by manual or mechanical cleaning is specified in accordance with latest edition of ISO 8501-1 for manual or mechanical cleaning.

On completion of the surface preparation, all dust and other foreign materials shall be removed and the primer coat applied before any contamination or rusting occur.

Should the cleaned surface be left uncoated for a period, showing any contamination, the surface preparation shall be repeated prior to painting.

7.6. Preparation and Application of Coating Materials

7.6.1. General

Coating SUBCONTRACTOR shall adhere strictly to the instructions and recommendations as prescribed by the coating Manufacturer for the preparation and application of all coating materials. Successive coats shall have a contrasting colours or tints.



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SUBCONTRACTOR shall submit his working procedure including as minimum information detailed in following section 10. PAINTING PROCEDURE.

7.6.2. Weather conditions

Painting SUBCONTRACTOR shall measure and record local conditions of temperature and humidity during blasting, painting and curing.

Coating shall only be applied when suitable weather conditions prevail. Coating shall not be applied under the following conditions or when such conditions are likely to prevail before the coating is cured.

1. At temperatures below 10°C (or according to Coating Manufacturer recommendation) or when the temperature is likely to fall below this figure before the surface film is dry, or on surfaces registering low temperatures.
2. When the relative humidity of the atmosphere exceeds 85 % and/or according to Coating Manufacturer recommendation for each specific painting product.
3. The steel temperature is less than 3°C above the dew point.
4. During foggy or misty conditions.
5. Before dew or moisture has evaporated.
6. When it is raining or rain is imminent.
7. In windy conditions or in presence of dust.

Guidelines for weather and other atmospheric suitability shall be agreed with CONTRACTOR but painting SUBCONTRACTOR shall remain responsible for scheduling his activities.

Coating contaminated during curing by dust, condensation or rain, shall be removed and redone if deemed necessary by CONTRACTOR.

7.6.3. Storage of materials

All products shall be received in sealed containers, clearly marked with product description, reference number, batch number and date of manufacture. Thinners, solvents, etc. shall be stored in a well-ventilated fireproof building, separate from other painting consumables. The building temperature shall be controlled if necessary in order that the coating products will not suffer from local climatic conditions. Recommendations on storage conditions by the coating Manufacturer shall be strictly followed.

7.6.4. Coating preparation

Coating components shall be power-stirred to obtain a homogenous consistency. No hand stirring is allowed for quantities greater than 5 litres. Before further use, coating shall be allowed to stand for a time long enough to remove aeration caused by stirring. The mixed coating shall not be used on expiry of its "pot life". Induction time, where indicated, shall be strictly observed.

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Two-pack or multiple pack coating systems shall be mixed in the proportions and under the conditions recommended by the Manufacturer.

For inorganic zinc primers, after mixing the silicate binder and the zinc powder, the mixed product shall be sieved prior to application, continuously and slowly power-stirred during application.

The mixed coating shall colour match with other prepared products of the same coat.

Coatings visually showing deterioration such as settling, separation, gelling, skin formation, etc. shall be discarded.

Only the required thinner and quantity (percentage) recommended by the coating Manufacturer shall be used.

#### 7.6.5. Coating application

Painting shall be done according to the application instructions of the Coating Manufacturer and shall be performed by skilled and experienced staff, aware of health and hazard issues related to painting activities.

Coating may be applied by brush, roller, conventional spray or airless spray methods as approved or specified by the coating Manufacturer.

The use of roller shall be avoided on blast cleaned surfaces or rough welds; roller can be either used for successive layers or stripe coats.

Brush or rollers used shall be of a suitable size and shape and shall be kept clean by use of approved solvents. Where rollers are used, the nap shall be of sufficient length to work the coating well into the surface.

When using conventional spray or airless spray methods, all the equipment shall have adequate, well-maintained pressure regulating devices, effective strainers, traps, and separators, suitable size hoses and clean, well-maintained guns. The traps and separators for removing oil and water maintained from the compressed air shall be such that air atomizing guns will not deposit oil or water when directed on to a clean surface for 15 seconds.

Nozzles shall be of the correct size and provide the most suitable spray shape for the most effective and economical application of the coating without excessive overspray.

The specified coating thickness shall be achieved at all protrusions, corners and crevices. Edges, borders, bolt heads, etc. may require the application of a stripe coat by brush to achieve the complete coverage.

All coating materials shall be applied evenly in a normal full coat free from mud cracking, wrinkling, sagging, curtaining, fish eyes, orange peeling, pinholes, brush and roller marks and other defects.

Due care shall be exercised whilst spraying to prevent overspray and contamination of other surfaces by the use of shields, etc.

Under no circumstances shall zinc or aluminum in the form of coating pigments or metal spray shall be allowed to come into contact with stainless steels, nickel based alloys or copper based alloys.

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**7.6.6. Priming**

The priming coat shall be applied as soon as possible after the surface preparation has been carried out and before any contamination, deterioration or flash rusting of the cleaned surface. The specified surface preparation is understood to be the one at the moment of the application.

The primer shall not be applied before any possible post welding heat treatment (PWHT).

Angles, corners, sharp edges, bolt or rivet heads shall be stripe-coated by brush. This coat shall be the same product as the primer.

**7.6.7. Subsequent coat**

The specified coating shall be applied when the primer coat has properly dried in accordance with the recoating times indicated in the relevant Technical Datasheet, its correct application and thickness has been confirmed, and the primer surface has, if necessary, been cleaned to remove dust/moisture.

When more than one coat is required, the Coating Manufacturer's recommendations on overcoating time and all application instructions shall be followed. Successive coats shall have a contrasting colours or tints.

The use of coatings made from different Coating Manufacturers in a same coating system is not allowed (ref. to para 6.1.).

Wet film thickness shall be checked when each coat is applied to ensure that the full coating thickness will be achieved in the specified number of coats. Total system dry film thickness shall also be in accordance with this specification.

When a primer of inorganic zinc silicate is specified under an epoxy coating, it is recommended to apply a thin flash or mist coat, followed within minutes, with a full coat of the organic topcoat.

A final coat shall be applied in accordance with the undercoat overcoating time recommended by the Coating Manufacturer.

The final coat shall provide a smooth, even finished coating surface. Where gloss finish coats are applied, the surface shall be a smooth gloss finish with no breaks in the surface.

The multi-coat system shall be free of all the defects previously mentioned.

**7.6.8. Drying times**

Each coat shall be allowed to dry thoroughly in accordance with the Coating Manufacturer's instructions for overcoating, before the next coat is applied. Drying and curing times are highly dependent on local conditions.

**7.6.9. Contrasting coatings**

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Where it is necessary to apply more than one coat of a particular product to obtain a specified dry film thickness, then the first coat shall be selected sufficiently different in colour, in order to distinguish from the subsequent coats.

When different portions of a primerized structure are to be overcoated with different treatments (i.e. fireproofed / not fireproofed parts of a steel structures), a different colour of primer shall be selected, for field identification purpose.

**7.6.10. Painting before installation**

Prepared welding edges and surfaces within 50 mm to 75 mm of welding shall be left uncoated or coated with an approved welding primer only. In any case an adequate protection for transport and storage shall be provided.

All surfaces that will be inaccessible after assembly or installation shall be cleaned and coated before installation. Such surfaces include underneath of baseplate, skids, saddles, skirts, but also bored/punched holes in steel members, flange screw holes, etc.

When painting is carried out before installation, all reasonable steps shall be taken by the painting SUBCONTRACTOR to reduce to a minimum damage to the coating system before and during installation.

Metal contact surfaces - i.e. bolted joints in structures- should be coated with one full layer of the specified primer on both surfaces immediately before bolting up. Fretting surfaces where friction grip is required shall not be coated.

**7.6.11. Shipping, handling and storage of coated items**

Coated items shall not be handled or moved until all coatings have been properly dried or cured as required in the Coating Manufacturer's instructions.

Coated items shall be handled with equipment such as wide belt slings, web belts, and wide padded skids selected to prevent damage to the coating. Handling equipment likely to cause damage to the coating shall not be used. Items such as chains, cables, hooks, tongs, metal bars, and narrow skids shall not be permitted to come in contact with the coating. Dragging or skidding coated items shall not be permitted.

Coated items shall be loaded, padded, and secured for transport in such a manner that the coating will not be damaged in transit.

Coated items shall be separated so that the items do not bear against each other and shall be stacked off the ground using suitable means (e.g. parallel height ridges of rock-free sand, wooden timbers placed under the uncoated pipe ends) to avoid damages of the coating.

**8. INSPECTION AND ACCEPTANCE**

**8.1. General**

As part of the Quality Plan, the COMPANY shall determine the inspection operations associated with the various phases of execution and inspection.

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**TABLE 2** Inspection and Testing Requirements, in Appendix 2 describes all features related to inspection activities and the evaluation of results.

**8.2. Pre-job meeting**

It is advisable to schedule a pre-job meeting, to agree and clarify painting job requirements between all parties.

Attendees shall be the MANUFACTURER/SUBCONTRACTOR superintendent and coating supervisor, CONTRACTOR quality control representative, Coating Manufacturer's technical representative, COMPANY representative and the COMPANY's nominated coating specialist.

Other attendees may be included with prior written agreement.

**8.3. Inspection activities**

The following inspection and testing activities shall be performed during the application of coating systems:

- Pre-blasting inspection
- Environment conditions
- Surface preparation examination and profile checking
- Soluble salts contamination
- Thickness checking
- Curing checking
- Adhesion checking
- Final visual examination

**8.4. Pre- Blasting Inspection**

Surfaces shall be checked for imperfections that could not be removed by blasting operation and can impair the application of coating.

Such imperfection can include the presence of oil and grease on the surface, fabrication defects that require additional preparation before blasting, such as edges, welds, inclusions, pits and craters etc.

Preparation shall conform to minimum grades described in standard ISO 8501-3, in accordance with corrosivity category of the environment.

**8.5. Environment conditions**

Before commencement of any coating application (including surface preparation activity), the surface temperature, ambient temperature, dew point and relative humidity shall be measured and recorded.

Blasting activities and painting application shall not be performed in adverse weather condition, as specified in para 7.6.2.

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**8.6. Surface Preparation Conditions**

Grade of cleanliness of the surface shall be verified by visual comparison with the reference Standard ISO 8501-1 and 2.

Blast cleaned surface assessment shall be executed by comparison with ISO comparator in accordance to Standard ISO 8503-1 for blast profile pattern, and by TESTEX "Press-O-Film" replica tape or stylus gage for measurement of roughness profile depth.

**8.7. Soluble Salt Contamination**

Testing for chloride and soluble salt concentrations and the pH level shall be done using a Bresle Sampler according to ISO 8502-6. The chloride and soluble salt concentrations shall be less than 30 mg/m<sup>2</sup> and the pH shall be neutral (between 6 and 8).

When these levels are exceeded, the surfaces shall be either steam cleaned or high pressure water washed as per SSPC SP1 or ISO 12944 before abrasive blasting.

The cleaned surface shall be retested to verify that the contaminant levels are within the acceptable range.

**8.8. Thickness Check**

Dry film thickness shall be measured with a magnetic or ultrasonic probe. The equipment shall be calibrated at least twice daily in accordance with the Coating Manufacturers' recommendations and each specified thickness to be measured.

It is suggested that, in order to achieve the specified dry-film thickness, wet-film thickness is checked during the coating application by wet film thickness gauges such as the Elcometer wheel or comb type.

The method and procedure for checking the thickness of dry film on rough surfaces shall be in accordance with ISO 19840.

Acceptance criteria shall be in accordance with principles of ISO 19840.

In any case, dry film thickness shall not exceed the maximum allowed thickness for each single product (reference shall be made to coating Manufacturer's recommendation).

If the dry film thickness does not meet the specified value, additional coats shall be applied, except for inorganic zinc silicate primers that in case of overthickness (maximum value specified by coating Manufacturer) shall be re-blasted and re-applied at the required dry film thickness.

**8.9. Drying/Curing**

Final curing will be checked by assessing solvent resistance at the end of application, after the complete curing.

Solvent type shall always be agreed with the Coating Manufacturer.



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For inorganic zinc silicate primers, MEK resistance shall be verified in accordance with ASTM prior to overcoating. The minimum resistance rating of 5 is required.

For organic primers, solvent rub test shall be performed as per ASTM D5402. As a result, no loss of coating thickness or deposit of cloth is acceptable.

In any case, Manufacturer's instruction on overcoating time shall be strictly observed for each single product.

**8.10. Adhesion check**

Adhesion tests shall be performed when coating is completely dry and fully cured. The coating shall be examined for adhesion between coats and for adhesion of the first coat to the substrate according to the relevant Standards:

Cross-cut test as per ISO 2409:  
acceptable values are 2 and lower for ISO 2409.

Pull-off test as per ISO 4624:  
shall be carried out at any location where there is evidence of any sort of failure in any coating including, but not limited to, lifting of coats or loss of adhesion between layers in coating system. Coating whose adhesion pull test result is less than 50 kg/cm<sup>2</sup> (5 MPa) shall be considered to have failed, except on silicon based coatings and on stainless steel surfaces.

Test can be performed on sampling plates, marked for identification and painted together with each item to be tested.

In case the test will fail to pass, adhesion will be re-checked directly on the item coated.

**8.11. Final visual Examination**

Film continuity shall be verified by visual inspection.

All surfaces shall be free from visible defects such as holidays, pinholes, run sags, flaking, orange peel and excessive overspray.

Areas found to have been improperly painted shall be recoated.

**8.12. Supplementary Testing**

The following tests may be carried out at the discretion of the CONTRACTOR:

Millscale test – A copper sulphate test shall be performed to determine the presence of millscale.

Holiday test – For immersed surfaces or splash zones, to detect coating losses. Test shall be performed in accordance to relevant applicable standards and shall be included in MANUFACTURER / SUBCONTRACTOR Painting Procedure.

**8.13. Repair of Defects or Damages**

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Any defect or damage that may occur shall be repaired before the application of further coats.

Areas which are to be overcoated shall be thoroughly cleaned and free from grease, oil and other contaminants and shall be dry.

The surfaces shall then be prepared to the standard as specified. Edges of sound coating around the repair area shall be feathered back approximately 50 mm for a smooth transition. If necessary vacuum blasting equipment shall be used for surface preparation.

Subsequently additional compatible coats shall be applied, until they meet the specification. Those additional coats shall be blend in with final coating on adjoining area.

Up to 100°C damaged areas of uninsulated/insulated surfaces shall after cleaning be touched up with one or two coats of surface tolerant high solids epoxy (compatible with previously applied coats of different nature). The repair coat shall overlap sound coating.

Above 100°C heat resistant coatings shall be used for touch up.

Galvanized steel presenting damages exposing the steel substrate shall be repaired. Prior touch up, the damaged surface shall be cleaned by power tool cleaning according to SSPC SP11. Touch up shall be executed in accordance with standard, and shall match original grey colour of galvanized steel.

Paints filled with zinc or zinc compounds shall not be used for repair of stainless steel surfaces.

In case of dissimilar seams – i.e. carbon steel welded on stainless steel material - coatings containing zinc shall not be applied over austenitic materials. The weld seam itself shall be painted with a zinc-free coating for a minimum extent of 50 mm.

#### 8.14. **Quality Control and Tests**

MANUFACTURER/SUBCONTRACTOR shall execute and record all inspections, tests and controls required by the Contractual documentation and defined in the applicable Quality Control Plans and relevant Quality Forms defined by CONTRACTOR.

MANUFACTURER/SUBCONTRACTOR shall also submit for approval to CONTRACTOR the working procedure and the repair procedure in accordance to project specification requirements.

#### 8.15. **Certification of Personnel**

Coating supplier shall train the Operators for his coating products/systems before the work commences. Such training shall lead to qualification of each Operator. Supervisors or Inspectors shall be individually certified by an approved organization.

#### 9. **DURABILITY and GUARANTEES**

Durability of coating systems, as defined in ISO 12955-5, will provide the corrosion protection for grade of corrosivity of the plant, as defined in para 4.2.



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MANUFACTURER/SUBCONTRACTOR shall guarantee that coating systems are applied in compliance with present specification and with the prescriptions of Paint Manufacturer to meet the Project quality requirements.

Inspection and tests performed by CONTRACTOR, do not release the MANUFACTURER/SUBCONTRACTOR from his obligation and responsibility on the quality of paint application work.

**10. PAINTING PROCEDURE**

Each MANUFACTURER/SUBCONTRACTOR shall issue a Painting Procedure relevant to the scope of supply to be submitted for approval to CONTRACTOR. The document shall include at least the following information:

- SCOPE of WORK - describing for each item to be coated:
  - base material
  - surface temperature: normal operating + upset conditions (i.e. steam-out)
  - thermal insulation (if any)
- APPLICABLE DOCUMENTS  
Reference to project specification.
- COATING SYSTEM composition:

<u>surface preparation</u>	method	grade	(as per ISO 8501/SSPC/NACE)
	surface profile (R <sub>z</sub> )		as per Paint Mfr's recommendation
– <u>primer coat</u>	paint type	DFT	product code (technical datasheet)
– <u>intermediate coat</u>	paint type	DFT	product code (technical datasheet)
– <u>finish coat</u>	paint type	DFT	product code (technical datasheet)
TOTAL DFT of the entire coating system			
- FINISH COLOUR in accordance with project specification.
- APPLICATION METHOD  
Including surface preparation, a complete description of method and operations, conditions during application, in accordance with project specification and Paint Manufacturer's instructions.
- INSPECTION  
Containing all test required by present specification, to be performed on the items scope of supply.
- REPAIR PROCEDURE  
Describing methods and suitable products.
- TECHNICAL DATASHEETS of painting products  
Paint Manufacturer's original technical datasheets shall be included as a part of the Painting Procedure.

**11. COLOUR AND IDENTIFICATION**

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The Colours specified shall be in accordance to CSN 673067 and RAL K1. SUPPLIER colour names or reference numbers shall not be used as reference.

**11.1. Final Colour**

Colour identification for each item is applicable for uninsulated surfaces, operating at temperatures of 100°C and below.

Colour for each item is shown in TABLE 1 of APPENDIX 1.

**11.2. PIPING Service Identification**

Selected process and utility piping may require additional colour identification to be placed directly on the coated piping or on insulation jacketing.  
Such coding can be realized with the finish base colour of the pipe or through the mean of bands.

A list of piping service and related band identification colours is reported in the following Table (based on CSN 130072 as reference):

OBJECT	COLOUR	CSN	RAL
Steam	Silver Grey	1010	7001
Air	Light blue	4400	5015
Flammable/Non-flammable Gases	Yellow Ochre	6600	1024
Water	Light Green	5014	6019
Fire water piping	Red	-	3000
Flammable liquids	Brown	2320	8024
Acids	Violet	-	4001
Alkalis	Violet	-	4001
Other	Black	1999	9005

Piping not needing a service identification can be painted in Light Grey RAL 7035.

**11.2.1. Methods of application**

**11.2.2. Coloured bands can be realized by paint or tape bands, stencils, decals, or metal tags, provided that they withstand atmospheric conditions and process temperatures.**

**11.2.3. Dimensions**

The width of the identification colour band depends on the pipe nominal diameter:

- Up to 100 mm, min 150
- From 100 mm to 800 mm 400
- More than 800 0,5 x pipe diameter

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11.2.4. Extent of application

Unless otherwise agreed, bands shall be located only at significant points for plant operation (e.g. where pipe starts and ends, at valves (on one side), at branches etc.); approximately, a 25 feet interval along piping can be observed.

11.3. **PIPING Flow Direction (ref. CSN 130072)**

Symbols (Arrows) shall be used to indicate the flow direction of commodities contained in piping.

11.3.1. Methods of application

The arrows shall be white or black in colour to contrast with the basic colour of the pipe. Tape bands, paint, stencils, or decals can be used as labelling, provided that they withstand atmospheric conditions and process temperatures.

11.3.2. Dimensions

The following sizes are recommended:

- Pipe 2"- 6" NPS: arrow to fit in a 25 mm x 100 mm rectangle,
- Pipe 8" NPS and larger: arrow to fit in a 50 mm x 150 mm rectangle.

11.3.3. Extent of application

Arrows shall be placed (preferably near the colour bands) at each section of pipe adjacent to fittings, valves, tees, and at both sides of elbows, tee-type connection to a utility station, at both sides of stanchion, and both sides of wall or ceiling penetration. Where flow of the commodity is possible in either direction, two arrows shall be indicated pointing in opposite directions.

11.4. **Lettering for EQUIPMENT**

For equipment, the name, tag number and service are to be indicated over each item.

11.4.1. Dimensions

**ITEM SIZE LETTER (or SYMBOL) HEIGHT**

Process Equipment	< 5 m diameter	100 mm
	> 5 m diameter	300 mm
Tanks and Spheres	< 15 m diameter	500 mm
	> 15 m diameter	1000 mm

Blank space between letters (symbols) shall be tailored according to their height; approximately, a 30 % of letters (symbols) height can be considered.

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#### 11.4.2. Others

Lettering for tanks shall be placed at height of approx. 4/5 of the shell height.  
Lettering for horizontal and spherical vessels shall be placed at the height of the centerline.

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## APPENDIX 1

**TABLE 1**  
**Selection of coating systems**

### Products

Painting material codes relevant to systems shown in **TABLE 1** are listed below.

EPGZ	<u>Epoxy Primer for Galvanized Surfaces</u>
EPHSZP	<u>Epoxy primer containing zinc phosphate</u>
EPF	<u>2-pack Epoxy Phenolic</u>
EPHS	<u>High Build Epoxy</u>
EPmHSALMIO	<u>High Build Al Pigmented MIO Epoxy Paint</u>
EPmHSMIO	<u>High Build MIO Epoxy Paint</u>
EPPM	<u>Epoxy Tie Coat</u>
ESI	<u>Ethyl Zinc Silicate</u>
INTU-R	<u>Intumescent Coating</u>
PUR	<u>2-pack Polyurethane</u>
SYL	<u>Single-pack Silicone based</u>
TIP	<u>Thermo Indicative Paint</u>
ZRE	<u>Zinc-Rich Epoxy</u>
ZRS	<u>Zinc-Rich Silicone</u>

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ITEM	OPER. TEMP.	SURFACE PREPAR.	SYSTEM STRUCT.	PRODUCT TYPE	COAT THK	TOTAL DFT	FINISH COLOR	PAINT SYSTEM code
	(°C)	grade	coat	code	(µm)	(µm)	(RAL)	
STRUCTURAL STEEL (CARBON STEEL)								
Columns, beams, and structural members NOT Fireproofed	ambient	abrasive blast (ISO Sa 2.5)	primer	EPHSZP	120	320	LIGHT GREY	DT120-1/ DT120-2
			interm.	EPHS	120			
			finish	PUR	80		7035	
Surfaces to be fireproofed with cement products	ambient	abrasive blast (ISO Sa 2.5)	primer	ZRE	75	100	MFR STD	xxx
			finish	EP	100			
Surfaces to be fireproofed with intumescent products	ambient	abrasive blast (ISO Sa 2.5)	primer	EPHS	80		LIGHT GREY	D- C5INTU- 1
			interm.	INTU-R	Note 14			
			finish	PUR	60		7035	
Handrail, guardrail, ladder	ambient	abrasive blast (ISO Sa 2.5)	primer	EPHSZP	120	320	SAFETY YELLOW 1021	DT120-1/ DT120-2
			interm.	EPHS	120			
			finish	PUR	80			
Grating	Hot Dip Galvanized							
HOT DEEP GALVANIZED	ambient	brush-off abrasive sweeping (ISO Sa 1)				200	service identif.	D-ZZ-1
			primer	EPHS	40			
			intermediate	EPHS	80			
DRY METALLIZED SURFACES	ambient	--	finish	PUR	80	280	--	D-Im123-1B
			pen. primer	EPPM	40			
			primer	EPHS	80			
			intermediate	EPHS	80			
			finish	PUR	80			
EQUIPMENT (VESSELS, COLUMNS, REACTORS, HEAT EXCHANGERS), TANKS, FIRED HEATERS,								
UNINSULATED Carbon Steel	up to 120	abrasive blast (ISO Sa 2.5)	primer	EPHSZP	120	320	LIGHT GREY	DT120-1/ DT120-2
			interm.	EPHS	120			
			finish	PUR	80		7035	
	121 to 400	abrasive blast (ISO Sa 2.5)	primer	ESI	75	125		DT400-1/ DT400-2
			interm.	SYL	25			
			finish	SYL	25		ALUMINIUM	
UNINSULATED Carbon Steel	401 to 600	abrasive blast (ISO Sa 2.5)	primer	SYL	25	75		DT600-1/ DT600-2
			interm.-	SYL	25			
			finish	SYL	25		ALUMINIUM	
INSULATED Carbon Steel	up to 120	abrasive blast (ISO Sa 2.5)	primer	EPF	125	250	MFR STD	DT120-3
			finish	EPF	125		-	

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INSULATED Carbon Steel	121 to 400	abrasive blast	primer	ESI	75	100	MFR STD	DT400-3
		(ISO Sa 2.5)	finish	SYL	25			
INSULATED Carbon Steel	401 to 600	abrasive blast	primer.	SYL	25	50		DT600-3
		(ISO Sa 2.5)	finish	SYL	25		MFR STD	
INSULATED Stainless Steel	up to 200	brush-off abrasive	primer	EPF	125	250		DT200-1
		(ISO Sa 1)	finish	EPF	125		MFR STD	
Carbon Steel Refractory Vessel Surfaces		abrasive blast (ISO Sa 2.5)	primer	ESI	75	100		--
							Note 15	
			finish	TIP	25			
PIPING and PIPING SUPPORTS								
UNINSULATED Carbon Steel	up to 120	abrasive blast	primer	EPHSZP	120	320	LIGHT GREY	DT120-1/DT120-2
			interm.	EPHS	120			
		(ISO Sa 2.5)	finish	PUR	80		7035	
	121 to 400	abrasive blast	primer	ESI	75	125		DT400-1/DT400-2
			interm.	SYL	25			
		(ISO Sa 2.5)	finish	SYL	25		ALUMINIUM	
UNINSULATED Carbon Steel	401 to 560	abrasive blast	primer	SYL	25	75	ALUMINIUM	DT600-1/DT600-2
			Interm.-	SYL	25			
		(ISO Sa 2.5)	finish	SYL	25			
INSULATED Carbon Steel	up to 120	abrasive blast	primer	EPF	125	250	MFR STD	DT120-3
		(ISO Sa 2.5)	finish	EPF	125		-	
INSULATED Carbon Steel	121 to 400	abrasive blast	primer	ESI	75	100	MFR STD	DT400-3
		(ISO Sa 2.5)	finish	SYL	25			
INSULATED Carbon Steel	401 to 600	abrasive blast	primer.	SYL	25	50	MFR STD	DT600-3
		(ISO Sa 2.5)	finish	SYL	25			
INSULATED Stainless Steel	up to 200	brush-off abrasive	primer	EPF	125	250	MFR STD	DT200-1
		(ISO Sa 1)	finish	EPF	125			
SUBMERGED INTO WATER (SPLASH ZONE) OR SOIL	ambient	abrasive blast	primer	EPmHSA LMIO	250	500		D-Im123-1A
		(ISO Sa 2.5)	finish	EPmHS MIO	250			
DRY METALLIZED SURFACES	ambient	--	primer	EPPM	40	280	--	D-Im123-1B
			primer	EPHS	100			
			intermediate	EPHS	100			
			finish	PUR	80			
PACKAGED EQUIPMENT								

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	REFER TO EACH SUB-ITEM FOR PAINT SYSTEM AND FINISH COLOR				
PUMPS, COMPRESSORS, TURBINES and other ROTATING EQUIPMENT					
	NOTE 7	MFR'S STANDARD SYSTEM	NOTE 7	LIGHT GREY	MFR
				7035	
ELECTRIC MOTORS					
	NOTE 7	MFR'S STANDARD SYSTEM	NOTE 7	TRAFFIC BLUE	MFR
				5017	
ELECTRICAL EQUIPMENT					
	NOTE 7	MFR'S STANDARD SYSTEM	NOTE 7	LIGHT GREY	MFR
				7035	
INSTRUMENTS and CONTROL PANELS					
	NOTE 7	MFR'S STANDARD SYSTEM	NOTE 7	LIGHT GREY	MFR
				7035	
CRANES and HOISTS					
	NOTE 7	MFR'S STANDARD SYSTEM	NOTE 7	SAFETY YELLOW	MFR
				1021	
FIRED EQUIPMENT					
Fire water hose reels, monitors, hose reels and cabinets, hydrants	NOTE 7	MFR'S STANDARD SYSTEM	NOTE 7	SAFETY RED	MFR
				3000	

**NOTES**

- All temperatures noted in this schedule shall be maximum operating and not design.
- Coating thicknesses indicated are minimum dry film thicknesses. Maximum allowed coating thicknesses are defined by Paint Manufacturer in technical datasheet of each painting product.
- Surface preparation shall be executed in accordance with referenced standards, surface roughness assessment as per standard ISO 8503. Roughness profile value for blasted surfaces shall be in accordance with Paint Manufacturer's requirements.
- Refractory lined items such as heaters and stacks shall be painted in accordance with calculated skin temperature.
- Parts of Equipment protruding from insulation (saddles, nozzles, manholes) and piping components not insulated (flanges, valves, supports) will be completely coated as per relevant paint code system for uninsulated surfaces.



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- 6 Surfaces which will be inaccessible after erection (i.e. faces of column skirts in contact with concrete structures, firm plate supports) and hidden surfaces (i.e. casing of air coolers, inside of column skirts) shall be completely shop painted.
- 7 For minimum requirements of Manufacturer's standard systems, see para 5.2.
- 8 Finish colours are applicable only for uninsulated items operating at temperatures below 100°C.
- 9 Coating systems for steel surfaces under fireproofing shall be approved by the fire protection product Manufacturer.
- 10 Coating systems for personal protected piping shall be selected among systems for uninsulated surfaces.
- 11 Shop painted items, for which delivery is foreseen by ocean transport shall be duly protected during shipment, to avoid premature failure of the coating.
- 12 Thickness depends on construction type and asked fire grading
- 13 Fire protective coating has to be proved by certificate of Slovak Authority in compliance with Slovak standards.
- 14 Thickness depends on construction type and asked fire grading.
- 15 For thermo-indicative paint system the International product Intertherm 715 shall be used. Interzinc 22 primer is recommended.
- 16 Final colour of metal cladding for shelters shall be light grey 7035.

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## **APPENDIX 2**

### **RECOMMENDED MANUFACTURERS FOR COATING SYSTEMS**

DP: N.A.

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DUSLO A.S.

### RECOMMENDED MANUFACTURERS FOR COATING SYSTEM DT120-1/ DT120-2

MANUFACTURERS	PRODUCTS	GENERIC CLASS
CARBOLINE	Carboaguard 893 SG	EPHSZP (Epoxy primer zinc phosphate)
	Carboguard 890 LT	EPHS ( High Solid Epoxy)
	Carbothane 134 HP	PUR (Polyurethane)
HEMPEL	Hempadur FD 17410	EPHSZP (Epoxy primer zinc phosphate)
	Hempadur Mastic 45880	EPHS ( High Solid Epoxy)
	Hempathane HS 55610	PUR (Polyurethane)
INTERNATIONAL	Interplus 356	EPHSZP (Epoxy primer zinc phosphate) or equivalent
	Interplus 356	EPHS ( High Solid Epoxy)
	Interthane 990	PUR (Polyurethane)
NOR MAALI/JOTUN	Norecoat FD ZP Primer/ Penguard Express ZP	EPHSZP (Epoxy primer zinc phosphate)
	Norecoat FD Primer/ Penguard Express	EPHS ( High Solid Epoxy)
	Hardtop XP	PUR (Polyurethane)
PPG	Sigmafast 278	EPHSZP (Epoxy primer zinc phosphate) or equivalent
	Sigmafast 278	EPHS ( High Solid Epoxy)
	Sigmadur 550H	PUR (Polyurethane)

### RECOMMENDED MANUFACTURERS FOR COATING SYSTEM DT120-3

MANUFACTURERS	PRODUCTS	GENERIC CLASS
CARBOLINE	Thermaline 400 EU (2 coats)	EPF (Epoxy-phenolic)
HEMPEL	Hempadur 85671 (2 coats)	EPF (Epoxy-phenolic)
INTERNATIONAL	Intertherm 228 HS (2 coats)	EPF (Epoxy-phenolic)
NOR MAALI/Jotun	Tanguard Storage (2 coats)	EPF (Epoxy-phenolic)
PPG	Sigmatherm 230 (2 coats)	EPF (Epoxy-phenolic)

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DUSLO Code: 2260/15/15/TPIT

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DUSLO A.S.

**RECOMMENDED MANUFACTURERS FOR COATING SYSTEM DT400-1/DT-400-2**

MANUFACTURERS	PRODUCTS	GENERIC CLASS
CARBOLINE	Carbozinc 11	ESI (Ethyl Zinc Silicate)
	Thermaline 4700 (2 coats)	SYL (Single-pack Silicone Based)
HEMPEL	H's Galvosil 15700	ESI (Ethyl Zinc Silicate)
	H's Silicone Alum. 56914 (2 coats)	SYL (Single-pack Silicone Based)
INTERNATIONAL	Interzinc 2280	ESI (Ethyl Zinc Silicate)
	Intertherm 50 (2 coats)	SYL (Single-pack Silicone Based)
NOR MAALI/JOTUN	Resist 78	ESI (Ethyl Zinc Silicate)
	Solvalitt ALU (2 coats)	SYL (Single-pack Silicone Based)
PPG	Sigmazinc 158	ESI (Ethyl Zinc Silicate)
	Sigmatherm 540 (2 coats)	SYL (Single-pack Silicone Based)

**RECOMMENDED MANUFACTURERS FOR COATING SYSTEM DT400-3**

MANUFACTURERS	PRODUCTS	GENERIC CLASS
CARBOLINE	Carbozinc 11	ESI (Ethyl Zinc Silicate)
	Thermaline 4700 (1 coat)	SYL (Single-pack Silicone Based)
HEMPEL	H's Galvosil 15700	ESI (Ethyl Zinc Silicate)
	H's Silicone Alum. 56914 (1 coat)	SYL (Single-pack Silicone Based)
INTERNATIONAL	Interzinc 2280	ESI (Ethyl Zinc Silicate)
	Intertherm 50 (1 coat)	SYL (Single-pack Silicone Based)
NOR MAALI/JOTUN	Resist 78	ESI (Ethyl Zinc Silicate)
	Solvalitt ALU (1 coat)	SYL (Single-pack Silicone Based)
PPG	Sigmazinc 158	ESI (Ethyl Zinc Silicate)
	Sigmatherm 540 (1 coat)	SYL (Single-pack Silicone Based)

**RECOMMENDED MANUFACTURERS FOR COATING SYSTEM DT600-1/DT 600-2**

MANUFACTURERS	PRODUCTS	GENERIC CLASS
CARBOLINE	Thermaline 4700 (3 coats)	SYL (Single-pack Silicone Based)
HEMPEL	H's Silicone Alum. 56914 (3 coats)	SYL (Single-pack Silicone Based)
INTERNATIONAL	Intertherm 50 (3 coats)	SYL (Single-pack Silicone Based)
NOR MAALI/JOTUN	Solvalitt ALU (3 coats)	SYL (Single-pack Silicone Based)
PPG	Hi Temp 1027 (3 coats)	SYL (Single-pack Silicone Based) or equivalent

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DUSLO Code: 2260/15/15/TPIT

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### **RECOMMENDED MANUFACTURERS FOR COATING SYSTEM DT600-3**

MANUFACTURERS	PRODUCTS	GENERIC CLASS
CARBOLINE	Thermaline 4700 (2 coats)	SYL (Single-pack Silicone Based)
HEMPEL	H's Silicone Alum. 56914 (2 coats)	SYL (Single-pack Silicone Based)
INTERNATIONAL	Intertherm 50 (2 coats)	SYL (Single-pack Silicone Based)
NOR MAALI/JOTUN	Solvalitt ALU (2 coats)	SYL (Single-pack Silicone Based)
PPG	Hi Temp 1027 (2 coats)	SYL (Single-pack Silicone Based) or equivalent

### **RECOMMENDED MANUFACTURERS FOR COATING SYSTEM DT200-1**

MANUFACTURERS	PRODUCTS	GENERIC CLASS
CARBOLINE	Thermaline 400 EU (2 coats)	EPF (Epoxy-phenolic)
HEMPEL	Hempadur 85671 (2 coats)	EPF (Epoxy-phenolic)
INTERNATIONAL	Intertherm 228 HS (2 coats)	EPF (Epoxy-phenolic)
NOR MAALI/JOTUN	Tanguard Storage (2 coats)	EPF (Epoxy-phenolic)
PPG	Sigmatherm 230 (2 coats)	EPF (Epoxy-phenolic)

### **RECOMMENDED MANUFACTURERS FOR COATING SYSTEM D-Im123-1-A**

MANUFACTURERS	PRODUCTS	GENERIC CLASS
CARBOLINE	Carboguard 940	EPmHSALMIO or equivalent
	Carboguard 940	EPmHSMIO or equivalent
HEMPEL	Hempadur 45703	EPmHSALMIO or equivalent
	Hempadur 45751/3	EPmHSMIO or equivalent
INTERNATIONAL	Interzone 954	EPmHSALMIO or equivalent
	Interzone 954	EPmHSMIO or equivalent
NOR MAALI/JOTUN	Normastic 405 ALU/ Jotamastic 87 Alu	EPmHSALMIO or equivalent
	Normastic 405/ Jotamastic 87	EPmHSMIO or equivalent
PPG	Sigmashield 880GF	EPmHSALMIO or equivalent
	Sigmashield 880GF	EPmHSMIO or equivalent

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### RECOMMENDED MANUFACTURERS FOR COATING SYSTEM D-Im123-1-B

MANUFACTURERS	PRODUCTS	GENERIC CLASS
CARBOLINE	Carboguard E 19	EPPM (Epoxy Tie Coat)
	Carboguard 890 LT (2 coats)	EPHS (High Build Epoxy)
HEMPEL	Carbothane 134 HP	PUR (Polyurethane)
	Hempadur 15570	EPPM (Epoxy Tie Coat)
	Hempadur FD 17410 (2 coats)	EPHS (High Build Epoxy)
	Hempathane HS 55610	PUR (Polyurethane)
INTERNATIONAL	--	EPPM (Epoxy Tie Coat)
	Intergard 269	EPHS
	Intergard 475HS	EPHS
	Interthane 990	PUR (Polyurethane)
NOR MAALI/JOTUN	Penguard Tie Coat 100	EPPM (Epoxy Tie Coat)
	Norecoat FD Primer (2 coats)/ Penguard Express (2 coats)	EPHS
PPG	Hardtop XP	PUR (Polyurethane)
	Sigmacover 522	EPPM (Epoxy Tie Coat)
	Sigmaprime 700 (2 coats)	EPHS (High Build Epoxy)
	Sigmadur 550H	PUR (Polyurethane)

### RECOMMENDED MANUFACTURERS FOR COATING SYSTEM D-ZZ-1

Manufacturers	Products	Generic Class
CARBOLINE	Carboguard 890 LT (2 coats)	EPHS (High Build Epoxy)
	Carbothane 134 HP	PUR (Polyurethane)
HEMPEL	Hempadur FD 17410 (2 coats)	EPHS (High Build Epoxy)
	Hempathane HS 55610	PUR (Polyurethane)
INTERNATIONAL	Intergard 475HS (2 coats)	EPHS High Build Epoxy)
	Interthane 990	PUR (Polyurethane)
NOR MAALI/JOTUN	Norecoat FD Primer (2 coats)/ Penguard Express (2 coats)	EPHS (High Build Epoxy)
	Hardtop XP	PUR (Polyurethane)
PPG	Sigmaprime 700	EPHS (High Build Epoxy)
	Sigmadur 550H	PUR (Polyurethane)

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### RECOMMENDED MANUFACTURERS FOR COATING SYSTEM D-C5INTU-1

Manufacturers	Products	Generic Class
CARBOLINE	Carboguard 893SG	EPHS (High Build Epoxy)
	Thermo Lag 3000	INTU-R (Intumescent Paint)
	Carbothane 134HP	PUR (Polyurethane)
HEMPEL	Hempadur FD 17410	EPHS (High Build Epoxy)
	Hempacore FD 43601	INTU-R (Intumescent Paint)
	Hempathane HS 55610	PUR (Polyurethane)
INTERNATIONAL	Intergard 269	EPHS (High Build Epoxy)
	Interchar 212	INTU-R (Intumescent Paint)
	Interthane 990	PUR (Polyurethane)
NOR MAALI/JOTUN	Norecoat FD Primer	EPHS (High Build Epoxy)
	Steelmaster 60SB	INTU-R (Intumescent Paint)
	Hardtop XP	PUR (Polyurethane)
PPG	Sigmaprime 700	EPHS (High Build Epoxy)
	Steelguard series	INTU-R (Intumescent Paint)
	Sigmadur 550H	PUR (Polyurethane)

## APPENDIX 3

TABLE 2

DP: N.A.

DUSLO Code: 2260/15/15/TPIT

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## Inspection and Testing Requirements



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TEST TYPE	METHOD	FREQUENCY	ACCEPTANCE CRITERIA	CONSEQUENCE
PRE-BLASTING STEEL PREPARATION	as per para 8.4	100% of surfaces	no defects in accordance with specified requirements	repair of defects
ENVIRONMENT CODITIONS	as per para 8.5, 7.6.2	before start of each shift + every 4 hours	in accordance with specified requirements	no blasting or coating performed
VISUAL EXAMINATION of CLEANED SURFACE	as per para 8.6	100% of surfaces	no defects in accordance with specified requirements	<ul style="list-style-type: none"> <li>• re-blasting</li> <li>• re-cleaning</li> </ul> re-testing until acceptable
ROUGHNESS	as per para 8.6	spot checks (min 5 readings per 10 m <sup>2</sup> )	in accordance with specified requirements	re-blasting
SOLUBLE SALTS TEST	as per para 8.7	spot checks (minimum 1 for each item)	as per para 8.7	re-cleaning and resting until acceptable
WET FILM THICKNESS	as per para 7.6.7	frequently during application	in accordance with Manufacturer specified requirements	additional film build as appropriate if needed
DRY FILM THICKNESS	as per para 8.8	In accordance with STD ISO 19840	Thickness in accordance with minimum specified and maximum allowed (by Paint Manufacturer)	additional coats or recoating as appropriate
PRIMER CURE	as per para 8.9	spot check for ZRE and ESI primers	as per para 8.9	allow longer curing time; check weather condition in accordance with Paint Manufacturer's requirements
VISUAL EXAMINATION	as per para 8.11	100% of surfaces after each coat	in accordance with specified requirements	repair of defects
ADHESION	as per para 8.10	test panels and spot checks	as per para 8.10	coating to be rejected
HOLIDAY DETECTION	as per para 8.12	100% of surface	no holidays	repair and retesting

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## APPENDIX 4

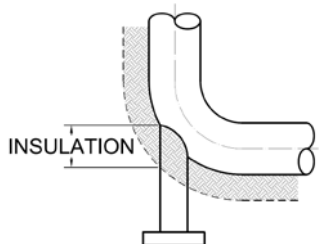
### TABLE 3

#### Piping Supports Coating Selection

DP:

DUSLO Code:

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PIPING SUPPORTS COATING SELECTION									
FABRICATION DESTINATION	SUPPORT		Max Temp. (°C)	LINE COATING SYSTEM	SUPPORT COATING SYSTEM			NOTES	
	Base Material	REF. MATCL (per JSD-1300-10)			TEMP. RANGE	PRIMER	FINISH		
WELDED to PIPE  AT PREFAB. SHOP (spooling)	Carbon Steel Low Temp. Carbon Steel Alloy Steel Cr-1/2 Mo 1 1/4 Cr - 1/2 Mo 2 1/4 Cr -1 Mo 5 Cr - 1/2 Mo 7 Cr - 1/2 Mo 9 Cr -1 Mo	CS, CL, AS	-46÷343	DT-120-1	DT-120-1 up to 100°C	ETHYL ZINC SILICATE	as per system DT-120-1	  (1) Coating System DT-120-3 (on insulated lines) shall be applied for 150 mm from the welding seam. On the remaining surface of pipe support a polyurethane finish coat shall be applied.	
				DT-400-1	DT-400-1 101°C to 343°C		as per system DT-400-1		
				DT-120-3	DT-120-3 up to 150°C note (1)	EPOXY PHENOLIC	EPOXY PHENOLIC note (1)		
			CH, AH	above 343	DT-400-1 DT-600-1	SAME AS THE SUPPORTED LINE			
CLAMPED to PIPE or WELDED AT SITE (ERECTION)	Carbon Steel Low Temp. Carbon Steel Alloy Steel Cr-1/2 Mo 1 1/4 Cr - 1/2 Mo 2 1/4 Cr -1 Mo 5 Cr - 1/2 Mo 7 Cr - 1/2 Mo 9 Cr - 1 Mo	CS, CL, AS	-46÷343	DT-120-1	up to 100°C	ETHYL ZINC SILICATE	as per system DT-120-1		
				DT-120-3			101°C to 343°C	as per system DT-400-1	
			CH, AH	above 343	DT-400-1 DT-600-1	DT-600-1			
		CLAMPED or WELDED to PIPE	Stainless Steel	SS	up to 343	DT-200-1	SAME AS THE SUPPORTED LINE note (2)		