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1 SCOPE

This specification describes the minimum requirements for surface preparation, coating materials, application methods and quality insurance and inspection concerning the painting works occurring on site and delivered equipment of TRM project in China. This specification applies to:

- Structural steels and pipings of Plant.
- External structural steels and pipings of LNG Storage Tanks.
- Equipment installed on plant or on the LNG Tanks

2 DEFINITIONS

3 APPLICABLE DOCUMENTS

A. MAIN CODES TO BE APPLIED

A.1 Preparation of steel substrates before application of paints and related products. Visual Assessment of surface cleanliness

ISO 8501-1	Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
SSPC Vol. 2 Chap.2	
SSPC Vis1	Visual Standard for Abrasive Blast Cleaned
SSPC-SP1	Solvent Cleaning
SSPC-SP2	Hand Tool Cleaning
SSPC-SP3	Power Tool Cleaning
SSPC-SP7	Brush-off Cleaning
SSPC-SP8	Pickling
SSPC-SP10	Near White Blast Cleaning
SSPC-SP11	Power tool Cleaning to Bare Metal
SSPC Vol.2 Chap.3	Painting System Specifications
SSPC-PS Guide 12.00	Guide to Zinc Rich Coating Systems
SSPC Vol.2 Chap.5	Paint Application Specifications
SSPC-PA2	Measurement of dry Film Thickness with Magnetic Gages

A.2 ASTM standards

ASTM D3359	Measuring Adhesion by Tape Test
ASTM D4417	Field Measurement of Surface Profile of Blast Cleaned Steel

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ASTM D4752 Standard Test Method for Measuring MEK resistance of Ethyl Silicate (inorganic) Zinc Rich Primer by Solvent Rub.

ASTM A780 Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coating.

ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

ASTM A 153 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Hardware.

A.3 NACE standards

NACE Discontinuity (Holiday) Testing of protective Coatings. RP0188-99

A.4 RAL

German Specification for Colors (RAL)

A.5 CHINESE CODES

HG/T20679-2014 External Anti-corrosion Design Specification for Chemical equipment and Piping

HG/T 20229-2017 Code for Construction and Acceptance of chemical Equipment and Pipeline Anticorrosive Engineering

B . SUPPLEMENTARY CODES AND STANDARDS

Where the Codes and Standards listed in section A do not cover a specific painting or surface preparation activity, the following supplementary Codes and Standards may be applied.

B.1 Preparation of steel substrates before application of paints and related products. Visual Assessment of surface cleanliness

ISO 8501-2 Part 2: Visual assessment of surface cleanliness.

ISO 8502-1 to 4 Tests for the assessment of surface cleanliness.

ISO 8502-6 Tests for the assessment of surface cleanliness: extraction of soluble contaminants for analysis-The Bresle method.

ISO 8503-1 to 4 Surface profile of abrasive blast-cleaned steel.

ISO 8504-1 to 3 Methods for surface preparation.

ISO 2409 Paints and varnishes. Cross-cut test

ISO 4624 Paints and varnishes. Pull-off test.

ISO 1461 Hot dip galvanized coating on fabricated iron and steel articles-specification and test methods.

B.2 PAINTS AND VARNISHES – CORROSION PROTECTION OF STEEL STRUCTURES BY PAINTS SYSTEMS

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ISO 12944-1	Part 1: General introduction
ISO 12944-2	Part 2: Classifications of environments.
ISO 12944-3	Part 3: Design and constructive requirements.
ISO 12944-4	Part 4: Surfaces types and preparation.
ISO 12944-7	Part 7: Execution and supervision of painting work.
ISO 12944-8	Part 8: Development of specifications for new and maintenance works

B.3 EVALUATION OF PAINT AND VARNISH DEFECTS. DESIGNATION OF INTENSITY, QUANTITY AND SIZE OF COMMON TYPES OF DEFECTS.

ISO 4628-1	Part 1: General Principles and rating schemes.
ISO 4628-2	Part 2: Designation of degree of blistering.
ISO 4628-3	Part 3: Designation of degree of rusting.
ISO 4628-4	Part 4: Designation of degree of cracking.
ISO 4628-5	Part 5: Designation of degree of flaking.
ISO 4628-6	Part 6: Rating of degree of chalking by tape method.

4 ORDER OF PRECEDENCE

The Codes and Standards listed in section 3A shall apply as the basis for all Onshore Vendor applications. The Chinese codes listed in section 3A shall also be applied where they are more stringent than the International equivalent. Where the International equivalent is more stringent, this shall be applied. Where the Codes and Standards listed in the section 3A do not cover a specific painting or surface preparation activity, the supplementary Codes and Standards listed in section 3B may be applied.

5 GENERAL

References to "Operating Temperature" in this specification shall be taken to mean the maximum temperature in normal operation.

References to carbon steel and low alloy steel in this specification shall be taken to include low chrome alloy steels (up to and including 9% Cr). References to stainless steel shall be taken to mean austenitic stainless steels such as grades 304, 316, 321, 347 etc.

Hot-dip galvanizing shall be carried out in accordance to ASTM A123 or ISO 1461.

6 EXCLUSIONS

Equipments and Structures made of corrosion resistant materials such as stainless steels or non ferrous alloys, except where specified otherwise. e.g. Stainless Steel Piping (cf section 13.).

The following items do not require preparation or painting unless specifically instructed otherwise:

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- 1) Brickwork, concrete fireproofing, exterior concrete, and pavement.
- 2) Fiber reinforced cement sheeting, brass, copper, slate, glass and tile.
- 3) Aluminium or aluminized steel including insulation weatherproofing.
- 4) Galvanized steel surfaces unless otherwise specified. (Hot-dip galvanized derrick structure of flare and vent stack shall be finish painting).
- 5) Screw threads and gasket contact surface.
- 6) Finished machined parts of machinery.

Internal surfaces of areas which are completely sealed to atmospheric elements, except where specified otherwise.

Machined faces.

7 EXTENT OF PAINTING

- 7.1 Carbon steel bolting for structural steel work shall be painted after connection. Bolts for flange shall be galvanized and unpainted.
- 7.2 Piping systems including fittings, flanges, strainers, traps, valves, etc. shall be painted to suit the operating temperature involved.
- 7.3 Equipment support such as skirts, legs, saddles, etc. shall be painted with the system specified for the equipment. Both the outside and inside of the equipment skirts should be painted. Pipe support shall be painted with System No.1 as specified in 1 - 5 of annex I. In case of stainless steel equipment with carbon steel support, carbon steel shall be painted in accordance with Note 1 of 1-6 of annex I.
- 7.4 Personnel protection portion shall be considered as uninsulated surface for both metal mesh and lagging personnel protection.
- 7.5 Extent of painting work for manufacturer's shop and construction site shall be carried out in accordance with Annex1-A of this specification.

8 GENERAL REQUIREMENTS

- 1) The COATING APPLICATOR and the VENDOR shall submit to the CONTRACTOR its own painting procedure based on this specification.
- 2) Where conflict arises between this specification and other contract documents, the CONTRACTOR will obtain a written ruling from the COMPANY before proceeding with the work
- 3) The VENDOR shall complete, document in ANNEX IV in order to help CONTRACTOR to control if VENDOR procedure is in accordance with the requirement or must be completed or modified. No VENDOR procedure will be checked without this document correctly filled up.

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4) Equipment and packages with electrical equipment, machinery's, valves (except Bulkvalves see section 12.7) shall be delivered fully painted (System according to this specification), unless otherwise specified in Equipment's requisition/specification.

5) Equipment working under pressure shall be painted after completion of all heat treatment, pressure test and examination performed in the vendor's shop.

Spools shall be supplied fully painted after inspection and pressure tests if needed.

6) Inorganic zinc rich primers shall be based on alkyl silicate media and shall contain minimum 74% metallic zinc by weight in the dry film and zinc rich epoxy shall be based on two pack epoxy media and shall contain minimum 77% by weight metallic zinc in the dry film. as specified in SSPC PS Guide 12.00 Guide to Zinc Rich Coating Systems.

7) If dismantling of assembly item is impossible after functional test, inaccessible area shall be painted with the first coat minimum (plus the tie-coat in case of zinc ethyl silicate primer based paint system) before assembly.

8) Any inaccessible surfaces for proper coating application and/or inspection shall be coated prior to final assembly. Specifically, flange and bolt holes shall be coated prior to final installation.

9 COATING MANUFACTURERS

- Agreed COATING MANUFACTURERS are listed in section 18.
- The COATING MANUFACTURER selected through the VENDOR LIST shall be notified to the CONTRACTOR. Prior to any painting work commencing, the complete Product and Safety Data Sheets shall be supplied to the CONTRACTOR with the detailed Painting Procedure. The painting work shall only start after written approval of the procedure and the proposed COATING MANUFACTURER by the CONTRACTOR.

10 SURFACE PREPARATION

10.1 Pre-surface Preparation

- Oil, grease, wax, dirt and other foreign matters shall be removed by cleaning and degreasing from metal surfaces in accordance with SSPC SP1.
- Before and after blasting, all welding seams shall be closely inspected for the presence of welding flux and spatters, slivers, inclusions, all burns, sharp edges, and underlying mill scales. Imperfections shall be mechanically removed, welding porosity's and welding pinholes will be eliminated and the involved area will be reblasted to standard. Sharp edges shall be rounded (R>2mm at minimum).

Whole of design requirements for paint application is contained in ISO 12944-3.

10.2 Blast Cleaning

ABRASIVE:

- Abrasive shall be obtained from a reputable abrasive supplier, sand is forbidden.
- Blasting abrasives shall be dry, clean, free from contaminants, dry silica safe.
- It shall be free of contaminant (Dust, oil, grease, and foreign matters...).

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- Material with sharp particles and of a type and size and quality adequate to give the following surface preparation requirements:
- Carbon Steel Minimum Surface cleanliness: Sa 2 ½ as per ISO 8501.1
- Carbon Steel Surface roughness: Ry 50 to 75 microns; Ra 10 / 13 microns or Medium "G" as per ISO 8503.2.
- Stainless Steel refer to section 10.5
- Dust level : Level 2 maximum as per ISO 8502.3
- Surfaces to be coated shall be rendered dust free prior to the application of each coat by blowing the surface with clean dry air or by using an industrial vacuum cleaner.
- Compressed air used for blasting shall be free of oil, water and pressure. (7 bar at blasting nozzle).
- Compressed air used for propelling blasting abrasive shall be free from oil and water contamination.

10.3 Mechanical or Manual surface Preparation

Where an abrasive blast cleaning is recognised as impractical or could be damageable for the vicinity (equipment; apparatus...), Manual and Mechanical (Power Tool) cleaning may be used at the CONTRACTOR's discretion..

In this process, dirt, rust, loose mill scale are removed and the metal surface prepared by hand chipping, scrapping or wire brushing, or abrading. Mechanical preparation shall be carried out by powered hand tools such as powered wire brushes or needle guns as far as practical. to achieve the standard ISO 8501-1 grade St 3.

On completion the surface should have a pronounced metallic sheen.

10.4 Meteorological conditions

Surface preparation and painting work shall be stopped under any of the following conditions :

- 1) Below 5°C of ambient air temperature.
- 2) Steel surface temperature less than 3 °C above ambient air dew point.
- 3) Greater than 85% of the relative humidity. In the case of inorganic zinc rich primer, application shall be done when relative humidity is between 50-90%.
- 4) In condition of strong or gusty winds or poor visibility or raining.
- 5) Above 50°C of surface temperature.

10.5 Stainless steel surface preparation

In the case of stainless steel piping or equipment, all surfaces requiring painting shall be blast cleaned with a suitable silica safe non-metallic abrasive low in chlorides and heavy metal elements, such as aluminum oxide or a proprietary abrasive based on inert aluminum silicate. The surface preparation grade shall be SSPC-SP7. The abrasive particles shall be sized to produce the surface profile that shall be specified 35 to 50 microns.

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Any solvent used for shop or field cleaning of stainless steel surfaces shall be an organic solvent free from metallic elements and shall contain less than 50 ppm total halide.

10.6 Surface Preparation Quality Control

The quality of all prepared surfaces shall be examined in accordance with section 17.5 of this specification to confirm that their requirements have been met in full prior to the application of any paint.

11 PAINT APPLICATION

11.1 The time elapsed between surface preparation and primer coat application shall not exceed 4 hours. In any case, just prior to coating, the surface cleanliness shall be checked as specified in section 17 of this specification.

Blast cleaned surfaces shall not be left unpainted during night.

Any prepared surfaces which have visible rust or are outside the four hours limit shall be re-prepared as stated in section 10.

11.2 Paint shall be applied strictly in accordance with the COATING MANUFACTURER's recommendations and the requirements of this specification. Particular attention shall be paid to thinning, mixing and curing times between subsequent coats.

11.3 All areas such as external corners, edges, welds, bolts, nuts and interstices shall receive an additional "stripe" coat of primer coat before the requirement given in the relevant Schedule in Annex I is applied (not applicable to inorganic zinc silicate primer). Operation repeated with the intermediate coat.

11.4 Coating shall not be conducted:

When the steel surfaces temperatures is less than 3°C above the air dew point.

When the relative humidity of the air is above 85 % for epoxy coatings and 90 % for zinc silicate coating (subjected to COATING MANUFACTURER's recommendation / requirements compliance).

11.5 Prior to apply a succeeding coat, all previous coatings shall be allowed to dry for at least the minimum time specified by the COATING MANUFACTURER. Special care has to be taken not to exceed the maximum overcoating time allowed by the COATING MANUFACTURER. The COATING MANUFACTURER's advice regarding the influence of the applied coating thickness, steel temperature, relative humidity, % of thinner added, shall be taken into account in determining the correct over coating intervals.

11.6 Prior to apply the following coat, previous coat shall be rendered free of dust, grease and other foreign matters.

11.7 During application of paint containing Zinc powder, particular attention shall be paid to avoid zinc spraying on Stainless steel.

The quality of coating application shall be inspected in accordance with section 17 of this specification to confirm that the CONTRACTOR's requirements have been met in full.

11.8 Surfaces that do not require painting should be protected from the effects of preparation and painting using suitable masking materials.

12 REPAIRS

12.1 General

If defects are found during the intermediate or final inspections, these defects shall be

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recorded as per the definitions of ISO 4628 (Type, dimension and scale) and repaired in accordance with sections 12.2 to 12.7 below.

12.2 Minor defects (localised appearance, scratches, etc)

Subject to the agreement of the CONTRACTOR and depending upon the specific paint system used, surface preparation at minor defects may be carried out by localized blast cleaning or power tool cleaning. Care shall be taken to ensure that adjacent painted surfaces are not damaged during the operation. Surface preparation shall include abrading the first 25mm (1inch) of intact coating immediately adjacent to the damaged area. The full coating system shall be applied to the bare steel overlap the 25 mm (1 inch) of prepared intact coating surrounding the repair.

12.3 Repair procedure

The repair procedure shall be in full compliance with this specification and shall be submitted for approval, in writing to CONTRACTOR prior to commencement of any work. The procedure shall include all surface preparation requirements, including both bare and coated metal surfaces, to ensure that full substrate and inter-coat adhesion is achieved.

12.4 Major defects (products, application and unsatisfactory tests results)

The paint shall be removed completely by abrasive blast-cleaning and the entire system shall be re-applied fully in accordance with the requirements of this specification.

12.5 Touch up on zinc ethyl silicate Primed Surfaces

Exposed areas of bare steel that were originally primed with inorganic zinc rich primer shall, after cleaning and preparation, be primed with one coat of zinc rich epoxy primer. The undercoat and finish shall be in accordance with the original coating schedule as shown in Annex I .

12.6 High temperature supplier system based on zinc ethyl silicate primer

High Temperature Coating System based on Zinc Ethyl Silicate Primer (Operating Temperatures > 120°C)

For operating temperatures higher than 120°C (see Annex I) bare metal areas on substrates previously primed with inorganic zinc silicate shall also be primed using a zinc silicate primer. In these cases, the surface shall be prepared in accordance with section 10 of this specification, except that abrasive blasting only shall be used. The intermediate and finish coats shall be reinstated in accordance with the relevant Schedule in Annex 1.

12.7 Part Coated Items

Items requiring significant handling during installation, such as large valves, may be supplied part coated, that is without the finishing coat, at the CONTRACTOR's discretion. In this case any damage to the factory coatings shall be made good at site before applying the final coat. On no account shall items be supplied in zinc rich primer only, due to the formation of zinc salts, the difficulties associated with their removal and their effect upon the adhesion of any further coats of paint applied subsequently.

13 STAINLESS STEEL AND GALVANIZED SURFACES

Uninsulated and insulated surface of stainless steel shall be coated with painting system in

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accordance with the systems summarized in 1-6 Annex I.

Galvanizing works shall be complied after fabrication as much as possible in order to minimize the use of touch up painting. All welds produced after galvanizing work shall be easily accessible for touch-up painting.

13.1 Stainless Steel Protection

- a) Austenitic Stainless steel is susceptible to stress corrosion at operating temperatures above 50°C under chloride conditions. They may also be susceptible to crevice and pitting corrosion at much lower temperatures in the same environment. Hence, in some circumstances, an external coating is required as a protection against these forms of degradation
- b) Austenitic stainless steels (300 series) and nickel alloys, such as Incoloy 800 and Inconel 625, may suffer zinc embrittlement when exposed to molten zinc at temperatures in excess of 700°C. For these alloys, direct contact with zinc should be avoided.

The following should be taken into consideration at design stage to protect such materials and their welds against zinc contamination:

- Bolts and nuts, which come in contact with austenitic stainless or high Ni alloys, shall not be galvanized. Zinc containing substances shall not be applied.
- Austenitic stainless steel and nickel alloy equipment and piping shall be suitably protected or located such that molten zinc from adjacent galvanized structures will not drip onto them during field welding operations or in the unlikely event of a fire.
- Equipment and piping operating at temperatures in excess of 400°C shall not be galvanized.
- Insulation weatherproofing on or in the vicinity of austenitic stainless steel or nickel alloy equipment and piping shall not be fabricated from galvanized sheet.
- Galvanised or zinc coated components shall not be welded to austenitic stainless steel or nickel alloy equipment or piping.

Paints and primers containing metallic zinc shall not be used on austenitic stainless steel or nickel alloy substrates.

13.2 Stainless steel surface

All Austenitic stainless steel shall be painted according to this document and Paint supplier recommendation.

Blasting abrasive shall not contain ferric particles, it shall be of a type and size suitable to give an angular profile with a Ra of 10 microns.

Care shall be taken for handling and assembling tools used. Tools shall be in stainless steel or well protected to avoid stainless steel and duplex contamination. Test shall be performed to assess ferrous contamination as per ISO 8502-1 (direct colorimetry method using Prussian blue): no surface pollution shall be detected.

Blasting operation shall be performed in a segregated area (blasting cabin) avoiding any ferric contamination.

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In the case of operating temperatures below 120°C : stainless steel shall be applied in a minimum three coats with Total DFT (which shall be equivalent to those specified in Annex – 1).

In the case of operating temperatures above 121°C : stainless steel are applied in a minimum two coats with Total DFT (which shall be equivalent to those specified in Annex - 1).

Painting system for cryogenic condition (<0 °C) shall be equivalent to System No.11 for carbon steel in table 1-7 and System No. 7 for stainless steel in table 1-6 (refer to annex 1).

The VENDOR and COATING APPLICATOR shall provide the contractor with the following certificates to ensure that:

- a) Cleaner and Thinner have less than 50 ppm chloride content.(Recognised acceptable limit).
- b) All paint applied on stainless steel are free of contaminant i.e. metallic pigments able to alter the substrate natural passivation, Sulphur or chloride which could affect the substrate at ambient or elevated temperatures. Halogens content shall be below 200 ppm as per ASTM D 808. (Recognised acceptable limit).

13.3 Galvanized surfaces

Galvanized surfaces shall be performed as per the Standards ASTM A 123 or ISO 1461. Hot dip galvanized coatings on fabricated iron and steel articles.

Galvanized surfaces will not be painted except for security or safety markers, in this case paint system 18 as per 1-11 annex 1 of this specification shall be applied.

Surface preparation shall consist on a light sandblasting (low pressure with few abrasive).

Care shall be taken to ensure that the removal of the zinc coating is kept to a minimum.

Galvanizing works shall be complied after fabrication as much as possible in order to minimize the use of touch up painting. All welds produced after galvanizing work shall be easily accessible for touch-up painting.

Touch-up and repair of galvanized surfaces shall be carried out using a zinc rich epoxy coating. Surface preparation and coating application shall be in accordance with ASTM A 780.

14 BOLTING

Carbon steel bolting for structural steelwork shall be painted after connection.

Bolts for flanges shall be galvanized and unpainted. See also section 13.3 of this specification.

15 EQUIPMENT

Equipment shall be delivered fully painted as per this Specification

Some Flanges or Valves could be delivered only with the Primer + Tie coat if an inorganic zinc is concerned.

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Repairs if any shall be performed accordingly.

16 TOUCH UP

Prior to application of any coat, all welded portion and / or all damage to the previous coats shall be touched –up.

16.1

- 1) Mechanical surface preparation shall be applied for small areas of damage exist in otherwise sound coatings. For large areas abrasive blasting to be used to SSPC- SP10 or if blasting is not practical considering the site conditions , mechanical cleaning shall be applied with SSPC-SP11, with Contractor's approval.
- 2) Surface preparation to include abrasion of the first 50 mm of intact coating surrounding the damage.
- 3) The first coat of paint applied over mechanically cleaned steel to be applied by brush.
- 4) Where damage is extensive one coat of finish to be applied overall after primer and undercoats have been applied to the damaged areas.

16.2 Touch-up of damaged inorganic zinc rich primer coating shall be with organic zinc rich primer or surface tolerant epoxy primer for operating temperatures of 120°C and silicone-based zinc rich primer for operating temperature above 120°C.

16.3 Items supplied with the manufacturer's standard painting system shall be touched-up with the same generic painting materials or compatible with each other to be used.

16.4 Touch-up and repair of galvanized surfaces shall be carried out using a zinc rich epoxy coating. Surface preparation and coating application shall be in accordance with ASTM A780.

17 INSPECTION

17.1 Vendor's and Coating Application's Obligation

- a) The VENDOR shall be responsible for ensuring the quality of the work fully meets the requirements of this specification.
- b) The CONTRACTOR may decide to send a coating inspector during or at the end of work to review the quality of the workmanship. This in no way relieves the VENDOR from its obligations with regard to quality control of the surface preparation and painting work. For the PAINT MANUFACTURER, shall prepare a paint work planning and advice the CONTRACTOR before the date of blasting operation.
- c) All results from the following tests shall be recorded in a daily painting inspection report, an example of this report is available in ANNEX III.
- d) The VENDOR shall send a painting work plan to the CONTRACTOR and shall notify the CONTRACTOR of the scheduled date for commencement of the surface preparation and painting work by fax a minimum of 1 week before the date of the first blasting operation.

17.2 Abrasive / Paint material

- a) Storage

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- Abrasive and paint material shall be stored indoors.
- Verify the abrasives are packaged in sealed, moisture proof containers and stored in a clean and dry location. (spot)
- Verify that the storage conditions for all paint materials are adequate and properly maintained as required by the paint manufacturer. (spot)

b) Paint Material

- Verify that paint material and solvents for thinning are as specified. (all materials)
- Verify that "Shelf Life" of paint materials has not been exceeded. (all materials)
- Verify that paints and solvents shall be delivered in their original container with intact labels and seals.
- Verify that all paint materials has attached Technical Information and Material Safety and data Sheets.
- Verify that paint preparation / mixing procedure complies with paint manufacturers instructions and is being followed.

17.3 Environmental Condition

Confirm that substrate, air and dew point temperatures are as specified for proper surface preparation and paint application. The frequencies of measurement / inspection shall be carried out as follows:

Environmental conditions beginning of shift and every 4 hours thereafter minimum.

17.4 Equipment

As minimum the following instruments shall be used.

- Thermometer and Hygrometer
- Surface Temperature Termometer
- SSPC-Vis 1 Visual standard or ISO Visual Comparator
- Profile Comparator, Profile Gauge, or replica Tape.
- Wet Film Thickness Gauge
- Dry Film Thickness Gauge (Magnetic Gauge and Eddy Current Instrument Gauge)
- Cutting Tool, Cutting Guide, Tape etc. complying to ASTM D3359

17.5 Before each operation:

Shall be checked and reported to the daily report

- Air temperature.
- Relative Humidity.
- Surface temperature.
- Air Dew point .

Surface temperature shall be superior to 3°C minimum above ambient air the dew point.

17.6 Before paint application:

Shall be checked and reported to the daily report

- - Surface cleanliness as per ISO 8501.1
- - Surface Roughness as per ISO 8503.2
- - Dust level as per ISO 8502.3

17.7 Specific paint test:

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Prior to the starting of the first painting work, all paint systems shall be applied for testing on different kind of supports, in accordance with the specification . In a general way, the shapes of supports shall be chosen to reach as close as possible the shape encountered on the project structures.

In addition, samples shall be prepared as follows:

2 sheets steel 300x300mm (thickness 5 mm mini)

4 sheets steel 200x100 mm (thickness 3 mm mini)

This amount of sample shall be prepared for each paint system.

The paint system shall be applied on one face only. A 30mm stripe width shall be protected with a tape from the following coats.

These tests intend to define:

- Surface preparation
- Rate of thinner to be used for each paint
- The skillness of operators
- The suitable equipment
- The delay for top coating....

These tests shall be carried out under the supervision of:

- The COMPANY painting inspector
- The paint MANUFACTURER representative
- The CONTRACTOR painting inspector or QC representative.

A test statement shall be drawn-up and application methods qualified after approval of all involved parts.

For all painting work, shall be recorded:

- Batch number of each component of each paint applied.
- Curing test for zinc as per ASTM D 47 52 level 5.
- Appearance: the cured coatings shall be visually free of pinholes, voids, bubbles, mud cracking, and other "holidays".
- Date and time between each application
- Measurement of dry film thickness at every stage of coating (e.g. after priming, undercoating and finish coating).
- Holiday detection as per NACE RP 0188-90 when lining are concerned
- Adherence test: After full curing of the paint system (21 days at 20°C). For the VENDOR, fully coated test plates shall be made. Surface preparation, paint application shall be done in the same time and under the same conditions than as the treated item (a total of three steel test plates per coated item, each 250x150x5 mm).
- Porosity detection on coating as per paint manufacturer recommendations.

For thickness lower than 250 microns:

The adhesion test shall be checked by cross-cut tape test in accordance with the ISO 2409. Result: class No 1 as a minimum. In case of result lower than classification

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No.1, refer to the following test:

For thickness higher than 250 microns, or for results lower than classification No.1, such as defined above:

Proceed with a pull-off test according to ISO 4624 "Paints and varnishes - Pull-off test for adhesion". Adhesion will $\geq$ 5 Mpa minimum tested with a pneumatic or hydraulic apparatus.

18 COATING SYSTEMS

GENERAL: Approved COATING MANUFACTURERS shall be chosen in accordance with the CONTRACTOR APPROVED Vendor List. If not agreed through the vendor list, any new supplier shall be subjected to the CONTRACTOR / COMPANY approbation.

18.1 Paint Systems

Refer to the annex I

18.2 Paint Schedules for VENDOR

The specific requirements for surface preparation are detailed in the Annex-1 of this specification. The surface preparation standards quoted refer to the pictorial standards contained in SSPC Vis 1 or ISO 8501 –1.

The paint systems required by this specification are listed in Annex-1.

Where conflict arises between this specification and other contract documents, the Contractor shall obtain a written ruling from the COMPANY before proceeding with the work.

Inorganic zinc rich primers shall be based on alkyl silicate media and shall contain minimum 74% metallic zinc by weight in the dry film and zinc rich epoxy primer shall be based on two pack epoxy media and shall contain minimum 77% by weight metallic zinc in the dry film as specified in SSPC-PS Guide 12.00 Guide to Zinc Rich Coating Systems.

18.3 VENDORS' Standards / VENDORS' Specifications

The VENDOR may propose his alternative paint systems to those given in Appendix 1, providing the proposal is accompanied by written evidence that the VENDOR's paint system is capable of equivalent performance. In any event the acceptance of the VENDOR's alternative paint system shall be entirely at the COMPANY's discretion.

Before application of the VENDOR's proposed alternative coating system, the complete Product Data Sheets and Safety Data Sheets shall be supplied to the CONTRACTOR with the VENDOR's detailed Painting Procedure. Coating application shall only start after written approval from the COMPANY, via the CONTRACTOR

Powder Paint

The use of powder coating materials shall be avoided, and where used shall be subject to COMPANY approval.

Powder coatings shall have a final dft of not less than 350 microns on items which will be subjected to outdoor exposure in service. The finish coat shall be UV resistant. For those items subjected to indoor exposure a lower coating thickness may be allowed subject to the

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COMPANY's approval.

The VENDOR shall provide detailed surface preparation and coating procedures to the CONTRACTOR with all relevant products technical data sheets.

Manufacturer's standard painting systems shall be suitable for onshore coastal and offshore jetty environmental conditions and follow the Color Schedule in accordance with § 16. 3 of this specification.

- 1) In the case of operating temperatures below 120°C, carbon steel shall be applied in a minimum of three coats with Total DFT (which shall be equivalent to those specified in Annex-1), employing two component coatings that are self curing or chemically curing. On the other hand, stainless steel shall be applied in a minimum three coats with Total DFT (which shall be equivalent to those specified in Annex – 1).
- 2) In the case of operating temperatures above 121°C, carbon steel shall be applied in a minimum of two coats with Total DFT(which shall be equivalent to those specified in Annex - 1). On the other hand, stainless steel are applied in a minimum two coats with Total DFT (which shall be equivalent to those specified in Annex - 1).
- 3) Paint application is over a blast cleaned surface or a surface prepared by pickling as per SSPC-SP8.
- 4) Painting system for cryogenic condition (<0 °C) shall be equivalent to System No.11 for carbon steel and System No. 7 for stainless steel in table 1-7 and 1-6 in Annex - 1.
- 5) Manufacturers shall follow the color schedule in accordance with 18.4 of this specification.

Further a CONTRACTOR approval, COATING MANUFACTURER's standards shall be applicable to:

- Pump, Compressor, Blower, Valves, PSV..., Packaged Unit, Loading Arm, Seawater screen Electrical Equipment and Instrument Items.
- Other Items where it will be demonstrated that CONTRACTOR's paint system is impossible to be applied, or not suitable for specific item used, or coming from stock already painted.

Before application, the complete Product Data Sheets and Safety Data Sheets shall be supplied to the CONTRACTOR attached to its Painting Procedure. The application could start after written approval.

VENDOR's standard paint systems approved by CONTRACTOR shall be built of three coats minimum.

The VENDOR's standard paint systems shall also comply with the following:

Vendor shall take into account details given by requisition document about item exposure:

- Working conditions (Chemical environment, temperature, Humidity, etc...).On this project shall be considered onshore coastal and offshore jetty environmental conditions. Atmospheric corrosivity category C5-M as per ISO 12944-2.

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- Outdoor exposure under direct sun light (UV) exposure.
- Outdoor exposure protected against sun light exposure.
- Indoor exposure.

These details will help VENDORS to choose suitable finish coat in accordance with Item exposure.

If for any reason a Vendor's standard paint system is delivered with a finish topcoat not suitable for intended exposure, it shall be top coated with an epoxy tolerant plus polyurethane topcoat after checking of different paint material compatibility's. Extra-cost will be under the COATING MANUFACTURER responsibility.

To allow any possible painting touch up after installation on site, all items coated with a VENDOR's standard, shall be delivered on site with a sufficient quantity of finish coat to restore any small damage.

System based on zinc ethyl silicate coat:

For system based on zinc ethyl silicate primer, the following precautions shall be taken:

- Particular attention shall be paid to ensure that the maximum dry paint film thickness as recommended by the COATING MANUFACTURER is not exceeded.
- Two hours after application, zinc ethyl silicate shall be sprayed with fresh water if this is the COATING MANUFACTURER's normally recommended practice.
- Before overcoating the zinc ethyl silicate primer, an MEK test shall be performed as per requirements of ASTM D 4752 to confirm that the coating has fully cured. The required degree of cure shall be level 5.

18.4 Final Coat Colours

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COLOUR SCHEDULE

Description			Colour			RAL n °		
Structural steel	Structural steel, Platform and ladder		Grey			7037		
	Hand rail and Cage		Yellow			1023		
	Support for Pipings, Instruments,Control Valves,Transmitters, Gauges, etc		Grey			7037		
Galvanized Derrick Structure			Grey			7037		
Description			Pipe		Color band		Lettering and Arrow	
Piping			Colour	RAL n °	Colour		Colour	
	LNG 液化天然气		银色（保温层）	/	白色		Red	R03
	NG 天然气		灰	7035	淡黄	Y06	大红	R03
	PTW 淡水		灰	7035	艳绿	G03	白色	
	IA 仪表风		蓝色	5000	浅灰	B03	黑	
	PA 工厂风		灰色	7035	浅灰	B03	红	
	FW 消防水		红色	3000	大红	R03	白色	
	N2 氮气		米黄	1019	淡黄	Y06	红色	
	FL 火炬		桔色	2011	淡黄	Y06	大红	R03
	WW 污水		灰	7035	黑		白	
	SW 海水		非金属本色	/	艳绿	G03	白	
	NaOH烧碱		Orange	2011	紫	P02	白色	
	DO 柴油		桔色	2011	棕	YR05	白色	
Description			Colour			RAL n °		
Equipment	Cab	Chassis	Black			9005		
	Drums, Heat Exchangers	Below 120 ℃	Light Grey			7035		
		Above 121 ℃	Aluminium			9006		
	Fire Fighting Equipment		Safety Red			3000		
	Tank External		White			9010		
Description			Colour			RAL n °		

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Rotating Equipment	Pumps, Compressors, Turbines, Blower	Grey Beige	1019
	Motors	Orange	2011
Lifting Beams		Yellow/Black Stripes	1023/9011
Flare Stacks & Vent Stacks		Aluminium	9006
Electrical Items	Local Panels	Grey	7037
	Transformer	Light Grey	7035
	Junction Boxes (internal / external)	Light Grey	7035
Instruments Items	Local Panels, Transmittal Stanchions, Metering Skids	Grey	7037
Packaged Unit		As above	As above

Note: The here above color schedule is not applicable to Galvanized items for galvanized derrick structure.

18.5 Equipment Touch up

If touch up have to be performed on equipment on site, they must be done as per this Specification

LETTERING SCHEDULE As per Annex II of this document.

19 SAFETY

The COATING MANUFACTURER's health and safety instructions regarding the use of paints are provided on the data-sheets and warning labels. These recommendations shall be fully understood by the operators; which ones will comply with before any work. Paint safety data sheets should have to be available on the painting site.

20 RUST PREVENTION

Un-painted area shall be applied with suitable rust prevention as follows:

- All unpainted machined metal surfaces shall be coated with a suitable, easily removable rust preventive grease or strippable protective coating.
- For internal machined surfaces of an assembled unit, the rust preventive should be of a type that does not require removal before operation of the equipment.
- All vessel internal surfaces shall be protected from rust during transportation and storage. Rust prevention shall be either by desiccant (silica-gel) VCI (Vapour Volatile Corrosion Inhibitor) or nitrogen purge, unless specifically requested. When desiccant or VCI is used, those shall be packed in sufficient number of pouches made of permeable material. Putting uncovered materials or scattering it inside the vessel is not permitted.
- Rust prevention shall be removed before painting.

21 HANDLING OF FINISHED PRODUCT

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Care shall be taken to avoid damage to coating systems during loading, transport, unloading and storage. All slings, ropes and chains shall be rubber sheathed or otherwise suitably protected. Synthetic belt slings are preferred. Adequate timbers blocking shall be provided when stacking coated items, and no items shall be stacked directly on the ground. Small pieces of equipment shall be packaged (or crated) to avoid coating damages.

22 REPORTS AND CONTRACTUAL DOCUMENTS

Quality controls, batch number records, meteorological conditions records, coating reports etc. shall be issued by the Quality Control Department of THE COATING APPLICATOR.

Contractual documents:

- A blasting and coating report issued by the COATING APPLICATOR QC
- Department (see attached form ANNEX III) shall be added to the painting report.
- The product certificates of material used to perform the painting work.
- Extent of and condition of all surfaces prepared
- Air temperature, dew point and substrate temperatures at the start, during and at end of work.
- Characteristics of paint used (e.g. shelf life, mixing ratio, thinning ratio, pot life. etc.)
- Surfaces preparation achieved and surface profile
- DFT of primer, intermediate and finish coats.
- Total dry film thickness

23 GUARANTEES

Painting works shall be warranted in accordance with:

ISO 4628-3 Evaluation of degradation of paint coatings

Designation of degree of rusting Rust scale shall be maximum Ri 2 after 5 years

24 LIST OF DOCUMENTS

24.1 FOR VENDOR

- a) To be submitted with the enquiry response
- Type, Manufacturer and Quality of all abrasive to be used.
 - Technical Data Sheet of proposed Painting Materials (Product , application and Health & Safety data)
 - Inspection equipment used. (Number and date of last official calibration).
 - Form of inspection report including :
 - Environmental conditions
 - Means of cleaning
 - Method of surface preparation and standard achieved
 - Surface profile
 - Degree of cleanliness

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Means of paint application

Dry film thickness per coat

Results of zinc silicate cure tests

Overcoating intervals

Thickness of finished coating system

Completion of test panels

Repair form for each discrepancy

Results of adhesion test

- Paint system form for Vendor
- Means of loading, transport and storage .
- Certificate of abrasive, cleaner and thinner for stainless steel

b) b) To be submitted at the painting completion work

- Inspection report for each item coated

24.2 FOR COATING APPLICATOR

c) To be part of the required procedure:

- Quality of abrasive
- Paint systems as per annex 1 and relevant trade mark names.
- Technical Data Sheet of Paint for carbon steel (Product data and application data)
- Inspection equipment used. (Number and date of last official calibration).
- Certificate of abrasive, cleaner and thinner for stainless steel.
- Form of inspection report (i.e. annex III.) including: Environmental conditions, Means of cleaning, Method of surface preparation and standard achieved, Surface profile, Degree of cleanliness, Means of paint application, Dry film thickness per coat, Results of zinc silicate cure tests, Overcoating intervals, Thickness of finished coating system, Completion of test panels, Repair form for each discrepancy, Results of adhesion test.
- Paint system form for Vendor
- Means of loading, transport and storage .
- Certificate of abrasive, cleaner and thinner for stainless steel

d) To be submitted at the painting completion work

- Inspection report for each item coated (as per section 17)

25 PRODUCTS TO BE DELIVERED BY VENDORS

VENDORS will have to incorporate in crates or other packing, a sufficient quantity of finish coat paint to allow site touch up for 5% of the surface per system (Only for manufacturer standard system).

26 ANNEXES

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ANNEX I	Paint systems
ANNEX II	Lettering Schedule
ANNEX III	Surface Preparation and Coating Report
ANNEX IV	EQUIPMENT INFORMATION

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ANNEX-I PAINTING SYSTEMS

1-1. Substrate: Structural Steel, Pipe Support, guardrail and other accessory structures (For onshore coastal environmental condition)

Material: Carbon Steel and Low Alloy Steel

System No	Operating Temperature (°C)	Insulation or Fireproofing	Hot-Dip Galvanized (ISO 1461 ASTM A 123) (μm)	Surface Preparation (SSPC or ISO 8501)	Primer		Intermediate Coat		Finish Coat		Total DFT (μm)
					Generic Description	DFT (μm)	Generic Description	DFT (μm)	Generic Description	DFT (μm)	
1	Below 120	Unfireproofed	80	SP7 or Sa 1	Epoxy Primer	75	Penguard Midcoat MIO	100	Polyurethane	75	330
2	Below 120	Fireproofed (Note 1)	80	SP7 or Sa 1	Epoxy Primer	75	Penguard Midcoat MIO	100	None		225

Note 1: Compatibility between primer coat, intermediate coat and fireproofing will be confirmed when Vendor paint system will be known.

Note 2:对于 9KC和1KC无保温的碳钢管道,其地上支撑、管墩处的管道防腐层.结构:粘弹体防腐带+环氧玻璃布+耐候性面漆,环氧玻璃布为二布五油结构,厚度不小于1.2mm,面漆涂层厚度不小于80um。不锈钢管道和非金属管道不适用上述管道支撑处的防腐结构。

Note 3:所有碳钢材质的钢结构、管支架等支撑结构、护栏等采用锌基双重复合涂层防腐体系,热浸锌后,其底漆选用环氧连接漆,不再使用环氧富锌底漆,具体涂层如下:

热浸锌	80um (参照标准ISO1461, ASTM A123)
表面处理	SP7 或Sa1
底漆	75um 环氧连接漆
中间漆	100um 环氧云铁中间漆
面漆	75um 聚氨酯面漆

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- 1-2. Substrate: Equipment such as Drums, Heat Exchangers, Air Receiver and Flare Stack; vent stack (For onshore coastal environmental condition)
Material: Carbon Steel and Low Alloy Steel

System No	Operating Temperature (°C)	Insulation or Fireproofing	Surface Preparation (SSPC or ISO 8501)	Primer		Intermediate Coat		Finish Coat		Total DFT (μm)
				Generic Description	DFT (μm)	Generic Description	DFT (μm)	Generic Description	DFT (μm)	
1	Below 120	Uninsulated	SP10 or Sa 2 1/2	Zinc Rich Epoxy Primer	75	High Build Epoxy	100	Polyurethane	50	225
3	121 to 200	Uninsulated	SP10 or Sa 2 1/2	Inorganic Zinc Rich Primer	75	Silicone Acrylic	25	Silicone Acrylic	25	125
4	201 to 400	Uninsulated	SP10 or Sa 2 1/2	Inorganic Zinc Rich Primer	75	Aluminum Silicone	25	Aluminum Silicone	25	125
2	Below 120	Insulated	SP10 or Sa 2 1/2	Zinc Rich Epoxy Primer	75	High Build Epoxy	100	None		175
5	121 to 400	Insulated	SP10 or Sa 2 1/2	Inorganic Zinc Rich Primer	75	None		Aluminum Silicone	25	100

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1-3. Substrate: Atmospheric Storage Tank Exterior (Shell and Roof including Attachments)

Material: Carbon Steel and Low Alloy Steel

System No	Operating Temperature (°C)	Insulation or Fireproofing	Surface Preparation (SSPC or ISO 8501)	Primer		Intermediate Coat		Finish Coat		Total DFT (μm)
				Generic Description	DFT (μm)	Generic Description	DFT (μm)	Generic Description	DFT (μm)	
1	Below 120	Uninsulated	SP10 or Sa 2 1/2	Pre-construction Primer (Note 1)	15 – 20	High Build Epoxy	100	Polyurethane	50	225
			(Note 2)	Zinc Rich Epoxy Primer	75					

Note 1: All surfaces within 50 mm of each edge of plate shall be left bare (for welding).

Note 2: Pre-construction primer shall be removed by blasting at site. In case the pre-construction primer is retained (with Contractor's approval), it may be painted over without counting film thickness of the pre-construction primer into total DFT.

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1-4. Substrate: Atmospheric Storage Tank Exterior (Bottom) (Note 3)

Material: Carbon Steel and Low Alloy Steel

System No	Operating Temperature (°C)	Insulation or Fireproofing	Surface Preparation (SSPC or ISO 8501)	Primer		Intermediate Coat		Finish Coat		Total DFT (μm)
				Generic Description	DFT (μm)	Generic Description	DFT (μm)	Generic Description	DFT (μm)	
6	Below 120	-	SP10 or Sa 2 1/2	Pre-construction Primer (Note 1)	15–20	None		None		200
			(Note 2)	High Build Epoxy	200					

Note 1: All surfaces within 50 mm of each edge of plate shall be left bare (for welding).

Note 2: Pre-construction primer shall be removed by blasting at site. In case the pre-construction primer is retained (with Contractor's approval), it may be painted over without counting film thickness of the pre-construction primer into total DFT.

Note 3: Tank foundation shall be bitumen-sand type.

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- 1-5. Substrate: Pipe (For onshore coastal environmental condition)
Material: Carbon Steel and Low Alloy Steel

System No	Operating Temperature (°C)	Insulation or Fireproofing	Surface Preparation (SSPC or ISO 8501)	Primer		Intermediate Coat		Finish Coat		Total DFT (μm)
				Generic Description	DFT (μm)	Generic Description	DFT (μm)	Generic Description	DFT (μm)	
1	Below 120	Uninsulated	SP10 or Sa 2 1/2	ZincRich Epoxy Primer (Note 2)	75	High Build Epoxy	100	Polyurethane	50	225
3	121 to 200	Uninsulated	SP10 or Sa 2 1/2	Inorganic Zinc Rich Primer	75	Silicone Acrylic	25	Silicone Acrylic	25	125
4	201 to 400	Uninsulated	SP10 or Sa 2 1/2	Inorganic Zinc Rich Primer	75	Aluminum Silicone	25	Aluminum Silicone	25	125
2	Below 120	Insulated	SP10 or Sa 2 1/2	ZincRich Epoxy Primer (Note 2)	75	High Build Epoxy	100	None		175
5	121 to 400	Insulated	SP10 or Sa 2 1/2	Inorganic Zinc Rich Primer	75	None		Aluminum Silicone	25	100

Note 1: Inorganic Zinc Rich Primer may be applied as an alternative with Contractor's approval.

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	文件名称：涂漆涂色工程规定				版次	2

1-6. Substrate: Austenitic Stainless Steel Structure, Equipment, Pipe and Pipe Support (Note 1) (For onshore coastal and offshore jetty environmental condition)

Material: Austenitic Stainless Steel

System No	Operating Temperature (°C)	Insulation or Fireproofing	Surface Preparation (SSPC or ISO 8501)	Primer		Intermediate Coat		Finish Coat		Total DFT (μm)
				Generic Description	DFT (μm)	Generic Description	DFT (μm)	Generic Description	DFT (μm)	
7	-170 to 120	Uninsulated	SP7 or Sa 1 (Note 2)	Phenolic Epoxy (Note 3)	100	None		Phenolic Epoxy	100	200
8	Above 121	Uninsulated	SP7 or Sa 1 (Note 2)	Aluminum Silicone (Note 3)	20	Aluminum Silicone	20	Aluminum Silicone	20	60
9	-170 to 120	Insulated	SP7 or Sa 1 (Note 2)	Phenolic Epoxy (Note 3)	100	None		None		100
10	Above 121	Insulated	SP7 or Sa 1 (Note 2)	Aluminum Silicone (Note 3)	20	Aluminum Silicone	20	None		40

Note 1: Carbon steel pipe and equipment supports for stainless steel pipe shall be painted to painting system No.1 for onshore coastal environmental condition (1-1) and painting system No. 11 for offshore jetty environmental condition.

Zinc Rich Epoxy Primer next to stainless steel material must be carefully control to avoid contamination.

Note 2: SSPC-SP3 can be applied as per paint manufacturer's recommendation.

Note 3: Paints used on stainless steel surfaces should be of low chloride content.

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ONLY FOR INFORMATION

1-7. Substrate: Structural Steel, Equipment, and Pipe and Pipe Support (For offshore jetty environmental condition)

Material: Carbon Steel and Low Alloy Steel

System No	Operating Temperature (°C)	Insulation or Fireproofing	Surface Preparation (SSPC or ISO 8501)	Primer		Intermediate Coat		Finish Coat		Total DFT (μm)
				Generic Description	DFT (μm)	Generic Description	DFT (μm)	Generic Description	DFT (μm)	
11	Below 120	Uninsulated	SP10 or Sa 2 1/2	Zinc Rich Epoxy Primer (Note 1)	75	High Build Epoxy	125	Epoxy Paint	100	300
12	Below 120	Insulated	SP10 or Sa 2 1/2	Zinc Rich Epoxy Primer (Note 1)	75	High Build Epoxy	125	None		200
3	121 to 200	Uninsulated	SP10 or Sa 2 1/2	Inorganic Zinc Rich Primer	75	Silicon Acrylic	25	Silicon Acrylic	25	125
4	201 to 400	Uninsulated	SP10 or Sa 2 1/2	Inorganic Zinc Rich Primer	75	Aluminum Silicon	25	Aluminum Silicon	25	125
5	121 to 400	Insulated	SP10 or Sa 2 1/2	Inorganic Zinc Rich Primer	75	None		Aluminum Silicon	25	100

Note 1: Inorganic Zinc Rich Primer may be applied as an alternative with Contractor's approval.

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- 1-8. Substrate: Pump, Compressor, Blower, Packaged Equipment (such as Road Tanker Loading PKG, LNG Sampling Package, CPI Separator, Nitrogen Generation Package), Generator, Crane, Lording Arm, Electrical Panels/Equipments, etc., and Instrument Panels/Valves etc.

Material: Carbon Steel and Low Alloy Steel

System No	Operating Temperature (°C)	Insulation or Fireproofing	Surface Preparation (SSPC or ISO 8501)	Primer		Intermediate Coat		Finish Coat		Total DFT (μm)
				Generic Description	DFT (μm)	Generic Description	DFT (μm)	Generic Description	DFT (μm)	
13	Below 120	Insulated / Uninsulated	Manufacturer's standard painting system with a minimum of three coats and total DFT 225 μm for onshore coastal environmental condition and total 300 μm for offshore jetty environmental condition.							
14	Above 121	Insulated / Uninsulated	Manufacturer's standard painting system with a minimum of two coats and total DFT 125 μm for onshore coastal and offshore jetty environmental condition.							

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- 1-9. Substrate: Pump, Compressor, Blower, Packaged Equipment (such as Road Tanker Loading PKG, LNG Sampling Package, CPI Separator, Nitrogen Generation Package), Generator, Crane, Lording Arm, Electrical Panels/Equipments, etc., and Instrument Panels/Valves etc.

Material: Austenitic Stainless Steel

System No	Operating Temperature (°C)	Insulation or Fireproofing	Surface Preparation (SSPC or ISO 8501)	Primer		Intermediate Coat		Finish Coat		Total DFT (μm)
				Generic Description	DFT (μm)	Generic Description	DFT (μm)	Generic Description	DFT (μm)	
15	Below 120	Insulated / Uninsulated	Manufacturer's standard painting system with a minimum of three coats and total DFT 200 μm for onshore coastal and offshore jetty environmental condition.							
16	Above 121	Insulated / Uninsulated	Manufacturer's standard painting system with a minimum of two coats and total DFT 60 μm for onshore coastal and offshore jetty environmental condition.							

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1-10. Not applicable

1-11. Substrate: Galvanized Item: Derrick Structure of Flare , Vent Stacks and Piping.

Material: Galvanized

System No	Operating Temperature (°C)	Insulation or Fireproofing	Surface Preparation (SSPC or ISO 8501)	Primer		Intermediate Coat		Finish Coat		Total DFT (μm)
				Generic Description	DFT (μm)	Generic Description	DFT (μm)	Generic Description	DFT (μm)	
18	Below 120	-	SP7 or Sa 1 (Note 1)	Epoxy Zinc Phosphate	50	Epoxy Paint	50	Polyurethane	50	150

Note 1: The surface to be coated shall be followed as per paint manufacturer's recommendation.

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1-12. Substrate: Potable Water Tank, Plant Air Receiver (Internal).

Paint system to be approved for Potable Water Lining through certificates submitted by the PAINT MANUFACTURER

Material: Carbon Steel

System No	Operating Temperature (°C)	Insulation or Fireproofing	Surface Preparation (SSPC or ISO 8501)	Primer		Intermediate Coat		Finish Coat		Total DFT (µm)
				Generic Description	DFT (µm)	Generic Description	DFT (µm)	Generic Description	DFT (µm)	
19	Ambient	-	SP10 or Sa2 1/2	Pre-construction Primer	15-20	High Build Epoxy	(Note 2)	High Build Epoxy	(Note 2)	300
			SP10 or Sa2 1/2	High Build Epoxy (Note 1)	(Note 2)					

Note 1: Pre-construction Primer shall be removed by blasting at field.

Note 2: Dry Film Thickness shall be as per paint manufacturer's recommendation.

Note 3: The internal coating, shall be certified as a suitable lining for potable water content.

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1-13. Substrate: Sea Water Piping Line (Internal)

Material: Carbon Steel

System No	Operating Temperature (°C)	Insulation or Fireproofing	Surface Preparation (SSPC or ISO 8501)	Primer		Intermediate Coat		Finish Coat		Total DFT (μm)
				Generic Description	DFT (μm)	Generic Description	DFT (μm)	Generic Description	DFT (μm)	
20	Ambient	-	SP10 or Sa2 1/2	Glass Flake Lining (Vinylester Type) shall be applied with 3 coats						1,000
21	Ambient	External	SP10 or Sa2 1/2	Epoxy Glass Flake Offwhite	200			Epoxy Glass Flake black	200	400

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- 1-14. Substrate : Buried Pipings (Including steel structure of underground valve Wells (hard Wells) pipes, elbows, etc.
Material : Carbon steel

System No	Operating Temperature (°C)	Buried Pipings	Surface Preparation (GB/T 8923)	Surface roughness (ISO 8503)	First Coat		Second Coat		Finish Coat		Total DFT (μm)
					Generic Description	DFT (μm)	Generic Description	DFT (μm)	Generic Description	DFT (μm)	
25	Below 90°C	External	SA 2½	Ry30-85 μm	Zinc Rich Epoxy Primer	75	None		Liquid Epoxy×2	400	475

Note 1: For the insulating joint, only two liquid epoxy coatings shall be used

REPAIRS AND Field Joint coating.

- For field Joint coating the same material as on the coated piping shall be used.
- If needed on pipe during installation, an Epoxy solvent free with a short gel time will be used. By preference, the same coating manufacturer will be retained.

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ANNEX- 1-A EXTENT OF PAINTING WORKS

Substrate	At Manufacturer's Shop	At Construction Site	
		At Field Shop	At Field
1. Structural Steel	Complete Paint System	-	Touch - up
2. Equipment External (Drum, Heat Exchanger,)	Complete Paint System	-	Touch - up
3. Flare and Vent Stack	Complete Paint System	-	Touch - up
4. Equipment External Pump, Compressor, Blower, Packaged Equipment, Generator, Crane, Lording Arm.	Complete Paint System	-	Touch-up
5. Atmospheric Storage Tank External	Pre-construction Primer	-	Complete Paint System
Atmospheric Storage Tank Internal	Pre-construction Primer	-	Complete Paint System
6. Galvanized Derrick Structure	Complete Paint System	-	Touch-up
7. Electrical and Instrumentation Items	Complete Paint System	-	Touch - up
8. Pipe, Pipe Support, Instrument Support	-	Up to Primer (Note 1) (Note 2)	Touch-up, Intermediate and Finish Coat
9. Valve, In-line Components	Up to Primer	(Note 1)	Touch-up, Intermediate and Finish Coat
10. Skid mounted valves	Complete Paint System		Touch-up

Note 1: Application of intermediate and finish coats will be applied at field shop as much as possible.

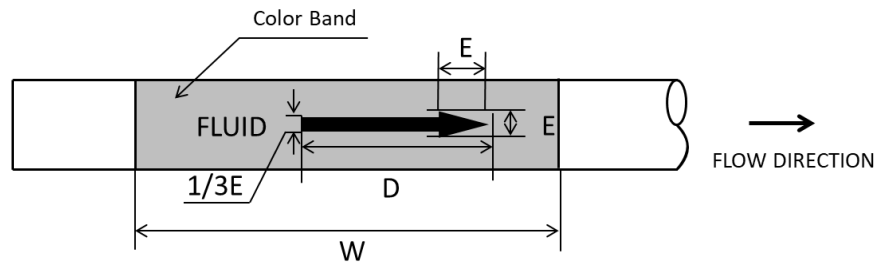
Note 2: Painting of spool up to finish coat in field shop shall be considered.

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ANNEX II LETTERING SCHEDULE

1 piping

(1)The fluid name, arrow and color band shall be marked in accordance with Fig.-1.



Note: Including Galvanized and Stainless Lines not to be insulated.

FIG.-1 FLUID IDENTIFICATION COLOR, ARROW AND COLOR BAND FOR PIPES

(2)"Arrow" shall indicate the flow direction of each service line for uninsulated and insulated pipe in accordance with Fig.-1 , and the color shall in accordance with COLOUR SCHEDULE as specified in 18.4

(3)The arrow and color band shall be identified near the operating point on the loading/unloading piping lines in accordance with Fig.-1 and piping connection point on the utility supply piping lines.

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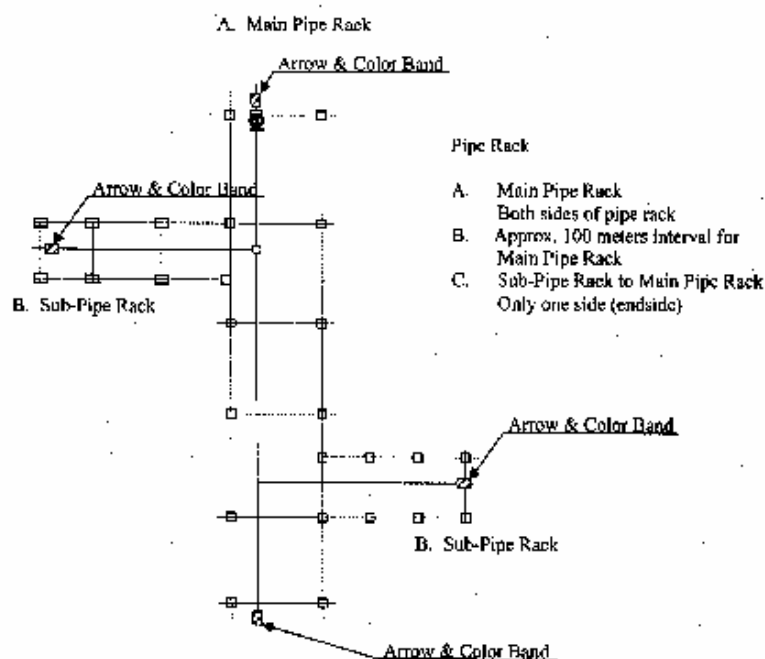


Fig-2.1 Around Pipe-rack

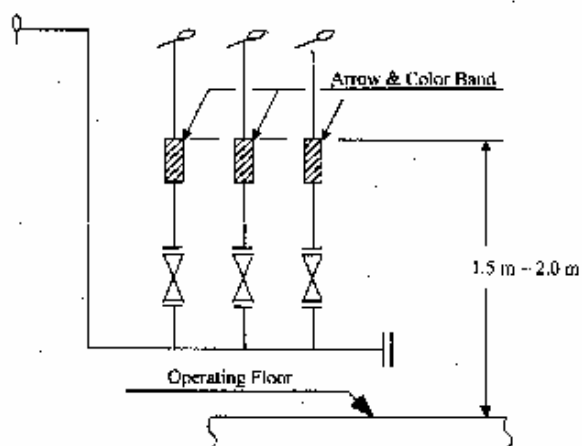


Fig-2.2 Around Block Valve

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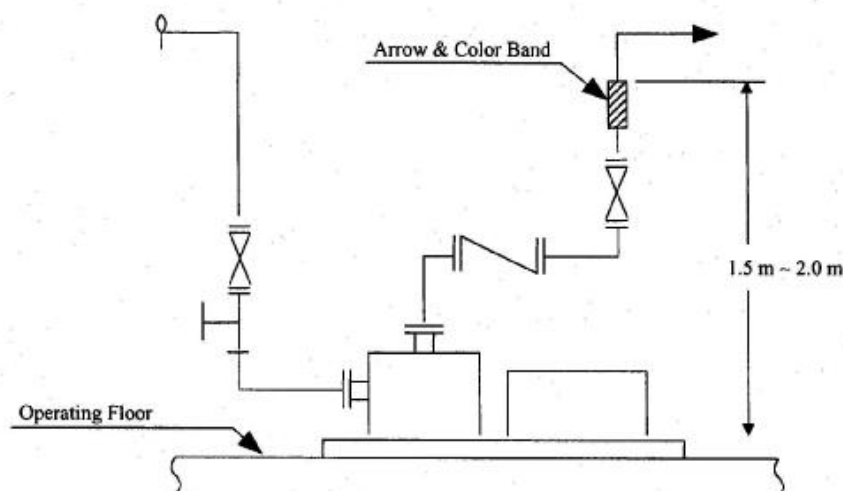


Fig.-2.3 Around Pump

FIG.-2 TYPICAL INTERVAL AND LOCATION OF LETTERING FOR PIPING

(4) Detail dimension of arrow shall be in accordance with table-1, and the “W” of color band shall be determined at site in consideration of visibility to operator.

Table-1 DIMENTION OF ARROW

DN	DN25-DN50	DN80-DN150	DN200-DN300	DN350-DN600	DN600 Above
DIMENTION (D*E)	15cm*4cm	25cm*9cm	40cm*15cm	50cm*20cm	70cm*25cm

(5) Actual location of arrow or arrow and color band such as topside or underside of horizontal position and vertical position on pipes shall be determined at site in consideration of visibility to operator.

2. Equipment

(1) The item number of equipment shall be clearly indicated on the surface of each equipment in accordance with Fig. - 3 and Fig. - 4. The item number of equipment shall be marked with black (N 1.0).

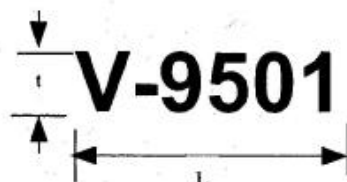


FIG.-3 LETTERING PROCEDURE FOR EQUIPMENT

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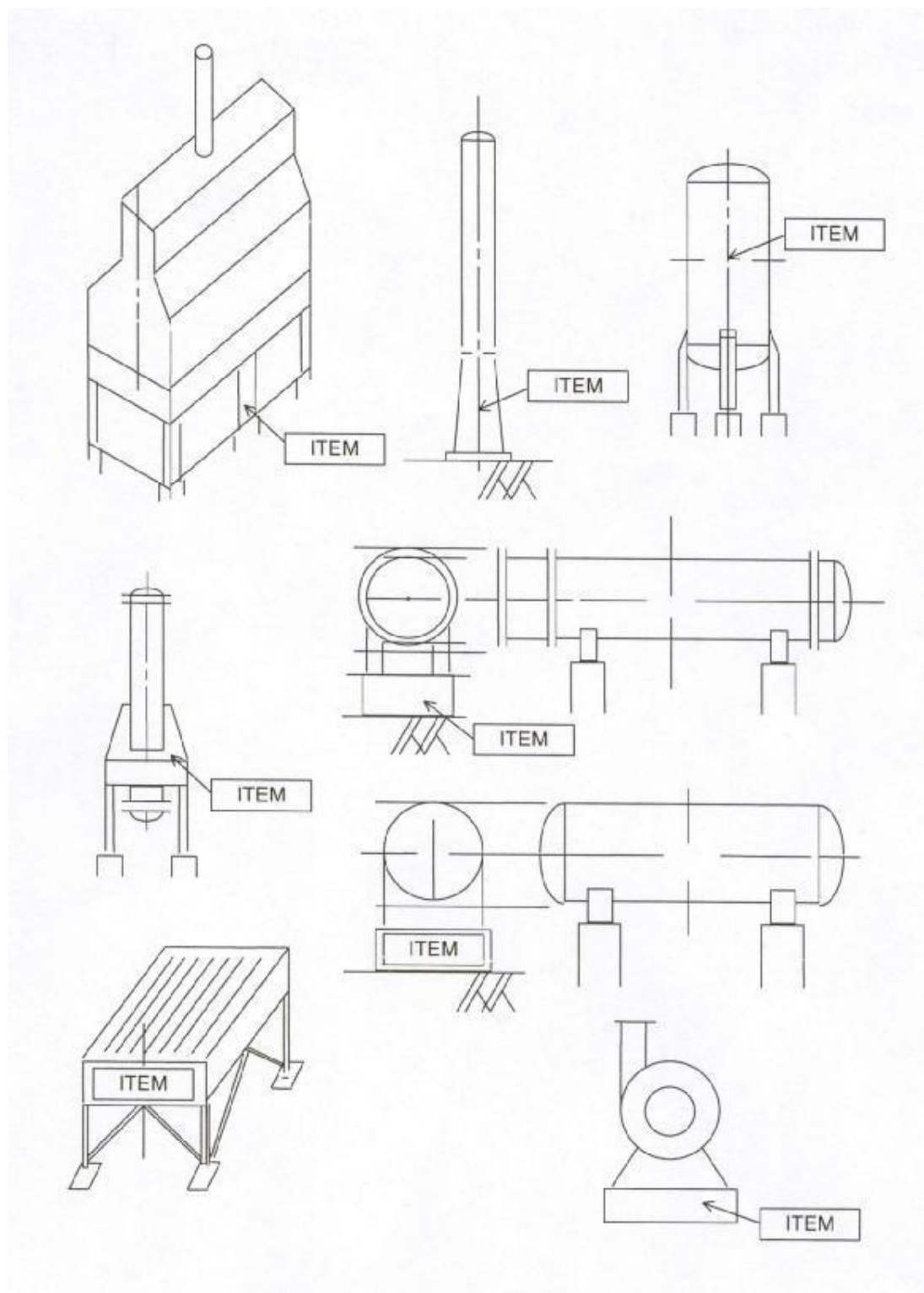


FIG.-4 TYPICAL LOCATION OF LETTERING FOR EQUIP. ITEM NO.

- (2) The size of letters for equipment shall be in accordance with Table - 2.
The number of lettering shall be one (1) per equipment.

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TABLE - 2 DETAIL DIMENSION OF LETTERING FOR EQUIPMENT (MM)

EQUIPMENT	DIMENSION OF LETTERING	
	t	L
O.D. < 3,000 mm	120 mm	As required
O.D. ≥ 3,000 mm	200 mm	As required

(3) For the concrete foundation surface or fireproofed surface, epoxy white paint shall be applied as a background of lettering.

(4) In case of lettering the equipment item number on the corrugated jacket surface, lettering shall be marked on the flat aluminum plate by screw to the insulation jacketing.

3. Storage Tank

(1) All storage tanks shall be clearly indicated tank item number.

(2) Lettering procedure shall be in accordance with Fig. – 5.

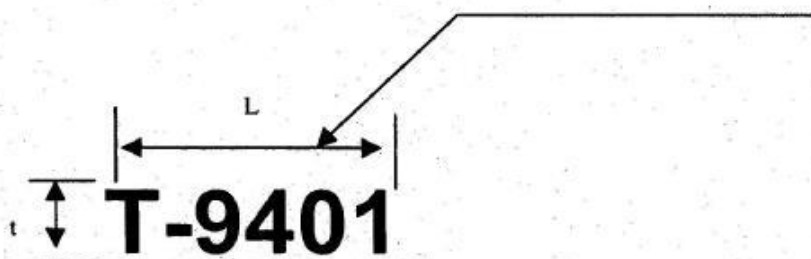


FIG.-5 LETTERING PROCEDURE WITH TANK ITEM NO.

(3) Sizes and dimensions shall be in accordance with Table - 3 and Fig. – 6.

TABLE - 3 DETAIL DIMENSION OF LETTERING FOR STORAGE TANK

DIAMETER OF TANK	DIMENSION OF LETTERING	
	t	L
O.D. < 10	500 mm	As required
11 < O.D. < 20	750 mm	As required

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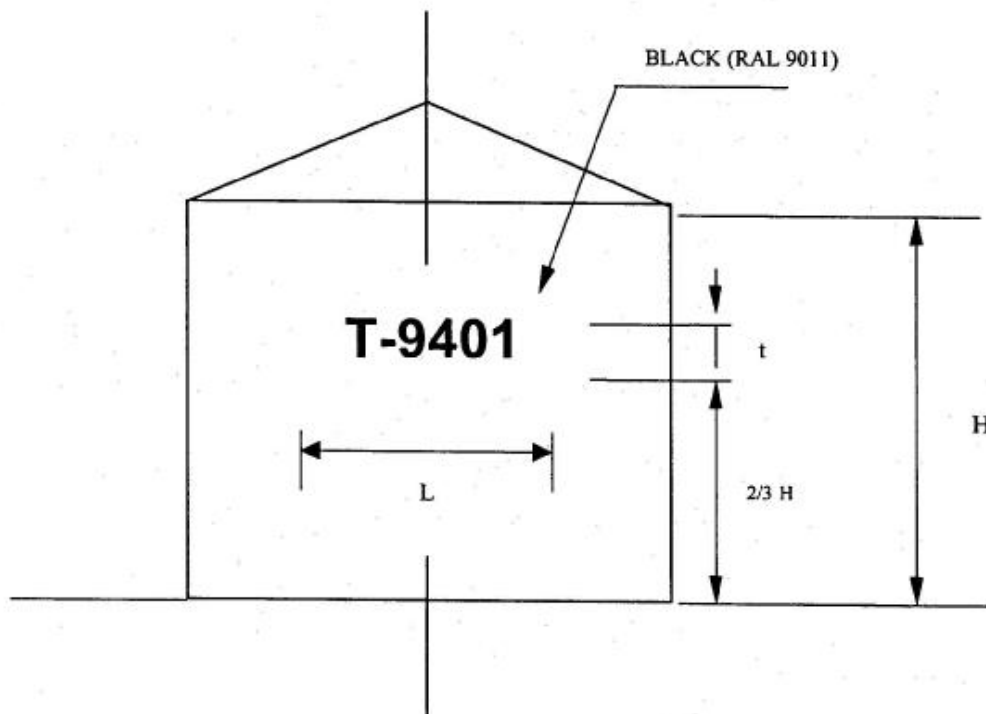


FIG.-6 LOCATION OF LETTERING FOR STORAGE TANK

- (4) As a guideline for the location of lettering, Fig. – 6 shall be followed but detail instructions will be fixed at the field.
The number of lettering shall be one (1) per each tank.

4. Letter Style

Letter shall be Gothic type in accordance with Fig. – 7.

The ratio of height and width of the letters shall be decided by Contractor with consideration given to the proportions of the letters.

ABCDEFGHIJKLMNOPQRSTUVWXYZ
1234567890

FIG.-7 LETTER STYLE

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ANNEX III SURFACE PREPARATION AND COATING REPORT

REFER TO THE FORM PAGE 2/2

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APPENDIX II

SURFACE PREPARATION and COATING REPORT

N°:

PAGE: 1/1

PROJECT N°:

INVOLVED SURFACE:

SURFACE PREPARATION	CLEANLINESS:
	ANCHOR PROFILE:

	项目代码	TRM	项目简称	接收站可靠性改造项目		
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ANNEX IV EQUIPMENT INFORMATION

VENDOR:

Subcontractor:

Equipment:

Type (Valve, Pipe etc.length, Ø... For skid: volume or weight etc.)

Nb or Name of the equipment:

Quantity:

Type of substrate:

Carbon Steel ☐

Stainless Steel ☐

Cast iron ☐

Other (to define) ☐

Temperatures:

Ambient ☐

Operating Mini:

Operating Maxi:

Insulated ☐

Uninsulated ☐

Fireproofing ☐

Environmental zone:

Inside ☐

Outside ☐

Under a shelter ☐

Underground ☐

Immersed ☐

Other (to define) ☐

VESSELS:

For Internal Coating, Type of Fluid:

Potable water: Yes No

Remarks