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|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0 |
|-----------------------------------------------------------------------------------|-----------------|------------------------------------------|

# **SPECIFICATION FOR PAINTING**

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|                                                                                      |             |             |           |         |          |
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## REVISION LOG

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|-----------------------------------------------------------------------------------|---------------------------------------|--------------------------------------------------------------|
|  | <p align="center"><b>PAINTING</b></p> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : ii OF iii |
|-----------------------------------------------------------------------------------|---------------------------------------|--------------------------------------------------------------|

## **CONTENTS**

|                                               |          |
|-----------------------------------------------|----------|
| <b>1. SCOPE .....</b>                         | <b>1</b> |
| <b>2. CONFLICTS AND DEVIATION .....</b>       | <b>1</b> |
| <b>3. CONTRACTOR'S RESPONSIBILITIES .....</b> | <b>1</b> |
| <b>4. GENERAL .....</b>                       | <b>2</b> |
| <b>5. COLOR SELECTION .....</b>               | <b>3</b> |
| <b>6. INSPECTION AND TEST .....</b>           | <b>3</b> |
| <b>7. SURFACE PREPARATION .....</b>           | <b>4</b> |
| <b>8. SAFETY .....</b>                        | <b>6</b> |

|                                                                                   |                 |                                                            |
|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 1 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|

## 1. SCOPE

- 1.1 This Specification covers the requirements for the surface preparation and external coating of equipment, tanks, piping, structural steel and other items, and is applicable where stated in the Project Specifications. Appendix provides the Owner's preferences for surface preparation and types of coating to be used
- 1.2 The interior coating of storage tanks are covered in this Specification.

## 2. CONFLICTS AND DEVIATION

- 2.1 Any conflicts between this Specification and other HDO Standard Specifications, related Standard Drawings, codes and contract documents shall be referred to HDO for clarification.
- 2.2 Any deviations from this Specification require written waiver approval from HDO.

## 3. CONTRACTOR'S RESPONSIBILITIES

- 3.1 The Contractor shall prepare a coating specification for the Owner's approval showing:
  - 3.1.1 Items to be coated.
  - 3.1.2 Coating types and suppliers.
  - 3.1.3 Colour schedule.
  - 3.1.4 Method to be adopted for special pipe work coating (where applicable).
  - 3.1.5 Surface preparation.
  - 3.1.6 Inspection requirements
- 3.2 The Contractor shall specify coating requirements in all equipment and material Requisitions prepared by Contractor
- 3.3 The Contractor shall employ trained and experienced coating applicators.
- 3.4 The Contractor shall employ specialist coating inspectors.
- 3.5 Where solvent washing is required, the Contractor shall treat or dispose of the used solvent in accordance with local environmental and health regulations and the Owner's environment, health and safety standards.
- 3.6 The painting Contractor shall be responsible for:
  - 3.6.1 The quality of workmanship, which shall be performed in accordance with this specification and all other relevant documents such as site regulations, safety rules, referred standards and codes, etc.
  - 3.6.2 Obtaining the Principal's assurance that the equipment is certified safe and available and that all appropriate tests are completed before starting any painting work.
  - 3.6.3 The protection of all equipment, structures and any other areas from mechanical damage, environmental damage, damage caused by abrasives during blast cleaning, paint droppings, or overspray.
  - 3.6.4 The earthing of electrical equipment.
  - 3.6.5 Taking all necessary precautions to avoid interference with the execution of work of other contractors.
  - 3.6.6 Maintenance of the paint work until completion of the contract. This shall include the repair of any

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|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 2 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|

damages caused by third parties.

- 3.6.7 The characteristics of the paints and paint materials obtained from the paint Manufacturer. The characteristics shall be obtained via the provision of separate technical, and health and safety data sheets.
- 3.6.8 Provision of all painting, thinning and cleaning materials, tools, site accommodation, transport services, and competent supervision, necessary for the satisfactory completion of the works.
- 3.6.9 Control of waste resulting from the Contractor's painting and coating activities, in accordance with site regulations and specific contract requirements.
- 3.6.10 Maintaining workshop facilities, tools and equipment in a good, clean condition. Spray guns, brushes, rollers, paint pots and the like shall be regularly cleaned and shall be suitable for their purpose.
- 3.6.11 Unless otherwise specified by the Principal, the supply of all necessary equipment, weather protection and scaffolding for the painting of storage tanks to ensure that the work is carried out in accordance with this DEP and to the agreed programme.
- 3.6.12 Preparation of appropriate work planning, which shall be in agreement with that of the Principal.

#### 4. GENERAL

##### 4.1 Structural Steel

- 4.1.1 Structural steel is to be primed at shop, except when it is galvanized.
- 4.1.2 Miscellaneous steel structures such as stairs, ladders, handrails, platforms and gratings are to be primed at shop, except where galvanized.
- 4.1.3 Grating, structural bolting, anchor bolting and miscellaneous structural steel shall be hot-dip galvanized.
- 4.1.4 Hot-dip galvanizing shall be in accordance with 'ASTM A123' or 'ASTM A153', as applicable, and following the recommendations given in 'ASTM A385'.
- 4.1.5 Structural steel which is to be fire-proofed shall be surface-prepared and primed in accordance with Appendix

##### 4.2 Uninsulated Equipment Surfaces

Uninsulated external surfaces of carbon steel and low alloy steel pressure vessels, tanks, drums, exchangers, including supports (inside skirts also), etc. are to be primed and top coated according to painting schedule & system.

##### 4.3 Carbon Steel and Low Alloy Steel Piping

- 4.3.1 Pipe: Shop Fabricated; all uninsulated and insulated for personnel protection, cold conservation, or antisweat are to be primed and top coated according to painting schedule & system.
- 4.3.2 Flanges and valves are to be primed and top coated according to painting schedule & system.

##### 4.4 Machinery, Rotating Equipment and Package Units

- 4.4.1 On machinery, pumps, motors, compressor, agitators, fans, blowers, control valves, skid mounted package units, etc., manufacturer's standard multicoat finish for chemical plants is required. Manufacturer shall state paint manufacturer's numbers with his proposal and on the manufacturing drawings.

##### 4.5 Heaters and stacks to be primed.

##### 4.6 Field Assembled Carbon Steel and Low Alloy Steel Vessels and Tanks

- 4.6.1 Unless otherwise noted, shop fabricated sections of field assembled vessels and tanks shall be

|                                                                                   |                 |                                                            |
|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 3 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|

Shop primed and top coated according to painting system & table.

#### 4.7 Insulated Carbon Steel and Low Alloy Steel Equipment and Piping

4.7.1 Steel under insulation on piping, vessels, tanks, exchangers, drums, valves are shall be primed and top coated according to painting schedule & system

4.8 Insulated or fireproofed carbon steel and low alloy steel pressure vessels, tanks drums exchangers that will be shipped overseas shall be primed and top coated according to painting schedule & system.

4.9 Uninsulated carbon steel an low alloy steel on insulated items such as nozzle flanges, exchanger flanges, supports, skirts, legs, lugs, ladder and platform clips, manways, etc., shall be shop primed and top coated based on the operating temperature of the item.

4.10 The following materials or surfaces are not painted unless specifically called for in the equipment specification or drawing: brickwork, concrete or masonry surfaces, aluminum, galvanized steel, brass, copper, nickel, stainless steel, slate, glass, tile, transite, fiberglass and other corrosion resistant materials..

#### 4.11 Concrete Surfaces

4.11.1 Concrete surfaces which require coating shall be allowed to cure for a minimum of 30 days prior to the start of coating application.

4.11.2 Concrete surfaces shall be brush-off blast cleaned until all surface latency and contamination have been removed and a slightly etched profile, similar to sandpaper, has been attained.

4.11.3 All exposed voids, honeycombing, bug-holes, imperfections and hairline cracks shall be patched or repaired with a filler compatible with the coating to be applied. All grit and dust shall be removed after blasting and before coating application.

### 5. COLOR SELECTION

Unless specified appendix table, the choice of colors will be decided in a meeting with the contractor and a representative of the owner.

### 6. INSPECTION AND TEST

#### 6.1 Surface Contamination

6.1.1 Tests indicating the extent of substrate contamination as a result of iron, chlorides and dust are specified in ISO 8502-1, ISO 8502-2 and ISO 8502-3, respectively.

#### 6.2 Wet Film Thickness, WFT

6.2.1 Spot checks shall be carried out during the course of the painting operation to ensure that film thickness is being maintained. These shall be performed according to the procedure described in ISO 2808, Method No. 7B.

#### 6.3 Dry Film Thickness, DFT

6.3.1 ISO 2808, Method No.6, describes the test techniques suitable for measurement of the dry film coating thickness.

#### 6.4 Holiday Testing

6.4.1 Holiday testing shall be conducted in accordance with ASTM D 5162 on equipment where the continuity of the coating is important, for example internal tank linings which are subjected to corrosive conditions. The Principal shall specify the maximum number of holidays permissible.

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|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 4 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|

## 6.5 Adhesion

- 6.5.1 The adhesion of the primer to the steel substrate and the intercoat adhesion of the subsequent coat(s) after curing shall be determined by the application of either a cross-cut test in accordance with ISO 2409 or a pull-off test described in ISO 4624.

## 6.6 Inspection Records and Reports

- 6.6.1 The Principal shall have the right to inspect the paint work at all stages of preparation and to reject any tools, instruments, materials, equipment or work which do not conform to this specification.

- 6.6.2 Prior to final acceptance of the paint work an inspection shall be made. The Contractor and the Principal shall both be represented and they shall sign an agreed inspection report.

- 6.6.3 These reports shall include:

### 6.6.4 General

- (a) Names of the Contractor and the responsible personnel.
- (b) Dates when work was carried out.

### 6.6.5 Materials preparation

- (a) Equipment and techniques used.
- (b) Materials receipt condition.
- (c) Type and calibration of instruments used.

### 6.6.6 Environmental conditions

- (a) Weather and ambient conditions.
- (b) Painting periods

### 6.6.7 Surface preparation

- (a) Condition of surface before preparation.
- (b) Tools and methods used to prepare surface.
- (c) Condition after preparation.

### 6.6.8 Paints and painting

- (a) Information on systems being applied.
- (b) Mixing and testing prior to application.
- (c) Paint application techniques.

### 6.6.9 Testing

- (a) Type of quality control checks carried out, and results.
- (b) Compliance or otherwise with specification.

## 7. SURFACE PREPARATION

- 7.1 All surface to be finish painted shall be cleaned free of all dirt, dust, grease, oil or other contaminants. All jagged edges, weld scale, slag, and flux shall be removed and all seams and unprimed margins and abraded areas shall be treated in accordance with the degree of surface preparation specified. All surfaces to be painted shall be cleaned and prepared in accordance with the Steel Structures Painting Council specifications.

- 7.2 Shop primed and factory finished equipment, and shop and field primed piping will only be "spot-

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|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 5 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|

cleaned” in damaged areas by means of power tool brush cleaning or hand-tool cleaning and then “spot-primed”, before applying a top coat, unless otherwise noted in the specification of requisition.

- 7.3 Concrete and masonry surfaces shall be brushed free of dust, dirt and other foreign matter and be completely dry prior to coating. Concrete surfaces having a glazed appearance, such as produced by steel trowelling, shall be etched with a 10 percent solution of hydrochloric acid (or muriatic acid) followed by water rinsing. Allow a minimum of 3 days drying time for masonry surfaces. Moisture content should indicate less than 8 percent on a Delmhorst moisture meter (or equal) before coating. Surfaces which have pits or voids shall be grouted with a suitable mortar. Porous concrete block shall be filled with block filler prior to coating.
- 7.4 Wood surfaces shall be brushed free of dust and dirt and rough spots shall be sanded smooth. The wood surface shall be thoroughly dry at the time of priming. Wood surfaces shall be painted only if specifically recommended in the applicable specification.
- 7.5 All cleaned surfaces shall be primed the same day that cleaning is performed. Cleaned surfaces left unprimed overnight or on which rain falls, shall be recleaned before priming.
- 7.6 Surface preparation shall be done by one of the following methods in accordance with the SSPC Specification.

| <u>SPECIFICATION</u> | <u>NOMENCLATURE</u>                   | <u>DESCRIPTION</u>                                                                                                                                                                                                       |
|----------------------|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SSPC-SP-1-63         | Solvent Cleaning                      | Removal of oil, grease, dirt, soil, salts, and contaminants by cleaning with solvents, vapor, alkali, emulsion or steam                                                                                                  |
| SSPC-SP-2-63         | Hand Tool Cleaning                    | Removal of loose rust, loose mill scale, and loose paint to degree specified, by hand chipping, scraping, sanding, and wire brushing.                                                                                    |
| SSPC-SP-3-63         | Power Tool                            | Removal of loose rust, loose mill scale and loose paint to degree specified, by power tool chipping, descaling, sanding, wire brushing and grinding.                                                                     |
| SSPC-SP-4-63         | Flame Cleaning                        | Dehydrating and removal of rust, loose mill scale, and some tight mill scale by use of flame, followed by wire brushing.                                                                                                 |
| SSPC-SP-5-63         | White Metal Blast Cleaning            | Removal of all visible rust, mill scale, paint and foreign matter, by blast cleaning by wheel or nozzle (dry or wet) using sand, grit or shot. (For very corrosive atmosphere where high cost of cleaning is warranted.) |
| SSPC-SP-6-63         | Commercial Blast Cleaning             | Blast Cleaning until at least two thirds of each element of surface area is free of visible residues. (For rather severe conditions of exposure.)                                                                        |
| SSPC-SP-7-63         | Brush off Blast Cleaning              | Blast cleaning of all except tightly adhering residues of mill scale, rust and coatings, exposing numerous evenly distributed flecks of under lying metal.                                                               |
| SSPC-SP-8-63         | Pickling                              | Complete removal of rust and mill scale by acid pickling, duplex pickling or electrolytic pickling. (May reduce the resistance of the surface to corrosion, if not primed immediately.)                                  |
| SSPC-SP-9-63         | Weathering followed by Blast Cleaning | Weathering to remove all or part of mill scale by Blast Cleaning followed mill scale by Blast Cleaning followed by blast cleaning to one of the above standards.                                                         |

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|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 6 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|

SSPC-SP-10-63T    Near White

Blast cleaning nearly to white cleanliness, until at least 95% of each element of surface area is free of all visible residues. (For high humidity, chemical atmosphere, marine or other corrosive environment.)

## 8. SAFETY

- 8.1 All prudent precautions shall be taken to ensure the safety of personnel and property. The subcontractor shall insure that extreme caution is exercised when using oil or oil-based paints, cleaning fluid or cleaning compound, etc., in close proximity to oxygen piping, oxygen equipment, tanks, casings, etc. Heavy concentrations of volatile or toxic fumes must be avoided. In confined spaces, blowers or exhaust fans may be necessary. Where good practice dictates, masks, non-sparking tools and other such special equipment shall be used. The subcontractor shall consult the contractor when any doubt exists regarding safety precautions for oxygen piping, equipment, tanks, casings, etc.
- 8.2 The painting subcontractor shall remove all material and debris created by him and leave his work in a clean, finished condition, which shall include cleaning of all drips and spills and the washing and polishing of all window glass stained during painting.
- 8.3 Before submitting his proposal, the subcontractor shall consult the contractor to determine what limitations will be enforced in regard to the number of painters and other employee permitted to work at one time on various portions of the work. These limitations will be strictly enforced in order to safeguard the operations of the plant. All the subcontractor's employees must obey all safety precautions while on plant property.

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|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 7 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|

TABLE 1

COLOR SPECIFICATION FOR EQUIPMENT & PIPING

| No. | Description                                                                               | Final Color<br>(Munsell No.)                              | Remarks |
|-----|-------------------------------------------------------------------------------------------|-----------------------------------------------------------|---------|
| 1   | Vessel, Heat Exchanger and Smaller Tank (Outdoor & Indoor)                                | Silver<br>(9.5B7.5/0.4)                                   |         |
| 2   | Storage Tank                                                                              | White                                                     |         |
| 3   | Machineries (such as pump, compressor, conveyor, agitator, etc.)<br>- Outdoor<br>- Indoor | 10 GY 7.5/4<br>10 GY 6.5/4                                |         |
| 4   | Piping                                                                                    | Silver<br>(9.5B7.5/0.4)                                   |         |
| 5   | Pipe Rack, Steel Structure                                                                | 2.5 PB 6/1                                                |         |
| 6   | Framing for Boiler and Heater                                                             | Silver<br>(9.5B7.5/0.4)                                   |         |
| 7   | Stack                                                                                     | Steel : Silver<br>(9.5B7.5/0.4)<br>Concrete : White & Red |         |
| 8   | Inside of Cooling Tower                                                                   | N-1.5                                                     |         |
| 9   | Duct.                                                                                     | Silver<br>(9.5B7.5/0.4)                                   |         |
| 10  | Valve                                                                                     | - Body<br>Silver<br>(9.5B7.5/0.4)                         |         |
|     |                                                                                           | - Handle<br>Fire water : Red                              |         |
|     |                                                                                           | Fire foam : Red                                           |         |
|     |                                                                                           | Others : Black                                            |         |
| 11  | Hand Rail                                                                                 | 2.5Y 8/12                                                 |         |

TABLE 2

STANDARD COLOR FOR SWITCHBOARDS

| Application                                                                             |                                                              |                        | Color<br>(Munsell Renotation)                        | Color Name<br>(for reference) |
|-----------------------------------------------------------------------------------------|--------------------------------------------------------------|------------------------|------------------------------------------------------|-------------------------------|
| External surfaces of<br>switchboards<br><br>(1) Internal<br>surfaces of<br>switchboards | (a) Indoor-use                                               |                        | 7.5 BG 6/2                                           | Bright grayish<br>blue green  |
|                                                                                         | (b) Outdoor-use                                              |                        | N7                                                   | Light gray                    |
|                                                                                         | (a) Indoor-use                                               |                        | 2.5Y 8/2                                             |                               |
|                                                                                         | (b) Outdoor-use                                              |                        | 2.5Y 8/2                                             |                               |
| (2) External and internal surfaces of interior panels*                                  |                                                              |                        | 7.5GY 7/2                                            |                               |
| (3) Metallic parts of frames, covers etc. of high voltage apparatus in switchboards     |                                                              |                        | 7.5BG 4/1                                            | Bright grayish                |
|                                                                                         | (4) Frame of measuring instruments, relays and other devices |                        | 7.5BG 4/1                                            |                               |
|                                                                                         | (5) Handles of switches controllers, etc.                    | (a) General usa        | 7.5BG 3/3                                            | Blue green                    |
|                                                                                         |                                                              | (b) Emergency stop use | 5R 4/13                                              | Red                           |
|                                                                                         | (6) Push button switches                                     | (a) On                 | 5G 3.5/9                                             | Green                         |
|                                                                                         |                                                              | (b) Off                | 5R 4/13                                              | Red                           |
|                                                                                         | (7) Names plates                                             | (a) Metallic plate     | Frosted silvery background with inscription in black |                               |
|                                                                                         |                                                              | (b) Plastic plate      | White background with inscription in black           |                               |

Note \* : The interior panels refer to panels which are equipped with main supervisory and control devices inside the switchboards.

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|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 9 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|------------------------------------------------------------|

TABLE 3

STANDARD COLOR FOR ELECTRICAL  
EQUIPMENT OTHER THAN SWITCHBOARDS

| Application                                           |                    | Color in Munsell Color Code   | Color Name (for reference) | Remarks |
|-------------------------------------------------------|--------------------|-------------------------------|----------------------------|---------|
| Transformers<br>Power Condensers<br>Starting reactors |                    | 5B 4.5/6                      |                            |         |
| Motors                                                |                    | Same as Pump Compressor       |                            |         |
| Bus ducts (*2)<br>Cable ducts                         |                    | 5G 6/1                        |                            |         |
| Loud speakers and handset stations for paging system  |                    | 7.5BG 6/1                     | Bright grayish blue green  |         |
| Poles for lighting                                    |                    | 5G 6/1                        |                            |         |
| Lighting fixtures                                     | Fluorescent lamps  | Manufacturer's standard color |                            |         |
|                                                       | Incandescent lamps | 5G 6/1                        | Grayish green              |         |
|                                                       | Mercury-arc lamps  | 5G 6/1                        | Grayish green              |         |

Note(\*2) : The standard color for bus ducts between switchboards is the same as that of external surfaces of the switchboards.

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|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 10 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|

TABLE 4

COLOR SPECIFICATION FOR INSTRUMENTS

| No. | Description                                  |                  |      | Final Color<br>(Munsell No.) | Remarks |
|-----|----------------------------------------------|------------------|------|------------------------------|---------|
| 1   | Panel                                        | External Surface |      | 7.5 GY 7/2                   |         |
|     |                                              | Internal Surface |      | 2.5Y 8/2                     |         |
| 2   | Instrument Frames mounted on the Panel board |                  |      | Manufacturer's Standard      |         |
| 3   | Control Valve                                | General          | -    | Manufacturer's Standard      |         |
|     |                                              | Emergency Stop   | Body | 5R 4/13                      | Red     |
|     |                                              |                  | Top  | 5R 4/13                      | Red     |
| 4   | Others Instrument                            |                  |      | Manufacturer's Standard      |         |

|                                                                                   |                 |                                                             |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 11 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|

TABLE 5

COLOR SPECIFICATION FOR BUILDING

| No. | Description                                               | Final Color<br>(Munsell No.) | Remarks |
|-----|-----------------------------------------------------------|------------------------------|---------|
| 1   | Steel Structures                                          | 2.5PB 6/1                    | Blue    |
| 2   | Steel Frame for Building                                  | 2.5PB 7/3                    |         |
| 3   | Outside Wall of Building                                  | Later                        |         |
| 4   | Inside of Building<br>- Wall<br>- Ceiling                 | Later                        |         |
| 5   | Door & Sash (Including Flashing)<br>- Outdoor<br>- Indoor | Later                        |         |
| 6   | Roof (Steel)                                              | Silver<br>(9.5B7.5/0.4)      |         |

|                                                                                   |                 |                                                             |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 12 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|

## Appendix I PAINTING SCHEDULE & SYSTEM

TABLE 1

| ITEM                                  | OPERATING TEMPERATURE | MATERIAL                       | CONDITION                      | PAINT SYSTEM NO | Surface Preparation (SSPC-SP-) |
|---------------------------------------|-----------------------|--------------------------------|--------------------------------|-----------------|--------------------------------|
| Vessels, Exchangers & Other Equipment | Under 93 °C           | Carbon Steel & Low Alloy Steel | Uninsulated or Insulated       | "C"             | 10                             |
| Vessels, Exchangers & Other Equipment | 94 °C ~ 398 °C        | Carbon Steel & Low Alloy Steel | Uninsulated or Insulated       | "D"             | 10                             |
| Vessels, Exchangers & Other Equipment | 399 °C ~ 538 °C       | Carbon Steel & Low Alloy Steel | Insulated                      | "B"             | 10                             |
| Piping, Flange & Fitting              | Under 93 °C           | Carbon Steel & Low Alloy Steel | Uninsulated or Insulated       | "C"             | 10                             |
| Piping, Flange & Fitting              | 94 °C ~ 398 °C        | Carbon Steel & Low Alloy Steel | Uninsulated or Insulated       | "D"             | 10                             |
| Piping, Flange & Fitting              | 399 °C ~ 538 °C       | Carbon Steel & Low Alloy Steel | Insulated                      | "B"             | 10                             |
| Piping, Flange & Fitting              | Under 93 °C           | Carbon Steel & Low Alloy Steel | Only Uninsulated & Marine Area | "E"             | 10                             |
| Piping, Flange & Fitting              | ALL                   | Austenitic Stainless           | Insulated                      | "I"             | 1                              |
| Valves                                | ALL                   | Carbon Steel & Low Alloy Steel | ALL                            | "D"             | 10                             |

| ITEM                                            | OPERATING TEMPERATURE | MATERIAL             | CONDITION                      | PAINT SYSTEM NO | Surface Preparation (SSPC-SP-) |
|-------------------------------------------------|-----------------------|----------------------|--------------------------------|-----------------|--------------------------------|
| External Surface of Field Erected Storage Tanks | ALL                   | Carbon Steel         | Insulated                      | "F"             | 6                              |
| External Surface of Field Erected Storage Tanks | ALL                   | Carbon Steel         | Uninsulated                    | "G"             | 6                              |
| Surface for overseas Equipment                  | -                     | Carbon Steel         | Insulated                      | "H"             | 3                              |
| Steel Structure                                 | ALL                   | Carbon Steel         | Exept Fireproofing             | "C"             | 10                             |
| Steel Structure                                 | ALL                   | Carbon Steel         | Only Uninsulated & Marine Area | "E"             | 10                             |
| Steel Structure                                 | ALL                   | Carbon Steel         | Fireproofing                   | "A"             | 10                             |
| Instrument Tube, Fitting                        | ALL                   | Austenitic Stainless | Mastic or Insulated            | "I"             | 1                              |
| Concrete Surface                                | ALL                   | Concrete             | -                              | "J"             | Special                        |
| Furnace, Stack, Duct                            | Under 93 °C           | Carbon Steel         | Uninsulated                    | "C"             | 10                             |
| Furnace, Stack, Flue Gas Duct                   | 94 °C ~ 398 °C        | Carbon Steel         | Uninsulated                    | "D"             | 10                             |

|                                                                                   |                 |                                                             |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 14 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|

TABLE 2

| PAINT<br>SYS.<br>NO | SSPC<br>-SP- | Primer                                                                             |        |     | Intermediate coat                                      |        |     | Top Coat                                                             |        |     | TDFT |
|---------------------|--------------|------------------------------------------------------------------------------------|--------|-----|--------------------------------------------------------|--------|-----|----------------------------------------------------------------------|--------|-----|------|
|                     |              | Type of Coat                                                                       | N<br>o | DFT | Type of Coat                                           | N<br>o | DFT | Type of Coat                                                         | N<br>o | DFT |      |
| "A"                 | 10           | Inorganic Zinc<br><b>KCC</b><br>IZ180N or equivalent                               | 1      | 75  | -                                                      | -      | -   | -                                                                    | -      | -   | 75   |
| "B"                 | 10           | silicone resin based<br>heat-resistant primer<br><b>KCC</b><br>QP160 or equivalent | 1      | 25  | -                                                      | -      | -   | -                                                                    | -      | -   | 25   |
| "C"                 | 10           | Inorganic Zinc<br><b>KCC</b><br>IZ180N or equivalent                               | 1      | 75  | -                                                      | -      | -   | polyamide cured<br>epoxy resin<br><b>KCC</b><br>EH6270               | 1      | 100 | 175  |
| "D"                 | 10           | Inorganic Zinc<br><b>KCC</b><br>IZ180N or equivalent                               | 1      | 75  | -                                                      | -      | -   | silicone resin based<br>heat resistant paint<br><b>KCC</b><br>QT6604 | 1      | 40  | 115  |
| "E"                 | 10           | Inorganic Zinc<br><b>KCC</b><br>IZ180N or equivalent                               | 1      | 75  | polyamide cured<br>epoxy resin<br><b>KCC</b><br>EH6270 | 1      | 100 | aliphatic polyester<br>poly-urethane<br><b>KCC</b><br>UT6581         | 2      | 40  | 255  |
| "F"                 | 6            | Inorganic Zinc<br><b>KCC</b><br>IZ180N or equivalent                               | 1      | 75  | -                                                      | -      | -   | -                                                                    | -      | -   | 75   |
|                     |              |                                                                                    |        |     |                                                        |        |     |                                                                      |        |     |      |
| "G"                 | 6            | Inorganic Zinc<br><b>KCC</b><br>IZ180N or equivalent                               | 1      | 75  | polyamide cured<br>epoxy resin<br><b>KCC</b><br>EH6270 | 1      | 100 | aliphatic polyester<br>poly-urethane<br><b>KCC</b><br>UT6581         | 2      | 40  | 255  |

|                                                                                   |                 |                                                             |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 15 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|

|     |         |                                                                                    |   |    |   |   |   |   |   |   |    |
|-----|---------|------------------------------------------------------------------------------------|---|----|---|---|---|---|---|---|----|
| "H" | 3       | zinc phosphate<br><b>KCC</b><br>MP125                                              | 1 | 50 | - | - | - | - | - | - | 50 |
| "I" | 1       | silicone resin based<br>heat-resistant primer<br><b>KCC</b><br>QP160 or equivalent | 1 | 25 | - | - | - | - | - | - | 25 |
| "J" | Special | Later                                                                              |   |    |   |   |   |   |   |   |    |

Note : The Product Model shall be changed by the equivalent Product or vendor's recommendation with HDO's approval

|                                                                                   |                 |                                                             |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 16 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|

## Appendix II LINING SYSTEM SELLECTION

**TABLE 1. Lining System Selection Table**

| SERVICE OR PRODUCT | LINING SYSTEM | Surface to be Painted       | Remarks                 |
|--------------------|---------------|-----------------------------|-------------------------|
| Crude Oil          | 10            | Bottom, Shell 1.5m low side |                         |
| Jet Fuel           | 11            | ALL                         |                         |
| Gasoline, Naphtha  | 11            | Bottom, Shell 0.3 low side  | As per design condition |
| Diesel, Kero,      | 11            | Bottom, Shell 0.3 low side  | As per design condition |
| Bunker-C, LSWR     | 11            | Bottom, Shell 0.3 low side  | As per design condition |
| Aromtices          | None          |                             |                         |

|                                                                                   |                 |                                                             |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 17 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|

**TABLE 2. Lining System Selection Table (MISC service)**

| SERVICE OR PRODUCT                                        | LINING SYSTEM                     |    |    |     |
|-----------------------------------------------------------|-----------------------------------|----|----|-----|
|                                                           | MAXIMUM OPERATING TEMPERATURE, °C |    |    |     |
|                                                           | 38                                | 54 | 71 | 100 |
| Acrylonitrile                                             | 1                                 | 1  | 1  |     |
| Brine, Saturated                                          | 5                                 | 5  | 7  |     |
| Caustic Soda (NaOH) 20%                                   | 7                                 | 7  | 7  |     |
| Caustic Soda (NaOH) 50%                                   | 8                                 | 8  | 8  |     |
| Maleic Acid (dry)                                         | 8                                 | 8  |    |     |
| Nitric Acid 15%                                           | 2                                 | 2  | 2  |     |
| Nitric Acid 30%                                           | 2                                 | NR | NR |     |
| Potassium Hydroxide 20%                                   | 7                                 | 7  | 7  |     |
| Potassium Hydroxide 50%                                   | 8                                 | 8  | 8  |     |
| Sodium Hydroxide 10%                                      | 5                                 | 7  | 7  |     |
| Sodium Hydroxide 20%                                      | 7                                 | 7  | 7  |     |
| Sodium Hydroxide 50%                                      | 8                                 | 8  | 8  |     |
| Sodium Hydroxide 73%                                      | NR                                | NR | NR |     |
| Styrene Monomer<br>(inhibited)                            | 1                                 | 1  | 1  |     |
| Sulfuric Acid 15%                                         | 6                                 | 6  | 2  |     |
| Sulfuric Acid 30%                                         | 6                                 | 6  | 2  |     |
| Sulfuric Acid 65%                                         | 2                                 | 2  | NR |     |
| Sulfuric Acid 95%                                         | NR                                | NR | NR |     |
| Water: Condensate, Deionized,<br>Demineralized, Distilled | 9                                 | 7  | 7  |     |
| Water, salt                                               | 5                                 | 5  | 7  |     |
| Water, Tap                                                | 9                                 | 9  |    |     |
| Clarifier:                                                | 5                                 | 5  |    |     |
| Raw Water                                                 | 9                                 | 9  |    |     |
| Raw Water, Good for Potable                               | 9                                 | 9  |    |     |
| Wastewater                                                | 5                                 | 5  |    |     |

|                                                                                   |                                       |                                                             |
|-----------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------|
|  | <p align="center"><b>PAINTING</b></p> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 18 OF 26 |
|-----------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------|

## **LINING SYSTEM NUMER 1**

### **SURFACE PREPARATION**

STEEL: Blast to white metal per SSPC-SP-5

Or Nace 1, with a 25 micron (1 mil) profile.

Concrete: Not recommended over concrete

| COMPANY                    | COAT         | LINING PRODUCTS     |                   |          |                   |
|----------------------------|--------------|---------------------|-------------------|----------|-------------------|
|                            |              | STEEL               |                   | CONCRETE |                   |
|                            |              | PRODUCT             | Microns<br>D.F.T. | PRODUCT  | Microns<br>D.F.T. |
| Carboline                  | Primer       | Carbozinc 11        | 75 (3 mils)       |          |                   |
|                            | Intermediate | None                |                   |          |                   |
|                            | Top          | None                |                   |          |                   |
| Sigma<br>Coatings,<br>Inc. | Primer       | Tornusil<br>MC#7551 | 75 (3 mils)       |          |                   |
|                            | Intermediate | None                |                   |          |                   |
|                            | Top          | None                |                   |          |                   |

|                                                                                   |                                       |                                                             |
|-----------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------|
|  | <p align="center"><b>PAINTING</b></p> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 19 OF 26 |
|-----------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------|

## **LINING SYSTEM NUMER 2**

### **SURFACE PREPARATION**

STEEL: Blast to white metal per SSPC-SP-5

Or Nace 1, with a 75 to 100 micron (3 to 4 mils) profile.

Concrete: Normally not used over concrete

| COMPANY   | COAT   | LINING PRODUCTS     |                   |          |                   |
|-----------|--------|---------------------|-------------------|----------|-------------------|
|           |        | STEEL               |                   | CONCRETE |                   |
|           |        | PRODUCT             | Microns<br>D.F.T. | PRODUCT  | Microns<br>D.F.T. |
| Carboline | Primer | Carboglas<br>1601SG | 500 (20 mils)     |          |                   |
|           | Top    | Carboglas<br>1601SG | 500 (20 mils)     |          |                   |

|                                                                                   |                 |                                                             |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 20 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|

## **LINING SYSTEM NUMER 5**

### **SURFACE PREPARATION**

STEEL: Blast to white metal per SSPC-SP-5

Or Nace 1, with a 50 to 75 micron (2 to 3 mils) profile.

Concrete: Clean and roughen by acid etch or sweep blasting,

and apply 500 microns (20 mils) of Carboline 295WB surfacer

| COMPANY                    | COAT         | LINING PRODUCTS                     |                   |                 |                   |
|----------------------------|--------------|-------------------------------------|-------------------|-----------------|-------------------|
|                            |              | STEEL                               |                   | CONCRETE        |                   |
|                            |              | PRODUCT                             | Microns<br>D.F.T. | PRODUCT         | Microns<br>D.F.T. |
| Carboline                  | Primer       | Carbomastic #3                      | 200<br>(8 mils)   | Carbomastic #14 | 200<br>(8 mils)   |
|                            | Intermediate | Carbomastic #14                     | 200<br>(8 mils)   | Carbomastic #14 | 200<br>(8 mils)   |
|                            | Top          | Carbomastic #14                     | 200<br>(8 mils)   | Carbomastic #14 | 200<br>(8 mils)   |
| Sigma<br>Coatings,<br>Inc. | Primer       | Colturiet<br>TCN 300 Black<br>#7472 | 200<br>(8 mils)   |                 |                   |
|                            | Intermediate | Colturiet<br>TCN 300 Brown<br>#7472 | 200<br>(8 mils)   |                 |                   |
|                            | Top          | Colturiet<br>TCN 300 Black<br>#7472 | 200<br>(8 mils)   |                 |                   |

|                                                                                   |                                       |                                                             |
|-----------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------|
|  | <p align="center"><b>PAINTING</b></p> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 21 OF 26 |
|-----------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------|

## **LINING SYSTEM NUMER 6**

### **SURFACE PREPARATION**

STEEL: Blast to white metal per SSPC-SP-5

Or Nace 1, with a 75 micron (3 mils) profile.

Concrete: Clean and roughen by acid etch or sweep blasting,

and apply 375 micron (15 mils) of Carboline's Phenoline 300 surfacer.

| COMPANY   | COAT         | LINING PRODUCTS         |                   |                         |                   |
|-----------|--------------|-------------------------|-------------------|-------------------------|-------------------|
|           |              | STEEL                   |                   | CONCRETE                |                   |
|           |              | PRODUCT                 | Microns<br>D.F.T. | PRODUCT                 | Microns<br>D.F.T. |
| Carboline | Primer       | Phenoline 300<br>Orange | 200<br>(8 mils)   | Phenoline 300<br>Orange | 200<br>(8 mils)   |
|           | Intermediate | Phenoline 302           | 200<br>(8 mils)   | Phenoline 302           | 200<br>(8 mils)   |
|           | Top          | Phenoline 302           | 200<br>(8 mils)   | Phenoline 302           | 200<br>(8 mils)   |

|                                                                                   |                                       |                                                             |
|-----------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------|
|  | <p align="center"><b>PAINTING</b></p> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 22 OF 26 |
|-----------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------|

### **LINING SYSTEM NUMER 7**

#### **SURFACE PREPARATION**

STEEL: Blast to white metal per SSPC-SP-5

Or Nace 1, with a 50 to 75 micron (2 to 3 mils) profile.

Concrete: Clean and roughen by acid etch or sweep blasting,

and apply 375 microns (15 mils) of Carbolin's Phenoline 300 surfacer.

| COMPANY                    | COAT         | LINING PRODUCTS                 |                   |                            |                   |
|----------------------------|--------------|---------------------------------|-------------------|----------------------------|-------------------|
|                            |              | STEEL                           |                   | CONCRETE                   |                   |
|                            |              | PRODUCT                         | Microns<br>D.F.T. | PRODUCT                    | Microns<br>D.F.T. |
| Carboline                  | Primer       | Phenoline 368                   | 125<br>(5 mils)   | Phenoline 368              | 125<br>(5 mils)   |
|                            | Top          | Phenoline 368<br>WG Finish      | 255<br>(9 mils)   | Phenoline 368<br>WG Finish | 255<br>(9 mils)   |
| Sigma<br>Coatings,<br>Inc. | Primer       | Colturiet<br>Phenguard<br>#7409 | 100<br>(4 mils)   |                            |                   |
|                            | Intermediate | Colturiet<br>Phenguard<br>#7435 | 125<br>(5 mils)   |                            |                   |
|                            | Top          | Colturiet<br>Phenguard<br>#7436 | 125<br>(5 mils)   |                            |                   |

|                                                                                   |                 |                                                             |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 23 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|

## **LINING SYSTEM NUMER 8**

### **SURFACE PREPARATION**

STEEL: Blast to white metal per SSPC-SP-5

Or Nace 1, with a 50 to 75 micron (2 to 3 mils) profile.

Concrete: Clean and roughen by acid etch or sweep blasting,

and apply 375 microns (15 mils) of Carbolin's Phenoline 300 surfacer.

| COMPANY                    | COAT         | LINING PRODUCTS                 |                   |                         |                   |
|----------------------------|--------------|---------------------------------|-------------------|-------------------------|-------------------|
|                            |              | STEEL                           |                   | CONCRETE                |                   |
|                            |              | PRODUCT                         | Microns<br>D.F.T. | PRODUCT                 | Microns<br>D.F.T. |
| Carboline                  | Primer       | Phenoline 373                   | 125<br>(5 mils)   | Phenoline 373           | 125<br>(5 mils)   |
|                            | Intermediate | Phenoline 373<br>Finish         | 125<br>(5 mils)   | Phenoline 373<br>Finish | 125<br>(5 mils)   |
|                            | Top          | Phenoline 373<br>Finish         | 125<br>(5 mils)   | Phenoline 373<br>Finish | 125<br>(5 mils)   |
| Sigma<br>Coatings,<br>Inc. | Primer       | Colturiet<br>Phenguard<br>#7409 | 100<br>(4 mils)   |                         |                   |
|                            | Intermediate | Colturiet<br>Phenguard<br>#7435 | 125<br>(5 mils)   |                         |                   |
|                            | Top          | Colturiet<br>Phenguard<br>#7436 | 125<br>(5 mils)   |                         |                   |

|                                                                                   |                                       |                                                             |
|-----------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------|
|  | <p align="center"><b>PAINTING</b></p> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 24 OF 26 |
|-----------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------|

## **LINING SYSTEM NUMER 9**

### **SURFACE PREPARATION**

STEEL: Blast to white metal per SSPC-SP-5

Or Nace 1, with a 50 to 75 micron (2 to 3 mils) profile.

Concrete: Clean and roughen by acid etch or sweep blasting,

and apply 500 microns (20 mils) of Carbolin's 295WB surfacer.

| COMPANY                    | COAT         | LINING PRODUCTS              |                   |                  |                   |
|----------------------------|--------------|------------------------------|-------------------|------------------|-------------------|
|                            |              | STEEL                        |                   | CONCRETE         |                   |
|                            |              | PRODUCT                      | Microns<br>D.F.T. | PRODUCT          | Microns<br>D.F.T. |
| Carboline                  | Primer       | 191                          | 125<br>(5 mils)   | 191              | 125<br>(5 mils)   |
|                            | Intermediate | 191 HB<br>Finish             | 125<br>(5 mils)   | 191 HB<br>Finish | 125<br>(5 mils)   |
|                            | Top          | 191 HB<br>Finish             | 125<br>(5 mils)   | 191 HB<br>Finish | 125<br>(5 mils)   |
| Sigma<br>Coatings,<br>Inc. | Primer       | Colturiel<br>GPL-HB<br>#7405 | 75<br>(5 mils)    |                  |                   |
|                            | Intermediate | Colturiel<br>GPL-HB<br>#7431 | 150<br>(6 mils)   |                  |                   |
|                            | Top          | Colturiel<br>GPL-HB<br>#7432 | 75<br>(3 mils)    |                  |                   |

|                                                                                   |                 |                                                             |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 25 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|

## **LINING SYSTEM NUMER 10**

### **SURFACE PREPARATION**

STEEL: Blast to white metal per SSPC-SP-5

Or Nace 1, with a 50 to 75 micron (2 to 3 mils) profile.

Concrete: Clean and roughen by acid etch or sweep blasting,

and apply 375 microns (15 mils) of Carbolin's Phenoline 300 surfacer.

| COMPANY                                     | COAT         | LINING PRODUCTS                 |                   |          |                   |
|---------------------------------------------|--------------|---------------------------------|-------------------|----------|-------------------|
|                                             |              | STEEL                           |                   | CONCRETE |                   |
|                                             |              | PRODUCT                         | Microns<br>D.F.T. | PRODUCT  | Microns<br>D.F.T. |
| Wisconsin<br>Protective<br>Coating<br>Corp. | Primer       | Plasite<br>7122                 | 150<br>(6 mils)   |          |                   |
|                                             | Top          | Plasite<br>7122                 | 150<br>(6 mils)   |          |                   |
| Sigma<br>Coatings,<br>Inc.                  | Primer       | Colturiet<br>Phenguard<br>#7409 | 100<br>(4 mils)   |          |                   |
|                                             | Intermediate | Colturiet<br>Phenguard<br>#7435 | 100<br>(4 mils)   |          |                   |
|                                             | Top          | Colturiet<br>Phenguard<br>#7436 | 100<br>(4 mils)   |          |                   |

|                                                                                   |                 |                                                             |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|
|  | <b>PAINTING</b> | DOC. NO. : HDO-SPE-M-R01<br>REV. NO. : 0<br>PAGE : 26 OF 26 |
|-----------------------------------------------------------------------------------|-----------------|-------------------------------------------------------------|

### **LINING SYSTEM NUMER 11**

#### **SURFACE PREPARATION**

STEEL: Blast Cleaning to white metal corresponding to SSPC-SP-10

| TANK LINING SYSTEM NO. |                                               |                  |
|------------------------|-----------------------------------------------|------------------|
| COAT                   | STEEL SURFACE                                 |                  |
|                        | PRODUCT NAME                                  | D.T.T.<br>(MIC.) |
| PRIMER                 | KOREPOX HOLDING PRIMER<br>EP 170 Q.D OR EQUAL | 90               |
| INTERMEDIATE           | KOREPOX TANKER SHELTER<br>EP 174 OR EQUAL     | 125              |
| TOPCOAT                | KOREPOX TANKER SHELTER<br>EP 174 OR EQUAL     | 125              |
| TOTAL D.F.T. (MICRON)  |                                               | 300              |