

PAINING INSPECTION



1. GENERAL

1.1. SCOPE

1.1.1 This painting specification and inspection instruction covers the minimum requirements for shop painting, field painting and repair work at site for the surface preparation and paint application to the Un-buried equipment, piping, steel structures, storage tanks, etc., which will be exposed to sea breeze and corrosive environment for use in industrial plant construction projects.

1.1.2 Whilst the content of this painting specification and inspection procedure defines the essential requirements of surface preparation and painting, they do not relieve the construction contractor and/or equipment manufacturer from his responsibility to carry out the work in accordance with the appropriate codes and standards listed in clause 1.2.

1.2. REFERENCES: CODES, STANDARDS AND SPECIFICATIONS

- ISO 8501-1: 1988 (Swedish Standard: SIS 055900)
- Preparation of steel substrates before application of paints and related products. Visual assessment of surfaces cleanliness.
- SSPC: Steel Structures Painting council.
- Manual volume 1: good painting practice
- Manual volume 2 : systems and specifications
- ISO 8503-1-2-3-4
- Roughness characteristics of blast-cleaned steel substrate.
- ISO 4624 paints and varnish pull off test for adhesion
- BRITISH STANDARDS COLORS: BS 4800 / BS 381C

- ISO 3864 safety colors and safety signs.
- ASTM Standards
- DIN Standards

Manufacturer's standard / painting specification / procedure.

1.3. SITE CONDITION

- Max. Sunshine Temperature: 85° C
- Max. Relative humidity: 76%
- See breeze
- Thunderstorm - Fog
- SO₂ : 2 ppm
- H₂S: 10 ppm
- Wind velocity: 35 m/s

1.4. EXTENT OF PAINTING

All Unburied steel surfaces except stainless steel, aluminum, Nickel, Titanium, new and undamaged galvanized steel surfaces and non-ferrous materials shall be painted. Non metallic surfaces shall not be painted.

In particular, stainless steel and non-ferrous surfaces shall be protected from blasting, over spray and painting intended carbon steel, specially painting containing zinc.

Note 1: The following surfaces and materials shall require painting:

- a. All steel structures, sheds, pipe racks, steel supports, ladders, stairs, handrails, platforms, walkways, monorails, cranes and all other steel members unless specified otherwise.
- b. All carbon and low alloy piping, fittings and valves including painting of identification marks.
- c. All equipment like columns, vessel, drums, storage tanks, heat exchangers, coolers, pumps, compressors, filters, loading arms, etc.

Note 2: The following surfaces and materials shall not require painting except specified otherwise:

- a. Stainless steel, glass surfaces, plastic or plastic coated materials.

b. Any equipment furnished completely primed and finish painted by the manufacturer (e.g. instrument boards, motors) unless specifically required to repair paint damage or to match a color scheme.

c. Galvanized surfaces are not to be painted, except in acid areas and weld seam (if any).

d. Finished machine parts of machinery and gasket surfaces.

e. Cast iron, PVC and vitrified clay buried piping.

f. Non ferrous material (copper, brass, monel-inconel, aluminum, bronze)

The equipment and the parts listed below shall be shielded to prevent damage during surface preparation and painting operations. All openings, including those that are flanged or threaded, shall be sealed to prevent entry of sand, dust, or painting material.

- Nameplates.
- Packing glands.
- Packing seals.
- Bearings.
- Rotating equipment couplings.
- Rotating equipment shafts.
- Lubrication fittings.
- Pressure gauges.
- Gauge glasses.
- Motor starters.
- Instruments dials.
- Valve stems.
- Vent.
- Exposed linkages.
- Air intakes.
- Rubber parts and plastic.
- Light bulbs.
- Light bulb enclosures.
- Light reflectors.

After completion of painting operations, all materials used for shielding and sealing shall be removed.

1.5. WAIVERS

Any waiver of any article of this painting specification and inspection procedure shall be submitted for written approval by the purchaser/ and Owner.

1.6. PAINT MANUFACTURE 'S OBLIGATION

1.6.1. Paint manufacturers shall submit technical data sheets and test and analysis certificates to the Owner and purchaser.

1.6.2. The paint manufacturer shall state shelf life of all paints and protective coatings and shall provide recommendations for storage. All product containers shall be marked with their batch number and initial manufacture date.

The Contractor shall be responsible for ensuring that he is in possession of the latest available issue of the paint data sheets and product safety data sheets printed by the paint manufacturer for the particular batch of paint to be applied. Such data shall include specific recommendations and instructions concerning shelf life, pot life, thinners, directions for thinning and mixing drying time, curing time, recommended spray equipment, safety equipment cleaning solvent and any other provisions for application of primer, inner coat and finish coats. Product safety data sheets shall include information. Concerning general composition, physical data hazards and precautions during and after application, toxicity / first aid, storage, spillage and waste disposal. These recommendations shall be considered an inherent part of this painting specification and inspection procedure and followed accordingly. The Contractor shall (if requested), provide the latest original issue of the paint manufacture's data sheets with their technical offers for approval.

1.6.3. Paint Manufacturer recommendations and safety instruction fare part of this painting specification and inspection procedure.

1.7. CONFLICTING REQUIREMENT

Any conflict between the requirements of this painting specification and inspection procedure, referenced specifications, drawing, and paint manufacturer's recommendations, the requisition or the governing contract shall be referred to the purchaser and Owner for clarification before proceeding the actual work.

1.8. DESIGN REQUIREMENTS

1.8.1. Painting for the protection of equipment, piping, structural steels, tanks, etc., shall be designed and applied for the application over the specified minimum surface preparation standards detailed in this painting specification and inspection procedure in combination with the codes and standards listed in clause 1.2.

1.8.2. All painting shall be suitable for applications and services in sea breeze and corrosive environment conditions. The painting shall provide the dual function of protection against corrosion or deterioration and decoration of the surfaces painted.

1.8.3. The paint system shall generally be selected according to the operating temperature of the equipment and piping. (If max. operating temperature or regeneration temperature has been specified higher temperature will be used.).

1.8.4. All supports including skirts legs saddles etc., shall be painted with the paint system for surfaces as appropriate to the metal of the equipment or piping being supported.

1.9. PAINT MANUFACTURE TECHNICAL ASSISTANCE

1.9.1. The paint manufacturer shall submit paint technical data sheets and painting specification for approval to the purchaser and Owner.

1.9.2. A representative of the paint manufacturer shall be present during the beginning of work to assist in surface preparation and paint application (if to be requested by purchaser or Owner). Also upon Owner / purchaser's request the paint manufacturer's representative shall visit regularly, the paint application site to ensure that the paint is applied according to his recommendation a monthly report on problems encountered and the way to solve them.

1.10. GENERAL REQUIREMENTS

1.10.1. The construction contractor & Equipment manufacturer shall provide and maintain in good condition all plant, equipment and tools necessary to carry out the work in an efficient manner and provided lubricating oils, greases consumable materials and parts as necessary to maintain the plant equipment and tools in good working order.

1.10.2. The Contractor shall purchase such paint from approved manufacturers. Where relevant the construction contractor & Equipment manufacturer shall provide all blasting abrasives necessary to carry out the work. This must be reviewed by paint inspection services company.

1.10.3. The construction contractor & Equipment manufacturer shall provide skilled and experienced personnel to carry out the work together with competent and qualified supervision. The size of the workforce shall be regulated to the requirements and scheduling of the work. the qualification must be checked by paint inspection services company.

1.10.4. The construction contractor & Equipment manufacturer shall comply fully with this painting specification and inspection procedure unless otherwise approved by the purchaser and Owner. Additionally, the work will be subject to continuous inspection by the inspector who will be at liberty to check at every stage that the work is being carried out in accordance with all aspects of this painting specification and inspection procedure. When specified, the purchaser will request the provision of material samples and test panels of prepared and painted surfaces.

1.10.5. No substitution or modification to materials and methods of application detailed in this painting specification inspection procedure is permissible, unless prior approval of purchaser and Owner has been obtained.

1.10.6. Prior to the commencement of work, construction contractor & Equipment manufacturer shall submit for the approval of purchaser and Owner, fully detailed procedure as to how he intends to carry out the work within the frame work of this painting specification and inspection procedure. The construction contractor & Equipment manufacturer shall provide full details regarding the use of a lower tier subcontractor, location of work, choice of materials and any further information. This procedure must be reviewed by paint inspection services company.

1.10.7. Application of painting other than inorganic zinc primer shall be delayed until completion of all required shop pressure testing. Application of inorganic zinc silicate primer prior to pressure testing with consequent covering up of welds, shall only be permitted in specific cases agreed with purchaser and Owner. In such cases application of the subsequent tie coat shall be delayed until completion of pressure testing.

2. PAINTING SYSTEMS

2.1. APPLICABLE PAINT SCHEDULE SYSTEMS (EXTERNAL)

The following schedule summarizes the paint systems to be applied depending on the operating / service temperature regarding article 1.5.c of this painting specification and inspection procedure.

SYS NO.	APPLICATION	INSULATION STATUS	TEMP. RANGE	SURFACE PREPARATION	PRIMER	INNER COAT (NOTE-1)	FINISH COAT (NOTE-1)	REMARKS
1- A/G Piping, Towers, Vessels, Drums, Exchangers, Columns, External Surface of Storage Tanks and etc.								
<i>1-a. uninsulated</i>								
A	1-a-1. Temperature range: up to 90°C	Uninstalled	Up to 90°C	SA 2½	P1	I1	F1	
B	1-a-2. Temperature range: 91°C to 400°C	Uninstalled	90°C to 400°C	SA 2½	P2	I2	F2	(Note-3)
C	1-a-3. Temperature range: 401°C to 565°C	Uninstalled	401°C to 565°C	SA 2½	P3	-	F3	
<i>1-b. insulated</i>								
Ai	1-b-1. Temperature range :up to 90°C	Insulated	Up to 90°C	SA 2½	P1	-	-	
Bi	1-b-2. Temperature range:91°C to 400°C	Insulated	91°C to 400°C	SA 2½	P2	-	-	(Note-3)
Ci	1-b-3. Temperature range: 401°C to 565°	Insulated	401°C to 565°C	SA 2½	P3	-	-	
2- Steel structures(such as shelters and etc), Pipe rack, Ladder & Platforms, Handrail, Stairway and Cages								
D	2-a. exposed	Uninstalled	Ambient to 90°C	SA 2½	P1	I1	F1	
Di	2-b. fireproofed	Insulated	N/A	SA 2½	P1	-	-	

(1) Finish coat/Inner coat manufacture(s) shall guarantee compatibility, suitability and adhesion between primer and inner or finish coat.

(2) Paint schedule of followings shall be in accordance with manufacture's standard. Finish color of them shall be in accordance with Para. 10.3 of this painting specification and inspection procedure.

- Machinery (pumps, compressors, machinery and etc.)
- Valves and traps and other special piping components except small (under 2") welded ends valves
- Electrical equipment, instrument equipment and panel board
- Fire and safety equipment

(3) System No. B may be divided to the two categories (i.e. 91°C ~ 200°C and 201°C ~ 400°C). Prior Owner's approval is required. The above item must be checked and reviewed by paint inspection services company.

2.2. APPLICABLE PAINT SCHEDULE SYSTEM (INTERNAL)

The following schedule summarizes the paint system to be applied on internal surfaces of all kind of Water Storage Tanks.

SYS NO.	APPLICATION	INSULATION STATUS	TEMP. RANGE	SURFACE PREPARATION	PRIMER	INNER COAT (NOTE-1)	FINISH COAT (NOTE-1)	REMARKS
<i>Internal surface of water storage tanks</i>								
E	All internal surfaces of water storage tanks	N/A	Up to 90°C	SA 2%	P4	I3	F4	

2.3. DEFINITION OF PAINTS

Primer

Code	Description	DFT
P1	Epoxy zinc rich	50 μ
P2	Two pack inorganic zinc silicate (Ethyl Silicate Based with min.80% metallic zinc by weight in the dry film)	65 μ
P3	Two pack modified inorganic liquid containing silicon resin and <u>methoxy</u> and powder containing silica & iron oxide (or aluminum)	125 μ
P4	Epoxy polyamine primer	100 μ

Inner Coats

I1	Epoxy resin paint	80 μ
I2	Single pack high temperature resistance silicon aluminum	25 μ
I3	Epoxy polyamine intermediate	100 μ

Finish Coats

F1	Polyurethane resin paint(gloss retention and weather/ UV resistance)	40 μ
F2	Single pack high temperature resistance silicon aluminum	25 μ
F3	Two pack modified inorganic liquid containing silicon resin and <u>methoxy</u> and power containing silica & iron oxide(or aluminum)	125 μ
F4	Epoxy polyamine top coat	100 μ

DFT: Dry film thickness

3. SURFACE PREPARATION

3.1. GENERAL

Before any surface preparation or paint application, the surface shall be completely dry.

All cleaned surfaces shall comply to the required standards at the moment the primer coat is applied.

3.2. DESCRIPTION ON SURFACE PREPARATION METHODS

3.2.1. Degreasing

Solvent or alkaline cleaning shall precede other methods of surface preparation and the application of any coating, whenever dirt, oil grease and other substances, harmful to life-time or appearance of primers or paints are present.

These agents shall be removed by means of clean solvent (such as white spirit) or suitable cleaning compounds. After cleaning, the surfaces shall be rinsed with an ample amount of potable water, and then allowed to dry thoroughly before any further step is taken. Only clean brushes and rags shall be used. This must be checked by paint inspection services company.

Generally the methods of surface preparation shall be specified according to SSPC.

3.2.2. Blast Cleaning

Blast cleaning operations shall not be carried out on surfaces that will be wet after blasting and before coating.

Near White-Metal Blast Cleaning As Per Sa 2 1/2":

Mill scale, rust, primer, paint or other foreign matter shall be removed to such an extent that the cleaned surface is equal in appearance to the pictorial standard SIS, Sa 2 ½ as a minimum. The process must be checked by paint inspection services company.

Blasting Materials:

Blasting materials shall be selected to obtain the blast profile in addition to the required degree of surfaces preparation. All abrasives shall be supplied fresh, unused, dry and free of duct, organic matter, and totally free of salt contamination.

- Sand shall be supplied per the general guidelines as laid down on page 21 of SSPC painting manual: "selection of abrasives".
- Expendable grit (from copper slag only) 16-80 mesh, B.S. sieve series. Grits shall not be recycled.
- Shot it not acceptable, except as a standardized production shop process.
- Sand shall be recycled free of any type of contaminate.

Blasting Material must be checked by paint inspection services company.

3.2.3. Site Power or Hand Tool Cleaning

Site Power Tool Cleaning

Power and hand-tool cleaning shall not be applied. To replace specified blast cleaning, it shall be used only when blast cleaning is prohibited or impossible.

Power Or Hand-Tool Cleaning As Per St 3 Standard

All loose matter, such a mill scale, rust, primer, paint or other foreign substances shall be removed. The cleaned surface shall be equal in appearance to the pictorial standard, St 3 for new and weathered steel; and for previously blast-cleaned steel. Power-tool cleaning shall be preferably used.

Site Hand Tool Cleaning:

In case power-tool cleaning is impossible, hand-tool cleaning as per St3 will be acceptable, but only after OWNER approval has been obtained.

3.3. SURFACE PREPARATION REQUIREMENTS

3.3.1. Surface preparation should remove foreign bodies to allow the type of priming paint used to wet the surface thoroughly and develop adequate adhesion.

3.3.2. Selection of abrasive for blast cleaning shall be in accordance with the recommendations given in SSPC-SP-COM and the recommendations agreed with the individual paint manufacturer for each type of paint used. Generally, this shall give a surface profile or anchor pattern within the range 50-75 microns with rogue peaks of maximum amplitude 100 microns. Spent abrasives shall be completely removed from the prepared surface by either vacuum cleaning or stiff brushing. For inorganic zinc primed surfaces the abrasive shall be hard sharp and angular, for which reason shot shall not be acceptable. The surface profile shall be checked in conjunction with an approved roughness comparator. This must be checked by paint inspection services company.

3.3.3. Surface preparation shall not take place in the following conditions:

- At temperatures below 5 °C
- When the relative humidity is greater that 85%
- When the metal surface temperature is less than 3 °C (5 °F) above the ambient dew point.

- Outside daylight hours.

Surface preparation may also be suspended at the direction of the inspector when adverse weather conditions are likely to develop before painting could be carried out.

3.3.4. All abrasives shall be free of all dust, dirt and other foreign matter. They shall be kept dry all the times and shall not be recycled, unless permitted by inspector.

3.3.5. The compressed air supply used for blasting shall be free from water and oil. Adequate separators and traps shall be provided and these shall be kept emptied of water and oil. Accumulations of water and oil shall be removed from the air receiver by regular purging.

This clause shall also apply to air used for the dusting of cleaned surfaces. The pressure and the volume of compressed air supply for blast cleaning shall meet the work requirements.

3.3.6. No acid washes or other cleaning solutions or solvents shall be used on metal surfaces after they have been blasted. This includes inhibitive washes intended to prevent rusting

3.3.7. Surface preparation shall result clean surface compatible to as 2 ½ as per. Swedish standard 05 5900

3.3.8. Chipping, scraping and steel wire brushing using manual or power driven tools can not remove firmly adherent mill scale and shall only be used where blast cleaning is impractical, with the approval of purchaser / and Owner inspector such preparation shall be in accordance with photographic illustrations in SIS 05 5900 (Grade C st3).

3.3.9. Surface preparation operations shall be terminated early enough during the day to permit application of the adopted on the prepared surface before the sunsets and rust sets, in, if, exceptionally, surface preparation is authorized at night, the prepared surface shall be wiped the next morning. They shall be freshened with light sand blasting before the primer is applied. A 50mm wide strip along the perimeter of the sand blasted surface shall be left unprimed unless adjacent surfaces have already been coated or if it is the last part of the surface to be prepared. Surface preparation, care shall be extended at least 25 mm to the interior of coated adjacent surfaces.

3.3.10. During surface preparation, care shall be taken not be damage or alter identification plates, machined surfaces and parts coated in the factory. These parts

shall be properly protected.

3.3.11. Any oil, grease, dust or foreign body present on the surface after surface preparation operations shall be removed before painting, if rust reappears on the surface, the surface shall be re-blasted.

3.3.12. Copper slag or coal slag shall not be authorized for surface preparation.

The all above process must be checked by paint inspection services company.

4. PAINTING APPLICATION

4.1. GENERAL REQUIREMENTS

4.1.1. For items that have received a shop prime coat the construction contractor shall clean all primed surfaces and shall touch up damaged shop prime coat, prepare and stripe primer on the field welds and apply inner and finish coats in accordance with the specified painting system.

4.1.2. It is the construction contractor responsibility to ensure compatibility between shop and field applied paint system. For piping and un-coated items, construction contractor shall follow the schedule of the relevant paint systems.

4.1.3. The painting materials shall be applied by the tools as advised by the paint manufacturer after obtaining OWNER approval. When spray application is recommended, supplemental repeated brushing is required to obtain adequate protection and crevices, bolts, rivets, welds, edges and other surfaces where the DFT can not be reached by spraying only. This brushing shall precede the spray application.

4.1.4. To the maximum possible extent each coat shall be applied as smooth and continuous film or uniform thickness, free of pores.

4.1.5. There shall be a minimum of application marks in the applied coats. Sags or runs shall be brushed out while the coat is still wet.

4.1.6. The acceptable tolerance in dry film thickness, when a range is indicated, shall be as specified; a minimum with an acceptable tolerance of 15 percent maximum per coat. Excessively thick coatings shall be blasted off the surface and recoating shall be done at the construction contractor expense.

4.1.7. Each coat must be thoroughly dry before a primed item is transported or

before a next coat is applied.

4.1.8. During application the items surface shall not have a temperature, which is detrimental to the appearances or life-time of the part. Maximum surface temperature should not exceed 45°C.

4.1.9. Subsequent coats shall be of a distinctly different shade.

All above process must be monitored by paint inspection services company.

4.2. MIXING

4.2.1. All the ingredients in each container shall be thoroughly mixed and homogenized. Mechanical mixing shall be such that all pigments or other agents are held in solution during application. Manual mixers are not authorized. Mixing shall be done according to the manufacturer's recommendation.

4.2.2. Paint mixed in the original container shall be transferred until all settled particles have been re mixed with the medium. This does not imply temporary removal of part of the medium to facilitate mixing.

4.2.3. Paint shall not be mixed or held solution with air bubbles.

4.2.4. If a skin has formed in the container, the paint shall not be used.

4.2.5. All pigmented products shall be strained after mixing unless applicator equipment is provided with adequate strainers. Strainers shall allow all pigments to pass through, but not any skin.

4.2.6. Products with unlimited pot life or which do not alter on standing may be mixed at any time, however if they have set, they shall be mixed immediately before use. Paint shall not be kept in the spray equipment post overnight, but shall be put back into a closed container and re-mixed before re-use. Containers shall be marked with the involved paint's pot-life.

The mixing process must be monitored by paint inspection services company.

4.3. THINNING

4.3.1. Thinners are to be added unless necessary for proper application. Thinning shall never exceed manufacturer's recommendations.

4.3.2. Thinners used shall be those suggested by the manufacturer.

4.3.3. When use of thinner is authorised by the manufacturer, it shall be added during mixing. Applicators shall not be add thinner after the paint has been thinned to the proper consistency. Thinners shall be added under the guidance of a specialist who is thoroughly familiar with the quantity and type of added thinner.

The process must be checked by paint inspection services company.

4.4. PRIMING

4.4.1. Prepared surfaces should be primed generally within four hours or before visible re-rusting occurs. Cleaned surface shall never be left overnight prior to coating, in such case re-blasting or re-cleaning is necessary.

4.4.2. In order to minimize contamination between successive coast of paint, over coating of the preceding coat shall be done as soon as it is permitted by the particular painting specification, and not delayed beyond the period specified. When delays are unavoidable, the painted surface shall be thoroughly cleaned and dried to the satisfaction of purchases and Owner before over coating may take place.

4.4.3. Any Primed surface which has been exposed for more than a few days will have become contaminated and should be cleaned down with fresh water and allowed to dry before over coating.

4.4.4. Primed and painted surfaces which have been exposed to marine conditions, including shipment overseas, will be contaminated with salt and should be lightly wire brushed, then washed with fresh water, before over coating. (if any)

4.4.5. Although zinc rich primer are very effective in preventing rusting, extended exposure develops a surface contaminated of zinc corrosion products which rich impair the adhesion of subsequent coats. zinc rich primers, both organic and inorganic which have been exposed long enough to develop white surface staining, should be prepared for over coating by one of the following methods:

- Light blast cleaning and dust removal.
- Wire brushing, followed by water washing.
- Scrubbing with fresh water, using bristle brushes.

4.4.6. The primer to finishing coat paint shall be from the same manufacturer for each system to ensure compatibility.

Priming process must be checked by paint inspection services company.

4.5. PAINTING

4.5.1. All painting shall be carried out in conformity with this painting inspection specification and inspection procedure and with the paint manufacture's recommendation. Paint application shall also follow the procedures covered SSPC-PA1 "Shop field and maintenance painting".

4.5.2. Particular attention shall be paid to the manufacturer's instructions on storage mixing, thinning and pot life. The paint shall only be applied in the manner detailed by the manufacturer. e.g. brush roller conventional or airless spray and shall be applied under the manufacturer's recommended condition. Minimum and maximum time intervals between coats shall be closely followed. This must be checked by paint inspection services company.

4.5.3. Hand mixing of paints shall only be permitted for containers up to 5 liters. All larger containers shall be mixed by mechanical agitators and brought to a uniform consistency. Where pigment separation readily occurs, provision shall be made for continuous mixing during application. This must be checked by paint inspection services company.

4.5.4. Two-pack paints shall be mixed in strict accordance with manufacturer's instructions. The pot life of such paints shall be specifically noted and any mixed paint, which has exceeded its pot life shall be specifically noted and any mixed paint which has exceeded its pot life shall be discarded irrespective of its apparent condition. This must be checked by paint inspection services company.

4.5.5. Construction contractor shall avoid contamination any adjacent items of plant and equipment by paint over spray, drips or spillage providing appropriate protection, where necessary. Stainless steel and high nickel-chromium alloy surfaces shall be protected against over spray or paint drips. Particularly those containing metallic pigments. If any such contamination does occur, the paint shall be immediately and thoroughly removed by contractor. This must be checked by paint inspection services company.

4.5.6. Painting shall not take place under adverse weather conditions:

- In particular rain, fog, snow or when such conditions are likely to occur before the paint has become dry.
- At temperatures below 5°C.
- When the relative humidity is greater than 85%.
- When the metal surface temperature is less than 3°C above the ambient dew

point or above the manufacturer's limit.

- In the case of exterior location, painting may also be suspended due to wind speed at the discretion of inspector. In cases where moisture tolerant coatings are used, painting may proceed on damp surfaces within the limits recommended by the manufacturer of the particular coating being applied.
- Painting shall not be carried out outside daylight hours on exterior locations. Painting may also be suspended due to dusty conditions.

4.5.7. The method of application shall be selected to ensure that the paint is applied in a uniform manner to the prescribed film thickness without any runs, sags or other blemishes. The pressure and volume of the compressed air used for spray application shall meet the work requirements and be free from oil and water contamination. Tracs separators and filters shall emptied and cleaned regularly. Application of primers on wire breached surfaces shall be by brush. This must be checked by paint inspection services company.

4.5.8. To ensure that the minimum thickness is achieved on all angles, corners bulkheads, welds, etc., such edges shall be stripe painted separately before applying the main system. Holding primers shall only be permitted where they are obtained from the same manufacturing source as the main priming coats, and where the manufacturer is able to provide a full guarantee that satisfactory intercoat adhesion will occur. This must be checked by paint inspection services company.

4.5.9. Where further painting is to be carried out, zinc silicate primers shall be sealed with a tie coat as soon as practical after complete curing has taken place, to avoid salt or chemical contamination and to seal the porous nature of the primer. The tie coat shall be selected to ensure sound adhesion to the zinc silicate primer and be compatible with the finishing coat process. When overcoating with aluminum silicone paint is designated, a tie coat is not necessary. Over spray and dry spray of inorganic zinc silicate primers shall be removed prior to application of subsequent tie coats or top coats. This must be checked by paint inspection services company.

4.5.10. In all instances where two or more coats of the same paint are specified, such coatings shall be of contrasting colors so that each stage of the work can be readily identified and film thickness determined accordingly. This also applies to the surface prepared and the color of the first primer coat. This must be checked by paint inspection services company.

4.5.11. Intervals between coats shall comply with manufacturer's recommendations and should generally be kept to the absolute minimum in order to prevent contamination between coats. where contamination occurs between coats, this shall

be completely removed, generally by washing with a suitable detergent solution and rinsing with clean fresh water. This must be checked by paint inspection services company.

4.5.12. All points of damage to paint work incurred at any stage of the work, including shop welding operation, shall be re-prepared by blast cleaning to the original standard and recoating with the specified priming coat to restore the film thickness. In all such instances preparation shall extend 25 mm into the sound paint work and a further 25 mm of sound paint work shall be lightly blasted to etch the surface. Repainting shall then be over the prepared surface and the etched paint work. Where blast cleaning can not be carried out, surface preparation of points of damage by scraping and power wire brushing is acceptable provided specific approval is given by Owner. In such instances, modification of the originally specified primer may be necessary to suit the changed method of surface protection. This must be checked by paint inspection services company.

4.5.13. Preparation of weld margins shall be preceded by the removal of masking tape where fitted and shall involve removal of all flux, welding spatter and other foreign matter as described in section 4 of SSPC-SP-COM. Where blast cleaning is used this may be by means of portable vacuum blast apparatus. Where power wire brushing is used, excessive cleaning to the extent this is liable to produce a polished surface shall be avoided. This must be checked by paint inspection services company.

4.5.14. Where touching up prior to top coating of zinc based primers involved, this shall be preceded by thorough cleaning with solvent or an emulsion type cleaner to remove all oil and grease. This shall be followed by thoroughly hosing down with clean potable water which in the case of surface that have not been tie coated shall be carried out in conjunction with manual scrubbing with stiff brushes in order to remove all surface dirt and other contaminants, zinc corrosion products (white rust), etc. This must be checked by paint inspection services company.

5. STORAGE CONDITIONS, PACKAGING & LABELING

5.1. STORAGE CONDITIONS

5.1.1. All paint and thinner containers shall be kept closed before use and stored under shelter.

5.1.2. Any paint, which has gelled or settled during storage, shall not be used.

5.1.3. Any paint for which the shelf life is expired shall not be used.

This must be checked by paint inspection services company.

5.2. STORAGE LIFE AND PACKAGING -

5.2.1. All paints materials shall shown no thinking, curdling gelling or hard caking when tested as specified in federal standard No. 141, method 3011 after storage for 24 months from date of delivery in a full tightly covered container.

5.2.2. The packaging shall meet the relevant requirements of ASTM D3951.

This must be checked by paint inspection services company.

5.3. LABELING

5.3.1. Labeling shall be as per ANSI Z129.1, precautionary labeling of hazardous industrial chemicals.

5.3.2. Each container shall be legibly marked with the following information:

- Name of paint
- Painting Specification no.
- No. of component
- Color
- Type of spray
- Kind and size of spray nozzle tip.
- Cleaning materials
- Maximum temperature resistance
- Flash point (°C)
- Pot life (hours)
- Shelf life
- Dry time for over coating
- Kind of thinner
- Lot number
- Stock number
- Manufacturer's name and address
- Date of manufacture
- Shelf life
- Quantity of paint in container
- Information and warning (if needed)

This must be checked by paint inspection services company.

6. TEST AND INSPECTION

6.1. GENERAL REQUIREMENT

6.1.1. Contractor shall advise the inspector before commencing specific paint applications.

6.1.2. Inspector shall have the right to inspect the paint work at all stages and to reject any and all tools, instruments, materials, staging, equipment or work, which do not conform to the painting specification.

6.1.3. In addition, the paint manufacturer shall be permitted all reasonable access to monitor surface preparation and application at his discretion. Independent inspection may also be employed for full-time supervision at the discretion of the purchaser and Owner.

6.1.4. Inspection by the paint manufacturer or an independent inspection service shall not relieve the Contractor responsibility within the Contract towards the Owner for ensuring that the work in equipment manufacturer's shop is carried out in accordance with the painting specification and inspection procedure.

6.1.5. Before commencement of shop preparation and painting, a meeting between the painting manufacturer, construction contractor and purchaser and/or Owner representative shall be convened, to establish and agree, when necessary, visible blast standards, blast profile, satisfactory application of the coatings and agreement and calibration of inspection equipment.

6.1.6. The acceptance or rejection of preparatory work and application is the sole right of inspector or his authorized representative.

6.1.7. Each coat paint shall be free from defects and damage. Finished paint shall have the correct shade, degree of gloss and evens and be free from tackiness after drying/ curing and from cracks, holidays, runs, sags, wrinkles, patchiness, brush or roller marks, or other defects that may be deleterious to the quality of the coating.

6.1.8. The purchaser and Owner have the right to take a sample from each paint batch at any time and give it for test in charge of the manufacturer.

6.1.9. Each coat shall be inspected prior to application for the next coat. Areas found to contain runs, overspray, roughness, cracks or other signs of improper application shall be repaired or recoated in accordance with the inspector.

6.2. HUMIDITY CHECK

The relative humidity of the air shall be measured with a “psychrometer”. Surface preparation and/or paint applications operations shall not commence until relative humidity is less than 85%. Relative humidity shall be measured and recorded a minimum of six (6) times a day whence two (2) times before commencement of work. Moisture on the surface being prepared or painted shall be measured every day with a surface moisture indicator before beginning surface preparation operations or applying a coat of paint. This must be checked by paint inspection services company.

6.3. ROUGHNESS CHECK

6.3.1. Total angular roughness R_t of the surface shall be measured after preparation and recorded or an impression made with:

- Tested “Press-O-Film” pads or equivalent.
- Electronic roughness tester (perthometer type or equivalent)

A minimum of two measurement or impression shall made per square meter of prepared surface. This must be checked by paint inspection services company.

6.3.2. All surface shall be blast cleaned to obtain a total angular roughness R_t included:

- Between 30 and 50 microns when total thickness of the coat of paint applied is less than 400 microns.
- Between 50 and 80 microns when total thickness of the coat of paint applied is greater than 400 microns.

This must be checked by paint inspection services company.

6.4. THICKNESS CHECK

Dry paint thickness shall be measured with a magnetic probe, such as Micro test of Elcometer or equivalent. It is imperative that the magnetic probe be calibrate for each thickness of coating steel support with a non- magnetic block whose thickness is as close as possible to the coating being checked. This must be checked by paint inspection services company.

Each coat’s thickness and total thickness shall be checked. Make five(5) separate spot measurements spaced evenly over each section of the structure 10 square meters in area (divide the entire surface in 10 square meter areas). This must be

checked by paint inspection services company.

On each spot, make 3 readings by moving the probe a short distance for each new gage reading. Discard any unusually high or low gage reading that cannot be repeated consistently. Take the average of the three (3) gage readings as the spot measurement. This must be checked by paint inspection services company.

6.5. ADHERENCE CHECK

Paint adherence shall be checked as per ASTM method D 3359. Method A (X cut) shall be used for paint film thicker than 125 microns, method B (lattice pattern) shall be used for paint films up to 125 microns. This must be checked by paint inspection services company.

Test method A: An X-cut is made in the film to the substrate, pressure-sensitive tape is applied over the cut and then removed. Acceptable ratings are 5A (No peeling or removal) or 4A (trace peeling or removal along incisions or at their intersections). This must be checked by paint inspection services company.

Test method B: A lattice pattern with either six or eleven cuts in each direction (cross cut) is made in the film to the substrate, pressure – sensitive tape is applied over the lattice and then removed, and adhesion is evaluated by comparison with descriptions and illustrations. Spacing between the cut lines shall be 1mm for film thicknesses up to 50 microns and 2mm for film thicknesses from 50 to 125 microns. Acceptable results are rate 5B (The edges of the cuts are completely smooth, none of the squares of the lattice is detached) or 4B (Small flakes of the coating are detached at intersections less than 5% of the area is affected). This must be checked by paint inspection services company.

If the test is unsatisfactory, the entire surface shall be blast cleaned and repainted. Recoating after this destructive test is at the Applicator's expense.

6.6. TEST AND INSPECTION RESULTS

All test and inspection results shall be written up into reports. All reports shall be submitted to the purchaser and Owner during provisional acceptance of the paint.

6.7. OTHER REQUIREMENTS

The construction contractor shall check the work for:

- General appearance: Defect such as mud-cracking, sagging and pin holing are not acceptable.

- Dry film thickness (DFT). The specified DFT for each coat shall be considered as a minimum.
- Adhesion of the total paint system shall be not less than 1.5 Mpa (15 kg/cm²) measured by pull off test.

7. 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 instruction.
- 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. Drawing 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.
- Coated items 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.

This must be checked by paint inspection services company.

8. GUARANTEE

The equipment manufacturer shall guarantee the painting system applied for a period of five (5) years from the date of shipment.

During this period, no painting failures such as cracking, peeling, lamination, loss of adhesion, etc. shall occur in the intended service conditions.

9. QUALITY CONTROL

9.1. GENERAL REQUIREMENTS

9.1.1. Equipment manufacturer shall submit to Contractor for approval, his proposed quality control and testing procedures covering all phases of surface preparation and paint application, as may be carried out in the shop and/or field respectively and associated procedures which define how control is established and maintained. The procedures shall form part of the "Quality Assurance Manual."

9.1.2. The quality control procedures shall be in the form of an inspection and test plan which reference all test procedures, hold point, witness points, acceptance and rejection criteria, frequency of testing and how control of quality is measures and maintained.

9.1.3. Where appropriate, results shall be plotted on statistical control charts showing upper and lower limits of acceptance.

9.1.4. Manufacturers of all materials shall supply test certificates of all test performed and a certificate of compliance stating that the material meets the requirements of the applicable painting specification.

9.1.5. Tests shall ensure that the quality of the surface coating is in accordance with that specified, and shall include, but shall not be limited to thickness testing, adhesion testing, holiday testing, abrasion testing, solvent testing, etc.

9.1.6. Requested test should be carried out in accordance with ASTM standard as specified in SSPC (good painting practice) volume 1.

10. IDENTIFICATION OF PIPES AND EQUIPMENT

10.1. GENERAL

Colored bands (formed by paint) compatible with the painting or insulation cladding beneath, designed to identify pipes shall be applied in accordance with the following method:

10.1.1. Basic, Color Codes, Line Number and Arrow for Piping

Unless otherwise agreed, color bands shall only be arranged at significant points for plan operation (e.g. where painted and insulated pipes start and end. At branches, at valves, at change of direction, etc.). This must be checked by paint inspection services company.

In the case of piping connected to equipment, color bands should be arranged <1.5m away from this equipment.

Line number and flow direction arrow shall be stenciled with black color painted on the visible sides of each piping section by the construction contractor.

The number and location shall be decided by the authorized personnel at site.

Maximum distance between two colored bands shall be 10 meters and also this

criteria shall be applied for two line numbers. This must be checked by paint inspection services company.

10.1.2. Tag Number of Equipment

- Tag number of each equipment shall be stenciled by the construction contractor. Color, Size, Number and Location shall be at the authorized personnel discretion at site.
- Item No. shall be in English language.
- Storage tanks shall have digits stenciled in black on white back ground.
- On piping, the line contents are to be written in full or with chemical formula with flow direction and pressure / temperature conditions.

This must be checked by paint inspection services company.

10.2. COLOR CODING OF PIPING SYSTEMS TABLE

For the color bands following table shall be applied:

Service	Base Color	Band Code Color	Band
- Oil Supply Process	Black	Orange	
- Oil Return	Black	Blue	
- Heating Oil (Fuel Naphta)	Black	Yellow	
- Lubricating Oil	Black	White	
- Flare Gas	Brown	Red	
- Product Pellets	Brown	White	
- Product Laden Gas	Brown	Yellow	
- Product Wet/Fluffy	Brown	Gray	
- Tail Gas	Brown	Green	
- Vent/Exhaust Gas	Brown	Black	
- Slurry Drains (Chemical Drains)	Brown	Black	
- Vacuum And Dust Collection	Brown	Blue	
- Drinking Water	Green	White	
- Process Water	Green	Yellow	
- Service Water	Green	Orange	
- Raw Water (Unireated)	Green	White	
- Cooling Water	Green	Blue	
- D.M. Water/Soft Water	Green	Red	
- Boiler Feed Water	Green	Black	
- Inst. Air	Light Blue	White	

- Process Air	Light Blue	Yellow
- Plant Air	Light Blue	Orange
- Caustic Soda	Orange	Gray
- Fire Water	Red (Fire)	---
- Steam Supply	Silver Gray	Orange
- Steam Condensate Return	Silver Gray	Blue
- Steam Tracing	Silver Gray	Yellow
- Nitrogen	Silver Gray	Black
- Pelletizer Additive	White	Orange
- Reactor Additive	White	Black
- Hydrogen	Yellow	Orange
- Natural Gas	Yellow	Gray
- Refinery Gas	Yellow	Black
- L.P.G	Yellow	Blue

Base color band and code color band for process fluid shall be specified later.

NOTES FOR COLOR CODING OF PIPING SYSTEMS TABLE

1. Painted bands shall be compatible with the under laying paint system or insulation cladding and shall be provided at the following significant points of plant.

- Commencement and termination of pipe run.
- Branches
- Local to valve
- 1.5 meter away from connection to equipment.
- Change of direction

2. The width of the basic color band shall be 2 x 120mm.

3. The code color band shall be positioned in the center of the basic color and shall be of the following widths:

- Pipes up to NPS 8": 50 mm wide
- Pipes NPS 10" and above: 100mm wide

This must be checked by paint inspection services company.

10.3. FINISH COLOR SCHEDULE

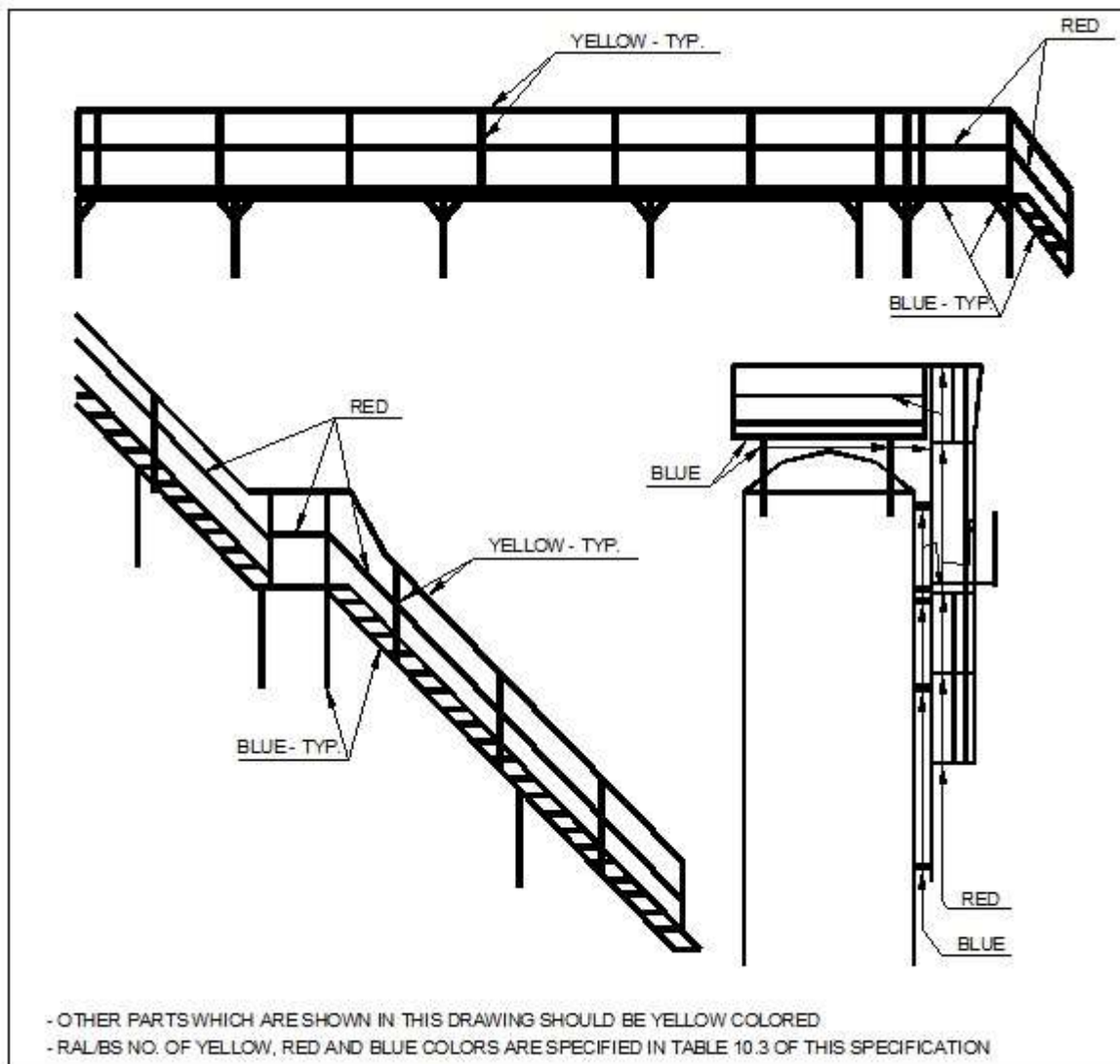
Item	Color	Code RAL	Code BS
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1. Main steel structures and pipe racks – See Figure No. 1	Light French Blue	-	175
2. Equipment structure, equipment support and pipe support			
2.1. Equipment structure and equipment support– See Figure No. 1	Light French Blue	-	175
2.2. Pipe support			
2.2.a. Pipe supports which are attached to tanks	White	9010	-
2.2.b. Pipe supports which are welded to piping components	Same as relevant piping color	-	-
2.2.c. Pipe supports which are not welded to piping components	Light French Blue	-	175
3. Platforms, ladders, stairways: See Figure No. 1			
- Upper loaders, TOE boards, horizontal poles, top rails.	Bold Yellow		363
- Platform lower edges and TOE boards, mid rails, safety platform, safety cages	Rail Red		593
4. Indoor & outdoor piping (except fire-fighting systems or systems involving safety precautions).	Light Gray	7038	631
5. Equipment in general, vessels, exchangers, columns, reactors, etc. (except firefighting system or safety precaution)	Light Gray	7038	631
6. Tanks, spheres, etc.	White	9010	-
7. Instrument. And electrical Switchboards control panels, junction boxes, cabling distribution boards. (out door)	Light Green		217
7. Instrument. And electrical Switchboards control panels, junction boxes, cabling distribution boards. (In door)	French Gray		630
8. Electric static machines: transformers, resistors, etc.	Light Gray	7038	631
9. Machinery: pumps, compressors, turbines, etc.	Light Gray	7038	631
10. Machine tools and bedplates of machines	Light Green		280
11. Piping containing caustic soda sulfuric acid, hydrochloric and chromic acid, hydrogen sulfide, sulfur dioxide, ammonia etc.	Golden Yellow	1007	356
12. flanges, gate valves, pumps inlet and exit	Golden Yellow	1007	356

flanges and gate valves on lines detailed in (11)

13. Pipes carrying fire fighting water and foam.	Signal Red	3020	537
14. Vessels and equipment containing caustic soda, sulfuric acid, hydrochloric and chromic acid, hydrogen sulfide, sulfur dioxide, ammonia etc.	Light Gray With 300mm Yellow Band As Note 1	7038/1007	631/356
15. Safety valves on towers, vessels pumps, heat exchangers, including valves prior to and after safety valves.	Golden Yellow	1007	356
16. wheeled manual fire extinguishers moving and stationary fire fighting equipment	Signal Red	3020	537
17. Boxes containing breathing apparatus, respirators, masks and other safety equipment	Emerald Green	6000	228
18. Safety showers, eye wash showers and safety shower cabins.	Green/White As Note 2	6024/9002	
19. Fuse boxes, motor switches and electric cable metallic joints	French Blue	5002	166
20. Back and front shields of mobile plant	Golden Yellow / Black As Note 2	1007/9005	356/642
21. forks of fork lift trucks, sling hooks of all bridge cranes or mobile cranes	Golden Yellow	1007	356
22. Guards and safety parts on rotating machinery belts, coupling pumps and motors.	Golden Yellow	1007	356
23. electric motors	Light Gray	7038	631
24. Vessels and equipment with operating temperatures in excess of 93°C	Aluminum	9006	
25. pipes, columns, supports and metallic structural parts of equipment representing a hazard in walkway areas.	Golden Yellow / With As Note 2	1007/9002	356

Figure No. 1



NOTES FOR FINISH COLOR SCHEDULE

1. For item 14, 300mm yellow bands shall be painted either horizontally or vertically depending on the shape of the vessel, description of the gas/liquid shall be stenciled on to the yellow band.

2. Bands shall be in 150mm wide diagonal alternative colors as follows:

- Item 18- green and white
- Item 20- golden yellow and black
- Item 25- golden yellow and white

This must be checked by paint inspection services company.

11. REPAIR OF DEFECTS OR DAMAGED PAINTED SURFACES

11.1. REQUIREMENTS

11.1.1. Any defect of damage that may occur shall be repaired before the application of further coats and where necessary the particular surface(s) made paint free. Remedial work shall be carried out prior to packing for shipment. This must be checked by paint inspection services company.

11.1.2. Areas where due to inadequately prepared surface, solvent entrapment, excessive application of prime and/or finish coats, etc., the rested paint system consistently fails to meet the required test standards for adhesion/cohesion, the Contractor shall remove the affected area by blast cleaning and shall reapply the full paint system to meet the required standard. This must be checked by paint inspection services company.

11.1.3. Areas which are to be over coated shall be thoroughly cleaned free from grease, oil and other foreign matter and shall be dry. The surfaces shall then be prepared to the standard as originally specified (for large damaged areas), or prepared to the highest possible standard using mechanically operated tools (for small local damaged spots up to 1m²). This must be checked by paint inspection services company.

11.1.4. Subsequently additional compatible coats shall be applies, until they meet the painting specification. Theses additional coats shall blend in with the final coating on adjoining areas. This must be checked by paint inspection services company.

11.1.5. During the agreed maintenance period, any observed defective coatings, rusted areas or failures developing in the paint systems, shall be repaired to the satisfaction of the Owner/ purchaser inspector. This must be checked by paint inspection services company.

11.1.6. When factory painted or painted surfaces have been marked in handling, the damage paint and non-adherent paint shall be removed and the surface thoroughly cleaned. The edges on the damaged area shall be smoothed. Surface preparation shall extend approximately 5 cm into the sound coat. The primer and finishing coats shall be applied in accordance with paragraph 12. This must be checked by paint inspection services company.

Note: if sand blasting is not applicable for any reason to be agreed upon by inspector, zinc silicate primer shall not be used for touch up repairs. Zinc rich 2 components epoxy primer or an approved epoxy primer formulated for application

on hand or mechanically brushed surfaces should be used instead. The touch up primer shall be compatible with the paint system. This must be checked by paint inspection services company.

12. DOCUMENTATIONS

12.1. DOCUMENT TO BE SUBMITTED BY THE CONSTRUCTION CONTRACTOR / EQUIPMENT MANUFACTURER

Once the paint system has been adopted the construction contractor / equipment manufacturer shall submit the following for approval to the purchaser/ and Owner

- Detailed schedule of works including blast cleaning and paint application operations.
- A description of surface preparation conditions especially properties of abrasives used.
- At the time of application, the construction contractor / equipment manufacturer shall be in possession of the application technical data sheets for the paint used.

This must be checked by paint inspection services company.

13. EQUIPMENT, DEVICES & TOOLS FOR APPLICATION, TEST & INSPECTION

13.1. MATERIAL PROVIDED BY THE CONSTRUCTION CONTRACTOR / EQUIPMENT MANUFACTURER

In addition to all required equipment, devices & tools for application, test & inspection, the construction contractor / equipment manufacturer shall possess for his use and/or that of the inspector:

- Instruments for taking temperature, ambient hygrometry and surface moisture.
- Instruments for checking the blasting nozzle pressure.
- Instruments for measuring roughness of prepared surface.
- Instruments for checking paint coat thickness and porosity.

Or any other equipment in order to enable the applicator self control each level of protection's job for a quality-control clearance before inspection.

End- Paint Inspection Services

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