



## STANDARDS & SPECIFICATIONS (STRUCTURAL)

<b>PROJECT</b>	<b>:</b>	<b>ENGINEERING / TECHNICAL CONSULTANCY SERVICES FOR PREPERATION OF EXECUTION METHODOLOGY, SOW AND COST ESTIMATES FOR REPLACEMENT /REFURBISHMENT OF BRIDGES IN MH ASSET</b>
<b>LOCATION</b>	<b>:</b>	<b>MH ASSET (NORTH AND SOUTH FIELD)</b>
<b>CLIENT</b>	<b>:</b>	<b>ONGC, MUMBAI</b>
<b>CONSULTANT</b>	<b>:</b>	<b>ENGINEERS INDIA LTD, DELHI</b>
<b>EIL JOB NO.</b>	<b>:</b>	<b>B774</b>

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## STANDARDS

S.No	Document No.	Description	Rev. No.
1	7-60-0801	Standard handrails for offshore structures	4
2	7-60-0802	Standard grating details	4
3	7-60-0803	Standard Stairs for Offshore Platforms	4
4	7-60-0806	Jacket welding details	2
5	7-60-0807	Deck welding details	3
7	7-60-0811	Standard details of escape ladder	2

## LIST OF STANDARD SPECIFICATIONS

S.No.	Document No.	Document Title	Rev. No.
1.	6-60-0004	Standard Specification for Minor Offshore Structural Works	3
2.	6-60-0013	Standard specification for Minor fabrication and assembly of offshore structures and components	3
3.	6-60-0015	Standard specification for Skid Mounted Assemblies	3
4.	Spec 6001 F	General specification for materials, fabrication and installation of structures	14
5.	FS-2005	Specification For Protective coating	9
6.	FS - 2009F	FS for Welding & NDT	8



Offshore Design Section  
Engineering Services  
ISO – 9001:2008

**FUNCTIONAL SPECIFICATION  
FOR Welding & NDT**

Spec. No.	2009F
Rev. No.	8
Discipline	Quality Assurance
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**FUNCTIONAL SPECIFICATION**  
**FOR**  
***“Welding & NDT”***

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Offshore Design Section  
Engineering Services  
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**FUNCTIONAL SPECIFICATION  
FOR Welding & NDT**

Spec. No.	2009F
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## 1.0. SCOPE

This specification covers the minimum technical requirements for welding & inspection of Piping, Pressure Vessels, Structural & Subsea Pipeline work. For piping, this specification covers CS, CS NACE, SS and Cu-Ni. For piping DSS material welding & NDT, Annexure I shall be referred. This specification modifies and/or supplements the referenced codes that apply to all piping, pressure vessels, structural and pipeline welding. These requirements cover welding done at Contractor's fabrication plant, Contractor's Yard, Vendor / Supplier Premises or field installation, either onshore or offshore. This specification also covers the acceptance standards to be applied to production welds inspected by various NDT Techniques like RT, UT, AUT, MPI & LPT.

### 1.1. Regulatory Considerations

In addition to this specification, Contractor shall also comply with all applicable regulatory and national code requirements.

### 1.2. Abbreviations

AISC	American Institute of Steel Construction	NDE	Non Destructive Examination
API	American Petroleum Institute	NDT	Non Destructive Testing
ASME	American Society of Mechanical Engineers	ONGC	Oil and Natural Gas Corporation Ltd.
ASNT	American Society for Nondestructive Testing	PAUT	Phased Array Ultrasonic Testing
ASTM	American Society for Testing and Materials	PCN	Personnel Certification in NDT
AUT	Automated Ultrasonic Testing	PQR	Procedure Qualification Record
AWS	American Welding Society	PWHT	Post Weld Heat Treatment
BPVC	Boiler and Pressure Vessel Code	pWPS	Preliminary / Proposed Welding Procedure Specification
CRA	Corrosion Resistant Alloy	QA	Quality Assurance
CS	Carbon Steel	RT	Radiographic Testing
CTOD	Crack Tip Opening Displacement	SMYS	Specified Minimum Yield Strength
Cu-Ni	Cupro Nickel	SS	Stainless Steel
DCN	Design Change Note	TMCP	Thermo Mechanically Controlled Process
DCR	Design Change Report	TOFD	Time Of Flight Diffraction
DNV	Det Norske Veritas	TPI	Third Party Inspection
DSS	Duplex Stainless Steel	UT	Ultrasonic Testing
ECA	Engineering Critical Assessment	WPQR	Welding Procedure Qualification Record
FAW	Flux Cored Arc Welding	WPQT	Welding Procedure Qualification Testing
GMAW	Gas Metal Arc Welding	WPS	Welding Procedure Specification
HAZ	Heat Affected Zone	Company	Shall mean ONGC
HRC	Rockwell Hardness		
HV 10	Vicker's Hardness (10 Kg Load)		
ITP	Inspection & Test Plan		
LPT	Liquid Penetrant Testing		
MPI	Magnetic Particle Inspection		
NACE	National Association of Corrosion Engineers		
NCR	Non Conformance Report		



### 1.3. Quality Assurance

#### QA 1.3.1 Procedures/ITP:

Before commencing fabrication / installation, the Contractor shall submit a quality plan and a set of fabrication procedures to Company for review and approval. These documents shall include the following minimum requirement:

1. Welding & Consumable Control Procedures,
2. Welder Qualification Procedures,
3. PWHT Procedures and illustration of their proposed areas of application.
4. List of proposed all type of Welding Procedures and their areas of application.
5. List of Qualified all type of Welding Procedures and their areas of application.
6. Material identification & control procedure.
7. Detailed procedures for Non Destructive Testing, Technique sheet & Inspection.
8. Procedures for control of tolerances during fabrication.
9. DCN / DCR Control Procedure
10. Material handling procedure at Fabrication shop, Yard, Offshore installation separately
11. Painting/coating procedure
12. Name of fabrication/NDT agencies involved at Fabrication shop, Yard, Offshore installation with complete address of works & respective activities/job of the project and valid ISO 9001: 2008 certificate.

The quality plan shall include brief details and the sequence of all examinations that will be performed by the Contractor. The names of the individuals responsible for the implementation of all quality assurance and quality control functions shall also be included.

The contractor shall prepare a comprehensive ITP showing the role & scope of various agencies involved in inspection and same shall be submitted for Company's review and approval before commencement of fabrication / installation activity.

Contractor shall be required to do of his own QA internal audit at least 2 times at each yard/offshore activities.

#### QA 1.3.2 Manpower:

All personnel involved in welding related tasks shall have adequate qualifications and understanding of welding technology. The qualification level shall reflect the tasks and responsibilities of each person in order to obtain the specified quality level. The organization responsible for welding shall nominate at least one authorized welding coordinator in accordance with ISO 14731 – Welding Coordination – Tasks and Responsibilities (or equivalent) to be present on the location where welding is performed. The coordinator shall have comprehensive technical knowledge according to ISO 14731, paragraph 6.2a or equivalent.

The Contractor shall employ sufficient number of qualified inspectors. When an item is ready for inspection, the contractor QA personnel shall inspect it first and should be satisfied before offering the same to the Company inspector.

The contractor shall give tentative inspection schedules in advance so that the Company inspectors can effectively plan for the inspection.

#### QA 1.3.3 NDT:

In addition to visual inspection, NDT Techniques like RT, UT (Manual UT, PAUT, AUT & TOFD), MPI & LPT are required to be used for inspection. Radiography shall preferably be with X-ray.

γ (Gamma) ray can be used as explained below. However, use of Cobalt 60 Isotope is not allowed.

RT/PAUT as applicable for Piping & Structural welding( CS & CS NACE) is as follows:

- 1.The X-ray must be used till 10mm thickness joint of Piping & Structural welding.
2. RT-Gamma ray can be used without separate permission of ONGC, from 11 mm thickness till 25mm for Piping & Structural welding joint. However the "Project specific procedure qualification" is must ..



3. Beyond 10mm in case of Piping joints, beyond 19 mm in case of Structural joints , the PAUT can be done without separate permission of ONGC . However the “Project specific procedure qualification” is must.

Only personnel certified in accordance with PCN or ASNT recommended practice SNT-TC-1A shall be allowed to carry out Non Destructive Examination. PCN is the preferred qualification.

1.The technique sheet for the referred NDT shall be prepared by the LSTK contractor. The technique sheet preferably should be concise & precise in single page separately for each type of job & each type of NDT method used.

2.The technique sheet along with NDT procedure shall have approval of PCN or ASNT -Level III qualified (respective NDT method) personal of CA /ONGC.

3.The same technique sheet shall be displayed in the laboratory/workplace by the NDT operator.

4.The NDT operator of LSTK contractor must have to demonstrate/ go for the “Project specific procedure qualification” to be witnessed by ONGC/CA/TPI for the 1st time during start of NDT techniques”.

This entire point referred above shall be applicable for all type of NDT method as applicable in piping, pipeline & structural application.

#### QA 1.3.4 Calibration of NDT instruments:

*For standardisation of calibration of instruments used for referred NDT method ,it is essential to have valid calibration certificates for all NDT instruments, Portable Gas detectors, tong tester etc. from NABL accelerated laboratories (India) or from labs which are authorised by local government bodies or from the original manufacturer of the instrument.*

*Further for RT regarding NDT instruments ( RT machine, isotope ) shall require valid permission from the local government-regulatory body at the location of use”*

#### QA 1.3.5 Mechanical integrity :

**Mechanical integrity** of all flange joints has to be ensured in proper record.

A standard checklist for the activity along with post box-up checkup should be developed & practiced. The checklist shall include the following:

- i) Alignment of flanges
  - ii) Inspection of gasket surface for possible defects such as bends or greases.
  - iii) Inspection of mating flanges for dirt, mechanical damage and corrosion. Use suitable solvent to clean the surface. The contact area of flanges shall be free from excess pitting and radial scratches.
- iv) Ensuring the gasket is properly seated
  - v) Ensuring that fasteners are tightened as per tightening procedures and using specific values with well maintained tools and torque wrenches.
- b) Each joint shall be boxed up and tightened by only skilled technician.
- c) Ensuring right type of gaskets & fasteners etc. confirming to the specifications.
- d) Ensuring that the stud & nuts are free of dirt and corrosion. The studs should be straight and threads free from nicks, burr and chips etc.
- e) Checking of individual joint for any leak during commissioning/ pressure testing by special tapes, soap solution or as per relevant code.”

**Digital radiography** in lieu of film radiography can be used with the permission from ONGC on submission & approval of following documents.

- 1.Past track record of the technology/vendor in offshore application on similar material (Parent & welding consumable). PO copy & performance report of the user is required.
- 2.Complete procedure of using the technology with specification, protection of 1<sup>st</sup> image, calibration, validation of software, Technique etc. with respect to all the relevant standard.
3. The specific training & “procedure qualification “on the subject is required to be provided to ONGC/CA/TPI free of cost.
4. For storage of data a dedicated PC of sufficient memory for entire project with viewing software etc. must be provided without extra cost to ONGC..
5. Optimum nos. of re-use of film is restricted to 150 nos. or damaged whichever is earlier..





#### QA 1.3.6 ISO QMS certification :

*ISO QMS 9001: 2008 – valid certification of all the agencies/ subcontractors engaged (by LSTK contractors) for NDT and fabrication/welding activities shall be required.”*

#### QA 1.3.7 Inspection of material::

It shall be the responsibility of the contractor to inspect all materials upon receipt and to ensure that the correct grade of material has been supplied and that identification, dimensions, material quality and end preparation are in accordance with the requisite standards and specifications. Different materials shall be kept in discrete sections of the storage area and all material shall be marked in a manner that allows it to be related to the original manufacturer's certification.

Procedures for the transfer of material identification marks shall be agreed with the Company prior to the commencement of fabrication. Any material which is not readily identifiable shall be removed from the worksite and quarantined until its material grade and source can be confirmed.

#### QA 1.3.8 Welding machines :

Welding shall not be performed when the ambient temperature is lower than zero degree C, when surfaces are wet or exposed to rain, snow or high wind velocities, when welders are exposed to inclement conditions, or when conditions prevent required inspections.

Only welding equipment that is in good working condition and that is properly grounded shall be used. All welding machines shall be calibrated prior to commencement of fabrication and calibration certificates shall be available for ONGC QA audits. Certification shall be valid for 6 month periods, or as per manufacturer's recommendation.

*All the welding machines/transformers shall be based of **Inverter technology** or better one instead of conventional transformer/rectifiers based one.*

*All welding machines shall be calibrated prior to commencement of fabrication from NABL accelerated laboratories (India) or from labs which are authorised by local government bodies or from the original manufacturer of the machines.*

*All the welding cables, Grinder cables shall be free from any intermittent joints and shall have proper industrial explosion proof electrical plug-top. All used pipes for Gas- cutter shall be in good conditions with armoured & quality stamped.*

#### QA 1.3.9 Grounding of Equipment & air strikes:

- Each welding machine and panels shall be individually grounded to the platform or portion of the platform being welded.
- No machine or panels shall be grounded to floating equipment during welding on the structure.

Arc strikes should be made in weld groove. Arc strikes on the surface of base metal shall be removed by grinding, including any hardened zone beneath the strike. Any such repair shall be visually and magnetic particle inspected.



#### QA 1.3.10 Welding consumables :

Company shall approve all consumables including brands. Welding Consumables shall have physical, chemical, fatigue and corrosion resistance properties comparable to base metal. Manufacturer's batch test certificate shall be submitted for each batch of consumables used. Test results shall include chemical, physical (including impact), corrosion resistance (if welding material for sour service application or with NACE requirements) & fracture toughness (if welding material or WPS with CTOD Requirements). If these batch test results are not readily available (like corrosion test results, fracture toughness etc.), contractor shall carry out additional batch testing to confirm the same.

*The welding consumables which shall not be in no case of a date manufacture older than one year with effect from date of starting the fabrication.*

*Apart from above, prior to Production welding, the contractor has to do HIC test separately for welding consumables as guided by CA or Company."*

The control of Welding Consumables shall be in accordance with a well documented procedure. This procedure shall include techniques for storage, handling, recycling and re-baking of welding consumables to ensure that the diffusible Hydrogen content of weld metal is maintained at less than 5ml per 100 g of weld metal. The procedure shall, as a minimum, be in accordance with the manufacturer's recommendations. Since a variety of welding consumables may be in use at any manufacturing location, strict control shall be exercised to prevent loss of identification or the use of incorrect weld metal.

#### QA 1.3.11 Miscellaneous requirement :

The welder and weld area shall be provided with protection during periods of inclement weather and/or excessive wind conditions. The procedures shall include means of protecting electrodes, wires, fluxes, etc. Good House Keeping is essential in the job-area

Gas shielded welding processes should generally be used only for shop fabrication or in enclosed conditions. When used outdoor, suitable windshields must be provided to allow adequate gas coverage of molten puddle.

Heated quivers or rod boxes shall be placed at each welding location when low hydrogen welding electrodes are used.

The implementation of the procedures will be audited by ONGC QA team during the phase of Design, Fabrication & Installation activity at least two times par phase. Apart from audit the surprise checking also may be carried out by ONGC QA team at any time. ONGC shall be informed about the timely corrective actions taken by the fabricator as a result of any CAR/NCRs issued during such audit.

Copies of various QA procedures shall be readily available and shall be referenced in the quality plan and shall be made available during QA audit by Company.

Welders and welding operators shall be qualified as per the applicable specification. When using welding processes which have high potential for non-fusing type defects, in addition to the NDT requirements specified in the respective Codes, bend test shall also be carried out. GMAW and FCAW are regarded as welding processes with high potential for non-fusing type defects.

Welder Qualification Tests shall be witnessed by Company representative and/or by a reputed TPI agency. The Company representative shall be advised in advance that the Contractor is conducting welder qualification to enable auditing of test facilities.



Qualification test welds shall be made on test coupons prepared in accordance with the relevant standard. Certified as per QA1.3.4, the “Amp/volt tong tester” shall be available at the Contractor’s establishment at all times.

The Contractor shall be responsible for all costs, including labor and laboratory testing, associated with welder qualification tests and retests.

All welders working on the project shall wear identification cards made at contractor’s cost which shall contains photograph, welders name, welder no. Procedure qualified and Company’s/Engineer’s representative’s signature. If the fabricator has a different system for welder’s identity card, same can be followed after agreement.

The period of validity of welder qualification shall be in accordance with the Standard used for qualification. A qualification can be cancelled if the welder / welding operator show inadequate skill, knowledge and performance.

No wooden planks shall be used in any stage of fabrication job as platform of scaffolding.

During fabrication at yard there must have two independent escape route for workers..

#### QA 1.3.12 Production Records :

At all stages of fabrication, the Contractor shall maintain all relevant production records using a recording system agreed by the Company. The records shall include:

1. Material & Welding consumable certificates.
2. PWHT Records.
3. Fit-up reports.
4. Weld visual reports.
5. Painting/top coat report with surface finish report.
6. Dimensional inspection together with NDE & pressure test records.
7. Welder & welding operator qualification.
8. Approved Isometric drawings marked with unique weld numbers / NDT Drawings.
9. Authenticated copies of NDT operator’s certificates.
10. Records of any agreed deviations to the fabrication standards.

Welding Procedures shall be tested to demonstrate that acceptable welds can be made by the procedure. During WPS Qualification, the quality of welds shall be determined by both non-destructive & destructive testing as per the applicable code. Additional testing requirements specified in this specification shall also be carried out. The Welding Procedure Qualification Testing (WPQT) shall be witnessed by Company representative and also by a reputed TPI agency. Only qualified and approved WPSs shall be used for production welding.

#### QA 1.3.13 CTOD Testing:

1. Material subjected for CTOD Testing shall be tested and shall meet or exceed CTOD value of 0.35mm.
2. Welding consumable subjected for CTOD Testing shall be tested and shall meet or exceed CTOD value of 0.25mm.
3. WPS subjected for CTOD testing shall be tested and shall meet or exceed CTOD value of 0.20 mm.
4. CTOD testing shall be done from Govt. labs or Govt. accelerated labs with prior information to ONGC.



## PP2.0. PIPING & PRESSURE VESSELS

### PP2.1. Codes & Standards

The following Codes shall be the minimum acceptable standards for welding and inspection during piping & pressure vessel fabrication. The latest edition, addenda, code cases and supplement available at the time of bidding will be used. Any part of any other non-listed code referred to in these listed codes as augmentation is to be considered applicable.

ASME B31.3	Process Piping
ASME B31.4	Pipeline Transportation System for Liquid Hydrocarbons and other Liquids
ASME B31.8	Gas Transmission and Distribution Piping System
ASME BPVC Sec.VIII, Div.1	Rules for Construction of Pressure Vessels
AWS A2.4	Standard Symbols for Welding, Brazing and Nondestructive Examination.
ASME BPVC Sec.IX	Welding & Brazing Qualification
NACE MR0175	Standard Material Requirements - Metals for Sulfide Stress Cracking and Stress Corrosion Cracking Resistance in Sour Oilfield Environments
NACE TM0284	Standard Test Method - Evaluation of Pipeline and Pressure Vessel Steels for Resistance to Hydrogen-Induced Cracking
NACE TM0177	Standard Test Method - Laboratory Testing of Metals for Resistance to Sulfide Stress Cracking and Stress Corrosion Cracking in H <sub>2</sub> S Environments
ASME BPVC Sec. V	Nondestructive Examination
ASME Sec. II, Part C	Specification for Welding Rods, Electrodes and Filler Metals
ASTM E164	Standard Practice for Contact Ultrasonic Testing of Weldments
ASTM E165	Practice for Liquid Penetrant Inspection Methods
ASTM E709	Practice for Magnetic Particle Examination
ASTM E94	Standard Guide for Radiographic Examination
ASTM E384	Standard Test Method for Knoop and Vickers Hardness of Materials
ISO 14731	Welding Coordination – Tasks and Responsibilities
ASNT SNT-TC-1A	Personnel Qualification and Certification in Nondestructive Testing



## PP2.2. Weld Procedure Qualification & Documentation

The Contractor shall not commence production welding until appropriately qualified welding procedures have been accepted by the Company.

### A. Piping

Weld procedures including brazing procedures shall be qualified as per ASME Code Section IX & ASME B31.3

*The applicable WPQT (Welding Procedure Qualification Testing) was done in last 2 years for ONGC Job dated with effect from date of starting fabrication. If it is not of ONGC project, it shall be fresh WPQT for project specific.”*

Such previously qualified welding procedures may be considered for use for CS & CS NACE Piping, where they comply with the present document and are appropriate to the scope of work. These WPSs should have been qualified by the same fabricator in the presence of reputed TPI agencies. New, project specific WPS shall be prepared using the old WPQT as explained above of earlier qualified WPSs as supporting documents. In this exercise, good engineering practice and guidelines given in ASME Sec. IX shall be followed and using PQRs in an arbitrary manner to support a new WPS will not be acceptable.

However, for critical applications involving the welding of CRA materials (SS, DSS, Cu-Ni, Cu etc.), previously qualified procedures are not acceptable and fresh project specific WPQT & WPS is required.

Mechanical testing of WPQT coupons for CS piping shall confirm to the requirements of ASME Sec.IX / ASME B31.3. In addition to the above requirement, hardness testing shall be performed on each test coupon. Maximum hardness value shall be 325 HV10 for normal service piping. For Sour Service piping, a maximum permitted hardness of 248 HV10 (22 HRC) shall apply. CVN (Charpy V Notch) Impact Testing of Carbon Steel Pipe work shall be performed in accordance with ASME B31.3 Table 323.2.2.

For each welding process, the welding procedures shall specify all equipment settings. The Contractor's Welding Supervisor shall check daily and record machine settings for each weld procedure used during welding activities. This record shall be available for audit by the Company representative.

### B. Pressure Vessels

Welding Procedures shall be qualified as per ASME Sec. IX & ASME BPVC Sec. VIII Div.I



### PP2.3. Welder Qualification

Welders shall be qualified as per ASME Boiler and Pressure Vessel Code, Section IX.

Qualification on production welds is not permitted.

A welder shall not be permitted to weld on pipe work or attachments to pipe work unless they are qualified to the procedure in use and the documentary evidence has been sighted by the Company representative.

Tack welds shall be made by a qualified welder using the same type of electrode as is used for the root pass.

The Company may request a retest of any welder at any time and from time to time during the work. If a welder fails to qualify, then at the discretion of the company representative, all non- installed welds completed by that welder shall be examined by additional radiographic tests, over and above that which would normally be required or specified in the drawings for that pipe work and the same shall be charged to the Contractor's account.

Welds not identified and recorded, or welded by unqualified welders, shall automatically be rejected. It will be the Contractor's responsibility to prove that the welds conform to the applicable Specification. This may require 100% radiography.

### PP2.4. Production Welding

1. The quality of piping welding shall be such that a weld efficiency factor as defined in ASME B 31.3 of 1.0 is achieved.
2. The deposited filler metal shall match the chemistry, corrosion resistance (if required) and minimum physical properties of the parent metal when similar metals are welded.
3. Circumferential welds on pipes shall be staggered at least four times the pipe wall thickness or 25 mm, whichever is greater, apart.
4. Branch connections shall be joined to their headers with full penetration welds.
5. Backing rings, back-up rings or chill rings shall not be used.





6. Back or seal welding of screwed fittings is prohibited unless specified in the drawing or is part of the approved welding procedure.
7. Oxy-acetylene torches shall not be used for pre-heating.
8. Pipes of dissimilar materials shall not be welded to each other but shall be flanged unless otherwise approved.
9. Compressor and turbine piping, including lube and seal oil piping, and other piping requiring special cleaning as shown in the drawings provided by the supplier shall have the root pass deposited by the gas tungsten arc process. The backside of the root pass shall be purged with inert gas.
10. If the bore of the pipe is different from the bore of fittings or flanges, to which it is welded, by more than 3mm (total bore diameter), the thicker member shall be bored, taper bored or ground smooth to match the specified bore. Figure 328.4.3 of ASME B 31.3 will governs the geometry of all taper boring and beveling.
11. Coupling or other weld-on type branch connection shall be located at least 80 mm away from any weld joint.
12. When socket weld fittings or valves are used, pipe shall be spaced approximately 1/16 inch to avoid “bottoming” which could result in excessive welds stress.
13. The inside of the brazed fitting and outside of the tube shall be cleaned with sand Paper. Flux paste to be evenly applied to the joint.
14. Reinforcing pads shall be added only after external and internal visual inspection of the attachment. Reinforcing pads shall be provided with 1/4” tapped weep hole. Weep holes should be plugged after welding of pads is over.
15. Exposed machined and threaded surfaces shall be protected from oxidation during heat treatment.
16. Flange bolt holes shall straddle the established horizontal and vertical centerlines of the pipe except where connection to equipment dictates otherwise.
17. Cleaning of the piping after fabrication and heat treatment shall be performed externally and internally to remove all loose scale, weld spatter, sand and other foreign materials.



18. Welding shall not be done when quality of completed weld would be impaired by prevailing weather conditions, air borne moisture, blowing sand or high winds. Windshields may be used when practical.
19. Temporary attachments to the outside of surface of the pipe shall not be made without the approval of Company. Any such attachments which are permitted shall be removed by grinding or by using Oxy – Acetylene torch to 3 mm above permanent material surface, removal of the remaining 3mm shall be by grinding, followed by MPI / DPI. Company may require an ultrasonic check to establish that the remaining wall thickness is not less than the design minimum. Arc air gouging, hammering or other mechanical means shall not be used for the removal of temporary attachments.
20. Welder shall be supplied with temple stick – thermal crayons or pended gauges so that welders and inspector can check and control the temperature of element.
21. No weld shall be coated, painted, hydro tested before it has been inspected and accepted.
22. No weld is to be cooled by quenching or by any means other than natural cooling.
23. Welding for Severe Cyclic Condition: The weld reinforcement shall be smooth and shall blend smoothly with the external surface of the pipe to minimize possible stress concentration effects.
24. Field Welding
- Where field welds are designated, the prefabricated pipe shall be cut off 150 mm longer than the dimensions shown on the pipe fabrication drawings to allow for modification then precise fit-up in place.
  - Additional field fit welds may be included in a spool by the Contractor for those spots which may have restricted site access or which may be cumbersome for transportation.
  - The location of field welds, where not indicated on the drawings, will be the responsibility of the Contractor.

#### **PP2.5. NDT Techniques**

NDT Techniques like RT, UT, MPI & LPT shall be used for the examination of welds as per the requirements given in this specification.





### Radiography:

1. Radiography will be performed for every pipe thickness and material grouping and for each welding process and procedure, progressively throughout entire job. At least one of each type and position of weld made by each welder will be examined. A record shall be kept by the Contractor of the quality and extent of each welder's work.
2. Radiography is not required for the welds on slip-on flanges or socket welds or seal welds.
3. Fluorescent intensifying screens such as calcium tungsten shall not be used.
4. For each weld found to be defective two additional welds made by the same welder who produced the defective weld will be subjected to radiographic examination. These additional examinations will be made immediately after the defective welds is found and are in addition to the minimum examination requirements for the line class as specified in the drawings or specifications.
5. Weld repairs shall be re-examined by the same method used to detect the original defect.

### PP2.6. NDT Procedure

Contractor shall prepare NDT Procedures covering all aspects of the work. NDT Procedures shall be submitted to the Company representative for review and approval. Written NDT Procedures shall be qualified as per the requirements of ASME Sec. V, in the presence of Company representative. Qualification of the NDT procedures shall be required before NDT can be performed on production welds.

#### A. Piping

NDT Procedures shall be prepared as per the requirements of ASME B31.3, ASME Section V and the applicable ASME Code Cases.

#### B. Pressure Vessels

NDT Procedures shall be prepared as per the requirements of ASME BPVC Sec. VIII Div.1 and ASME Sec. V



## PP2.7. Extent of NDT Coverage

### A. Piping

- I. Random radiography (10%) shall be performed covering on one weld in each 10 welds for each welder on the following:
  1. Water ( in case of carbon steel)
  2. Air
  3. Chemical
  4. Diesel
  5. Closed & Open drain
  6. Relief
  7. Hydraulic Oil
  8. Oily water
  9. Glycol & Thermoil
  10. Vent gas
  11. Lube oil & Seal oil
- II. 100% Radiography shall be performed on size 2" and above and 10% on below 2" for the following:
  1. Crude oil
  2. Jet fuel
  3. Fuel gas / instrument gas
  4. Process gas
  5. Production flow lines ( well fluid)
  6. Injection water
  7. Hydrocarbon (process)
  8. Water ( in case of 90/10 Cu-Ni)
  9. H.P. and L.P. Flare lines.
  10. Piping system not covered under any of the above services
- III. For fillet welds and brazed joints where carrying out radiography is not possible, magnetic particle test or dye penetrant test shall be carried out. The extent of inspection shall remain same as for radiography.

All the lines which are stress relieved or have design pressure more than 50 Kg/ cm<sup>2</sup> shall be radiographed for 100% of weld joints even if not required as per I to III

Field welded joints, which cannot be leak tested due to unavoidable circumstances & reasons shall be 100 % examined by RT and MPI/LPT.



In addition to the requirements mentioned above, for welded joints of NACE material, 100 % hardness test shall also be carried out.

Welds, which cannot be radiographed because of their location, inaccessibility, excessive & impractical radiographic exposure time required or due to safety reasons, can be examined by ultrasonic and / or liquid penetrant / magnetic particle method as applicable with permission from Company. The extent of inspection shall be the same as for radiography

## B. Pressure Vessels

NDT Coverage shall be as per the requirements given in ASME BPVC Sec.VIII Div.I and the design documents.

### PP2.8. NDT Operator

NDT Operator Qualification & experience records shall be submitted for Company's review. NDT Operators shall be minimum Level II qualified, PCN qualification is preferred. Skill levels of NDT Operators shall be further examined by Company through practical mock tests & written examination. Contractor shall make necessary arrangements for the same with no additional cost to Company.

### PP2.9. Advanced UT Techniques

PAUT (Phased Array Ultrasonic Testing) can be used for the examination of CS & CS NACE piping welded joints with thickness beyond 10 mm for which separate permission from Company is not required. However *"Project specific procedure qualification" to be witnessed by ONGC/CA/TPI for the 1<sup>st</sup> time during start of NDT techniques..*

The permission to use PAUT will be subject to satisfying the following conditions:

1. Past track record of the agency performing PAUT shall be submitted for Company's review and approval.
2. Written PAUT Procedure shall be prepared as per the applicable code and shall be submitted for Company's review and approval.
3. PAUT Procedure shall be demonstrated and qualified as per the Code requirements and to the satisfaction of the Company in the presence of Company Representative. During the demonstration, it shall be established that the scanning technique employed covers the entire weld volume and HAZ.
4. NDT Operator Qualification records (minimum level II) including experience in PAUT shall be submitted for Company's review and approval.
5. Skill levels of NDT Operators will be further examined through practical mock tests and written tests. Contractor shall make the necessary arrangements for the same with no additional cost to Company.
6. Familiarisation and interpretation Training on PAUT shall be provided to Company's inspectors as and when required with no cost to ONGC.



7. For any ambiguous indication observed in PAUT, especially in the case of volumetric discontinuities, if ONGC desires, RT of that joint shall be carried out without any additional cost to ONGC.
8. Soft copy of scan data (A-Scan, C-Scan, Sector Scan etc.) of each joint along with the software for viewing the same shall be submitted to ONGC.

## PP2.10. NDT Acceptance Criteria

### A. Piping

Technique	Material	Acceptance Criteria
RT	CS , SS	ASME B31.3
	CS NACE, Cu-Ni	ASME BPVC Sec.VIII Div. I, UW 51
UT	CS, CS NACE	ASME B31.3
PAUT	CS, CS NACE	ASME B31.3 & Code Case 181
MPI	CS, CS NACE	ASME B31.3
LPT	CS, CS NACE, SS, Cu-Ni	ASME B31.3

- a. Internal weld protrusion in pigged lines shall not exceed 1.6 mm.
- b. Orifice flange butt weld shall be internally ground smooth and flush.

### B. Pressure Vessels:

ASME BPVC Sec. VIII Div.1

## PP2.11. Heat Treatment

1. Preheat and post-weld heat treatment (PWHT) shall be in accordance with ASME B 31.3, ASME B31.4, ASME B31.8 or ASME BPVC Sec.VIII, Div.I, as applicable.
2. The method and equipment used in heat treatment shall be acceptable to the Company.
3. All threaded connections shall be protected from oxidation during heat treatment and be chased or gauge checked after heat treatment.
4. Exposed machined and threaded surfaces shall be protected from oxidation during heat treatment.
5. Cleaning of pipe work after fabrication and heat treatment shall be performed, externally and internally to remove all loose scale, weld spatter, sand and other foreign materials.



6. For all welds requiring PWHT, the specified inspection and NDT shall be performed after completion of PWHT process but not before the welds have cooled to ambient temperature. NDT prior to PWHT, performed in addition to mandatory NDT following PWHT, shall be at the discretion of the Contractor. However, where defects requiring repair are located by this inspection, it shall be brought to the notice of Company.
7. Machined surfaces shall be protected by a suitable paint or compound to prevent damage from scaling during PWHT.
8. After final heat treatment, the Contractor shall identify the piping as having received PWHT. The method of identification shall be recorded on the as-built isometric and P&ID together with the other recorded information.
9. A legible heat treatment chart shall be provided to the Company. This chart must show the rate of increase of temperature, the holding temperature and time and the rate of decrease of temperature.

## PP2.12. Repair Welding

If the company representative considers a weld to be grossly defective, it shall be cut out and the joint re-welded and all costs associated therewith shall be the Contractor's responsibility.

Mechanical defects such as scratches and gouges may be ground smooth provided the depth of the defect does not exceed 10% of the nominal wall thickness of the pipe.

Repair welding shall only be carried out in accordance with an approved repair procedure. Minimum Pre-heat for repair welding shall be 50<sup>0</sup> C more than that used for production welding.

After gouging to remove the defects, the area shall be ground smooth and shall be examined with MPI to ensure that the entire defect has been removed. LPT shall be used for non-ferromagnetic materials. As a minimum, completed repairs shall be examined by the same NDT methods used for the original weld.

Only two times repairs are allowed on any welded joint.

Dents or grooves whose depth is greater than 10% of the nominal pipe wall thickness shall be removed by cutting out and replacing that length of pipe in which the defect occurs. The minimum length of a cutout shall be four times the nominal diameter or 150 mm, whichever is the lesser.

Internal weld metal projecting into the pipe on weld neck orifice flanges shall be removed and ground smooth with the pipe.



## ST3.0. STRUCTURAL

### ST3.1. Codes & Standards

The following Codes shall be the minimum acceptable standards for welding and inspection during Structural Fabrication. The latest edition, addenda, and supplement available at the time of bidding will be used. Any part of any other non-listed code referred to in these listed codes as augmentation is to be considered applicable.

AWS D1.1	Structural Welding Code - Steel
AWS D1.3	Structural Welding Code – Sheet Steel
AWS A2.4	Standard Symbols for Welding, Brazing and Nondestructive Examination.
AISC	Manual of Steel Construction – Allowable Stress Design. Specification for Structural Steel Buildings
API RP 2A	Recommended Practice for Planning, Designing and Constructing fixed Offshore Platforms – Working Stress Design
API Spec. 2B	Specification for Fabricated Structural Steel Pipe
API RP 2X	Recommended Practice for Ultrasonic & Magnetic Particle Examination of Offshore Structural Fabrication and Guidelines for Qualification of Ultrasonic Technicians
ASME BPVC Sec. V	Nondestructive Examination
ASME Sec. II, Part C	Specification for Welding Rods, Electrodes and Filler Metals
ASTM E164	Standard Practice for Contact Ultrasonic Testing of Weldments
ASTM E165	Practice for Liquid Penetrant Inspection Methods
ASTM E709	Practice for Magnetic Particle Examination
ASTM E94	Standard Guide for Radiographic Examination
ASTM E384	Standard Test Method for Knoop and Vickers Hardness of Materials
BS7448	Fracture Mechanics Toughness Tests
EEMUA158	Construction Specification for Fixed Offshore Structures in the North Sea
ASNT SNT-TC-1A	Personnel Qualification and Certification in Nondestructive Testing
ISO 14731	Welding Coordination – Tasks and Responsibilities



### ST3.2. Welding Processes

Only Gas Metal Arc (GMAW), Gas Tungsten Arc (GTAW), Submerged Arc (SAW), Shielded Metal Arc (SMAW), or Flux Cored Arc (FCAW) welding process shall be used for production welding. Other welding processes shall not be used. Automatic stud welding machines can be used for welding of studs to steel (for fixing insulation etc.).

Use of GMAW process shall be limited to the following:

- a) GMAW welding shall not be exposed to air drafts greater than 8 Km/h.
- b) GMAW-S can be used for groove welds in materials 10 mm or less using a procedure qualified by the contractor.
- c) GMAW-S can be used for fillet welds of 20 mm or less
- d) GMAW-S may be used for the root pass only in combination with SAW welding, and for the root pass in non-critical joint applications.
- e) Spray transfer mode of metal deposition for GMAW is limited to the flat position. f)

Weld areas shall be blasted or ground to white metal prior to welding when GMAW or GMAW-S is used.

**Use of FCAW process shall be limited** to the following:

- a) FCAW welding with external gas shielding shall not be exposed to air drafts greater than 8 Km/h.
- b) Electrode diameters greater than 3 mm are not acceptable.
- c) Self – shielded flux core shall not be used as root or fill pass beneath other processes.
- d) *FCAW welding shall not be used at any case for piping & structural welding during installation or otherwise in offshore environment.”*

### ST3.3. Weld Procedure Qualification & Documentation

The Contractor shall not commence production welding until appropriately qualified welding procedures have been accepted by the Company. All weld procedures to be utilized on this project shall be qualified.





Welding procedures shall be qualified in accordance with AWS D1.1 Structural Welding Code – Steel, except as modified by this specification: The essential variable list of all welding processes shall be increased to include any change in the manufacturing process for the base metal, i.e. separate procedures are required for As Rolled, Controlled Rolled, Normalized, Quench & Tempered or TMCP steel.

Welding of thin sheet shall be as per AWS D1.3 – Structural Welding Code – Sheet Steel.

Unless otherwise specified, all welds shall be full penetration multi-pass welds.

Draft / Proposed WPS shall be agreed with the Company prior to the commencement of procedure qualification.

*The applicable WPQT (Welding Procedure Qualification Testing) was done in last 2 years for ONGC Job dated with effect from date of starting fabrication. If it is not of ONGC project, it shall be fresh WPQT for project specific.”*

Such previously qualified welding procedures may be considered for Structural Welding where they comply with the present document and are appropriate to the scope of work. These WPSs should have been qualified by the same Contractor in the presence of reputed TPI agencies. New, project specific WPS shall be prepared using the old WPQTs as explained above of earlier qualified WPSs as supporting documents. In this exercise, good engineering practice & AWS D1.1 guidelines shall be followed and using PQRs in an arbitrary manner to support a new WPS will not be acceptable.

In addition to the testing requirements specified in AWS D1.1 following tests as applicable shall also be carried out during WPS qualification.

#### A. Hardness Testing

Welding procedure qualification shall include a hardness traverse of the HAZ, Weld Metal and base metal.

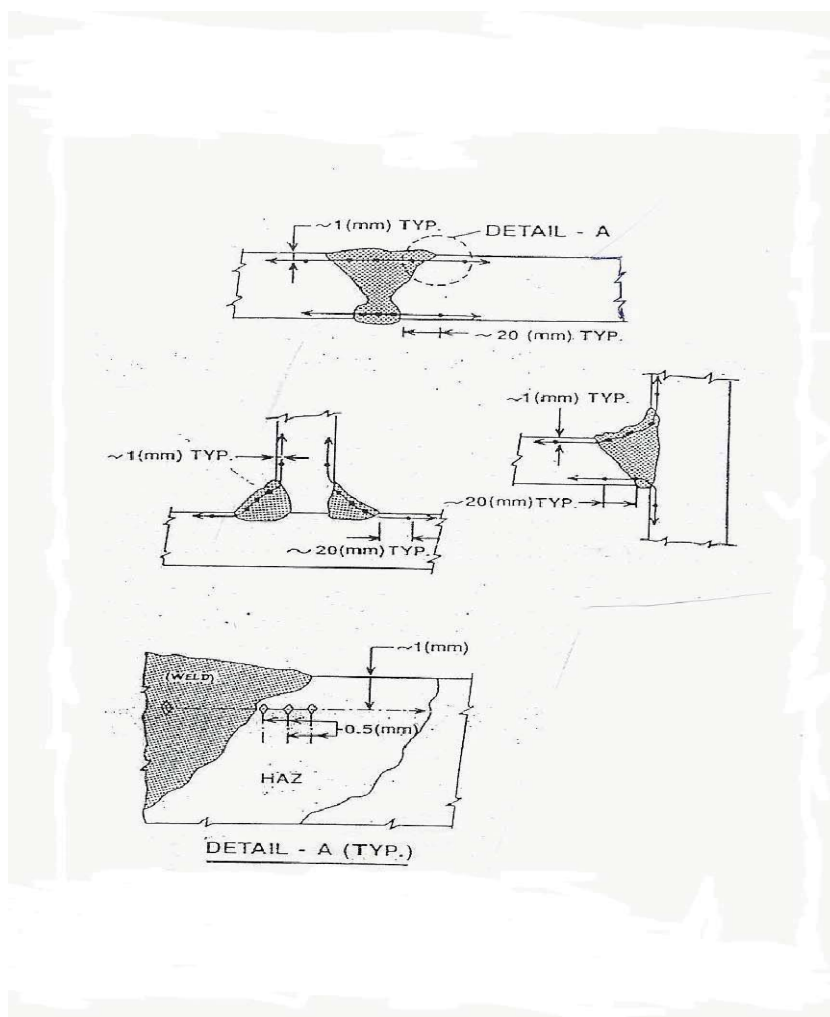
1. Hardness testing shall be performed along the transverse shown in Fig. 1.
2. The required hardness survey shall be tested on a suitable macro section machined from the same welded test assembly made to determine other weld joint properties.
3. The hardness surveys shall be prepared and tested in accordance with ASTM E 384, Standard Test Method for Knoop and Vickers Hardness (Hv) of Materials, using an applied load of 10 kgf.
4. Indentations shall be made along all of the transverses shown for each type of weld tested, approximately 1 mm below the surface of the base metal. In the weld metal, a minimum of three equally spaced indentations along the traverse shall be made. In the heat-affected zone, the indentations shall start as close to the fusion line as practicable. A minimum of three readings shall be taken at





each weld toe. One additional reading shall be taken at least 20 mm from the fusion line at each traverse to represent unaffected base metal.

5. The maximum hardness value obtained from any indentation shall not exceed 350 Hv. If any single value exceeds 350 Hv and a retest adjacent to the failed test also produces one or more values exceeding 350 Hv, the procedure qualification test has failed these requirements and a new test weld shall be made with some planned modifications of essential variables or techniques (change heat input, increase preheat, later bead sequence, etc.) and retest.
6. A photomicrograph of the hardness test section shall be included in the PQR clearly showing the hardness impressions.





### B. Impact Testing

All groove welding procedure qualifications for Class A and Class B steels shall include Charpy V-notch impact testing of the deposited weld metal and the heat affected zone (HAZ). Locations for the weld and HAZ specimens shall be generally as shown in AWS D1.1, except that three sets of HAZ specimens shall be located at: (1) the fusion line (FL) (2); a position 2.0 mm into the HAZ from the fusion line (FL+2mm); and (3) a position 5.0 mm into the HAZ from the fusion line (FL+5mm). An additional set of specimens shall also be taken from the location centred within the root pass of the weld. For acceptance the average impact energy shall meet the minimum requirement of the relevant Specification with no single value more than 6.5J lower than the average requirement. When different classes of material are to be joined the required energy level is equal to that of the lower class joined. Testing temperature shall be -10°C.

### C. CTOD Testing

CTOD testing may be used to justify an increase in the maximum thickness of material that can be welded without the application of PWHT as defined elsewhere in this Spec.

CTOD testing shall be carried out as per BS 7448/ISO15653. Each set of CTOD tests shall comprise a minimum of three valid specimens.

CTOD testing is required on full penetration test welds representing the maximum thickness of materials that are to be welded by any single process or combination of processes.

Separate tests are required to qualify single and double sided preparation.

The steel selected for performance of the test programme shall have minimum Carbon Equivalent not less than 0.02 of the maximum CE value to be used on the project. All test plates shall be welded using heat inputs representative of the highest to be used during production welding.

For each test the least values of  $\delta_c$ ,  $\delta_u$  or  $\delta_m$  shall be greater than or equal to 0.20mm when tested at 0°C unless specified otherwise in the relevant drawings.

### Heat Input

Charpy qualification of weld deposit and HAZ is valid only for welding procedures with heat inputs maintained within  $\pm 25\%$  of the tested weld. This may require more stringent tolerance on travel, speed, voltage and amperage.



In similar fashion the inter pass temperature is limited to that actually achieved and sustained during the procedure test.

### ST3.4. Welder & Welding Operator Qualification

Welders shall be qualified as per AWS D1.1 Structural Welding Code – Steel. All welder qualification must have been performed on the entire weld thickness. ‘Tack Welders’ or ‘Fillet Welders’ partial qualification is not allowed. Qualification on production welds shall not be allowed.

### ST3.5. Production Welding

1. **Chill rings and backing strips** can provide improved root beads on single sides welds. Their use, however is prohibited as they may cause fatigue crack initiation.
2. Unless otherwise specified, all welds shall be **full penetration multi-pass welds**. Full Penetration Welds shall be used for built-up-girders.
3. **All faying surfaces shall be seal welded.**
4. Welding shall proceed in a manner that **minimizes residual stresses or distortions**. The Contractor shall be responsible for preventing or correcting distortions. If excessive distortion becomes evident, corrective methods shall be applied as agreed with the Company Representative.
5. Welds shall **not be quenched or cooled other than by contact with the natural atmosphere**. Welds shall be protected from rapid cooling caused by rain, wind, or other inclement weather.
6. **Gas shielded welding processes (eg. FCAW, GTAW and GMAW), when used outdoor shall be provided with proper wind protection.**
7. **Pre-heat requirements**  
Welding pre-heat shall be as specified in the Qualified Welding Procedure, but shall not be less than as specified in AWS D1.1 (Table 3.2). The guidelines given in Appendix XI of AWS D1.1 shall also be taken into account and adopted as appropriate.  
If any metal is damp or less than 10°C, a minimum preheat of 38°C shall be required regardless of thickness.



Preheating shall be carried out by using Oxy-fuel bulbous type torches, induction or electric resistance heating. Oxy-Acetylene cutting torches shall under no circumstances be used for preheat application.

8. **Inter – pass temperature**

The temperature of previously deposited weld metal and surrounding base metal within 75 mm of each side of the weld and throughout the wall thickness shall meet the following requirements prior to depositing subsequent beads

Minimum – Not less than the specified pre heat.

Maximum - 200°C or the maximum sustained and documented during procedure qualification, not to exceed 260°C.

9. **Arc Strikes and Temporary Attachments**

Arc strikes shall be ground out and repaired. After repair, MPI shall be carried out. Temporary attachments shall be removed by grinding or by using Oxy – Acetylene torch to 3 mm above permanent material surface, removal of the remaining 3mm shall be by grinding, followed by MPI / DPI. Company may require an ultrasonic check to establish that the remaining wall thickness is not less than the design minimum. Arc air gouging, hammering or other mechanical means shall not be used for the removal of temporary attachments.

10. **Post Weld Heat Treatment**

PWHT shall be required in the following circumstances or when shown on the design drawings:

- a) When fabricating tubulars with d/t ratios less than 20.
- b) For nodal joints where the minimum throat thickness exceeds 40mm. c)
- For other areas where the minimum throat thickness exceeds 50mm.

*PWHT shall be carried out for all above three cases individually for Onshore-Yard fabrication in compliance to ST 3.5-point no.11. PWHT shall be carried out for all type of non-TMCP steel. For any special steel as specified by steel manufacturer and approved by ONGC for obviating PWHT with CTOD may be considered.*

*However PWHT is waved off for welding during installation phase at offshore and CTOD shall be carried out with qualified PQR (fresh) per every new project & subsequent WPS (fresh) is required for structural welding. In this case (offshore) the Fracture Mechanics Assessment ( FMA ) , its ( FMA ) separate report, Crack Tip Opening Displacement (CTOD) method and its ( CTOD ) test report , as per BS 7448/ISO15653 shall be used to obviate the requirement for PWHT (as for all applicable cases separately for b & c only).*

**Fracture Mechanics Assessment Report and CTOD, as per BS 7448/ISO15653** may be used to obviate the requirement for PWHT (as per b c), if approval in writing is given by the Company. In this case CTOD test shall be carried out during the WPS qualification.

*This entire clause of ST .3.5.10 shall also be applicable for welding jobs with piping.*



#### 11. Criteria for PWHT

All PWHT shall be performed in accordance with AWS D1.1 and the applicable welding procedure qualification.

- The CONTRACTOR shall inform the COMPANY prior to any PWHT operation.
- No welding shall be performed on fabrications subsequent to PWHT.
- PWHT requirements shall be stipulated on the relevant WPS and shall comply with AWS D1.1, Section 5.8. The temperature for PWHT shall be  $600^{\circ}\text{C} \pm 20^{\circ}\text{C}$  unless recommended otherwise by the steel manufacturer.
- For all welds requiring PWHT, the specified inspection and NDT shall be performed after completion of PWHT process but not before the welds have cooled to ambient temperature. NDT prior to PWHT, performed in addition to mandatory NDT following PWHT, shall be at the discretion of the Contractor. However, where defects requiring repair are located by this inspection, it shall be brought to the notice of Company.
- The contractor shall submit a heat treatment procedure for approval by the Company. This procedure shall define heat and cooling rate, holding time at temperature and details of temperature measurement and control methods.
- PWHT temperature/time charts shall be clearly identified and retained for inclusion in the project records.

#### 12. Weld Through Primers

Weld through primers to be used during fabrication are subject to the approval by the Company and shall be included in the weld procedure qualification. During Weld Procedure Qualification, the thickness of weld through primer shall be measured. Any increase in thickness of primer in production shall necessitate re-qualification of the affected WPS.

#### ST3.6. NDT Techniques

NDT Techniques which are to be used for inspection are Visual Inspection, RT, UT and LPT / MPI.

#### ST3.7. NDT Procedures

Contractor shall prepare detailed written NDT Procedures and shall submit the same for Company's review and approval.

Structural	Technique	Specification
Structural General	RT, MPI & LPT	ASME Sec.V & AWS D1.1
Butt & T, K, Y Joints	UT	API RP 2X
UT of Tubular – (Factory Manufactured) Long Seam	UT	ASTM E-273 or ASTM E-164 and AWS D1.1
Butt Joints	Advanced UT System	ASME Sec. V, AWS D1.1 and applicable Code Cases



NDT Procedures including equipments shall be qualified as per the requirements of AWD D1.1, API RP 2X and ASME Sec. V as applicable in the presence of Company representative.

### ST3.8. Extent of NDT Coverage

NDT coverage shall be as per API RP 2A with the following modifications.

#### A. Structural Tubulars

Radiographic Examination shall be performed for the following welds

1. 10 % RT of Longitudinal Weld Seams (L)
2. 100 % RT of all girth welds in tubular - Circumferential Weld Seams (C)
3. 100 % RT of Intersection of long seams (L) and Circumferential Seams (C)

Inspection requirement for mill fabricated structural tubular, who are authorized to put API monogram, shall be as per the applicable code (like API 2B).

#### B. Tubular Joints:

1. 100 % UT & MPI of Major brace to chord welding.
2. 100% UT & MPI of Major brace to brace welding.
3. Before fit-up, UT Lamination check shall be carried out on the area of the chord where bracing will be welded to ensure that the area is free from laminations.

#### C. Miscellaneous Bracing

1. 10% UT & MPI of Conductor Guide Bracing
2. 10% UT & MPI of secondary bracing and subassemblies, i.e., splash zone and / or mudline secondary bracing, boat landing etc.
3. 100% UT & MPI of attachment weld connecting secondary bracing / sub assemblies to main members

#### D. Deck Members

1. 100 % RT of all primary full penetration welds like splices in main skid beams, main truss beams and deck beams.
2. 10 % RT of all secondary full penetration welds including secondary deck beams.
3. 100 % Visual & MPI of all partial penetration welds including fillet welds.





Chevron / Transverse crack check using UT is required for primary steel with thickness > 25 mm welded using SAW process. Scanning shall be carried out along the weld cap.

100% UT and / MPI shall be carried out on all welds in built-up girders.

Notes:

1. Partial inspection should be conducted as 10 percent of each piece, not 100 percent of 10 percent of the number of pieces. Partial inspection should include a minimum of three segments randomly selected unless specific problems are known or suspected to exist. All suspect areas (e.g., areas of tack welds) shall be included in the areas to be inspected. If rejectable flaws are found from such 10% inspection, additional inspection should be performed until the extent of rejects has been determined and the cause corrected.
2. Welds, which cannot be radiographed because of their location, geometry, inaccessibility, excessive & impractical radiographic exposure time required or due to safety reasons, can be examined by ultrasonic and / or liquid penetrant / magnetic particle method as applicable with permission from Company. The extent of inspection shall be the same as for radiography

### ST3.9. NDT Acceptance Criteria

Technique	Acceptance Criteria
RT	AWS D1.1
UT – Butt & TKY Joints	API RP 2X Level C
UT – Long Seam of Mill Fabricated Tubular	API RP 2X Level A

### ST3.10. NDT Operator

NDT Operator Qualification & experience records shall be submitted for Company's review. NDT Operators shall be minimum Level II qualified, PCN qualification is preferred. NDT Operators doing examination of TKY joints should have previous verifiable experience in similar job. Skill levels of NDT Operators will be further examined through practical mock tests & written examination. Contractor shall make necessary arrangements for the same with no additional cost to Company.

### ST3.11. Advanced Ultrasonic Systems

**Phased Array UT (PAUT)/TOFD** shall be used where the thickness is beyond 19 mm, for which permission is not required from Company. However *The PAUT/TOFD used shall satisfy the following conditions which has to be established by the NDT agency during the "Project specific procedure qualification" to be witnessed by ONGC/CA/TPI for the 1<sup>st</sup> time during start of NDT techniques.*

The **PAUT/TOFD** will be used subject to satisfying the following conditions:

1. Past track record of the agency performing PAUT / TOFD shall be submitted for Company's review and approval.



2. Written UT Procedure shall be prepared as per the applicable code and shall be submitted for Company's review and approval.
3. PAUT / TOFD Procedure shall be demonstrated and qualified as per the Code requirements and to the satisfaction of the Company in the presence of Company Representative. During the demonstration, it shall be established that the scanning technique employed covers the entire weld volume and HAZ.
4. NDT Operator Qualification records (minimum level II) including experience in PAUT / TOFD shall be submitted for Company's review and approval.
5. Skill levels of NDT Operators will be further examined through practical mock tests and written tests. Contractor shall make the necessary arrangements for the same with no additional cost to Company.
6. Familiarisation & interpretation Training on PAUT / TOFD shall be provided to Company's inspectors as and when required with no cost to ONGC.
7. For any ambiguous indication observed in PAUT / TOFD, especially in the case of volumetric discontinuities, if ONGC desires, RT of that joint shall be carried out without any additional cost to ONGC.
8. Soft copy of scan data (A-Scan, C-Scan, Sector Scan etc.) of each joint along with the software for viewing the same shall be submitted to ONGC.

#### **ST3.12. NDT Waiting Period**

NDT of primary structural welded members should generally be carried out 24 hrs after completion of welding.

#### **ST3.13. Inspection of Low Fatigue Joints**

All low fatigue joints shall be inspected for acceptance to required profile and toe grinding shall be performed, if required.

Disk test shall be performed as mentioned in AWS D1.1.

#### **ST3.14. Repair Welding**

Repair welding shall be performed strictly in accordance with the qualified repair welding procedure.

##### Removal of Defects





Removal of defects for repair may be by any of the following methods: machining, grinding, chipping, or air carbon arc gouging. The method shall produce a clean uncontaminated surface for installation of the repair weld.

Gouging

Oxygen gouging shall not be used in quenched and tempered, normalized or TMCP steels. All gouges shall be ground, power wire brushed, or grit blasted to remove all traces of residual carbon and oxidation.

After gouging to remove the defects, the area shall be ground smooth and shall be examined with LPT to ensure that the entire defect has been removed.

Completed repairs shall be examined by the same NDT methods used for the original weld

Only two times repairs are allowed on any joint.



## PL4.0. SUBSEA PIPELINE SYSTEM

### PL4.1. Codes & Standards

The following Codes shall be the minimum acceptable standards for subsea pipeline welding and inspection. The latest edition, addenda, code cases and supplement available at the time of bidding will be used. Any part of any other non-listed code referred to in these listed codes as augmentation is to be considered applicable.

DNV OS F101	Submarine Pipeline System
BS 7910	Guide to methods for assessing the acceptability of flaws in metallic structures
ASTM E1961	Standard Practice for Mechanized Ultrasonic Testing of Girth Welds Using Zonal Discrimination with Focused Search Units
AWS A2.4	Standard Symbols for Welding, Brazing and Nondestructive Examination.
NACE MR0175	Standard Material Requirements - Metals for Sulfide Stress Cracking and Stress Corrosion Cracking Resistance in Sour Oilfield Environments
NACE TM0284	Standard Test Method - Evaluation of Pipeline and Pressure Vessel Steels for Resistance to Hydrogen-Induced Cracking
NACE TM0177	Standard Test Method - Laboratory Testing of Metals for Resistance to Sulfide Stress Cracking and Stress Corrosion Cracking in H <sub>2</sub> S Environments
ASME BPVC Sec. V	Nondestructive Examination
ASME Sec. II, Part C	Specification for Welding Rods, Electrodes and Filler Metals
ASTM E164	Standard Practice for Contact Ultrasonic Testing of Weldments
ASTM E165	Practice for Liquid Penetrant Inspection Methods
ASTM E709	Practice for Magnetic Particle Examination
ASTM E94	Standard Guide for Radiographic Examination
ASTM E384	Standard Test Method for Knoop and Vickers Hardness of Materials
ISO 14731	Welding Coordination – Tasks and Responsibilities
ASNT SNT-TC-1A	Personnel Qualification and Certification in Nondestructive Testing

### PL4.2. Welding Processes

Various welding processes as given in DNV-OS-F101 can be used for production welding. If the contractor propose to use mechanized welding process, a complete description of the process including examples of previously qualified welding procedures and subsea pipeline



projects completed using proposed process shall be submitted for Company's review and approval. Mechanised and Automatic welding systems shall be subject to a detailed pre-qualification programme or documentation before they may be used. The extent and the contents of a pre-qualification programme for such mechanised welding systems shall be agreed before start up. The Contractor shall prove and document that the welding systems are reliable and that the process can be continuously monitored and controlled.

### PL4.3. Welding Consumables

Welding consumables and welding processes shall give a diffusible hydrogen content of maximum 5ml / 100g of weld metal.

Cellulose coated electrodes may be used only subject to agreement for welding of Pipeline Girth welds in CS Line pipe with SMYS  $\leq 450$  MPa. If used, the delay between completion of root pass and the deposition of hot pass shall be simulated during welding procedure qualification. If the use of cellulosic electrode has been agreed, the following additional requirements shall apply:

1. Pre-heat shall be minimum  $100^{\circ}\text{C}$ .
2. Delay between the completion of root pass and the start of depositing the hot pass shall be minimum 6 minutes.
3. Immediately upon completion of welding during welding procedure qualification, the test pieces shall be water quenched as soon as the temperature of the test piece is below  $300^{\circ}\text{C}$ .
4. Non destructive testing of the test pieces shall be by Automated Ultrasonic Testing (AUT) or by Radiographic Testing and Manual Ultrasonic Testing.

Low Hydrogen Electrodes with uphill techniques shall be used for all repairs, when external lineup clamp is used, tie-in, special crossings and **fillet welds**.

### PL4.4 Welding Procedure Qualification

Welding Procedure shall be qualified as per DNV-OS-F101(Submarine Pipeline Systems) except as modified by this specification. Previously qualified welding procedures are not acceptable. However, for welding of CS & CS NACE Line Pipes (Girth welds) of SMYS < 450 MPa, WPS for new production job may be based on a previously qualified WPQR (Welding Procedure Qualification Record) provided

- a. The applicable WPQT (Welding Procedure Qualification Testing) was done in last 2 years for ONGC Job dated with effect from date of starting fabrication. If it is not of ONGC project, it shall be fresh WPQT for project specific.
- b. WPQT was witnessed by a reputed TPI agency.
- c. Meet all the requirements of this specification and DNV-OS-F101.
- d. Match all the essential parameters as given in DNV-OS-F101.
- e. Written approval shall be obtained from Company.

For new WPS, the contractor shall first submit the Preliminary WPS (pWPS) for Company's review and approval. The pWPS shall contain all the relevant information required for the applicable welding process, as given in Clause D700 of DNV-OS-F101. After getting the approval of pWPS, the contractor can go ahead with the WPS qualification as per the requirements given in



DNV-OS-F101. Qualification welding shall be performed using the type of welding equipment to be used for production welding and under conditions that are representative of the actual working environment for the work (for WPSs to be used on pipelay barges, qualification welding has to be carried out on floating vessels / barges).

WPS qualification shall be witnessed by Company Representative and a reputed TPI agency.

Repair welding procedure shall be qualified separately. Pre-heat for repair welding shall be minimum 50°C above the minimum specified pre-heat for production welding. Re-repair welding procedure shall also be qualified separately.

*In case of riser line, as it is considered part of pipeline, this WPQT & WPS is applicable till the flange joint of shutdown valve or launcher whichever is earlier. In case, this riser line is prefabricated in yard, the same WPQT & WPS is applicable. However internal/external line clamp may not be required as mentioned in clause PL4.6.”*

#### **PL4.5. Welder and Welding Operator Qualification**

Welders and Welding Operators shall be qualified as per the requirements of DNV-OS-F101 in the presence of Company Representative and a reputed TPI agency. Welders shall be qualified under conditions that are representative of the actual working environment. (Pipeline welders shall be qualified on floating vessel / barge)

#### **PL4.6. Production Welding**

The type of welding Equipment and Welding Procedure shall be qualified prior to the start of installation welding.

Internal line-up clamp shall be used for pipeline of size 6” and above. Internal lineup clamp shall remain in place at least until the root pass is completed around the full circumference.

External lineup clamp shall not be removed until a minimum of 50% of root pass, uniformly spaced around the circumference, has been completed.

Arc strikes – arc shall be struck only on fusion faces and not on other areas of the pipe.

The pipelay barge shall not be moved before the first hot pass is completed.

#### **PL4.7. Non Destructive Testing**

The extent of NDT for installation girth welds shall be 100% Automated Ultrasonic Testing (AUT) or Radiographic Testing. Radiography shall be carried out using X-ray with panoramic exposure. Gama ray may be used in case of inaccessible joints with approval of ONGC ( with submission of specific joint details & with AFC).

For wall thickness > 25 mm, AUT should be used. For >25mm, if RT is used, it shall be supplemented with Ultrasonic Testing.

While using GMAW (like mechainsed or semi-automatic welding) or FCAW welding process, AUT is the preferred NDT technique.



100% Ultrasonic Testing of first 10 welds shall be carried out while using GMAW or FCAW processes, when starting installation or when resuming production after suspension of welding and when radiographic testing is the primary NDT technique. If Ultrasonic Testing reveals defects not discovered by radiography, the extent of Ultrasonic Testing shall be 100% for the next 10 welds. If the results of this extended testing are unsatisfactory, the welding shall be suspended until the causes of the defects have been established and rectified.

UT lamination check shall be carried out on 50 mm wide band at the flame cut pipe ends.

For "Golden Welds" (critical welds e.g. tie-in welds that will not be subject to pressure testing, etc.) 100% ultrasonic testing, 100% radiographic testing, and 100% magnetic particle testing or 100% liquid penetrant testing of non-ferromagnetic materials shall be performed. If the ultrasonic testing is performed as automated ultrasonic testing, the radiographic and magnetic particle/liquid penetrant testing may be omitted subject to agreement.

Prior to commencement of WPS qualification, contractor shall prepare and submit NDT Procedures (RT, MPI, LPT, UT/AUT) for Company's review and approval.

NDT Procedures, Equipment qualification and Acceptance Criteria shall be as per the requirements given in Appendix D of DNV-OS-F101.

AUT Procedures, Equipment and qualification for AUT shall be as per the requirements given in Appendix E of DNV-OS-F101. Defect Acceptance Criteria shall be arrived at using ECA. AUT

shall be performed in accordance with DNV-OS-F101 Appendix E and ASTM E1961.

If the Contractor proposes to use AUT, the contractor shall arrange familiarization and interpretation training on AUT for Company inspectors as and when required without any additional cost to Company

If using AUT, Contractor shall carry out ECA to arrive at weld acceptability criteria which is subject to approval by Company. As a minimum, requirements of Appendix A of DNV-OS-F101 shall be met. Details of laboratory / agency performing ECA shall be submitted to Company for review and acceptance. The agency should have skilled personnel and previous experience to carry out ECA as per BS 7910 requirements.

The effectiveness of the AUT Procedure shall be demonstrated by a qualification programme in accordance with DNV-OS-F-101, Appendix E, Section H. The AUT system must demonstrate the ability to detect and accurately size length and vertical height of indications with a resolution compatible with the applicable acceptance criteria.

NDT Operators shall be qualified and certified in accordance with the requirements of Level II of the latest edition of SNT-TC-1A or equivalent PCN or CSWIP Level II.



Additionally, AUT operators shall have received a sufficient level of training of Automated Ultrasonic Testing, including practical and theoretical aspects applicable to the equipment and configuration to be examined. This training shall be documented and will be verified by the Company.

#### PL4.8. Repair Welding

Repair welding shall be performed in accordance with a qualified repair welding procedure. After grinding / gouging, Magnetic particle testing or liquid penetrant testing of non-ferromagnetic materials shall be performed to verify complete removal of defects before commencing weld repairs.

Pre-heat for repair welding shall be 50<sup>0</sup> C more than that used for production welding.

Only two times repairs are allowed on any joint.

If the repair welding station is after the pipe tensioner, a weld repair analysis shall be carried out.

The analysis shall determine the maximum allowable excavation length and depth combinations taking in to account all stresses acting at the area of the repair. The weld repair analysis shall be subject to agreement.

#### PL4.9. Other Materials

For materials other than CS & CS NACE, contractor shall prepare various procedures like WPS, NDT etc. and shall submit for Company's review and approval.

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Offshore Design Section  
Engineering Services  
ISO – 9001:2008

**FUNCTIONAL  
SPECIFICATION FOR  
Welding of Duplex Stainless  
Steel**

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## ANNEXURE I

# WELDING OF DUPLEX STAINLESS STEEL

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PREPARED / REVISED BY	REVIEWED BY	APPROVED BY			



## WELDING SPECIFICATION FOR DUPLEX STAINLESS STEELS

### 1.0 WELDING PROCESS

Shielded Metal Arc Welding (SHAW), Gas Tungsten Arc Welding (GTAW), Submerged Arc Welding (SAW) and Plasma Arc Welding (PAW) processes are suitable for Duplex stainless steel. These Welding methods along with the related operational precautions such as cleanliness and protective gas shielding should be used for making duplex stainless steel welds. Shielding / purging gases shall be selected ensuring freedom from hydrogen.

### 2.0 MICROSTRUCTURE

The ferrite content of the weld metal estimated through metallographic examination, should be between 30% to 55% to obtain weld joints with the best ductility and corrosion resistance. The filler metal composition and the welding heat input should be so selected as to give the ferrite content of the weld metal between 30% to 55%.

### 3.0 FILLER METALS (Welding Consumables)


Table 1 enclosed herewith tentatively lists the different filler metals used for duplex stainless steels conforming to UNS S 31803. Welding consumables shall be used only after conducting consumable qualification tests. Consumables shall be degreased or baked and stored in accordance with the manufacturer's recommendations.

### 4.0 MECHANICAL PROPERTY REQUIREMENTS

The weld metal should have the following mechanical properties :

- |     |                                       |   |                                                                 |
|-----|---------------------------------------|---|-----------------------------------------------------------------|
| 4.1 | Tensile Strength                      | - | 680 – 880 N/mm <sup>2</sup>                                     |
| 4.2 | Yield Strength<br>(0.2% Offset)       | - | 450 N/mm <sup>2</sup> (Min.)                                    |
| 4.3 | Elongation                            | - | 25% (Min.)                                                      |
| 4.4 | Impact Energy (Charpy V-notch Valves) |   |                                                                 |
|     | At + 20°C (68°F)                      | - | 100 Joules Average (72 ft. lb)<br>75 Joules Average (54 ft. lb) |



	<b>Offshore Design Section Engineering Services ISO – 9001:2008</b>	<b>FUNCTIONAL SPECIFICATION FOR Welding of Duplex Stainless Steel</b>	<b>Spec. No.</b>	<b>2009F Annex.1</b>
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At –30°C (-22°F) - 60 Joules Average (43.2 ft. lb)  
40 Joules Average (28.8 ft. lb)

## 5.0 QUALIFICATION TESTS

### 5.1 Welding Procedure Qualification Tests

#### 5.1.1 General

Each particular welding procedure shall be specially qualified for the job; no previous test reports shall be recognized as a qualification of the work to be performed. The welding filler metal to be used shall be of a grade, which will yield a weld metal equivalent to that of the base metal. Welding consumables shall be subjected to initial qualification testing and the consumable shall require company's approval. During Procedure Qualification, the heat input for 22% Cr Duplex steels shall be limited to 0.8 – 2.5 KJ/mm. In production welding, the heat input shall not deviate from that qualified by more than +/- 10%. P numbers shall not apply to duplex stainless steels. Each alloy designation shall be separately qualified in accordance with this specification.

#### 5.1.2 Welding consumable qualification tests and welding procedure qualification tests shall be conducted before the start of procurement by employing an approved welding procedure in presence of the Company's Representative. The welding procedure shall be prepared by the Contractor based on the information provided by the Supplier of raw materials and/or electrodes Supplier and approved by the Company. Welding procedure shall be such that it gives maximum hardness on the outer surface of pipe.

All the mills supplying the raw material/pipes etc. shall be required to pass the tests required for procedure qualification testing. Approved procedure shall be common to all the mills.

Laboratory tests shall be performed at an official Laboratory approved by the Company. Sufficient advance notice shall allow the Company to witness all or part of the tests.

#### 5.1.3 Test Samples

Tests mentioned below shall be performed on welded test pieces and shall include the parent metal, heat affected zone and the weld metal.

#### 5.1.4 Procedure Qualification Tests shall be carried out as given below :

##### i) Chemical Composition and Microstructure Examination

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The ferrite content measurement of test pieces shall be carried out by both the following methods:

- a) Metallographic determination and
- b) Magnegage method (According to Kotecki)

The procedure of ferrite measurement and the calibration of measuring instrument shall bear the approval of the Company before being employed.

ii) Mechanical Properties

These tests shall include tensile testing, impact strength and bend test. Bend tests shall be performed in accordance with ASTM A 370 with a plunger dia equal to 4 times the thickness. No defect shall be visible on bending.

iii) Hardness Tests

Each qualification test shall include a cross sectional hardness survey.

A complete survey of the weld, heat affected zone and the base metal shall be performed according to the following procedure :

- the test method shall be as per ASTM E 18.
- the distance between indentations shall be a maximum of 1 mm.
- The results shall not exceed RC 28.

iv) Corrosion Tests

- a) Intergranular Corrosion Tests (HUEY)

The welds shall be subjected to ASTM A 162 practice C (HUEY Test). Weight loss shall not exceed 3 to 4 mils/month.

- b) Chloride Stress Corrosion Cracking Test.

This type of test shall be conducted on the material at 155° C with aeration in 45% MgCl<sub>2</sub> solution as per ASTM G 36. Stress to



cause repute in 500 hours shall exceed 0.35 times the ultimate tensile strength. This test is required to be done per heat for each mill before start of procurement.

c) SSSC Test

Resistance of the material to SSSC shall be tested using :

- a) NACE TM 01-77 test solution (Test temp. 24 Deg. C). Minimum stress for cracking in 720 Hrs shall be 350 N/mm<sup>2</sup>.
- b) NACE TM 01-77 test solution (test temp. 90 Deg C and total pressure of H<sub>2</sub>S = 16 Bars).

Min. stress for cracking in 720 Hrs = 325 N/mm<sup>2</sup>.

v) Radiography

The welds shall be 100% radio graphed shall be as per ASME, Section – VIII, Division – I, UW – 51.

vi) Dye Penetrant / MP Testing

All fillet and groove welds other than these radio graphed shall be tested by dye penetrant testing or by magnetic particle testing method. No defect shall be accepted.

vii) Heat Treatment (if required)

Suitable heat treatment procedure shall be established for retaining the Duplex S.S. properties of welded joints which shall be approved by the Company before implementing.

## 5.2 Welder Qualification Tests

Welders shall be qualified at the fabrication yard / barge employing the qualified welding procedure. The test pieces of each welder shall be subjected to mechanical tests, radiographic examination, DPT/MP Test, microstructure examination and cross-sectional hardness survey with the same test procedure and acceptance criteria as mentioned in 5.1 above.

## 6.0 FABRICATION



6.1 *No fabrication shall start until the Company has approved the chemistry of the materials, the results of welding procedure qualification tests and welders are qualified as per the approved procedure.*

6.2 Working practices shall be designed to minimize contamination and before welding, internal and external surfaces shall be cleaned for a distance of at least 50mm from the fusion face.

6.2 In production welding the heat input shall be monitored and the same shall not deviate from the qualified WPS by more than +/- 10%.

6.2 Production/Fabrication Tests

Shop/Site Fabrication Tests for each weld shall include :

- Non – destructive hardness tests by portable hardness tester
  - Radiography
  - DPI/MP Examination
  - Ferrite Measurement by either
    - a) Magnegage method (extended range, according to Kotecki)
- OR
- b) Forster Probe Method.



**Offshore Design Section  
Engineering Services  
ISO – 9001:2008**

**FUNCTIONAL  
SPECIFICATION FOR  
Welding of Duplex Stainless  
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<b>Spec. No.</b>	<b>2009F Annex.1</b>
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Procedure	Supplier Commercial Name	Typical Chemical Composition in %	Comments
Plasma auto or Manual	Smitweld SW 4462 (Revised Composition)	C:0.010 Mn:1.6 Si:0.25 P:0.20 S:0.008 Cr:23.0 Ni:8.8 Mo:3.1 N:0.012	Filler metal recommended when as welded
	Thyssen	C:0.016 Mn:1.57 Si:0.17 Cr:22.8 Ni:9.18 N:0.04	Very low nitrogen (traces) ferrite level practically identical to 22-6-31.
	Thermanit 22- 09		Excellent results when welded with nitrogen in welding gas.
SAW	Thyssen Thermanit	C:0.016 Mn:1.57 Si:0.17 Cr:22.8 Ni:9.18 N:0.04	With flux SAP CN 100 – as welded condition gives ferrite range 35-65%
SMAW	Thermanit 22- 09	$C \leq 0.030$ Cr:22.0 to 23.0	
	Sandvik 22-9- 3LR Smitweld Arosta 4462 Philips Rs 22-9- 3LC Avesta 223 FAL-PW	Ni:9 to 10 Mo $\approx$ 3, N:0.10 to 0.15	These electrodes even with low heat input, give welds with specified ferrite range.

# लघु अतटीय संरचना कार्य के लिए मानक विनिर्देश

## STANDARD SPECIFICATION FOR MINOR OFFSHORE STRUCTURAL WORK

3	21/06/2022	Reaffirmed & Re-Issued as Standard Specification	RS	CS	BP	SM
2	06/02/2017	Revised & Issued as Standard Specification	BM	CS	BP	RN
1	22/01/2014	Revised & Issued as Standard Specification	RG	BP	BVK	SC
0	09/05/2008	Issued as Standard Specification	BVK	UVL	VKM	VC
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

**Abbreviations:**

API	:	American Petroleum Institute
ASTM	:	American Society for Testing and Materials
AWS	:	American Welding Society
BS	:	British Standard
Gr	:	Grade
IS	:	Indian Standard
MPI	:	Magnetic Particle Inspection
MS	:	Mild Steel
NDT	:	Non Destructive Testing
OD	:	Outside Diameter
UT	:	Ultrasonic Testing

**Ocean Engineering Standards Committee:**

**Convenor:** Mr. Bhaskar Pal

**Members:** Mr. Charanjit Singh  
Mr. Bhaskar V. Mandalika  
Mr. Kalyan R. Vinjamuri  
Mr. K. Suresh (Construction)



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## **1.0 INTRODUCTION**

This specification covers the requirements for execution of minor structural works on existing offshore structures. The scope of work related to structural works is included elsewhere in the Bid Document.

## **2.0 CONTRACTOR'S RESPONSIBILITIES**

Contractor's responsibilities, besides the scope of work to be performed by him as defined elsewhere, shall include the following:

- 2.1** The contractor shall perform pre-engineering survey of the areas for installations/modifications and obtain the accurate dimensions for fabrication. Any obstructions to performing the installations/ modifications shall also be identified during the survey. Means of overcoming the obstructions and any other modifications to the details shown in the drawings shall be incorporated by the contractor with the approval of the Company.
- 2.2** The contractor shall develop a detailed installation scheme keeping in mind operational requirements of the platform and in consultation with the company. The complete installation scheme and sequence shall be submitted for company's review and approval prior to start of offshore work. Any modification/temporary arrangement, staging and scaffoldings required for installation/erection shall be the contractor's responsibility.
- 2.3** The contractor shall take utmost precaution not to damage any existing structures/facilities during execution. However, the contractor shall be fully responsible for any damage caused to the existing facilities during the entire duration of the execution of the works on platforms. The contractor shall replace with new item(s) or repair any damage caused during the modification works to the satisfaction of the company at no extra time and cost to the company.
- 2.4** Contractor's responsibilities shall also include minor modifications, removal and dismantling of any existing piping, equipment or any other system, with prior approval of company, to facilitate the proposed installation/modification works. The redundant materials shall be delivered and handed over to Company at the specified destinations of Company.
- 2.5** Performing post construction survey and furnishing an as-built report of the works.
- 2.6** Providing all tools, tackles and facilities for inspection and interpretation of testing results by company.
- 2.7** Protection and safety of personnel, structures and facilities.
- 2.8** Clean up of the area, removal of staging, scaffoldings and other temporary installation works.

## **3.0 MATERIAL**

Unless specified elsewhere in the Bid Document the material used for construction shall conform to this specification.

- 3.1** All materials shall be new, without any defects, shall be of standard quality, manufactured/supplied by reputed manufactures.

3.2 If a deviation from these specifications or a substitution of material is sought, the contractor shall submit written request to company for approval along with necessary supporting documents including test results, manufacturer's certificate, etc. prior to execution of job.

3.3 In case of any doubt the Company may ask for any additional information and testing which Company feels necessary. Contractor shall carry out all these tests at no extra time and cost to Company.

### 3.4 Structural Steel

3.4.1 All sections and miscellaneous steel materials shall be free from loose mill scales, rust, oil, mud, paint or other coatings. All materials shall be straight and free from twist.

3.4.2 Unless specified elsewhere in the Bid Document, structural steel shall conform to any of the following grades:

- |      |                                                                    |   |                                                        |
|------|--------------------------------------------------------------------|---|--------------------------------------------------------|
| i)   | Carbon Steel (Nominal Strength)<br>Beams, Plates & rolled sections | - | ASTM-A36 or IS: 2062-Grade-Br or approved equivalent   |
| ii)  | Carbon Steel (High Strength)<br>Beams, Plates & rolled sections    | - | ASTM A572 Gr.50/BS 7191 Gr.355D or approved equivalent |
|      | Plates with through thickness property                             | } | API 2H Gr.50                                           |
|      |                                                                    | } | API 2W Gr.50T                                          |
|      |                                                                    | } | BS 7191 Gr.355 EMZ                                     |
|      |                                                                    |   | Or approved equivalent                                 |
| iii) | Chequered Plate                                                    | - | IS 3502                                                |

#### Note:

Structural steel (Beams, Plates & rolled sections) shall be carbon steel (nominal strength) unless otherwise specified in the drawings.

### 3.4.3 Tubular

- All tubular sections shall be fabricated in accordance with API Spec.2B from plates which should conform to one of the steel grades indicated in para 3.4.2 above.
- Mill manufactured line pipes up to 406mm OD shall be of prime quality and shall conform to API-5L-Gr.B or equivalent, seamless.
- The use of spirally welded and electric resistance welded pipes shall not be permitted for any load bearing structural member.
- Tubular more than 406mm dia shall be rolled from MS plates or from high strength plates as per grade of material specified in cl. 3.4.2.

### 3.5 Delivery

- 3.5.1 All rolled shapes and plates are to be delivered in accordance with ASTM A-6, "Standard specifications for general requirements for rolled steel plates, shapes, sheet piping and bars for structural use" or IS: 1387 for steel manufactured as per IS standard.

### 3.6 Mill Certificates

- 3.6.1 Contractor shall supply the Company with relevant certificates indicating the process of manufacture, results of chemical and mechanical tests including specified supplementary tests for the materials. Each test certificate shall bear the heat number and other identification marks such that the same can be co-related with the material. These certificates shall be signed by manufacturer's representative and furnished along with material.

### 3.7 Ex-stock Steel

- 3.7.1 If ex-stock material is proposed, all these materials shall be traceable and identifiable to the mill certificate. Unidentified material shall not be used for permanent works.

### 3.8 Miscellaneous Items

#### 3.8.1 Hand Rails

All handrails (Fixed and removable types) and their supporting sockets shall be as per Appendix-I.

#### 3.8.2 Steel Bar Grating

Grating shall be as per Appendix-I.

#### 3.8.3 Fasteners

Unless shown otherwise in the drawings, all fasteners (hexagonal head bolts, nuts etc.) shall conform to IS: 1363.

## 4.0 SCOPE OF MATERIAL SUPPLY

### 4.1 By Contractor

- 4.1.1 Contractor shall be responsible for procurement and supply of all materials, consumables including inspection in order to complete the project as per schedule.

- 4.1.2 All materials procured by the contractor for execution of job in the system shall be subject to company approval. As a minimum, such materials to be supplied by the contractor shall include but not be limited to the following:

- 4.1.2.1 All structural and miscellaneous steels, nuts, bolts, gratings required for the work.

- 4.1.2.2 All consumables such as welding electrodes, oxygen, acetylene, inert gases etc. for welding and soldering purposes, as required.

- 4.1.2.3 All equipment and consumables required for isolation, removal of the damaged portion to be replaced, cutting, beveling etc.

- 4.1.2.4 All types of painting, materials including primers, paints, and solvents. Material and equipment for surface preparation, cleaning agents, compressed air etc.
- 4.1.2.5 All equipment and consumables required for all types of test and NDT (such as radiography, magnetic particle examination etc.) including radiographic film, X-ray machines, developing equipment and consumable etc.
- 4.1.2.6 All types of safety tools, tackles, devices and appurtenances etc.
- 4.1.2.7 Any other material not specifically listed above but required for successful completion of all works so as to make the system operational.

## **4.2 By Company**

The company shall not supply any material whatsoever for the execution of job.

## **5.0 FABRICATION**

- 5.1 Contractor shall develop shop drawings based on the design drawings and based on his pre-construction survey.
- 5.2 Fabrication shall conform to good engineering practice and to acceptable standards of offshore industry.
- 5.3 Welding shall be done in accordance with AWS D 1.1.

## **5.4 Welding Inspection**

Unless otherwise specified elsewhere in the Bid document, the following Welding Inspection criteria shall be followed:

- i) Splices in Structural Members : 100% Radiography  
(Tubular & Rolled sections)
- ii) TKY joints : 100% UT
- iii) Beam to beam connections, Stiffeners in beams
  - a) Flange : 100% UT
  - b) Web : 100% MPI
- iv) Handrail /Grating/ minor welding : Visual Inspection

- 5.5 Joints in gratings shall occur only at the supports.

## **6.0 TRANSPORTATION**

- 6.1 Contractor is responsible for the transportation of all procured material, pre-fabricated structural components and all other accessories required for offshore installation works, to the offshore platform/site. Materials so transported shall be properly sea-fastened to the transportation vessel. All transportation work shall satisfy the requirements of statutory authorities.



## **7.0 SURFACE PROTECTION**

- 7.1** Painting of structural steel work shall be performed as per applicable job/ standard specification for protective coating.



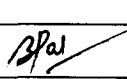

**APPENDIX - I: EIL STANDARDS**

- |    |                                            |                        |
|----|--------------------------------------------|------------------------|
| 1) | Standard Handrails for Offshore Structures | EIL Std. No. 7-60-0801 |
| 2) | Standard Grating Details                   | EIL Std. No. 7-60-0802 |
| 3) | Standard Stairs for Offshore Platform      | EIL Std. No. 7-60-0803 |



# अतटीय संरचनाओं एवं संघटकों की फेब्रिकेशन एवं असेम्बली के लिए मानक विनिर्देश

## STANDARD SPECIFICATION FOR FABRICATION AND ASSEMBLY OF OFFSHORE STRUCTURES AND COMPONENTS

						
3	24/01/2022	Reaffirmed and Re-Issued as Standard Specification	BM	CS	BP	SM
2	12/12/2016	Revised and Re-Issued as Standard Specification	VKR	CS	BP	RN
1	12/04/2013	Revised and Re-Issued as Standard Specification	RG	MS	BVK	DM
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Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

**Abbreviations:**

AC	:	Alternating Current
AISC	:	American Institute of Steel Construction
API	:	American Petroleum Institute
ASTM	:	American Society for Testing and Materials
AWS	:	American Welding Society
CT	:	Current Transformer
DC	:	Direct Current
MPI	:	Magnetic Particle Inspection
NACE	:	National Association of Corrosion Engineers
P&ID's	:	Process and Instrument Diagram.
RP	:	Recommended Practice
TPI	:	Third Party Inspection
UOE	:	U-Shape O-Shape Electrical Welding

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## **1.0 GENERAL**

### **1.1 Scope**

Contractor shall supply all material, labour, supervision, equipment, expendable material required to perform the fabrication of the works complete with appurtenances and systems in accordance with the requirements of these specifications, approved for construction drawings and contract documents.

Responsibility of the Contractor shall include, but not be limited to the following:

- a) Off-loading from terminals/ports, handling/tagging, transportation to contractors storage and warehouse of all equipment and materials.
- b) Preparation of fabrication drawings based on Approved for Construction drawings.
- c) Fabrication and assembly of all structural components of the works at the Contractors approved fabrication yard.
- d) Erection, shimming and alignment of all equipment on the platform decks.
- e) Fixing of cable trays, laying of cables, termination of cables and testing. Installation of equipments and their calibration.
- f) Fixing of conduits for Cathodic Protection, laying of cables, termination in a junction box at jacket walkway level, and testing.
- g) Inspection and Testing of Structural works of system
- h) Testing and tallying of all 'Packaged Units' and equipment (Vendor supplied items).
- i) Painting black surfaces as required and retouching of manufacturer's paintwork on vendor supplied items, wherever required.
- j) Preservation of equipment till offshore installation and hook-up.
- k) Weekly progress reporting

The Contractor shall be responsible for furnishing all tools, equipment, materials and supplies, which are required for the execution and completion of the works. This shall include equipment, tools, tapes required by the Company to conduct an inspection. All expendable supplies and materials necessary to complete the work shall also be supplied by the Contractor.

All scrap left over during the execution of the work will be the property of the Contractor. The disposal of such scraps shall be his responsibility. However, Company shall be the sole authority to decide as to what constitutes scrap.

All, structural fabrication and assembly shall be in accordance with the standards and codes as listed below:

- i) Recommended Practice for Planning, Designing and constructing fixed Offshore Platforms- API Recommended Practice 2A
- ii) Ultrasonic examination of offshore structural fabrication and guidelines for qualification of ultrasonic technicians- API RP 2X
- iii) Fabrication of Structural Steel Pipe- API SPEC 2B
- iv) Specification for the design, fabrication and erection of structural steel for buildings- AISC
- v) Structural Welding Code steel- AWS D 1.1
- vi) General requirements for rolled steel plates, shapes, sheet piling and bars for structural use- ASTM A6

- vii) Straight beam ultrasonic examination of plane and clad steel plates for special specification - ASTM A578
- viii) Specification for welding and weld inspection
- ix) Specification for Protective coating

## **1.2 Planning Meeting**

A planning meeting shall be held between the Contractor and the Company, prior to the initiation of any fabrication work. The purpose of this meeting shall be to finalise the fabrication sequence/programme for various components of the work.

After the start of the fabrication work, the Company representative shall hold a weekly meeting at the site to review the progress of the work. The fabrication superintendents of the Contractor shall attend this meeting.

The Contractor shall present the following in this meeting:

- a) Progress achieved during the week
- b) Fabrication, assembly and erection programme for the next week.
- c) Problems which may delay the fabrication/construction schedule.
- d) List of equipment/materials received during the week.
- e) Updated (cumulative) status of availability of materials at site

## **1.3 Field Deviations**

Any deviation from the approved for construction drawings must have prior written approval of the Company or Company's representative. After approval of the deviation, the construction drawings are to be revised and reissued by the Contractor. The revisions to be mentioned with date and highlighted on the drawings with reasons.

## **1.4 Safety**

Contractor shall ensure all safety measures before start of fabrication and maintain the safety standards during fabrication to prevent any mishap or accidents during fabrication/load out/installation. These shall include first aid, emergency equipment, medicines and evacuation contingency plan.

## **2.0 MATERIAL RECEIPT, INSPECTION AND STORAGE**

**2.1** The Company shall be informed of the material received in the fabrication yard. The Company representative shall check the consignment for the following:

- a) Specification and Quantity of steel received, as compared to those indicated on the Purchase Order.
- b) Mill certificates and heat markings for the steel received.
- c) Any visible signs of damage to the materials.
- d) Certificate of Special tests required (if not conducted in the steel mill)
- e) Corrosion Test Certificate of NACE carbon and Duplex stainless steel.

- 2.2** In the event of laminations, split ends or other defects discovered in materials that are intended to become a part of the structure, the Contractor, at his expense, may exercise either of the following options:
- a) Investigate the area surrounding the defect using non-destructive testing methods. If the defect is within the acceptable limits as defined in the relevant referenced codes and can be repaired as specified therein, the material may be accepted for use in the structure. This shall require the written approval of the Company, All such cost and time effect shall be to contractor's account.
  - b) Reject the entire section containing the defect. In the event rejection is decided upon, the damaged/defective material shall be marked in a conspicuous manner and removed from site within twenty-four hours to preclude its possible use. All damage and replacement shall be to Contractor's account.
- 2.3** If in the opinion of the Company representative, the defects are likely to be present in other items of material made from the same heat number, such items are also to be 100% non destructively tested by the Contractor at no extra cost and time to the Company.
- 2.4** Materials shall be kept clean and free from dirt, grease, paint spray other foreign matter and shall be suitably protected from environment.

### **3.0 STRUCTURAL FABRICATION AND ASSEMBLY**

#### **3.1 Shop Drawings**

The Contractor shall prepare shop drawings required for detailing the fabrication requirement. These drawings shall include all shop details including cuts, copes, connections, holes, bolts and piece numbers in accordance with the approved contract drawings. Welds, both shop and field, shall be identified by approved welding symbols as shown in AWS D 1.1.

The above shop drawings shall be reviewed by the Company to check that the general construction requirement and detailing is satisfactory. The Contractor shall make necessary corrections, additions required by the Company at no additional cost/time effect to the Company. Field deviations, if any, may be raised by Contractor in the prescribed format and is subject to review and approval by the Company.

Review of the shop drawings by the Company shall not relieve the Contractor of the responsibility for any error in detailing affecting subsequent layout and fabrication schedule.

#### **3.2 Manufacture of Tubular Structural Members**

Tubular of diameter greater than 406 mm shall be rolled from plates in accordance with API Spec. 2B.

The tubular shall be rolled in an API approved mill and shall carry valid API monogram. Tubular rolled by UOE process with expansion limited to 1.5 percent are acceptable.

The tubular shall be longitudinal seam welded by electric submerged arc process. Electric resistance welded or spiral welded pipes will not be accepted. Pipes shall have only one longitudinal seam weld. The welding and weld inspection shall be as per welding specification.

The tubular shall meet all the requirements of API Spec. 2B, with the following exceptions:

- a) The wall thickness and weight tolerances for tubular members shall be governed by the requirements of the code under which the plates have been rolled.
- b) For girth joints with offsets greater than 1.5 mm the following shall apply:
  - i) When cans are of different thickness the higher thickness shall be flame cut and ground smooth or machined to provide a 4 : 1 taper.
  - ii) When cans are of same thickness, the offset shall be tapered to a slope of 4 : 1 by deposit of additional weld metal and ground smooth.

In no case shall the metal thickness be less than the nominal thickness of the thinner can. Maximum offset permissible shall be governed by API Spec. 2B.

### **3.3 Built-up Girder**

Fabrication of built-up girders, if any, shall conform to the requirements of API RP 2A.

### **3.4 Inspection for Assembly**

- a) The Contractor, in conjunction with the Company, shall establish a numbering system to identify each section, member and joint uniquely in the structure. This numbering system shall be used for identification purposes on all shop drawings and for indexing cast numbers, material test certificates, all radiographs, records of magnetic particle inspection and ultrasonic testing and repair. These numbers shall be clearly marked on, in a permanent enough manner to last the duration of the works.

- b) **Edge Laminations**

Prior to assembly or erection, all flame cut or machined edges of plate, pipe or structural members shall be both visually and inspected by dye penetrant for exposed laminations. If a lamination is detected, it must be confirmed and delineated by magnetic particle ultrasonic inspection methods as appropriate. The extensions of defect behind the exposed face shall be determined by ultrasonic methods.

Any lamination extending back from the exposed edge to a depth of not more than 6.0 mm (1/4 inch) or one-half the material thickness, whichever is less, may be cleaned to sound metal and repaired by welding.

Any lamination extending back from the exposed edge to a distance greater than that specified above shall be rejected. The defective material shall be marked in a conspicuous manner and removed to preclude its possible use by error.

- c) **Subsurface laminations**

Prior to fit-up of the joint can sections into the assembly, the area of intersection of all bracing members with the can section shall be searched by ultrasonic inspection for subsurface laminations. The full intercept area plus 50mm all around shall be 100 percent inspected in conformance with the requirement of ASTM A578. Acceptance Standard shall be level II.

The Contractor shall perform the test using ultrasonic equipment of the pulse-echo, longitudinal beam type that shall provide linear presentation within ( $\pm$ ) 5 percent up to at least 75 percent of full screen height. Radiographic method may also be used for confirmation.



Any area of a size greater than 50mm in diameter causing complete loss of back reflection or one or more echo indications with amplitudes equal to or greater than 50 percent of the initial back reflection shall be cause for rejection, if that area is within 75mm in any direction of the line of the attachment weld.

If defects are within acceptable limits, the can shall be rotated so as to obtain acceptably sound metal in each attachment area.

The plates used for fabrication of lifting eyes shall be 100% ultrasonically tested.

### **3.5 Material Preparation**

#### **i) Straightening**

All rolled plates, bars and sections shall be flattened and straightened and made free from twist before marking and working. This shall be carried out in a manner, which ensures that no damage occurs.

#### **ii) Cutting and Edge Preparation**

- a) Steel may be sawn, sheared, cropped or flame cut and whenever possible it shall be done by a mechanically guided tool. All burrs and slag shall be removed before fabrication or assembly. All cut edges shall be dressed to the satisfaction of the Company and sharp edges or plate may be removed by light grinding. Preparation of base metal shall conform to Section 3.3 of AWS D1.1. All flame cut edges shall be finished by grinding.
- b) Any bevelled edge that has been damaged shall be restored within the tolerances. Where such restoration involves welding, only procedures approved by Company shall be used.
- c) Locating of slits or cuts made in tubular for insertions of stiffeners lifting lugs shall be at least 300mm away from any longitudinal seam weld or circumferential girth weld.

#### **iii) Machining**

- a) The ends of compression members at caps or bases, which are dependent on contact for the transmission of compressive stress, shall be machined so that the butting surfaces are in contact.
- b) It is to be ensured that machined ends are at right angles to the member. Attention shall be given to the necessity of adequate firm support to the member so that this is achieved in both the vertical and horizontal plane.

### **3.6 Splices**

- a) Tubular member of the same diameter and wall thickness may be spliced by girth butt welds, as per specification API Spec.2B with the following additions:

All joint cans, 3m or less in length shall be rolled in one section. Joint cans with a length greater than 3 m must be made-up of sections limited to 1.5 m minimum length. In no case, shall the girth weld/ fall within 75mm on either side of crown and saddle point.

- b) Beam splices shall be as per API-RP-2A with the following addition:  
Splices for deck beams must be staggered i.e. the splices in any two adjacent beams shall not lie in a line perpendicular to the beam axis.
- c) Joints in bar grating and deck plate in the span direction shall occur only at points of structural support. All plating shall be continuously seal welded to supporting members. However, stitch welding may be permitted for mud mat plates and wall plating in an insulated building module.

### 3.7 Alignment and Fit-up for Welding

- a) Whenever practical, clamps, magnets, holding devices or other setting up fixtures shall be used in assembling parts of the structure to avoid tack welding in the groove. If the type of holding device used for fit-up requires welding, such temporary attachments shall only be made with the approval of the Company and the welding of such attachments shall be made as per approved procedure.
- b) In fit-ups where clamps cannot be used, temporary spacer strips shall be used to ensure the correct root gap prior to tack welding and shall be removed in accordance with the requirements in (f) below.
- c) All parts not correctly fitted together shall be cut apart and rewelded.
- d) Electrodes used for tack welds shall be the same as electrodes used to complete the weld, in accordance with the approved welding procedure.
- e) All tack welds shall be cleaned and ground down to a featheredge at both ends prior to welding of the root pass. Any defective tack weld shall be removed prior to welding of the root pass.
- f) Temporary weld attachments, when permitted, shall be finally removed by cutting with a flame torch above the surface of the steel member. The final finish and removal shall be by power grinding to the original plate surface. Gouging out the attachments, by methods such as air arc cutting, below the plate surface will not be permitted. Any damaged area shall be ground at the discretion of the Company Representative, to merge smoothly with the original surface without welding up the damaged area. After grinding the surface is to be magnetic particle tested. Gouges between 7% and 20% of the member thickness may after grinding and magnetic particle testing is repaired using an approved procedure.
- g) Location of internal diaphragm plates, ring stiffeners and intersection of flanges of beams on tubular shall be at least 300mm from girth welds of tubular.
- h) The longitudinal seam(s) of the joint cans or other chord members shall be turned away from the braces so that this weld and joint welds are not within 75mm from weld toe to toe of each other at any point.

### 3.8 Structural Members Fit-up

#### General:

- a) The use of filler plates at connections will not be permitted.
- b) The use of details, which would lead to concentrations of stress, shall be avoided.
- c) Prior to commencement of fabrication the Contractor shall submit a fabrication and assembly procedure for approval of the Company. This procedure shall give the sequence of erection, assembly, lifting points and field joint locations.

#### Structural Shapes and Plates

Fit-up shall be as per welding specification.

## **Tubular Sections**

Fit-up shall be as per welding specification with the following additions:

- a) An approved type of external and/or internal line up clamp shall be used. The line-up clamp shall not be removed until sufficient weld metal has been deposited to hold the abutting tube ends in place. Tubes shall be supported and alignment maintained during welding, preferably by the use of accurately aligned rollers and guides.
- b) Welding, as far as practicable, shall be done from both sides and weld re-enforcement shall not exceed spec. of AWS D1.1

### **3.9 Roll/Flap up Structural Element**

This shall be suitable to contractor's fabrication philosophy, equipment, layout and yard facilities available, keeping in view good engineering practice and member components stressed within allowable limits.

### **3.10 Finishing of Surfaces**

The finishing of surfaces shall be as detailed as per specification for Protective Coating with the following additions:

- a) Any visual plate defects and random arc strikes shall be ground out, inspected, weld filled to an agreed procedure ground smooth and they shall be checked by dye-penetrant or magnetic particle inspection methods as directed.
- b) All rough edges on fencing and handrails shall be removed by grinding or filling and shall be ground smooth.
- c) Steel surfaces of piles and the structures, which are to be connected by grout bond, shall be clean and free of mill glaze, grease, oil or varnish.

#### **d) Galvanizing:**

Following structural shall be galvanized as per specification for Protective Coating.

- Gratings
- Handrails
- Stair Treads, Ladders and Cages
- Helideck Safety Net System

Galvanizing shall be done after completion of all cutting, drilling and punching operations and welding as applicable, but before final assembly in place.

#### **e) Grit blasting/painting**

All painting shall be done as per specification for Protective Coating.

The Contractor shall submit daily Shot/ Grit blasting/painting record in a Performa approved by Company's representative. The daily record shall contain information regarding ambient temperature, relative humidity, thickness of coats, anchor pattern of sand blasted surfaces and coats applied. The contractor shall provide SSPC photographs for comparison with blasted finish.

The Contractor shall line mark the four exterior corner jacket legs with a suitable paint over the protective coating system foot marked along the length of the jacket to facilitate assessment of jacket levels during upending and piling.

Diver operated grout ports, under water grout and inflate line connection location and pile guides, if any, shall be painted orange for visibility.

To facilitate checking of the penetration of piles during installation all pile add-ons except lead sections are to be foot marked as directed by the Company representative at site.

### 3.11 Repair and Remedial Measures

#### a) All members other than joint cans

Defects in the finished tube not deeper than 5 percent of the specified nominal wall thickness and mechanical marks not deeper than 5 percent or 1.5mm whichever is less, need not be removed. However, their extent must be determined. Shallow imperfections shall be ground to sound metal. The defect shall be removed by grinding in such a way that the ground area blends smoothly with the contour of the member. The ground area shall be well joined and the thickness of the ground plate shall not be reduced more than 7 percent of the nominal thickness. Welding repairs may be performed with the Company's approval for defects deeper than above but less than 20 percent of the nominal wall thickness.

Repair of defects deeper than 20 percent of the nominal wall thickness, or repair of defects with length and/or width more than 20 percent of nominal diameter is not acceptable. For tubular made from thermally treated plate, repair by welding shall be permitted only with the specific prior approval of the Company.

#### b) Joint cans

Repairs of Joint can defects shall be handled as specified in the preceding paragraph with the following added stipulation:

In areas where brace members are to be welded to the joint can, all defects deeper than 1.5mm but not greater than 20 percent of the nominal thickness shall be completely repaired by welding subject to the test and to the satisfaction of the Company.

- c) Where planar defects (cracks, lamellar tear etc.) are to be repaired (after prior Company approval) every effort shall be made to prevent propagation of the defect during its removal. During the final stages of removal, grinding not gouging shall be used. MPI or dye penetrate testing shall be used to check complete removal of the defect.
- d) The removal of weld metals or portions of the base metal may be done by machining, grinding, chipping, oxygen gouging or air carbon arc gouging. The unacceptable portions of the weld shall be removed without substantial removal of the base metal limited to a max. of 5% or 1.5mm whichever is less and shall be done in such a manner that the remaining weld metal or base metal is not nicked or undercut. Where air-arc gouging, is used, the edges shall always be ground to remove the hardened surface. The grooves are to be free from scale and to have acceptable contours.
- e) Local repairs in structural welding shall normally be inspected 100% by the method prescribed for the original weld.

- f) Every possible care shall be taken with repairs to minimize welding stresses.
- g) All weld repairs shall be carried out as per the requirements of specification for welding and weld.
- h) Members distorted by welding shall be straightened by mechanical means or by carefully supervised application of a limited amount of heat. The straightening by mechanical means can be carried out cold if the distortion does not exceed 0.2% elongation with the prior approval of the Company.

The temperatures of heated areas as measured by approved methods shall not exceed 600 degrees C.

The part to be heated shall be substantially free of stress and from external forces except those stresses imposed resulting from the mechanical straightening used in conjunction with the application of heat.

### **3.12 Structural Joints**

#### **a) Tubular Members**

The small diameter pipe framing into a large diameter pipe shall be considered the minor member. Window cutting shall not be permitted.

All minor tubular members shall be bevelled to a featheredge and to an angle and root opening which will permit the deposit of a sound weld with 100 percent penetration of the minor member wall thickness. The general recommendations for fabrication sequence and penetration for welding as given in API-RP-2A shall be followed. Joint details shall be as per Section 10 of AWS D 1.1.

#### **b) Structural Shapes**

All fabrication involving the connection by welding of structural shapes subjected to primary stress shall conform to size of weld and joint preparation shown on Contract Drawings. If not otherwise specified, such members shall be connected in such a way as to develop 100 percent penetration of the joint with single or double Vee-edge preparation, with a 45 degree groove and adequate root opening for proper weld penetration.

Web stiffeners shall be fitted accurately and neatly between the flanges of beams. They shall be bevelled for welding with 100 percent penetration to the flanges. Corners of stiffeners at the joint between flange and web shall be sniped so that weld over weld is avoided.

#### **c) Welded Connections**

All structural welds shall be full penetration welds.

#### **d) Bolted Connections**

As a general rule, bolted connections shall not be used unless specifically shown on the drawings. Use of bolted connections for temporary works may be permitted by the Company's representative at site at his sole discretion. All bolt holes shall be punched or

drilled at right angles to the metal surface and shall be finish-reamed to a diameter 1.5 mm larger than the specified bolt diameter. Holes shall be clean cut without torn or ragged edges. Outside burrs resulting from drilling or reaming operation shall be removed.

Punched holes shall not be permitted in high strength steel or in carbon steel greater than 11mm thick. No boltholes shall be enlarged by burning or flame cutting. Bolt holes shall not be placed where they may adversely affect the strength or integrity of a structural member.

Bolt threads shall be protected from damage during driving. Bolt heads and nuts shall rest squarely against the metal. Unfinished bolts transmitting shear shall be threaded to such a length that no more than one thread will be within the grip of the structural members. The bolts shall be of a length that will extend entirely through but no more than 6mm beyond the nuts. Bolts heads and nuts shall be drawn tight against the work with a suitable wrench. Bolt heads shall be tapped with a hammer while the nut is being tightened. After having been finally tightened, the nuts shall be securely locked with lock nuts.

### **3.13 Fabrication Tolerances**

#### **i) General**

Each component of the structure shall be accurately located in the position as shown on the drawings. Where a tolerance is shown on the drawings it shall take precedence over any generalized tolerances given in the documents. Tolerances shall not be cumulative. Fabrication tolerances shall be as per API RP 2A.

Fabrication tolerances shall conform to the applicable codes referenced above except as specifically modified below or as noted on the contract drawings. The overall length or width of any package shall not vary more than 6mm. A diagonal measurement across corners shall not vary more than 10 mm from the Contract Drawings.

Skid deck plate shall be heated and shrunk if necessary after installation to reduce water-holding valleys to a maximum of 3mm. Deck plate and grating shall be spliced only over a support.

As fabricated skid deck surfaces, including the skid beams, shall be level within 6mm.

Landing and stairway locations shall not vary more than 12mm from the horizontal dimensions shown on the drawings. Landing elevations shall be within a tolerance of 6mm of the elevations shown on the drawings. The vertical distance between stairs treads shall not vary more than 1.5mm and treads shall be level.

Handrail shall be fabricated such that, when installed, the top rail shall appear horizontal and the posts shall appear vertical. All welds shall be ground smooth prior to painting. Each handrail shall be clearly marked to aid in offshore installation, if required.

Butt offsets of pipe, plate or structural shapes shall not exceed 3mm. Butt offsets greater than 3mm shall be flame cut and ground smooth to produce a 3:1 transition at the taper. When members of unequal size are joined, the larger member shall be prepared with a tapered transition having a length not less than three times the offset, in both thickness and width, between the adjacent mating surfaces. The mismatch of mating surfaces of the joint preparation root face on tapered member splices shall not exceed 1.5mm.

The maximum acceptable variation in cross section from the theoretical dimension for wide flange beams shall not exceed the amount specified. Camber and sweep shall not exceed 6mm for lengths less than 6mm nor exceed 20mm over the entire length.

**ii) Beam Splices**

- Specified Tolerances for wide flange beams
- Depth over/under theoretical web depth  $\pm 3$ mm.
- Flange width over theoretical width 6mm.
- Flange width under theoretical width 4.5mm.
- Web off center  $\pm 4.5$ mm.
- Flange out of square 6mm for web depths inclusive of 300mm.
- Flange out of square 7.5mm for web depth beyond 300 mm

**iii) Jacket legs**

The inside diameters of all jacket legs through which piles are to be driven shall be maintained at a constant value.

**iv) Structural Shapes**

Structural shapes fabricated from plates shall conform to the requirements of ASTM A6.

**v) Secondary Members**

The centreline of each member shall be located at all points within a tolerance of ( $\pm$ ) 6mm of its position shown on the drawings. The lengths of members shall be within a tolerance of ( $\pm$ ) 3mm of the dimensions shown on the drawings.

The centreline of all members forming a part of a truss shall be located within a tolerance of ( $\pm$ ) 6mm of the dimensions shown on the drawings.

**vi) Squareness**

In assembling structures from individual trusses every practical effort shall be made to effect square ness and accuracy in alignment. The horizontal distance between diagonally opposite intersections of the centreline of longitudinal and transverse trusses of a structure shall be within a tolerance of ( $\pm$ ) 13mm of the dimension shown on the drawings.

**vii) Straightness of Members**

Straightness shall be held within 3mm in any 3 metres and shall not exceed 10 mm in the overall length of a member. The ends of sections shall be cut perpendicular to the length within 3mm.

**3.14 Fabrication - Miscellaneous**

**i) Temporary Erection Braces**

Fabricator may use temporary erection braces, at his cost, during any phase of the work. These must be removed by the Contractor after they have served their function. After removal of any temporary braces, all permanent members of the facility shall be cleaned of weld spatter and touch up painted. Temporary braces to permanent member shall be connected through a doubler plate.



**ii) Piling and Sump Installation Aids**

Contractor shall furnish all necessary supporting devices, lifting eyes and stabbing guides for piling and field-installed sumps.

**iii) Marking of Low Fatigue Life Joints**

Marking of low fatigue life joints for future inspection shall be carried out as described in design criteria. The marking panel shall be at least 400mm wide and shall have a length corresponding to number of letters in the marking. Letters shall be of 200mm x 200mm size, width of 40mm, with a border of 100 mm and in a medium suitable to withstand marine environmental.

**iv) Contractor shall fabricate and supply all components required for offshore field installation in separate identifiable packages.**

**3.15 Stress Relieving**

1. Tubular with outer diameter to thickness ratio less than 20 shall be stress relieved after manufacture.
2. Crown shim plates used for jacket leg to pile connection at jacket top shall be stress relieved after rolling, irrespective of diameter to thickness ratio.
3. Welded assemblies, where the thickness of one of the elements exceeds 65 mm, and/or where the thickness of weld exceeds 50 mm shall be stress relieved after assembly.
4. For offshore welds between pile add-ons of thickness exceeding 50mm and/or where thickness of one of the element exceeds 65mm shall be avoided as stress relieving cannot be preformed due to pile set up issues. The sectionalisation of piles shall be developed in such a way so as to avoid offshore welds requiring stress relieving. In unavoidable circumstances for welds between pile add-ons, deck leg stabbing points and transition piece stabbing points, CTOD test can be allowed as substitute to PWHT of Weld joints requiring PWHT due to higher thicknesses welded in the offshore environment. CONTRACTOR shall carry out CTOD testing on weld samples of actual thickness and weld position prepared under similar conditions prior to actual welding. CTOD testing of weld metal & HAZ shall be carried out to meet a minimum CTOD value of 0.25mm at -10° C for elements up to 75mm thickness and 0.38mm at -10° C for elements above 75mm thickness. Welding filler materials shall also meet the requirement of CTOD test.
5. Any other element/assembly specifically noted on the drawings shall be stress relieved.

All stress relief shall be achieved by thermal methods by heating the element or assembly to a temperature between 590 degree C and 620 degree C. The use of furnaces is desirable for all stress relief operations. A detailed procedure shall be developed and Company's approval obtained prior to performing the operations.

**4.0 INSPECTION AND TESTING FOR STRUCTURAL FABRICATION**

- a) The Company shall inspect fabrication and assembly of structures stage wise and after final completion.
- b) The Company shall have the right to inspect the materials, fabrication and erection of all items concerned with the works without limitation.
- c) The Company shall have free access at all times to any part of the Contractor's yard that concerns the work.

- d) The Company shall be advised by the contractor at least ten days prior to the start of any work, such as assembling or fabrication of any section, grit-blasting, painting. Company shall also be notified before undertaking repairs to welds and not after defects have been corrected. Whenever any piece is to be assembled that will prevent inspection of the area, Company shall be notified and the area inspected and any defects corrected before proceeding with the assembly.
- e) The Company shall have the right to inspect, at any time, work, tools or equipment to be used in any part of the Works, and shall have the right to reject any equipment or work which does not conform to the specification or the drawings. Defective work or work not conforming to the specifications or the drawings shall be redone by the Contractor at his cost and time effect.
- f) All necessary devices/equipments shall be calibrated and checked, before their use at the start of works. Records of all readings shall be maintained till the successful installation and satisfactory completion of the works.
- g) Company must approve all phases of the testing including leak repair or defects and replacement of materials and equipment found to be defective during testing, and shall sign all Test Certificates.
- h) The Company shall have the right to request any additional inspection to ensure that the Works conform to the Specifications.
- i) The Contractor shall furnish, install and maintain in a safe operating condition all scaffolding, ladders, walkways, adequate lighting and equipment necessary for inspection by Company. The safety and condition of the above equipment must conform to Local Industrial Safety Codes for such operations.
- j) The Contractor must ensure that all valves and removable plugs on jacket legs are closed prior to load-out and shall give written certification of same.
- k) After the fabrication is completed, the jacket legs and skirt sleeves, Pre-installed conductors and pile sections, launch truss chords and buoyancy tanks if any, shall be pressure tested for leaks through top and bottom closures. The pressure applied shall be 1.5 kg/cm<sup>2</sup> and maintained for 4 hours. A soap test shall be conducted to detect any leakage between the rubber diaphragm and the flange, and top closure plates and welds or any other joints.  
The manufacturer's test certificate shall be furnished to the Company.
- l) All grout and air lines for the jacket grouting system shall be cleaned by blowing clean air to ensure their operability. They shall be pressure tested at 40 kg/cm<sup>2</sup> for one hour. The protective housing at the bottom of jacket for the inflate lines shall also be pressure tested to the above pressure.

## **5.0 VESSELS AND EQUIPMENT**

### **5.1 Receipt**

The Contractor shall receive all vendor supplied vessels and equipment at the fabrication yard. The Company shall be informed at least 7 days in advance about anticipated arrival of vessels/equipment.

### **5.2 Inspection and Storage**

Upon receipt of vessels/equipment at the fabrication yard, the Contractor and the Company shall jointly inspect the vessels/equipment. This inspection shall be to check the following:

- i) Any 'storage' in the package as compared to the purchase order/packing list.
- ii) Visual inspection for damage/breakages.

- iii) Nameplate particulars/sizes compared to purchase order.
- iv) Shop test reports and certificates. These must be signed by the vendor, contractor/ TPI and Company representative witnessing the shop tests.

An inspection report on the above shall be submitted to the company within 7 days of the arrival of vessels/equipment at the fabrication yard. This report shall be jointly signed by the Contractor and Company's representative. Immediately after inspection, contractor shall initiate necessary action to procure the short supplied/damaged items. Generally 'repaired' items will not be accepted by the Company unless specific approval in writing has been given by the Company representative at site.

After the above inspection, the vessels/equipment shall be stored by the Contractor in a safe, and accessible place, adequately protected against weather and marine environment. If asked for by the Company, the Contractor shall mobilize the representative of the vendor to assess the damage to any equipment during transit.

Contractor shall develop preservation procedure on the basis of vendor's preservation procedure for various vessels, equipments from receipts & storage to pre-commissioning stage for Company's approval.

### **5.3 Erection**

When the structural deck is ready, the vessels/equipment shall be transported to the site and erected on the deck, according to installation instructions of the vendor. All equipment skids shall be seal welded to the deck framing.

All temporary supports, bracing or other foreign objects that are installed in vessels/rotating machinery or other equipment to prevent damage during shipping, storage and erection shall be removed.

(NOTE: All such supports, bracing etc. must be re-installed before shipment of completed unit for installation at site).

Rust preventives and oil used to protect the equipment during shipping and construction may be removed whenever these are detrimental to operation/checkout at fabrication yard. These shall be replaced immediately after checkout/operation checks are completed.

All base plates and sole plates of all bearing surfaces shall be leveled. Cold and hot alignment shall be made as per manufacturer's recommendations. Mechanical seals, permanent packing and accessories shall be installed, adjusted or replaced as necessary. All piping tie-ins shall be made.

After completion of erection and tie-in, all vessels and equipment shall be checked to conform to flow sheets P&IDs, construction drawings and Vendor drawings. The contractor shall maintain and furnish one set of all drawings, including vendor drawings to the Company representative at site. Any variations from the approved drawings must be clearly marked and signed jointly by the Contractor and the Company representative.

Contractor shall provide detailed work procedure for all equipments/vessels clearly indicating the method of installation (drag/lift) along with engineered aids required for installation.

#### **5.4 Pre-Commissioning Checks**

After the fabrication yard erection and hook-up has been completed, the Contractor shall start the pre-commissioning checks. A detailed list of pre-commissioning checks required to be performed by the contractor are given in a separate specification. It may not be possible to complete all the pre-commissioning checks in the fabrication yard. However, the Company desires that at least the following pre-commissioning checks/tests shall be completed in the fabrication yard.

Contractor to note that the installation check as called out in the following list shall include the following:

- i) Name-plates and/or certificates of equipment are correct and visible.
- ii) Equipment are properly installed in accordance with drawings and foundations are proper.
- iii) All necessary supports are attached and are in acceptable condition.
- iv) All connections of equipment to piping, tubing and wiring are made in accordance with drawings and specifications.

##### **a) Pressure Vessels**

- i) Installation check of the skid. This shall include opening of manway/manholes for inspection of vessels internals by the Company representatives. The man way shall be closed after inspection. All cleaning/passivation required shall be done in the fabrication yard.
- ii) System piping hydrostatic test for the skid unit (if not done in the Vendor's shop).
- iii) Instrument calibration (for vessel skids).

##### **b) Motor Driven Pumps**

- i) Visual and installation check.
- ii) Check for direction of rotation, if cable connections have been completed.
- iii) Instrument calibration.
- iv) Alignment of pumps
- v) Functional checks of local control panel/ station as required.

##### **c) Small Motor Driven Compressor Skids (e.g. Instrument/Utility Air Compressors)**

- i) Visual and installation check.
- ii) Functional operation check for the complete unit.
- iii) Local control panel functional check.
- iv) Instrument calibration

##### **d) Lifting Equipment (Cranes, Hoists, etc.)**

- i) Installation check.
- ii) Load tests
- iii) Function check of alarm points in the control cab.

**e) Heating, Ventilation and Air-conditioning system**

- i) Installation check.
- ii) Operation check for the system. This will include a check for noise/vibration.
- iii) Air tightness of ducting installed in methods.
- iv) Calibration of instruments

**f) Fire Water Pumps**

- i) Installation check for the driver
- ii) Rotary direction check.
- iii) No-load operation test for the diesel engine.

**g) Chlorinator/Water Markers**

- i) Installation check
- ii) Function operation check, including check on local control panels.
- iii) Instrument calibration.

**h) Sewage Treatment Unit**

- i) Installation check

**i) Heat Exchanger**

- i) Installation check
- ii) Instrument calibration
- iii) Check clearance for the tube bundle removal

**j) Building and Accessories**

- i) Installation check
- ii) Operate heating, ventilation and air-conditioning system.
- iii) Check pressurization of building.
- iv) Water flood check of flooring and roofs against leaks and stagnation.

## **6.0 PIPE WORK, VALVES AND FITTINGS**

### **6.1 Receipt**

As soon as piping, valves, specialty items, fittings etc. are received in the yard, Contractor shall arrange an inspection by the Company representative at site. This inspection shall include:

- i) Inspection of mill certificates for piping material/fittings/ co-relation of documents and materials.
- ii) Manufacturer's test certificates for valves/specialty items.
- iii) Check quantity received against quantity ordered as per the purchase order.
- iv) Visual inspection for any damage in transit.
- v) Corrosion Test Certificates as specified in specification for Corrosion and fire safe Certificates.

## **6.2 Inspection and Storage**

The inspection report shall be jointly signed by the Contractor and the Company representative at site. Contractor shall take immediate action to replenish damage and short supplied material.

## **6.3 Shop Drawings**

Two types of shop drawings shall be made by the Contractor:

- a) Piping isometrics – These shall be prepared prior to fabrication on the basis of isometrics marked “Issued for Fabrication indicating field joints, offshore joints, spool markings etc”.
- b) Hydrostatic test drawings – These shall be checked by the Company to ensure that adequate vents, drains and spaces necessary to allow testing of the facility have been provided. Even though not specifically shown on design drawings or Isos, all high points in the piping shall have a vent and all low points shall have a drain. No hydro testing shall be done unless the above shop drawings are received and approved by the Company.

## **6.4 Fabrication**

All piping shall be fabricated, installed and inspected in accordance with specification for Piping Design, Fabrication & Installation. Specifications for material, line classification, line numbering, valve types, branch reinforcements and miscellaneous piping requirements shall conform to specification for Piping Valve & Material. Prior to hydro-test, the Contractor shall submit a hydro-test procedure for approval of the Company.

Following additional cleaning precautions shall be taken:

- i) Prior to flanging, the inside of each pipe section shall be checked for foreign matter and adequately cleaned by the use of leather or canvas belt disc of proper diameter or by other methods approved by Company representative.
- ii) All open ends of pipe are to be capped off once installation onshore is completed.

Fabrication Tolerances shall be as follows:

- i) When the tolerances are specified on the drawings, complete piping shall meet those tolerances.
- ii) Tolerances shall not be cumulative.
- iii) Faces of flanges shall be right angles to the axis of the pipe, or to be tangent of elbows.
- iv) Bolt holes in flanges shall straddle center lines of bends, manifolds, and other assemblies, unless otherwise indicated on the drawings.
- v) On completion of welding flanges to pipe work, the face of each flange must be true and undistorted so that a straight edge across the flange face is in contact with the flange face at all points along the edge.

## **6.5 Welding**

All welding and weld-inspection shall be done in accordance with the requirements of Welding and Weld Specification.

## **6.6 Painting and Pipe work**

All pipe work, valves and fittings shall be painted in accordance with the requirements of specification for Protective Coating.

## **6.7 Testing and Inspection**

Testing, inspection and repair of welds shall be as per specification for Piping Fabrication & Installation, Pipe joints containing laminations, split ends, longitudinal seam defects, or any other injurious defects discovered during non-destructive testing shall be rejected and removed from site unless otherwise authorized by the Company.

## **6.8 Preparation for Pressure Testing**

Contractor shall be responsible for preparing the facilities for pressure testing. Such preparation shall include, but not be limited to the following:

- a) Submit to the Company for approval not less than 7 days prior to commencement of testing, in writing and in schedule form, a programme for pressure testing the piping, to include test procedures, time schedules, diagrams, and proposal for installation of any additional vents, drains, spades, and relief valves which may be required.
- b) All lines shall be flushed out with potable water before and after testing, so as to completely clear them of any loose mill scale and rust, oddments, and miscellaneous material.
- c) All orifice plates, control valves, flow meters, turbine meters, rotameters and strainer element shall be removed prior to testing, and shall be installed after flushing. All pressure gauge and instrument sensing points will be isolated and any float not capable of withstanding test pressure shall be removed and replaced after test.

## **7.0 ELECTRICAL EQUIPMENT AND ACCESSORIES**

### **7.1 Receipt and Inspection**

As soon as electrical equipment and accessories are received at the fabrication yard, the Company shall be informed. The material shall be checked for the following:

- i) Quantity of material received shall be checked against quantity ordered as per purchase order.
- ii) Visual inspection for any damages/breakages.
- iii) Nameplate check for specifications.
- iv) Shop test reports and certificates.

An inspection report, jointly signed by the Contractor and the Company shall be issued immediately. The Contractor shall initiate immediate action to replenish the damaged/short supplied material.

### **7.2 Erection**

All electrical equipment shall be erected and hooked-up as per the requirements of specification for Electrical Works for Skid Mounted Equipment.



### **7.3 Post Erection Check**

After erection on the deck, the electrical equipment shall be inspected / tested as follows:

#### **Generators**

- i) Installation check.
- ii) Insulation resistance test
- iii) Instrument calibration.
- iv) Sequence check, including starting/running of generators, functional check of all control and safety devices, calibration of relays, control panels (including remote controls, if any).

#### **Switchgear and MCC**

- i) Installation check.
- ii) Insulation resistance check.
- iii) Sequence check, including relay check, functional operation check, check for all interlocks.
- iv) Primary injection test of CT to check correctness of CT secondary circuit.

#### **Battery and Battery Chargers**

- i) Visual check for batteries.
- ii) Installation check.
- iii) Insulation resistance check for AC side of battery charger.
- iv) Operation test, including checking of output characteristics, temp. rise, efficiency and power factor, adjustable range of output voltage (for battery chargers only).

#### **D.C Distribution Board**

- i) Installation check.
- ii) Insulation resistance check.

#### **Control stations, Navigation Aids, Lighting fixtures, Paging and Intercom System, Lighting, Power Panels, Radio System etc.**

- i) Installation check.
- ii) Insulation resistance check.
- iii) Functional operation test.

#### **Electrical Cables**

- i) Cable laying conditions check.
- ii) Insulation resistance check.
- iii) Cable termination check.
- iv) Cable continuity checking and marking.

For any other equipment, tests/inspection to be done in the fabrication yard shall be mutually agreed between the Contractor and Company representative. All the above test and inspection reports shall be signed jointly by the Contractor and the Company representative.

## **8.0 INSTRUMENTATION**

### **8.1 Installation**

Instruments and accessories shall be installed as per specification for Installation of Instruments and Controls. Types of tubing, fittings, methods of installation and other items pertinent to instrumentation shall also be as per above Specification.

Instrument tubing shall all stainless steel of the type, diameter and wall thickness specified in the Installation of Instruments and Controls Specification. All tubing bends are to be made with a mechanical bender. In case of over-bending the run shall be discarded rather than attempting an upbend. Tubing runs are to be field-routed and must be designed to use principally 90 degree bends. The run must be supported with tubing clips and be located so as not to suffer damage from normal operation of the facilities specially from the contact.

Electrical connections to instruments are to be made in accordance with the specifications and in a neat, orderly manner. All long runs of flex capable are to be supported and routed to prevent damage. Special care is to be taken to assure proper tagging of wire ends.

### **8.2 Calibration**

All instruments requiring calibration shall, be so calibrated by qualified instrument technicians using suitable equipment and as per specification for Installation of Instruments and Controls. This is to be done in accordance with the manufacturer's bulletins and records of the work shall be kept to become part of the final records presented to the Company. Skid mounted instruments shall also be calibrated in the fabrication yard.

Following calibration, the instrument shall be tagged indicating that this has been done. Any acceptable but noteworthy deviations shall be noted on the tag. The calibration sheet for each instrument shall be signed jointly by the Contractor and the Company representative.

### **8.3 Inspection and Checkout**

Contractor shall temporarily power all electrical instruments and connect temporary air supply to all pneumatic instruments. All instruments regulators are to be set to the proper output pressure and each instrument loop given a complete cycle check along with the associated panels.

Checkout shall include, but not limited to:

- a) Impose full scale measurement on control instruments and transmitters, and verify that outputs are correct.
- b) Impose set point pressure on pressure switches and verify switch actions.
- c) Observe that all chart drives are operational.
- d) Verify that control valve travel matches the control signal input over the full range of 0 to 100 percent.
- e) Actuate the air operators of the manifold valves.
- f) Actuate each shutdown device by imposing suitable signal, and observe that it acts through the control panel to initiate a shutdown.
- g) Actuate the manual shutdown and verify that they work properly.
- h) Actuate the manual fire loop valve.
- i) Verify that all displacement level controllers are functional.

#### **8.4 Instrumentation System Checkout**

The Contractor will make any non-operating tests that will ensure instrument operability i.e removal all shipping stops, check points, travels, and verify instrument capability to measure, operate and stroke in the direction and manner required by the process application.

#### **8.5 Pre-commissioning Checks**

The Contractor shall test the installation in the following manner, in the presence of the Company's Representation. All testing and calibration facilities shall be proved by the Contractor and these facilities shall be subject to the approval of the Company's Representative.

- i) All pneumatic lines shall be disconnected and blown through with instrument air. The lines shall then be blanked off and pressurized viz bubble bottle to 1.4 kg/cm<sup>2</sup> (20 psig). The bubble rate, after pressurizing, shall be less than one (1) bubble in ten seconds.
- ii) Instrument air mains shall be isolated from the instrument and pressurized to 1.5 times the maximum working pressure. They shall be isolated from pressure sources and the pressure read on a gauge or manometer shall not fall by more than 0.07 kg/cm<sup>2</sup> (one (1) psig) in 10 minutes.
- iii) Process impulse lines shall be isolated from the instrument and pressurized hydraulically to 1.5 times maximum working pressure and the pressure shall not fall at a rate exceeding one(1) psig/hr. reading on a gauge or manometer.
- iv) All thermocouple, electric and electronic instrument wiring shall be tested for resistance between conductors and from conductors to earth with a potential not less than 500 V DC. These tests shall be carried out with all conductors disconnected from all instruments except the test instrument. The resistance shall not be less than 10 megohms.
- v) Wiring shall be checked to ensure that the correct transmitters are connected to the correct receivers with the correct polarity.
- vi) Correct connections of all switches electric or pneumatic shall be checked.
- vii) Alarm operation checks shall be made by the Contractor to check functionally all alarm and trip systems. Wherever possible, process conditions shall be simulated to check the operation. Faults in wiring shall be corrected.
- viii) The Contractor shall provide written results of all the above test and if required by the Company's Representative, provide reasonable evidence of the satisfactory condition of test equipment.

#### **9.0 CLEANING AND WASHING OUT**

- 9.1** After erection and hook-up in the fabrication yard has been completed all vessels, pipe work, and headers shall be adequately washed out using a high pressure high volume flow of fresh water.

Strainer shall be installed at appropriate points as directed by Company's Representative to protect fittings, etc.

Washing out shall be done with all valves fully open and all non-return valves properly open. All completion of washing out, certain valves and other fittings shall be removed, as directed by the Company's Representative for inspection for damage and further cleaning.

All vessels shall be opened up after washing out and shall be physically inspected for debris or any obstruction internals, by the Company's Representative accompanied by Contractor's personnel.

All parts of the structure and the facilities shall be adequately cleaned to the satisfaction of the Company's Representative on completion of all other aspects of the fabrication works.

Damaged paint work and coating will be touched up in accordance with specification for Protective Coating on completion of load-out, and any damaged fittings will be repaired, by Contractor at no additional cost to Company.

## **10.0 WEIGHING OF DECKS/MODULES AND OTHER TOP SIDES**

All Deck Structures, topside modules & buildings, and other topsides facilities etc. shall be accurately weighed, by the Contractor prior to load-out. Contractor shall include in his proposal the basic details of the weighing procedure and equipments intended to be used. Detailed weighing procedures shall be developed and submitted for Company's approval upon award of Contract. Load cells used shall have valid calibration Certificates.

While weighing it shall be noted that the point of application of the load cells shall be in such a manner that based on the results of the weighing it shall be possible to devise the reactions at each support point as well as the center of the gravity of the component being weighed.

The weighing activity shall include, but not limited to the following:

- a) Weigh Decks/Modules/Building/Miscellaneous topside items as per Company approved procedures.
- b) Prepare schedule of items both permanent and temporary on the module at the time of weighing including weights and location.
- c) Reconcile weighing results with the theoretical estimates.
- d) Prepare a detailed weight schedule of all items which are yet to be instilled, prior to lifting, together with any items which are to be removed i.e. rigging platforms etc.
- e) Prepare a final weighing report for every lift containing :
  - i) Weighing Results.
  - ii) Theoretical Prediction.
  - iii) Item schedule for (d) above.

Contractor shall assume full responsibility for all remedial measures required as a result of weight escalation beyond the weights budgeted for sea-transport, offshore lifting and final service operations. This responsibility shall include but not be limited to revision of the marine spread, strengthening and stiffening of the structures, offloading components in the lift etc.

## **11.0 PREPARATION FOR SHIPMENT**

### **11.1 General**

- i) The various components and modules shall be readied for shipment upon completion of the fabrication, out fittings and weighing, Contractor shall furnish all equipment, tools, materials and labour for the operations. The preparatory activity includes:
  - a) Surveying of waterfront and navigational route to ensure adequate draft and obstruction free waterway.

- b) Ready cargo/launch barges for receiving the modules, which includes obtaining the necessary certificates, deck strengthening, if any readying ballasting/deballasting arrangement including pumps, and outfitting of skid beams, load spreaders as required.
- c) Ready the various components and modules for shipment, as specified in this Section.
- ii) If the component is to be loaded out by lifting, lifting signs shall be of such lengths so as to maintain the plane of the bottom portion of the component parallel to the material barge deck.
- iii) All spreader frames, lifting slings, shackles and spares shall be installed on the structures. The strength and fabricated length certificates for all slings used shall be furnished to Company.
- iv) Each component mounted on the superstructure shall be securely anchored to the deck to prevent damage during towing.

Instruments shall be removed, tagged and crated in waterproof boxes constructed from 50mm thick lumber. Instruments shall be packed with sufficient desiccators for protection in transit and during storage at job site. Any equipment extending beyond the deck edge shall be removed, tagged and crated in waterproof boxes constructed from 50mm thick lumber. All boxes shall be securely attached to the deck for shipment. The contents of each package shall be clearly stated on the outside of each package, and a complete inventory of each and every package and its detailed contents shall be made and submitted to the Company's Representative for his approval and retention prior to the completion of load out.

- v) All openings, flange faces, threaded connections, valve stems, and other component parts subject to mechanical damage or corrosion shall be adequately protected. Such protection shall consist of, but not be limited to, bolted wood flange covers, scaling with water proof tape, enclosing with temporary metal housing and coating all machined and threaded surfaces with a rust preventive.

The protection shall be applied to all components, those removed and boxed and those remaining in place on the deck section.

- vi) All piping and handrails removed for shipment shall be properly tagged.
- vii) The obtaining of any permits, licenses, etc. required during for load out responsibility of Contractor.

## **11.2 Completion Review**

The Company shall perform a completion review of all fabrication and outfitting activities of the components ready for load out. Any outstanding items shall be completed prior to load out, to the satisfaction of the Company. Waivers from this requirement shall be given at the sole discretion of the Company.

## **11.3 Miscellaneous items**

Contractor shall furnish loose all items that are to be installed at offshore. These items are to be loaded out with the super-structure or jacket and adequately sea fastened. A complete list of all

such items including the location on the barge shall be handed over to the Company for verification and record.

#### 11.4 Adjustable Stairs

Adjustable Stair(s) to the top of the jacket shall be loaded out in the “pulled-up” position, unless Contractor is otherwise instructed by Company. Sufficient cables and tie-downs shall be provided by Contractor to adequately secure these stairs.

#### 11.5 Valve Checking

Prior to and following load out and sea fastening, all flood control, (if used), vent, grout, and other valves shall be checked to ensure easy operations. Any interference will be eliminated. Flood, vent, and grout valves will be left in the closed position and the flood valve handles shall be positively secured to jacket at the walkway level. Company will not accept a jacket until Contractor has, in the presence of Company’s Representative, operated each of the described valves, placed it in the closed position, and secured it in this position. All of these valves and associated operating lines shall be carefully protected during load out and sea-transportation.

Suitable marking shall be incorporated on the jacket to show the closed and open position of the flood valves so that verification of the closed position of the flood valves can be made at offshore prior to launching.

# स्कीड माउंटेड असेम्बली के लिए मानक विनिर्देश

## STANDARD SPECIFICATION FOR SKID MOUNTED ASSEMBLIES

3	12.08.2024	Re Affirmed and Re-Issued as Standard Specification	AR	BM	CS	MN
2	30.03.2019	Revised and Re-Issued as Standard Specification	VKR	CS	BP	RKT
1	18.11.2013	Revised and Re-Issued as Standard Specification	RG	BP	BVK	SC
0	09/05/2008	Issued as Standard Specification	BVK	UVL	VKM	VC
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

**Abbreviations:**

AISC	:	American Institute of Steel Construction
ANSI	:	American National Standard Institute
API RP	:	American Petroleum Institute Recommended Practice
ASTM	:	American Society for Testing and Materials
AWS	:	American Welding Society
IS	:	Indian Standard
NEMA	:	National Electrical Manufacturers Association
NPS	:	Nominal Pipe Size
OSHA	:	Occupational Safety and Health Administration

***Ocean Engineering Standards Committee***

Convener: Mr. Charanjit Singh

Members: Mr. Bhaskar V. Mandalika  
Mr. Kalyan R. Vinjamuri  
Mr. V. Shanmugam  
Mr. Amit Raj  
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## 1.0 SCOPE

This specification defines the minimum requirements for the design, fabrication, assembly, inspection, and preparation for export of skid mounted assemblies.

This specification shall be used with the individual equipment specifications and/or drawings. If conflicts exist, the individual specification and/or drawings shall govern.

## 2.0 SPECIFICATIONS

The following EIL specification shall be referred to supplement this specification

S. No.	EIL Specification Title	Specification No.
1.	Specification for Pressure Vessels	6-12-0001
2.	Specification for Centrifugal Pumps	6-41-0002
3.	Specification for Piping Package Units	6-44-0015
4.	Specification for Piping Valve Material	6-44-0006
5.	Specification for Installation of Instrument & Controls	6-52-0086
6.	Specification for Offshore Electrical Installation Works	6-51-0058
7.	Specification for Protective Coating	6-79-0020
8.	Specification for Ventilating, and Pressurization System	6-36-0002
9.	Specification for Reciprocating Pumps for Offshore Application	6-41-0202
10.	Specification for Diesel Engines	6-43-0040

## 3.0 SKID DESIGN AND FABRICATION

3.1 All skids shall be designed to fit the particular conditions of their service and the following items shall be investigated and considered in skid design.

- Land or marine based service
- Type of support under skid
- Unsupported span lengths during hydrostatic test conditions, during lifting, and in service.
- Type of equipment on skid
- Tie-down or anchor (as applicable)
- Handling and transportation conditions.

3.2 All skids shall be constructed of structural steel members conforming to standard specification no. 6-60-0011 for offshore structure materials.

3.3 Skew loading due to unequal sling length or inaccurate determination of center of gravity of the unit shall be avoided. The sling lengths shall comply with the tolerances specified in API RP-2A. Dynamic load factors as specified in API RP-2A shall be considered.

The skid shall be designed for offshore lifting in accordance with API RP-2A latest edition, wherever the package is to be installed offshore.

- 3.4 The primary members shall be adequately cross-braced to prevent flexing or distortion of skid during lifting, transporting and installation. Equipment skid members shall not be considered as restraint to its supports beam.
- 3.5 The skid shall be all-welded construction and as a minimum, all welding shall be done in accordance with the specification AWS D1.1, latest edition of the American Welding Society.
- 3.6 Only under special cases, bolted connection may be permitted subject to approval on case-to-case basis on submission of proper reasoning justification. In such cases, bolts meeting ASTM A 325 or A 490 specifications will be incorporated in all strength connections. These bolts nuts shall be hot dip galvanized.
- 3.7 If holes drilled in a beam flange or holes cut in the web of a member reduce the net section to the extent that the stresses in the member exceed the allowable stresses specified by AISC, the member shall be reinforced with welded plate having a thickness sufficient to provide the additional required area. In no case shall plate less than 6 mm (1/4-inch) thick be used. However, drilling of holes shall be avoided as far as possible.
- 3.8 Metal thickness at the point of equipment bolting shall be 10mm (3/8 inch) minimum.
- 3.9 Pad type lifting eyes designed for a load factor of 2.0 for lifting sling attachments shall be provided to facilitate loading and unloading.
- 3.10 Skids shall be designed for single point lift at hook and preferably a four-point lift at skid. Contractor shall provide all lifting slings, shackles, pins and spreader bars (if required). The design of skid, lifting slings, spreader bar etc. shall be such that no equipment/piping etc. on the skid require dismantling, reassembly during lifting, load out and offshore installation.

The stresses in skid beams, including those imposed by lifting slings during loading and unloading, shall not exceed the allowable stress as outlined in the 1989 edition of AISC specification. The primary beams and longitudinal base members shall be considered as having supports at the extreme ends of the skid span during lifting of the skid unit with equipment dry weight applied. A maximum deflection of  $L/360$  shall be allowed on primary beams designed with the above consideration of loading and support, where  $L$  is the span between supports. The members framing into the pad-eyes shall be designed with an impact factor of 2.0 and other structural members with an impact factor of 1.35 for the installation load case. The spacing of transverse beams shall not exceed  $L_u$  of the primary beams where  $L_u$  is defined in AISC specification.

- 3.11 If the skid is to be transported by truck at the fabrication yard or at any time while enroute to the job site or at the job site, the overhang from the truck bed shall not exceed  $1/3$  the total length of the skid. Further for truck transportation, the center-to-center dimension between primary longitudinal beams shall not exceed 1.83 m (6 feet).
- 3.12 The maximum allowable weight and dimensions of steel assemblies to be transported are the Contractor's responsibility.
- 3.13 30mm (1-1/4 inch) serrated edge grating conforming to ASTM A36/IS 2062 grade E250 sub quality BR/B0 or equivalent, latest issue, shall cover all open areas on top of individual equipment skid and walkways. Grating shall not be used as mounting surface for equipment or support for large equipment. Where skid will rest directly on deck truss girders with no deck plating and beams, all open areas on the skid shall be covered by suitably designed deck plating conforming to ASTM A36 or equivalent. The deck plating shall seal the deck completely thereby preventing rain/process liquid leakage to lower decks and equipment thereon.

- 3.14 All mounted equipment-containing hydrocarbons that can be spilled and/or drained into the skid area shall have a drip pan under the particular equipment. The drip pan shall be constructed of 6mm (1/4 inch) plate conforming to ASTM A36/IS 2062 grade E250 sub quality BR/B0 or equivalent. The drip pan shall be provided with a valved drain (2-inch NPS minimum) piped to the edge of the skid.

The skid shall have adequate provision for draining any pockets. All such provisions shall be suitably routed to the skid edge with a 2" ANSI 150# for further hook up to drain.

- 3.15 Adequate ladders and/or stairs and platforms as per latest OSHA rules and regulations shall be provided for operating and maintenance access to all instruments, controls and valves. Platform shall be equipped with handrails, knee rails, and kick plates. Platform and stair tread shall be made from bar grating and all stair treads shall have safety nosing. Floor grating shall be removable when required by individual specifications and drawings. Handrails must be continuous, uniform in height, and safe to slide hand along. Vertical ladders shall have safety chains across the top handrail stanchion.

#### 4.0 MECHANICAL REQUIREMENTS

- 4.1 The assembly shall be a self-contained unit mounted on a structural steel skid. All necessary valves, controls and other equipment shall be completely piped. All inlet, outlet, utility, and drain connections shall be extended to termination at the skid edge.
- 4.2 All terminal piping connections shall be held to plan and elevation dimensions as shown on the drawings.
- 4.3 Interconnecting skids shall be joined by flanged piping that has been checked for proper fit-up by assembly in the fabricator's shop.
- 4.4 All piping and instrument tubing shall be rigidly supported for service and shipment. The support and installation shall be made to allow piping to be removed without cutting of main structural members.
- 4.5 Lateral, torsional, etc., loading caused by piping reactions that are to be transmitted by the skid to the foundation shall be considered in skid design.
- 4.6 The skid unit shall be coated according to standard specifications on coating.
- 4.7 All control tubing and wiring on the skid shall be completed and terminated at a central junction box at the skid boundary for connection to off skid equipment.
- 4.8 All electrical work like cabling, termination at the skid limit etc. shall be executed as per specification for Electrical Works for Skid Mounted Equipments.

#### 5.0 PREPARATION FOR SHIPMENT

- 5.1 Each skid mounted component shall be securely, anchored to the skid to prevent damage during shipment.
- 5.2 Instruments to be removed, as required by other relevant specifications, shall be tagged and crated in waterproof boxes constructed from 50mm (2-inch) lumber.
- 5.3 Instruments shall be packed with sufficient desiccant for protection in transit and during storage at job site. Boxes shall be securely attached to the skid for shipment.

5.4 All openings, flange faces, threaded connections, valve stems, and other component parts prone to mechanical damage or corrosion shall be adequately protected. Such protection shall consist of, but not be limited to, bolted wood or plastic flange covers, sealing with waterproof type tape, enclosing with temporary metal housing, and coating all machined and threaded surfaces with a rust preventive. This protection shall be applied to all components, those removed and boxed and those remaining in place on the skid assembly.

5.5 All piping and handrails removed for shipment shall be properly tagged and secured to the skid from which they were removed.

## 6.0 INSPECTION AND TESTING

6.1 Notice shall be given to the Company at least three (3) working days prior to the start of any of the following phases of fabrication:

### 6.1.1 Fabricated piping and vessels:

- a) When fabrication begins.
- b) When 50% of welding is complete.
- c) When welding is complete but before assembly except when assembly of unit will allow convenient weld inspection both internally and externally: and 100% radiography.

6.1.2 Assembled complete.

6.1.3 Ready for hydrostatic test.

6.1.4 Partially dismantled (if necessary) and properly prepared for shipment.

6.2 The following outlines, but does not limit, the scope of intended inspection, and the requisite duties of the fabricator and condition of components to enable the inspection at various phases to be performed.

### 6.2.1 Fabricated Piping:

- a) Before fabrication begins.
  1. Review welding procedure, specifications and welder performance qualifications.
  2. Check materials
  3. Check wall thickness.
- b) When welding of 50% of joint is complete:
  1. Perform internal and external visual inspection.
  2. Perform random or 100% radiograph inspection of completed welds as specified in the applicable specifications.
- c) When welding is complete:

Same as (b) for remaining work.

### 6.2.2 Assembled

- a) The assembly shall be completed except for covers on devices that would require removal for inspection of circuitry.
- b) Fabricator shall provide electrical power as required and instrument air test harness, if required, consisting of two (2) needle valves, bleed valve, pressure gauge and regulator assembled so as to apply a simulated pressure signal to device.

- c) Dimensional check shall be made on all inter-connecting piping components for tolerances compliance.
- d) Final inspection of complete unit with all mounted equipment and auxiliary systems in place, including those to be shipped loose, to check conformity to drawings/specifications.
- e) **Structural Inspection**
  - 1. Inspect structural members for compliance with specifications and drawings.
  - 2. Welding quality: Butt welded joints in main beams shall be examined by magnetic particle or other approved methods at the discretion of the inspector.
  - 3. Check for adequate compartment drains.
  - 4. Check piping and equipment supports.
  - 5. Check lifting lugs, slings and clamp.
- f) **Instrumentation Inspection**
  - 1. Check for compliance with specifications.
  - 2. Check installation.
  - 3. Check workmanship.
  - 4. Simulate Operation.
- g) **Electrical Inspection:**
  - 1. Verify that component quantities and description are compatible with requirements.
  - 2. Perform point-to-point continuity tests.
  - 3. Check all equipment for proper voltage, phase and frequency.
  - 4. Perform manual operation of all mechanical linkage for proper alignment.
  - 5. Energize all equipment, run motors with couplings disconnected, and perform operational test by causing relays, solenoids, etc., to function by simulation of control action to test integrity of circuit.
  - 6. Perform voltage test in accordance with NEMA standards for equipment involved.
  - 7. In cases involving explosion proof equipment, manufacturer shall not power seals but shall provide seal compound for installation by others.
  - 8. Verify that earthing points are installed properly.
- h) **Painting**
  - 1. Paint as per specifications.
  - 2. Check general appearance.
  - 3. Verify that paint has been removed, if necessary, from all control valve stems and other machined surfaces, instrument glass, name plates, flange faces and other items that are not supposed to be painted.
- i) **Hydrostatic Testing**
  - 1. Hydrostatic testing is not required for individual sections of fabricated piping unless specified.
  - 2. Piping on assembled skid units shall be pressure tested as per ANSI B 31.3.
  - 3. Test fluid shall contain sufficient ethylene glycol for protection if there is possibility of exposure to freezing temperature after assembly and in transit to job site.
  - 4. A corrosion inhibitor similar to Cessco Film Guard 205 shall be applied to the internal surfaces of all skid components.

j) **General**

1. The interior surfaces of all components shall be thoroughly cleaned. Slag from welding and cutting, weld flux, steel, dust and water and other debris shall be removed.
2. Check general appearance, workmanship and operability, such as correct height of push button stations, valves, etc.
3. Check safety hazards such as conduit runs above grating, burns on structural steel or handrails, etc.

6.2.3 Partially dismantled and properly prepared for export shipment:

- a. Check bill of material or packing list against all back-ordered and/or boxed items.
- b. Check for proper removal and packing for safe storage of dismantled components.



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## 1.0 INTRODUCTION

### 1.1 Scope

This specification covers the minimum requirements governing surface preparation, selection and application of the protective coating system to be used on the interior and exterior surfaces of all types of production facilities including structural steel, vessels, piping and equipment on offshore platforms.

Individual equipment specifications and /or drawings, when furnished, are to be used with these specifications. If conflict exists, the individual specifications and/or drawings shall govern. This functional specification is applicable for both green field projects/job as well as brown field projects/job.

It includes the requirements with respect to protection against corrosion of both Ferrous and non-ferrous metals of all types of production facilities including structural Steel, vessels, piping and equipment on offshore platforms, SBMs.

This specification also covers the performance-based coating standard and is Applicable to painting and coating, for new construction, modifications and Maintenance of offshore facilities. All paint and coating systems to be used shall meet the qualification requirements and the minimum coating system requirements as specified in this specification.

The coating systems to be used in accordance with this specification shall be Suitable for a Marine environment C5-M, High Durability (H) as specified in ISO 12944, NORSOK M-501 & NACE SP 0108.

### 1.2 Definitions

The following definitions shall apply:

COMPANY : Shall mean ONGC or the designated representative.

CONTRACTOR : Shall mean the party contracted to perform the work in accordance with the drawings, specifications and work scope.


## 2.0 CODES AND STANDARDS

### 2.1 Mandatory Statutory Requirements


This document has been prepared to the International Standards detailed within. The CONTRACTOR shall ensure that the Work is executed in accordance with international standards, Statutory & Regulatory requirements.

### 2.2 Codes and Standards & Regulations


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The requirements of the latest published versions of the following listed Codes, Recommended Practices. Specifications and standards shall be met.																																						
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<table><tr><td>ASTM A123</td><td>Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products</td></tr><tr><td>ASTM A153</td><td>Standard Specification for Zinc-Coating (Hot-Dip) on iron and Steel Hardware</td></tr><tr><td>ASTM D4228</td><td>Standard practice for qualification of coating applicators for application of coating on steel surfaces.</td></tr><tr><td>ASTM B117</td><td>Salt Spray Test</td></tr><tr><td>ASTM G8</td><td>Cathodic Disbonding Test</td></tr><tr><td>ASTM G50</td><td>Standard practice for conducting atmospheric corrosion test</td></tr><tr><td>ASTM G53</td><td>Weathering Test (Part B)</td></tr><tr><td>ASTM D520</td><td>Standard Specification for Zinc Dust Pigment (Metallic Zinc Powder)</td></tr><tr><td>ASTM D523</td><td>Specification for Gloss</td></tr><tr><td>ASTM D610</td><td>Standard Practice for evaluation degree of rusting of painted steel surfaces</td></tr></table>					ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products	ASTM A153	Standard Specification for Zinc-Coating (Hot-Dip) on iron and Steel Hardware	ASTM D4228	Standard practice for qualification of coating applicators for application of coating on steel surfaces.	ASTM B117	Salt Spray Test	ASTM G8	Cathodic Disbonding Test	ASTM G50	Standard practice for conducting atmospheric corrosion test	ASTM G53	Weathering Test (Part B)	ASTM D520	Standard Specification for Zinc Dust Pigment (Metallic Zinc Powder)	ASTM D523	Specification for Gloss	ASTM D610	Standard Practice for evaluation degree of rusting of painted steel surfaces														
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ASTM C 633	Test Method for Adhesive/Cohesive Sprayed Coating	Strength of Flame		
ASTM D1200	Viscosity			
ASTM D1640	Drying time			
ASTM D1653	Standard test method for evaluation of painted or quoted specimens subject to corrosive environment			
ASTM D2247	relative Humidity Test			
ASTM D2697	Volume of Solids			
ASTM D3359	Standard test method for measuring adhesion by tape test.			
ASTM D4060	Abrasion Resistance of Coating			
ASTM D4285	Standard Test Method for Indicating Oil or Water in compressed air			
ASTM D4417	Test Method for field measurement of surface profile of Blasted steel			
ASTM D4541	Test Method for Pull-off Strength of Coating Using Portable Adhesion Testers			
ASTM D4752	MEK Test for Testing of Zinc Silicate Paint			
ASTM D4940	Standard Test Method for conductometric Analysis of water soluble ionic contamination of Blasting Abrasive			
ASTM D5894	Standard test method for evaluating drying or curing during film. Corrosion resistance under cyclic condensation/UV			
ASTM D6386	Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting			
ASTM E119	Standard Test Methods for Fire Test of Building Construction and Materials.			
ASTM E1529	Standard Test Methods for Effect of Large Hydrocarbon Pool Fires on Structural Members and Assemblies			
2.2.3 Indian Standards (Latest Revision)				
IS 5	Colours for Ready Mixed Paints and Enamels			
IS 2379	Pipelines Identification Color Code			
2.2.4 British Standard (Latest Revision)				
BS 476: Part 20/21 Intumescent Coating				
BS 2569: Specification for Sprayed Metal Coating				
BS 3900 Part G7 Heat Resistance Test				
2.2.5 International Standards Organization (Latest Revision)				

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ISO –898	International Standard for Mechanical Properties of fasteners made of carbon steel and alloy steel
ISO –8501	International Standard for Preparation of Surface
ISO-8502-6	Preparation of steel substrates before application of paints & related products Tests for the assessment for surface cleanliness:-Part-6:Extraction of soluble contaminants Analysis: The Bressle Method
ISO –8504	Preparation of steel substrates before application of paints and related products
ISO 1461	Hot dip galvanized coating on fabricated iron and steel articles-Specification and test methods
ISO 14713	Protection against corrosion of iron and steel structure-zinc and aluminum coating.
ISO 4624	Adhesion test of paint
ISO 12944	A Global Corrosion standard
ISO 4628	Evaluation of degradation of paint coating
ISO 834	Hydrocarbon Resistance Design (PFP)
ISO 20340	Paints and varnishes – Performance requirements for protective paint systems for offshore and related structures.
ISO 4628-6	Paints and varnishes – Evaluation of degradation of paint coatings – Designation of intensity, quantity and size of common types of defect – Part 6: Rating of degree of chalking by tape method

2.2.6 Occupational Safety and Health Act


OSHA	Occupational Safety and Health Act
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2.2.7 NACE Standards (Latest Revision)

NACE SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE Standard RP0287	Field Measurement of Surface profile Measurement of abrasive blast cleaned steel surfaces using a replica tape.
NACE RP0198	The control of Corrosion Under Thermal Insulation & Fire Proofing Materials-A System Approach
NACE Standard RP 0176-2003	Corrosion control of Steel Fixed Offshore Platforms Associated with Petroleum Production
NACE SP 0108	Corrosion control of Offshore Structure by protective coating
NACE 012	Specification for Application of Thermally Sprayed Coatings (Metallizing) of Aluminum, Zinc, and Their Alloys and Composites for the Corrosion Protection of Steel

2.2.8 Underwriters Laboratories

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UL1709	Hydrocarbon Fire Resistant Design (PFP)
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2.2.9 NORSOK Standard

M-501	Surface Preparation and Protective coating
M-001	Material Selection

2.2.10 American Welding Society (AWS)


AWS C.2.17	Recommended Practice for Electric Arc Spray
AWS C.2.18	Guide for Protection of steel with Thermal Spray Coating of Aluminium ,Zinc and Their alloys and composites
AWS C.2.23	Specification for Application of Thermally Sprayed Coatings (metalizing) of aluminium ,Zinc and Their alloys and composites for corrosion protection of steel

2.2.11 RAL 840 HR ACQPA: COLOUR CHART


2.2.12 Abbreviations and Definitions

APAS	Australian Paint Approval Scheme
ASTM	The American Society for Testing and Materials
C	Coating Thickness of metallic Zn (HDG coating)
COT	College of Occupational Therapists, (UK)
CP	Cathodic Protection DFT Dry Film Thickness
CPS	coating procedure specification
CPT	coating procedure test
CSDS	coating system data sheet
DFT	Dry Film Thickness
GRP	Glass Reinforced Plastic (fiber glass)
HB	High Build Epoxy
HDG	Hot-Dip Galvanized
HP	High Pressure (as in Water Washing at pressures above 300 Bar)
ITP	Inspection and Test Plan µm Micron
IMO	International Maritime Organization
ISO	International Organization for Standardization
MSDS	Material Safety Data Sheet
MEK	methyl ethyl ketone
MSC	Maritime Safety Committee
NACE	National Association of Corrosion Engineers
NSF	National Science Foundation
OH&S	Occupational Health and Safety
PFP	Passive Fire Protection
PIG	Paint Inspection Gauge

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PPE	Personal Protection Equipment			
PSPC	Performance Standard for protective Coatings			
QA	Quality Assurance as defined by ISO 9001 and 9002 Quality Systems			
QC	Quality Control of production processes by activity			
RH	Relative Humidity			
S/S	Stainless steel Supplier			
UHP WJ	Ultra High Pressure Water Jetting (> 2000 Bar)			
UL	Underwriters Laboratories			
VOC	volatile organic compound			
WB-IZS	Water Borne - Inorganic Zinc Silicate			
WFT	Wet Film Thickness			
<b>3.0 GENERAL</b>				
<b>3.1</b> Selection of Coating systems and application procedure shall be made with due consideration to conditions during fabrication, installation, and service of Installation.				
All painting activities shall be incorporated in the fabrication plan.				
Details of Management, Inspectors, operators, facilities, equipments and qualified procedures shall be established and document before commencing work.				
Following items shall not be coated unless otherwise specified.				
<ul style="list-style-type: none"><li>Fibre-glass</li><li>plastic or other non-metallic finish</li><li>Equipments, valves, etc. having factory coated finish</li><li>Indicators</li><li>Sprinklers, fusible plugs and fire detectors</li><li>Control Valve Stems</li><li>Stainless Steel Control Panels</li><li>Stainless Steel Tubing and pipe – work</li><li>Cupro-Nickel (CuNi) pipe work</li><li>Glass Reinforced Epoxy (GRE) pipe work</li></ul>				

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<p>The following specific items shall not be coated and shall be protected from blasting and coating being applied to adjacent equipment</p>				
<ul style="list-style-type: none"><li>Bearings and seals</li><li>Flange mating faces, Raised Face (RF) and Ring Type Joint (RTJ) and flat faced</li><li>Instrument dials and/or cases</li><li>Cable trays and cables</li><li>Level gauge glasses</li><li>Nameplates Shafts and similar polished or machined surfaces Instrument Tags and Valve Position.</li></ul>				
<p>3.2 Standard Coating</p>				
<p>The manufacturer’s standard coating shall be used for the following equipment</p>				
<ul style="list-style-type: none"><li>Indoor electrical equipment</li><li>Instrument and control panels</li><li>Insulated rotating equipment</li></ul>				
<p>3.3 Equipment Cleaning</p>				
<p>The following equipment shall be cleaned with biodegradable, water soluble cleaner and an epoxy primer shall be applied (tie-coat) to the manufacturer’s standard coatings prior to the specified intermediate coat.</p>				
<ul style="list-style-type: none"><li>Fan and blower housing</li><li>Outdoor electrical equipment</li><li>Engines and electric motors</li><li>Pumps, compressors and other non-insulated rotating equipment</li><li>Control and relief valves</li></ul>				


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Equipment shall be recoated as specified if the coating system applied by equipment manufacturer/packager does not comply with this specification or if coating repairs is necessary.				
<b>3.4 Flanges</b>				
Flanges on piping and valves (including control and relief valves) shall have a primer coat applied to bolt holes and the non-contact area of the face prior or being made-up. After make-up of these connections intermediate and finish coats shall be applied. Flanged ends shall have a finish coat as required in this Specification. Flange faces must not be coated.				
<b>3.5 Piping Spools</b>				
Primer and intermediate coatings and finish coat as per clause 13.2.2 shall be applied to spools pre-fabricated for offshore installation. If these spools have an end prepared for field welding, the coatings shall stop 150 mm from the prepared end.				
<b>3.6 Seal Welding</b>				
Where enclosed or inaccessible areas cannot be adequately painted, the areas shall be completely enclosed and seal welded. Small areas inaccessible to blasting and painting that cannot be boxed by welding shall be filled with epoxy mastic, caulking compound or other suitable filler to prevent retention of dirt and moisture.				
<b>3.7 Overspray</b>				
Adjacent structures, equipment and all other items shall be protected from blasting, overspray and drips with tarpaulin, plastic, tapes etc.				
<b>3.8 Nozzles Through Insulation</b>				
Flanged nozzles, man ways, platform clips, saddles and other attachments that extend through insulation shall be coated in accordance with the coating schedule for equipment and piping.				
<b>3.9 Coated Bolts</b>				
Galvanized bolts, studs and nuts, where used to bolt up piping, valves etc. or otherwise used to connect painted items, shall receive a top coat of paint over exposed areas after the connections are made. And shall be top coated with anti rust grease.				
<b>4.0 SAFETY</b>				
Safety conditions shall be met, as required by the Occupational Safety and Health Act (OSHA) or other governing bodies, as well as those that are the deemed necessary.				

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Particular care must be exercised when working in close or confined spaces, especially when spraying. The maximum allowable concentration of solvent in the air shall not be exceeded. Refer to the manufacturer's recommendations to determine the ~~maximum allowable~~ concentration value. When volatile solvents are flammable, the concentration in air shall be kept below 25 percent of the lower explosive limit by use of adequate exhaust or ventilation facilities.

### 5.0 ENVIRONMENTAL REQUIREMENTS

The contractor will recognize COMPANY's commitment to preserving the environment and shall comply with local codes and standards for transporting, storing, and disposing of hazardous materials and hazardous wastes.

Upon completion of the job, the contractor shall notify the COMPANY of the volume and type of hazardous waste generated.

Upon completion of the job, all non-hazardous wastes, such as empty paint cans, clothes blasting abrasives and equipment, shall be removed by the contractor from the job sites and properly disposed.

### 6.0 SURFACE PREPARATION

#### 6.1 General

The surface preparation procedures and requirements except for galvanizing and cadmium plating shall be in accordance with Steel Structural Painting Council (SSPC) - SP5, SP6, SP7 & SP10 and ISO-8501-1.


All fabrication and assembly shall be completed before surface preparation is taken up. Blast and application of coating to structural and piping items prior to assembly will be permitted provided surface preparation for splice ends are taken up by portable blasting tools before application of prime coat. All field splice surface preparation for Structure & Piping Items shall be carried out using portable blasting tools at field. All welding slag, weld spatters and burrs shall be removed prior to blasting. All bolt holes shall be drilled and their edges smoothed prior to blasting.

**First step of surface preparation:** Solvent cleaning is to be taken up for any surface preparation.


**Second step of surface preparation:** Steel surface shall be blast cleaned to develop specific anchor pattern/profile to develop efficient bond between paint & steel surface using blasting tool or portable blasting tools for all Structural, Piping & Pressure Vessel items.

Surface preparation for Equipment, Equipment Manufacturer's procedure shall be submitted for approval of Company.


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<p>In case of modification work on Old Platform or Maintenance work, portable blasting tool shall be used for surface preparation. However, use of Power Tool / Hand Tool cleaning methodology can be used with approval of Company establishing constraint in use of portable blast tool and shall be applicable for specific location (not for as whole of the work/project) only.</p>				
<h3>6.2 Requirements of Blasting</h3> <p>Only dry blasting procedures are allowed. Definitions of and requirements for, the various methods of surface cleaning are given below:</p> <ul style="list-style-type: none"><li>A. White Metal Blast: As per SSPC SP5 &amp; visual reference Sa3 as per ISO 8501-1.</li><li>B. Near-White Blast: As per SSPC SP10 &amp; visual reference Sa2.5 as per ISO 8501-1.</li><li>C. Commercial Blast: As per SSPC SP6 &amp; visual reference Sa2 as per ISO 8501-1.</li><li>D. Brush-off Blast: As per SSPC SP7 &amp; visual reference Sa1 as per ISO 8501-1</li></ul>				
<h3>6.3 Pre Blasting preparation</h3> <h4>6.3.1 Rough Edges</h4> <p>Sharp edges, fillets, corners and welds shall be rounded or smoothened by grinding (minimum radius 2 mm).Hard surface layers (e.g. resulting from flame cutting) shall be removed by grinding prior to blast cleaning according to ISO 8501-3, Grade-3.</p> <p>All surfaces should be washed with clean fresh water prior to blast cleaning.</p> <p>Any major surface defects, particularly surface laminations or scabs detrimental to the protective coating system shall be removed by suitable dressing. Where such defects have been revealed during blast cleaning, and dressing has been performed, the dressed area shall be re-blasted to the specified standard. Surface pores, cavities etc. shall be removed by suitable dressing or weld repair.</p>				
<h4>6.3.2 Weld Flux and Spatter</h4> <p>Weld flux, slag spatter, slivers etc. shall be ground smooth before blasting. Welding surface imperfections shall be removed and surface profile shall be prepared as per ISO 12944-3.</p> <p>Any surface on which grinding is done shall be spot blast cleaned or power tool cleaned to obtain required anchor pattern.</p> <p>All welds shall be inspected and if necessary repaired prior to final blast cleaning of the area.</p>				

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6.3.3 Surface Cleaning				
Prior to blasting, all deposits or grease or oil shall be removed from the surface in accordance with SSPC-SP1 Solvent Cleaning using biodegradable water soluble cleaner.				
6.3.4 Chemical Contamination				
All chemical contamination shall be neutralized and/or flushed off prior to any other surface preparation.				
6.3.5 Equipment Protection				
Items such as motors, machined surfaces, gauges, electrical and instrumentation items tags and nameplates, stainless steel galvanized steel, aluminum, brass, plated surfaces etc. shall be protected to prevent damage or contamination during blasting or painting.				
Prior to blasting, openings on engines, pump, vessels, piping etc. shall be effectively sealed to prevent abrasive entering and damaging internal components. All packaged equipment shall be covered and special care taken to cover and seal all instrumentation.				
6.4 Blasting Operations				
6.4.1 Weather conditions				
Blast cleaning shall not be done on any surface that is moist, or that may become moist, before the application of a primer.				
No blasting is permitted when the steel temperature is less than 3°C above the dew point, as measured by a sling hydrometer, or when the relative humidity of the air is more than 85 %.				
6.4.2 Preliminary Blasting				
If blasting is performed at night, the surfaces shall be re-blasted the following day to provide the specified surface preparation standard and the anchor profile required for the specified coating system.				
6.4.3 Blasting and Painting				
Blasting shall not be done adjacent to painting operations or coated surfaces that are not fully dry. Blasting shall overlap previously coated surfaces by at least 150 mm.				
6.4.4 Post – Blasting Procedure				

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The surface to be coated shall be clean, dry, free from oil/grease, and have the **specified anchor pattern/ roughness** and cleanliness until the priming coat is applied. Blast cleaned steel surfaces shall not be touched by bare hands.

Chloride contamination shall be checked **on the blasted steel surface prior to coating application** using Salt Contamination Meter - SCM 400 / **Bresle** patches / Quantab strips. Maximum permissible limit shall be 20 mg/m<sup>2</sup> for external surface & 50 mg/m<sup>2</sup> for internal of vessels.

**Testing of soluble chloride ion content shall be carried out at least on each component, once per 200m<sup>2</sup> and a minimum of three times per shift during the progress of work. Special attention shall be given to areas where water has been trapped and dried out.**

The blast cleaned surface shall be rendered dust free and coated with the specified primer as soon as possible to avoid formation of oxidation on the surface, but **in any case within four hours from the time of blasting**, and at least one hour prior to sunset on the same day. Any steel surface not primed within these limits or that is wet shall be re-blasted.

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

All areas around the intended paint surface shall be cleaned of sand prior to coating. Drains shall be purged of sand and flushed.

Biodegradable water – soluble cleaning solution used to clean previously painted surfaces shall not lift softens or otherwise damages the existing coating.

6.5 Blasting Equipment

6.5.1 Compressed Air

The air compressor shall be capable of maintaining a minimum of 700 kpa (7 kg/cm<sup>2</sup> or 100 psi) air pressure at each blasting nozzle.


The compressed air supply shall be free of water and oil. Adequate separators and traps shall be provided on the equipment, which shall be regularly purged of water and oil to maintain efficiency.

6.5.2 Nozzle


The nozzle shall be a 10 mm (maximum) internal diameter venture style nozzle.

6.5.3 Power Tools (Use can be permitted with specific approval for specific location)


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<p>Power tools may be used to obtain a metal surface finish as per SSPC SP11 where blasting is not possible, or on items which might be damaged by blasting.</p>				
6.5.4 Shot Blasting Equipment				
<p>Shot blasting equipment may be used for specific applications. Shot shall be changed as required to maintain the angular profile requirement.</p>				
6.6 Blasting Abrasive				
6.6.1 Abrasive				
<p>The abrasive shall be as per SSPC-AB-1. The abrasives shall be copper slag, steel balls, garnet or coal slag and shall be free of contamination of dust and chlorides to produce the required anchor profile and graded as to be free from clay, silt or other matter likely to become embedded in the steel surface. Abrasives which have a tendency to shatter and adhere or embed in the steel surface shall not be acceptable. Recycled abrasive shall not be used. Use of silica sand is not permitted.</p>				
6.6.2 Shot Blasting Material				
<p>Shot blasting material shall pass through a 16 mesh screen. At least 15% steel grit shall be mixed with the graded shot to remove any rust, scale or other impurities pined into the surface by the shot. Shot blasting material is limited to iron, steel or synthetic shot which is applied by compressed air nozzles or centrifugal wheels. Shot blasting material shall be checked at least two times a week for replacement of abraded material.</p>				
6.6.3 Alternative methods of Surface Preparation				
a) For Blast Cleaning				
<p>Power Tool Cleaning shall be confined to minor areas.</p>				
<p>Unless otherwise specified it shall be carried out in accordance with the requirement of ISO 5404-3. Power Tool Cleaning (grinding) to bare metal shall be done in accordance with SSPC SP-11.</p>				
<p>If Power Tool Cleaning is not feasible the surface cleanliness shall as a minimum, meet visual standard PSt3 in accordance with ISO 8501-2 at the time of coating. Care shall be taken to ensure that Power Tool Cleaning does not polish the steel surface. Hand tool cleaning is permitted prior to Power Tool Cleaning. If the surface being prepared lies adjacent to a coated surface the Power Tool Cleaning shall overlap the coated surface at least by 25 mm and the coated surface shall be feathered.</p>				

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b) Centrifugal Abrasive Blasting: [Applicable for all local / field splice for structural & Piping Items]				
A portable blasting machine using recyclable steel abrasive may be used to prepare steel decks and tank floors.				
c) Vacuum Blasting				
Vacuum Blasting may be used for spot repair of damaged or corroded area. It may be used in locations where open abrasive blasting is not permitted or desirable.				
d) Wet abrasive blasting				
Wet abrasive blast cleaning techniques may be used to avoid dust or in cases where fire and/or explosion risks are present. The cleaned surface should be washed off immediately after blast cleaning using fresh water. Corrosion inhibitors should not be used or only after written approval of the Principal. Corrosion inhibitor such as mass fraction 0.3 % sodium nitrite with mass fraction 1.2 % ammonium phosphate may be used to prevent flush rust, but Chromate inhibitors shall not be used. Corrosion inhibitor shall not be discarded into the sea. The paint Manufacturer shall approve the use of any inhibitor and the method for removing inhibitor residues before painting. The cleaned surface shall be dry at the time of painting. Particular care shall be taken to dry areas which are not self-draining, so that water collected is removed.				
e) Water Jetting				
High-pressure and ultrahigh-pressure water jetting may be used where abrasive blasting is not permitted because of the risk of damage to process equipment. Water jetting is restricted to maintenance painting. It is a hazardous operation and requires the use of well-trained, experienced operators. Where black spots occur in pits or other surface defects, the surface shall be cleaned again at higher pressure to remove the residual salts. Corrosion inhibitors should not be used or only after written approval of the Principal. Corrosion inhibitor such as mass fraction 0.3 % sodium nitrite with mass fraction 1.2 % ammonium phosphate may be used to prevent rust flash, but Chromate inhibitors shall not be used. Corrosion inhibitor shall not be discarded into the sea. The paint Manufacturer shall approve the use of any inhibitor and the method for removing inhibitor residues before painting.				
The cleaned surface shall be thoroughly dry at the time of painting. Particular care shall be taken to dry areas which are not self-draining, so that water collected is removed.				
7.0 COATING APPLICATION				
7.1 General Application				

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All application, inspection and safety procedures shall be carried out in accordance with SSPC Painting Manuals, Vol. 1 Chapter 14.2 and Vol. 2 Chapter 5) and as set out below.				
<b>7.1.1 Supply and Storage</b>				
<p>All coatings shall be furnished, mixed and applied in accordance with manufacturer's recommendations and as specified herein. Mixing of different manufacturer's coating applications on the same surface is not permitted.</p> <p>All coating materials and thinners shall be in original, unopened containers being the manufacturers label batch numbers and instructions. For materials having a limited shelf life, the date of manufacture and the length of life shall be shown. Materials older than their stated shelf life shall not be used.</p> <p>Materials shall be stored in accordance with the manufacturer's recommendations.</p> <p>Coating materials that have gelled, other than thixotropic materials or materials that have deteriorated during storage shall not be used.</p>				
<b>7.1.2 Pot Life</b>				
<p>If the coating requires the addition of a catalyst, the manufacturer's recommended pot life for the application conditions shall not be exceeded. When the pot life is reached, the spray pot shall be emptied, cleaned and a new material catalyzed. Manufacturer's recommendations to be followed</p>				
<b>7.1.3 Mixing</b>				
<p>Mixing and thinning directions as furnished by the manufacturer shall be followed. Only thinners specified by the manufacturer shall be used.</p> <p>All coating materials shall be stirred with a power mixer use, until the pigments, vehicles and catalysts are thoroughly mixed and then strained while being poured into the spray pot. During application the materials shall be agitated according to the manufacturer's recommendations.</p> <p>Different brands or types of paints shall not be intermixed.</p>				
<b>7.1.4 Unblasted Surfaces</b>				
<p>Coating shall not be applied within 75 mm of an unblasted surface.</p> <p>A 300 mm wide strip of uncoated, blasted surface shall be left between primed and unblasted surfaces, so as to prevent damage to the newly dried coating when additional blasting is done.</p>				

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### 7.1.5 Application Requirements

A Coating procedure test (CPT) shall be used to qualify all coating procedures. A suitable location on the component to be coated may be selected on which the CPT shall be carried out. Alternatively, a test panel (minimum 1 m x 1 m) containing at least 1 pipe-end (1500mm long& 50 mm Ø., 1 angle and 1 flat bar (1500 mm in length)may be used for other coating systems. The coating procedures shall be qualified under realistic conditions likely to be present during coating. Selection of coating systems and application procedures shall be made with due consideration to conditions during fabrication, installation and service of the installation.

### 7.2 Cleanliness

All Surfaces shall be clean free from dust and dry. Any blast cleaning dust or grit remaining on the surfaces shall be removed by means of compressed air before priming or application of any coating. Any surface with a rust bloom shall be re-blasted as per ISO: 8504.

#### 7.2.1 Temperature

**Coating shall only be applied when the temperature of the steel is at least 3°C above the dew point,** ambient air temperature must be within the limits specified by the manufacturer.

#### 7.2.2 Weather Conditions

**No coatings shall be applied during fog, mist or rain or when humidity is greater than 85% or on to wet surfaces.** In case the minimum temperature at the fabrication yard is below 5°C, the contractor shall propose alternate coating procedure for Company’s approval at the bidding stage itself.

The company has the right to suspend application of coating when damage to the coating may result from actual or impending weather condition.


When Relative Humidity (RH) is less than 60%, Zinc rich Epoxy Primer shall be used in instead of Inorganic Zinc Silicate as per recommendation of manufacturer and with prior approval of the company.

#### 7.2.3 Coats

Each coat shall be applied uniformly and completely over the entire surface. Each coat shall be allowed to dry for the time specified by the manufacturer before the application or a succeeding coat. To reduce the possibility of intercoat contamination and to assure proper adhesion between successive coats, all coats shall be applied as soon as possible after the minimum specified drying time of the preceding coat.

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### 7.3 Brush Application

#### 7.3.1 General Requirements

A **stripe coat** shall always be applied by brush. The stripe coat shall be applied for each coat to all edges, corners, welding seams, bolt holes, back side of piping, stiffeners, vent and drain holes, notches and any other area that is difficult to reach by spray gun & where spraying may not be effective.

The colour of the stripe coat shall be different from the previous or subsequent coat.

Inorganic zinc primer coatings shall not be applied by brushing, not even for touch – up repairs.

#### 7.3.2 Equipment for Brush Application

Brushes shall be of a style and quality that will permit proper application of coating. Round or oval brushes are most suitable for rivets, bolts, irregular surfaces and rough or pitted steel. Wide flat brushes are suitable for large flat areas. Brush width shall not be greater than 100 mm. No extension handles shall be used on brushes.

#### 7.3.3 Procedure for Brush Application

Rounding of Edges and surface preparation shall be done as per Clause No. 6.3.1 of this Specification prior to brush application.

(a)

Brushing shall be done so that a smooth coat, uniform in thickness, is obtained. There shall be no deep or detrimental brush marks.

(b)

Paint shall be worked into all crevices and corners.

(c)

All runs and sags shall be brushed out to prevent air pockets, solvent bubbles or voids.

(d)

When applying solvent type, coatings, care shall be taken to prevent lifting of previous coats.


#### 7.3.4 Finish Coat

An additional layer of finish coat shall be hand brushed at edges, corners, welds and hard-to-spray areas to eliminate holidays in the final coats.


### 7.4 Spray Application

#### 7.4.1 Equipment


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<p>(a) All equipment to be used for spray applications shall be inspected and tested before application begins.</p> <p>(b) All equipment shall be maintained in good working order and shall be equal to that described in the manufacturer's instructions.</p> <p>(c) All equipment shall be thoroughly cleaned before and after each use and before adding new material.</p> <p>(d) An adequate moisture trap shall be installed between the air supply and each pressure pot. The trap shall be of the type that will continuously bleed off any water or oil from the air supply.</p> <p>(e) Suitable pressure regulators and gauges shall be provided for both the air supply to the pressure pot and the air supply to the spray gun. Spray equipment and operating pressures shall comply with the recommendations of the manufacturer.</p> <p>(f) The length of hose between the pressure pot and spray gun shall not exceed 15 m.</p>				
<p>7.4.2 Procedures</p> <p>(a) Pressure pot, material hose and spray gun shall be kept at the same elevation where possible. When spraying inorganic zinc, the elevation difference shall not exceed 3m.</p> <p>(b) The spray gun shall be held at right angles to the surface.</p> <p>(c) Each pass with the spray gun shall overlap the previous pass by 50%.</p> <p>(d) The spray width shall not exceed 300 mm.</p> <p>(e) All runs and sags shall be immediately brushed out or the surface re-coated.</p> <p>(f) Large surfaces shall receive two passes (except when applying inorganic zinc) at right angles to each other (crosshatched).</p> <p>(g) The coated surface shall be checked for chloride contamination before application of subsequent coating. When surface are encountered with chloride contamination soluble salt removers shall be used before application of coatings.</p>				
<p>7.4.3 Airless Spray Equipment</p> <p>(a) Airless spray equipment may be used for applying epoxy or aliphatic polyurethane coatings.</p>				

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(b) The manufacturer's recommendations in selection and use of airless spray equipment shall be followed				
7.4.4 Field Welds				
No coating shall be applied within 150 mm of edges prepared neither for field welds nor to surfaces waiting non-destructive testing.				
7.4.5 Tie/Sealer Coat				
After application of Inorganic zinc Silicate primer, a tie/sealer coat of 25-35 µm DFT of polyamide epoxy on top of Primer coat shall be applied in order to seal porous surface of the zinc primer as per recommendation of the Manufacturer.				
7.5 Roller Application				
Roller application is permitted for paint materials where this is the manufacture's recommended method of application, such as for deck paints containing non-skid material. The manufacturer's recommended procedures shall be used.				
7.6 Over spray and Drip Protection				
Appropriate protection of buildings, structures and equipment from drips and spray and shall be provided to all equipment and facilities.				
7.7 Safety Equipment				
Appropriate safety equipment shall be provided for blasters, painters and other workers involved in the preparation and application of coating systems as per recommendation of paint manufacturer. Work areas shall be adequately ventilated.				
7.8 Handling and shipping of coated items				
Coated items shall be carefully handled to avoid damage to coated surfaces. No handling shall be performed before the coating system is cured to an acceptable level. Packing, handling and storage facilities shall be of non-metallic type.				
8.0 REPAIR OF DAMAGED AREAS				
All areas of paintwork that are locally damaged during transportation, handling or erection shall be repaired as specified below:				
Prior to the application of any re-coat, damaged coatings shall be removed, preparing the surface and reapplying the protective coat(s).				

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Following steps of repair shall be followed for damaged painted / coated areas.

### 8.1 Repair Procedure for Damaged coating

Surfaces where coating is damaged after application of the finish coat shall be repaired as follows;

#### 8.1.1 Top Coat

The top coat damaged, but base coat undamaged and the metal substrate is not exposed:

- (a) Damaged coating shall be removed with a hand file and abraded back to the sound coating using emery paper or a fine grinder.
- (b) The damaged area shall be wiped with a suitable solvent to remove debris. The periphery of repair area shall be feathered back for a minimum distance of 25 mm into the adjacent undamaged coating by light abrasion or grinding to produce a smooth chamfered surface profile.
- (c) Apply a new topcoat as specified.

#### 8.1.2 Base Coat

Coating damaged to base metal


- (a) The damaged area greater than 0.2m<sup>2</sup> in area, the surface of exposed metal shall be prepared to the original specified standard prior to repairing by power tool cleaning as per SSPC-SP3 or spot blasting to SSPC-SP5 and applying primer, intermediate coat and final coat as specified. Alternatively, high solid surface tolerant epoxy coating may be used in place of primer & intermediate coats, followed by specified topcoat
- (b) The damaged areas less than 0.2 m<sup>2</sup> in area may be repaired as per manufacturer's recommendation or by preparing the surface of exposed metal by power tool cleaning as per SSPC-SP11 to the original specified standard.

A primer, intermediate and final coat shall be applied as specified. Alternatively, high solid surface tolerant epoxy coating may be used in place of primer & intermediate coats, followed by specified topcoat. Brush application is acceptable. Even appearance and smooth feathering into surrounding coating in addition to correct dry film thickness and holidays must be achieved. Coating and surrounding repaired areas shall not be damaged and complete tie-in of the coating with surrounding areas shall be obtained. Zinc based products shall not be applied without Blast Cleaning to Sa 2 ½, instead Surface tolerant epoxy @ 100 microns shall be used as a primer in case blast cleaning is not possible or practical.


## 9.0 GALVANIZING

### 9.1 Galvanizing Standard

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<p>All steel grating, stair treads, handrails, ladders and other items specified as being galvanized shall be hot-dipped after fabrication in accordance with ASTM A123. Iron and steel hardware materials shall be hot-dip galvanized in accordance with ASTM A153.</p>				
<p>9.2 Surface Preparation</p> <p>All welding slag and burrs shall be removed. Surface contaminants and coatings, which cannot be removed by the normal chemical cleaning process in the galvanizing operation, shall be removed by abrasive blast cleaning.</p> <p>Steelwork shall be prepared in accordance with the requirements of ASTM A123 and/or ASTM A153.</p>				
<p>9.3 Zinc Coating Weight</p> <p>The weight of zinc coating on structural items shall be <b>minimum 0.705 kg/m<sup>2</sup></b> surface area. The composition of the zinc used in the galvanizing bath shall not be less than 98% zinc.</p>				
<p>9.4 Surface Finish</p> <p>The galvanized coating shall be continuous, adherent, as smooth and as evenly distributed as possible and free from any defect that is detrimental to the end use of the coated component. On 'silicon killed' steels, the coating may be dully gray, provided the coating is sound and continuous.</p>				
<p>9.5 Welding</p> <p>Galvanized members, that are to be permanently fixed by welding, shall be attached after the supporting members are primed, but before topcoats are applied. The heat affected area of the supporting structure shall be cleaned of all welding flux, the surface prepared and the coating reinstated. Grinding of edges prior to welding shall be permitted to reduce zinc oxide fumes formed during welding and eliminate the potential for weld porosity to occur. Adequate ventilation shall be provided and in confined spaces a respirator shall be used.</p>				
<p>9.6 Damaged Items</p> <p>All damage to galvanized items caused by fabrication, welding, handling and loading out of installation shall be reinstated.</p>				
<p>9.7 Reinstatement of Damaged Surfaces</p> <p>Repaired surfaces shall present the same appearance as adjacent galvanized areas and have approximately the same weathering characteristics as the galvanized surface.</p>				
<p>9.8 Painting Galvanized Surfaces</p>				

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All galvanized structural members shall be painted with coating system **13.7**. All galvanized surfaces shall be degreased, fresh water washed and treated as per SSPC SP1. It will then be sweep blasted and coated with surface tolerant epoxy – F8 as primer or compatible Epoxy primer followed by respective coating systems.

9.9 Painting Aluminium Helideck

**a) For Blast Cleaning**

All areas to be thoroughly cleaned with strong detergents and high pressure water to remove all traces of oil or grease. Aluminum oxide to be used as blasting media, abrasive size to be 60-80 mesh, surface profile 25-50 micron. Nozzle pressure to be 4-5 bars. During blasting nozzle movement should be continuous to avoid positional high density as aluminum is a soft metal.

For spot repairs after painting no spot blasting is recommended, positional rectification by mechanical tool cleaning shall be done. Part by part blasting and priming is preferable than one time area blasting and priming as it is difficult to identify oxidation over aluminum surface.

**b) For Power Tool Cleaning**

All areas to be thoroughly cleaned with strong detergents and high pressure water to remove all traces of oil or grease. 3M abrasive flap of 35or 60 meshes for electrical or pneumatic rotor grinding machine to be used for roughening the surface. It is preferable to prime the surface within 4-5 hours after cleaning to avoid oxidation over cleaned surface. Part by part blasting and priming is preferable than one time area blasting and priming as it is difficult to identify oxidation over aluminum surface.

9.10 Painting stainless steel (wherever applicable):

Stainless steel Handrails and ladders in the splash zone as specified in bid shall be coated as under:

- i. Surface preparation: Sweep blasting with non-metallic and chloride free grit to obtain anchor profile of approximately 25 µm to 50 µm.
- ii. Top coat: Two component epoxy- minimum 350µm DFT.

Also as per recommendation of paint manufacturer.

**10.0 INSPECTION AND TESTING PLAN (ITP)**

10.1 Quality Control

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Procedures for testing and documenting quality control shall be prepared prior to the initial start up of any work covered by this specification & submitted to company for approval. The procedures shall include methods to assure the specification requirements are complied. Further, environmental conditions, surface temperature, coating applicator, surface(s) being coated and coating applied and status of required examinations and tests shall be documented.

Testing and inspection shall be carried out in accordance with Table-10.2. Surfaces shall be accessible until final inspection is carried out.

ITP shall include breakup of various activities, estimated time, duration for each activity. Time duration for painting activity wise is to be included in the in the planning package of the fabrication yard and adhere to the painting schedule during fabrication of structure in the yard.

Following inspection activities shall be included in the Inspection and Test Plan (ITP) furnished in Table 10.2.

## 10.2 Inspection and Testing requirements


Requirement for Inspection & Test Plan for Equipment, Pressure Vessels and Package items shall be followed as specified in respective Discipline Design Criteria or Specification

**Table 10.2.1 - Inspection and testing requirement**

Test type	Test Method	Test Frequency	Acceptance criteria	Consequence
Environmental conditions	Ambient and steel Temperature. Relative Humidity. Dew point.	Before start of each shift + minimum twice per Shift.	In accordance with specified requirements	No blasting or coating
Visual examination	Visual for sharp edges weld spatter slivers, rust grade, etc.	100 % of all surfaces	No defects, see specified requirements	Defects to be repaired
Cleanliness	a) ISO 8501-1 b) ISO 8502-3	a) 100 % visual of all surfaces b) Spot checks	a) In accordance with specified Requirements b) Maximum quantity and size rating 2	a) Re-blasting b) Re-cleaning and retesting until acceptable
Salt test	ISO 8502-6 and ISO 8502-9	Spot checks	Maximum conductivity Corresponding to 20 mg/m <sup>2</sup>	Repeated washing with potable water and retesting


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			NaCl for External surface and 50mg/m <sup>2</sup> for internal surface of Vessel.		until acceptable
Roughness	Comparator or stylus instrument (see ISO 8503)	Each component or once per 200 m <sup>2</sup>	As specified		Re-blasting
Curing test (for Zn silicate).	ASTM D4752	Each component or once per 100 m <sup>2</sup>	Rating 4-5		Allow to cure
Visual examination of coating	Visual to determine curing, contamination, solvent retention, pinholes / popping, sagging and surface defects	100 % of surface after each coat	According to specified requirements		Repair of defects
Holiday detection	NACE RP0188 and as per note -1 below	As per coating system specification	No holidays		Repair and retesting.
Film thickness	ISO 19840. Calibration on a smooth surface	ISO 19840	ISO 19840, and coating system data sheet		Repair, additional coats or recoating as appropriate
Adhesion	ISO 4624 using equipment with an automatic centred pulling force, and carried out when coating system are fully cured	Each component or once per 200 m <sup>2</sup>	*See note-2 below		Coating to be rejected
Paint Material Inspection	Company appointed Inspector / representative shall physically verify paint material with respect to Test Certificate, data sheet, Batch Number, Date of Manufacture, date of expire and accept the Paint material.				
Surface preparation & Priming Coat application	Company appointed Inspector/ representative shall physically verify & record the surface preparation anchor pattern, record of surface salt acceptability and clear for priming coat application. Record of Temperature, Humidity and Dew point Temperature shall be recorded at the time of Start, at time interval Duration of Priming coating application and at completion time.				
Application intermediate coating	Company appointed Inspector/ representative shall carryout physical verification of coating application at random.				
Final coating application	Company appointed Inspector/ representative shall carryout physical verification of coating application at random.				
Final coating acceptance	Company appointed Inspector/ representative shall physically verify & record coating thickness, other field test and accept the coating.				
*Note:					

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1. Holiday Testing (Detection of pinholes)

Holiday testing shall be conducted in accordance with NACE SP0188. For immersion and splash zone services, 100% of the coated areas shall be inspected for holidays. For atmospheric services, 10% of the coated areas, which include weld seams, corners, and edges, shall be holiday detected. Any holiday is unacceptable and shall be marked and repaired according to spot repair procedures. Lined vessel shall be marked clearly in black letters on vessel surface: "LINED VESSEL - HOT WORK PROHIBITED".

Pinhole testing for electrically non-conductive coatings shall be carried out in accordance with NACE RP0188 for splash zone coatings, internal tank coatings and the external coatings of buried tanks, vessels and piping. The high voltage technique shall be used; nominally set at 5 V/μm based on NDFT, or as agreed with the paint Manufacturer but not exceeding 25 kV in total. For coatings that are < 500 μm DFT, the wet sponge technique may be used if approved by the company.

2. Adhesion test

Adhesion test shall be carried out on separate test plates, adhesion values in accordance with ISO 4624 shall be minimum 5.0MPa when using automatically centered test equipment.

10.3 Role of Paint Vendor Representative

The Contractor shall have to ensure that the Authorized technical-representative of the paint Manufacturer shall be qualified in accordance with NS 476 Inspector level II or certified as NACE coating inspector level II and physically inspects the painting / coating applications including surface preparation.

The Authorized technical representative of the paint Manufacturer shall have relevant knowledge of health and safety hazard, use of protection equipment, coating materials, mixing and thinning of coatings, coating pot-life, surface requirements, etc.


Paint manufacturers inspector /supervisor present in the fabrication yard shall be qualified according to NS 476 Inspector level-I, or certified as NACE coating inspector level-I and may carry out the inspection work under the guidance of an inspector level-II.

10.4 Qualification of Contractor's QC personnel at Fabrication Yard (Inspectors, supervisors, foremen)

The contractor's quality control inspector shall be qualified as a coating inspector in accordance with NS 476 Inspector level II or NACE level-II.

The contractor's quality control inspector shall qualify the tradesman level as blast-cleaner, painter, and applicator etc. for painting application.

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The personnel shall have relevant knowledge of health and safety hazard, use of protection equipment, coating materials, mixing and thinning of coatings, coating pot-life, surface requirements etc.

Contractor shall carry out tests in accordance with the painting Specification, relevant Codes & standards for all coating systems applied as per clause 13.0 that are planned to be used for this project before commencement of painting work.

Contractor shall generate Painting application document & inspection report item wise specifying date & time of application for each step of painting with test record.

The test shall be carried out on a test panel in compliance to ISO 4624.

The acceptance criteria are the requirement to the visual and non – destructive inspection of the coating system described in this specification # section 10.2. Operators failing to meet the requirement shall not be allowed to carry out the work on this project.

**10.5 Qualification of passive fire protection operators**

Operators including pump machine operator, shall be qualified, trained and certified according to the manufacturer’s procedures. Before any stud welding, the welders and the procedures to be used shall be qualified in accordance with the coating manufacturer’s procedures.

If the operators or stud welders have not been working with the type of application or material within a period of 12 months, the applicator shall document that necessary supplementary training have been given before start of any work.

**10.6 Equipment and Material**


Materials, tools or equipment used in the surface preparation and coating applications, shall be inspected regularly and rejected if they do not comply with the Specification.

**10.7 Inspection of Instruments**

The following items shall be inspected using the inspection instruments listed below:

Instrument Item	Inspection Instrument
Surface Profile	Keane-tator Surface Profile Comparator or Testex Press-o-Film Elcometer 124 with 122 testex tape
Holidays	Tinker – Razor Model M – 1
Surface Cleanliness	SSPC – Vis – 1
Viscosity	Zahn Viscometer or Ford Cup
Wet Film Thickness(WFT)	Nordson Wet Film Thickness Gauge

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	Sheen WFT Gauge	
Temperature & Humidity	Gardner Certified Hydrometer Indicator	and Temperature
Surface Temperature	Pandux Surface Temperature Thermometer Elcometer Surface temperature gauge	
Compressed Air Quality	Dry white cloth	

10.7.1 Calibration of Equipment

Each test instrument shall be maintained and calibrated as prescribed by the manufacturer.

10.7.2 Dry Film Thickness

The dry film thickness of the coating system shall be determined in accordance with SSPC-PA2 or by a Microtest thickness gauge (ISO 2178) or comparable instrument in accordance with the following procedure.

(a) Ten readings shall be taken for every 10m<sup>2</sup> of painted areas.

(b) 90% of all readings shall be within the specified dry film thickness.

(c) Where thickness accordance with the above procedure fall below the specified minimum an additional coat of the intermediate or finish coat shall be applied.

10.8 Repair

All work not done in accordance with this specification shall be redone or repaired as per coating system 13.10.

10.9 Maintenance


For maintenance of previously coated surfaces, the condition of the existing coating and the surfaces shall be checked using suitable methods, e.g. ISO 4628, to determine whether partial or complete repainting should be carried out. The type of surface preparation and protective paint system shall then be specified. The paint manufacturer should be consulted for recommendations. Test areas may be prepared to check the manufacturer's recommendations. Coating system 13.11 shall be followed for maintenance work.

10.10 Role of Company Representative / Company appointed TPI /CA


Refer Table 10.2

10.11 Surface preparation, Coating application & field Test Report


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<ul style="list-style-type: none"> <li>Contractor shall generate Painting application &amp; inspection report item wise (to be painted) for each activity of painting (surface preparation, priming, tie coat, 1<sup>st</sup> coat &amp; final coat as applicable) specifying date &amp; time of application. <del>A daily record shall be maintained</del> with following as minimum: <ul style="list-style-type: none"> <li>(a) Air Temperature at the start, finish of the work and at intermediate stage.</li> <li>(b) Relative Humidity &amp; dew point during application period (at interval of time).</li> <li>(c) surface roughness/ anchor profile,</li> <li>(d) Coating Material details &amp; batch number (for traceability),</li> <li>(e) Salt test, chloride contamination</li> <li>(f) Dry film thickness applied &amp; Identification of areas coated</li> <li>(g) Results of required field tests carried out.</li> <li>(h) Paint progress/ time lapse between coats.</li> </ul> </li> </ul> <p>These reports generated shall be documented in Construction Dossier in original and submitted to Company with PDF Copy.</p> <p><b>11.0 PAINT MATERIALS:</b></p> <p>The coating manufacturer shall provide a Coating System Data Sheet (CSDS) for each coating system to be used, containing at least the following information for each of the primer, intermediate coat (s) and topcoat product:</p> <ul style="list-style-type: none"> <li>Product name</li> <li>Colour</li> <li>Material type</li> <li>Batch numbers, Part A &amp; B</li> <li>Manufacturing Date</li> <li>Shelf life</li> <li>Volatile organic compounds (VOCs) (g/l)</li> </ul>				


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<ul style="list-style-type: none"><li>Cleaning Solvent</li><li>Thinner Type</li><li>Maximum percentage of thinner content by volume</li><li>Mixing ratio by volume or weight</li><li>Application method</li><li>Application temperature range (°C)</li><li>Application RH range (%)</li><li>Induction time (minutes)</li><li>Minimum recoat and dry to touch time (hours@ temperature)</li><li>Maximum recoat time (days @temperature)</li><li>Solids content by weight and/or volume</li><li>WFT Range (µm)</li><li>DFT Range (µm)</li><li>Pot life (hours@ temperature)</li></ul>				
<p>Paint manufacturer shall furnish all the characteristics of paint materials on printed literature, along with the <b><u>test Certificate with actual test values of supplied batch for all the specified characteristics given in the specifications.</u></b></p> <p>Paint Material inward &amp; traceability (location used) shall be maintained. These records shall be documented in Construction Dossier and submitted to Company.</p> <p>All the paint materials shall be of first quality and conform to the following general characteristics are furnished below:</p> <p>Table -11.1: Required <b>Characteristic of Paint Materials</b></p>				


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Descript ion	Technical name	Type and composition	Volu me of solids (appr x.)	DFT (Dry film thickn ess) per coat (appr x.)	Theoreti cal coverin g capacit y in M /coat/litr e (approx. )	Wei ght per litre in kgs/ litre (ap prox )	Tou ch dry at 25° C (ap prox .)	Har d dry at 25° C (ap prox .)	Over coating Interval (approx .)	Pot life (ap prox .) 25° C	Resis tance to dry temp eratur e	
1	2	3	4	5	6	7	8	9	10	11	12	
F-1	Epoxy MIO High build finish paint	Two pack polyamide cured epoxy, pigmented with lamellar micaceous iron oxide	80 ± 5%	100-125u	As per supplier s data	1.4	3 hou rs	Ove rnig ht	Min. : Overnight Max. : as recomm ended by manufac turer	2 hrs.	90°- 120° C	
F-2	Self -priming surface tolerant High build Epoxy coating	Two pack epoxy resin based suitably pigmented	80 ± 5%	100-125u	As per supplier s data	1.4	3 hou rs	24 hou rs	Min. :10 hours Max: as recomm ended by manufac turer	90 mint s	90°- 120° C	
F-3	Inorganic zinc-silicate coating SSPC SP-20, Level-II, containing 80±3% zinc in dry film by weight & zinc as per ASTM D520 Type-II	A two pack air drying self -curing solvent based Inorganic Zinc silicate coating.	65 ± 5%	65-75u	8-9	2.3	30 mts	less than 6 hou rs	Min. 16-24 hours Max. as recom mende d by manufa cturer	2 to 4 hou rs	400° C	
F-4	Organic zinc rich epoxy coating SSPC SP-20, Level-II, containing 80±3% zinc in dry film by weight & Zinc as per ASTM D520 Type-II	Two pack epoxy resin based zinc primer	65 ± 5%	65-75u	As recom mende d by manufa cturer	2.5	75 mts	less than 6 hou rs	Min. ; 6 hours Max. ; as recom mende d by manufa cturer	5 hou rs	90- 120° C	

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F-5	Heat resistant Aluminum paint based on Moisture Curing Silicone Binder	Single pack moisture cured silicon resin based medium with aluminum flakes	40±5 %	20-25u	As recommended by manufacturer	1.1	30 mts	1-2 hours	Min. ; 6-12 hours Max. ; as recommended by manufacturer	Not applicable	Upto 600° C																
F-6	Epoxy Phenolic based Tank Lining (see note-1)	Two Pack Epoxy Phenolic Based	60±5 %	125 u-150µ	As per suppliers data	Min 1.4	5 hours	8 hours	Min. ; 8 hours Max. ; as recommended by manufacturer	As recommended by manufacturer	Upto 200° C																
*F-7	Epoxy Passive fire protection (PFP)		100%	As per risk analysis Study report & as recommended by manufacturer																							
F-8	Extra High Build Epoxy	Two pack polyamide/Pol yami ne cured epoxy resin	100± 5%	2500 µm	As per suppliers data	Min 1.9	8 hours	Ove rnig ht	Min. 4 hrs Max. As recommended By manufacturer	30 minutes	140° C																
F-9	Glossy Aliphatic Acrylic Polyurethan e Topcoat	Two Components Aliphatic Acrylic Polyurethane	60±5 %	65-80 µm	As per suppliers data	--	1.5 hours	6 hours	Min. 6 hours Max. ; As per suppliers data	1 hour	90° -120° C																

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F-10	Solvent free epoxy for Drinking / potable water tanks (see note-2)	A Two pack solvent free epoxy tank coating for drinking water	100%	250-300µm	As per suppliers data	--	6 hrs	12 hrs	Min. ; 10 hours Max. ; 40 hours	1 hour	Upto 60°C
F-11	Ultra High Build glass flake Epoxy	A Two component glass flake Epoxy coating	96%± 2%	600-1000 µm	As per suppliers data	--	Refer Product Data Sheet	Refer Product Data Sheet	Refer Product Data Sheet	Refer Product Data Sheet	90-100 °C
F-12	Pure epoxy pigmented with aluminium (see note-3)	A Two component Pure epoxy coating pigmented with aluminium	60%± 2%	100-200 µm	As per suppliers data	---	3 hours	6 hours	7 hours -14 days	2.5 hours	---
F-13	Low volume solid epoxy primer As recommended by paint manufacturer	A Two pack epoxy solvent free epoxy tank coating for drinking water	47%± 2%	40 µm	As per suppliers data	---	30 minutes	8 hours	As recommended by supplier	8 hours	--
F-14	Sealer coat TSAC As recommended by paint manufacturer	Used as Sealer for TSAC Operating temperature >120°C	30%	15-25 µm	--	---	20 minutes	2 hours	As recommended by supplier	--	--
F-15	One coat of fast curing solvent less UV -resistant polyester resin (Isophthalic based reinforced with glass flakes.	Glass flake reinforced unsaturated Polyester coating	96%± 2%	600-1500 µm	As per suppliers data	--	2 hours	2 hours	As recommended by supplier	45 minutes	90-100 °C
<b>Note:</b>											
1. IMO PSPC COT Resolutions MSC. 288 (87)											

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2. APAS Approved to specification 0213, 2974F & 2974P / UL Certified in accordance to NSF/ANSI 61. [In case of water tank constructed using stainless steel SS316L, tank internal coating is not required.]


3. Approved for PSPC for water ballast tank according to IMO Res. MSC 215 (82)

12.0 APPROVED VENDOR’S RECOMMENDED LIST OF PAINT MATERIALS


Table-12.1: Approved Vendor’s Paint products

Description	Area of application	Berger Paints Ltd., India	Shalimar Paints, India	Carboline, USA (CDC) Carboline, India	Sigma Coatings (PPG Coatings), USA	Hempel, Denmark	Amercoat (PPG Coatings), USA	Jotun Coatings, Norway / Jotun India Pvt Ltd	KCC Corporation, Korea	International Brand (AKZO NOBEL), UK	Chokupaints, Singapore	Excel India Paints, India
1	2	3	4	5	6	7	8	9	10	11	12	13
F-1 Epoxy MIO High Build finish	Exterior surface of steel <120°C	Epilux 455 HB MIO	epiguard XL	Carboguard 893 MIO	sigma cover 410 (MIO)	Hempadur Mastic 45880/1W / 47550	Amercoat 383 HS / 410 (MIO)	Penguard Midcoat MIO	Korepox EH2350	Interseal 547/ Intergard 475 HS	Univan MIO	EXL GUARD 495
F-2 Self-priming surface tolerant High build Epoxy	Maintenance Painting	Barger Protectomastic RPL	epiplus 56	Carbomastic 615	Sigma Cover 630 / 620	Hempadur Mastic 45880/1W / 47550	amerlock 400 / 400C	Jotamastic 80/Jotaprime mastic 80	Korepox Primer EP 1760	Interseal 547/ Interseal 670 HS	Umeguard HS	EXL GUARD 680
F-3 Inorganic zinc silicate coating SSPC SP-20, Level-II, containing minimum 80% zinc in dry film by weight & zinc as per ASTM D520 Type-II	Primer coat Relative Humidity > 60%	Zinc anode 304 Coating	tuffcote zilicate -IZS	cabozinc 11	Sigma Zinc 158	Hempel's Galvosil 15780	dimetecote 9	Resist 78/Resist 804A	Galvany IZ 180 (N)	Interzinc 2280	Galbon S-HB	EXLZINC 113


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1	2	3	4	5	6	7	8	9	10	11	12	13																
F-4 Organic zinc rich epoxy coating SSPC SP-20, Level-II, containing minimum 80% zinc in dry film by weight & Zinc as per ASTM D520 Type-II	Primer coat When Relative Humidity < 60% & Primer for repair work	Epilux ZR HB Primer	Epigard 4	Carbozinc 858	Sigma zinc 109 HS	Avantguard 1736 G	Amercoat 68 HS	Barrier 80	Korepox Zinc Rich Primer EZ 175	Interzinc 52	-	EXLZINC 108																
F-5 Heat resistant Aluminum paint based on Silicone Binder	Temperature >400° C For equipments	Lumerous HR143	lustotherm 600	Thermaline 4700 aluminium	Sigmatherm540	Hempel's Silicon aluminium 56914	Amercoat 878 HS	Solvalitt	Yeolcoat QT 606	Intertherm 50	-	EXLTHERM HR600																
F-6 Epoxy Phenolic based Tank Lining	Internal lining of Diesel & crude oil tank	Epilux 9 HB Phenolic Coating	HB finish	Phenoline 187 VOC	sigma guard 730	hempadur 85671	Amercoat 90 HS	Tankguard storage	Kophenol EH2630	Interline 850	-	EXLLINI 965																
*F-7 Epoxy (PFP) (See note-2 below)	Protection of platform from pool and jet fire	-	-	Pyroclad X1	PITT-CHAR XP	Hempafire Pool 200	PITT-CHAR XP	Jotachar JF 750/Jotachar 1709	Firemask 3200	Chartek-7/ Chartek-7E/ Chartek-1709	-	EXLINTUMESCENT 447																


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1	2	3	4	5	6	7	8	9	10	11	12	13																
F-8 Extra High Build Epoxy	Steel plated helideck, walkways, escape route & laydown area	-	-	Carboguard 1207	Sigmashield 1090	Hempel's Spray Guard 35490/3	Tideguard 171	Jotacote UHB	Korepox H.S.EH3200	Interzone 485	-	EXL GUARD-991UHB																
F-9 Glossy Aliphatic Acrylic Polyurethane Topcoat	Finish coat for UV protection & required colour	Bergerthane Acrylic PU Coating	Shalithane HB rich	Carbothane 134HG	Sigmadur 550 / 585	Hemphane topcoat 55910/55610/55210	Amercoat 450 Series	Hardtop XP/Futura OS	Korethan Topcoat UT6581	Interthane 990/ Interthane 990 SG	-	EXLTHANE 570																
F-10 Solvent free Epoxy	Internal lining of potable water tank	Epilux 155 SF	-	Carboguard 703	Sigma Guard CSF 650 / 585	Hempadur 35530/35531	Amercoat 391 PC	Tankguard 412	Korepox H.B.EH3100	Interline 925	-	EXLLINE-989SF																
F-11 Ultra High Build glass flake Epoxy (Splash Zone)	Protection of structure in splash zone	Steel shield 1100	Tuffkote Epishield ST glass flake epoxy	Carboguard 1209	Sigmashield 905 / 880GF	Hempadur Multistrength 35870	Amerlock 400GF	Marathon XHB	Korepox H.B.EH3200 (GF)	Interzone 1016	Permax no.3000 S	EXL GUARD- 890GF																

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Description	Area of application	Berger Paints Ltd., India	Shalimar Paints, India	Carboline, USA (CDC) Carboline, India	Sigma Coatings (PPG Coatings), USA	Hempel, Denmark	Amercoat (PPG Coatings), USA	Jotun Coatings, Norway / Jotun India Pvt Ltd	KCC Corporation, Korea	International Brand (AKZO NOBEL), UK	Chokupaints, Singapore	Excel India Paints, India
1	2	3	4	5	6	7	8	9	10	11	12	13
F-12 Pure epoxy pigmented with aluminium	Internal lining of ballast water/salt water tank	.	.	Carbomastic 615A	Sigmacover 280	Hempadur uniq 47741/4774 D	Amercoat182ZP	Jotacote universal alu./ Jotacote universal N10	Korepox EH2030	Intershield 300	.	EXLGUARD- 343
F-13 Low volume solid epoxy primer As recommended by paint manufacturer	Used as Sealer/ Tie coat for TSAC & Over Zinc silicate primer Operating temperature <120° C	.	.	Carboguard 893ZP	Sigmacover 522/246	Hempadur 05990/15553/15570	Amercoat 182 ZP/71 TC	Penguard tie coat 100 /Penguard primer	Korepox Holding Primer EP 1700	Intergard 269	.	EXLGUARD- 247
F-14 Aluminium silicone sealer/tie coat As recommended by paint manufacturer	Used as Sealer for TSAC Operating temperature >120° C	.	.	Thermaline 1248 E	Sigmatherm 540	Hempel's Silicon aluminium 56914	Amercoat 878	.	.	Intertherm 50/ Intertherm 972	.	EXLTHERM-530

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Note:

1. The paint materials indicated in the table are indicative only and may be updated. Bidder is to select & procure latest paint material from the list of the recommended list of paint manufacturers meeting the DFT requirement of paint.

2. \*Epoxy (PFP) installed on the platform shall be Tough, durable and resistant to impact and vibration damage. Thickness of coating shall be based on risk analysis study report and fire safety measures to be taken to mitigate hydrocarbon and jet fire as per ISO 22899 jet fire certification up to 2 hours and NORSOK M-501. FIRE RATING shall implement based on safety study carried out in compliance to API 14J & API RP 2A.

3. Contractor to verify the latest status of availability & applicability of products before consideration and report their intention of change within the above listed vendors with proper reasons.

13.0 PROTECTIVE COATING SYSTEMS

13.1 SCOPE

Manufacturer's recommendations and latest product of paint shall be used to suit the environment conditions and for the intended purpose shall be followed. Care must be taken to achieve the specified dry film thickness indicated in the bid. **Items to be painted covered by these specifications are as follows:**

13.2 Section A: New Construction of offshore structure.

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**13.2.1 Coating System No.1:** Atmospheric Zone-I: Thermally sprayed aluminium coating shall be applied for items having service life of 10 years or longer which are :

13.2.1.1 exposed to seawater & not easily accessible for inspection or maintenance:-

- i) structural Steel items, piping, piping supports etc. **above splash zone** upto & including **Bottom plating of cellar deck**,
- ii) Conductors, Pump & Sump Caisson.
- iii) bottom framing beams & plating of Main Deck
- iv) bottom chord of Bridge including bottom of plating , piping .piping supports etc
- v) Boom of pedestal crane
- vi) Steel framing supporting helideck above main deck and upto and including bottom of steel helideck.

TSAC is not required for bottom of aluminium pancake.


13.2.1.2 Exposed to operating temperature > 120 °C as heat resistance paint.

- i) Flare Stack/vent boom


13.2.1.3 :Table for TSAC System

Application	Surface Preparation	Coating System	DFT
<b>Coating System No.1A</b> All carbon steel surfaces exposed to operating temperature > 120 °C. • Flare Stack/vent boom.	Cleanliness: SSPC –SP5/ Sa 3 Surface Profile: Minimum 75 µm	Thermally sprayed Aluminium or alloys of aluminium with sealer coat as top coat. *Sealer: (F-14)	225 µm (Min value 200 µm & Max value 250 µm ) For sealer, see Note- 1
<b>Coating System No.1B</b> All carbon steel surfaces exposed to atmosphere & operating temperature < 120 °C. • Jacket above splash zone up to and including Cellar Deck bottom surface including bottom of deck plating, primary & secondary beams etc. • Main deck bottom surface including bottom of deck plating, primary & secondary beams etc.	Cleanliness: SSPC-SP5/ Sa 3  Surface Profile: Minimum 75 µm	Thermally sprayed aluminium or alloys of aluminium with sealer, intermediate coat and final coat as top coat  *Sealer: (F-13) *Intermediate Coat (F-1) *Final Coat(F-9)	225 µm (Min value 200 µm & Max value 250 µm ) See Note- 1 : Sealer Coat Note- 2: Intermediate Coat Note- 3: Final coat

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<table border="1"> <tr> <td> <ul style="list-style-type: none"> <li>Bottom chord of bridge connecting offshore platforms including bottom of deck plating</li> <li>Steel framing supporting helideck above main deck and upto bottom of helideck below aluminium pancake &amp; bottom of steel helideck plating</li> <li>boom of pedestal crane</li> </ul> </td> <td></td> <td></td> <td></td> <td></td> </tr> </table>					<ul style="list-style-type: none"> <li>Bottom chord of bridge connecting offshore platforms including bottom of deck plating</li> <li>Steel framing supporting helideck above main deck and upto bottom of helideck below aluminium pancake &amp; bottom of steel helideck plating</li> <li>boom of pedestal crane</li> </ul>							
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<p><b>*Note-1:</b> All metallized surfaces shall be sealed in accordance with the following requirements: The sealer shall fill the metal pores. It shall be applied until absorption is complete. There should not be a measurable overlay of sealer on the metallic coating after application.</p> <p>The materials for sealing the metal coating shall be:</p> <ul style="list-style-type: none"> <li>Two-component epoxy for operating temperatures below 120 °C (F-13).</li> <li>Aluminium silicone above 120 °C (F-14).</li> </ul> <p>Volume solids in the sealers when applied shall be 15 % nominal. The overlay of sealer should be less than 38 µm (1.5 mil) on the TSA coating after application.</p> <p>The sealer should have a contrasting color to the TSA to aid visual inspection.</p> <p><b>*Note-2:</b> Intermediate coat over TSAC shall be applied as per coating system no.2</p> <p><b>*Note -3:</b> Final coat TSAC shall be applied as per coating system no.2</p> <p>Application of Thermally Spread Aluminium Coating (TSAC) is specified in Clause No. 14.0.</p> <ul style="list-style-type: none"> <li>Repair, field coating of pipes and coating of in-fill steel</li> </ul> <p>All requirements, including adhesion, applicable to metal spraying, shall apply.</p> <p>The treating and handling of the substrate shall be done in such a manner that the product in its final condition will have a continuous and uniform coating. Before the metal spraying operation starts, the area 30 cm to 40 cm in distance from the weld zone shall be sweep-blasted to ensure that all contamination is removed. The uncoated welding zone shall be blast Cleaned as specified for coating system no. 1.</p> <p><b>13.2.2 Coating System No.2: Atmospheric zone - II except for zone specified under coating system no. 1</b></p> <table border="1"> <thead> <tr> <th>Application Area</th> <th>Surface Preparation</th> <th>Coating System</th> <th>Coating DFT Range</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>					Application Area	Surface Preparation	Coating System	Coating DFT Range				
Application Area	Surface Preparation	Coating System	Coating DFT Range									

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Carbon steel with operating temperature < 120 °C – Structural steel, Exteriors of equipment, vessels, piping and valves (not insulated) in Atmospheric Zone <b>except for zone specified under coating system no. 1</b>	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900 /ISO 8501-1 surface profile : 40-60 µm Max.	Primer Coat: Inorganic zinc silicate primer (F-3)	65 - 75 µm
		Sealer Coat/tie coat: Low volume solid epoxy (F-13) as recommended by paint manufacturer	25 - 30 µm
		Intermediate coats: Two coat of high build epoxy (F-1) with MIO pigments	100 – 125 µm (each coat)
		Finish Coat: One Topcoat of Gloss Aliphatic Acrylic Polyurethane (F- 9)	65 - 80 µm
		Total DFT µm	355-435 µm

Notes:

1. This system is applicable for carbon steel surface with operating temperature less than 120° C.

2. Colour for final coat shall be as per colour code.

### 13.2.3 Coating System No.3: Protection of Carbon Steel in Submerged & Splash Zone

Application	Surface Preparation	Coating System	Coating DFT Range
Coating System No.3A: Submerged Zone <ul style="list-style-type: none"><li>• PLEM, SSIV and Riser clamps, etc.</li></ul>	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 Surface profile: 40-60 µm Max.	two coat epoxy based primer with aluminium pigment (F-12)	100-125µm (each coat) Total 200 µm min.
Coating System No.3B: Splash zone: Jacket, Boat landing, Barge Bumper, conductors, Riser & Conductor Protector, clamps, etc.	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 Surface profile: 75-100 µm Max.	Two coats of Ultra High Build Glass Flake Epoxy Coating (F- 11)	750 µm (each coat) Total 1500 µm min.

### 13.2.4 Coating System No.4: Galvanizing


All grating, handrails, ladders, safety cages shall be hot dip galvanized as per ASTM 123 & misc. hardware shall be hot dip galvanized ASTM A153. Galvanizing shall preferably be done after cutting shaping and welding has been done. The weight of zinc coating for grating, handrails, ladders, safety cages shall be minimum **705 gm** per square meter (**coating thickness of 100 µm**).

The weight/thickness of zinc coating for iron and steel hardware shall be as per ASTM A153.

The galvanized surface shall be free from bare spots, dross pimples, Lumpiness and runs, flux inclusions and slag inclusions.

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13.2.5 **Coating System No.5: Painting of All Galvanized items (as per 13.2.4) except gratings & Aluminium Helideck shall coated as below:**

Application	Surface Preparation	Coating System	DFT in $\mu\text{m}$
All Galvanised items and Aluminium Helideck painting for marking, lettering, etc.	SSPC SP1 & etched chemically with etch primer or physically by sweep blast cleaning with non-metallic and chloride free grit to SSPC SP7/Sa1. Cleaning with alkaline solution followed by hosing with fresh water as per SSPC SP1. surface profile : 25-50 $\mu\text{m}$	Low volume solid epoxy primer suitable for aluminium & galvanized surface. (F-13)	Minimum 50 $\mu\text{m}$
		Intermediate coat: Two coat of high build epoxy with MIO pigments. (F- 1)	100 $\mu\text{m}$ (each coat)
		Finish Coat: One coat of aliphatic polyurethane. (F-9)	Minimum 75 $\mu\text{m}$
			Minimum DFT 325 $\mu\text{m}$

13.3 **SECTION B: New Construction: Process vessels and piping, valves, manifolds, pumps, heat exchangers and related equipment**

13.3.1 All submersible type pumps protective coating system shall be as per manufacturer's standard which shall be suitable for Marine environment. Holiday test shall be carried out on protective coatings of all equipment as per NACE SP 0188.

13.3.2 Piping & other equipment


For Piping & other equipment made up of Carbon Steel Material, Protective coating system shall be followed as per Clause No. 13.2.2.

13.3.3 **Flanges**

Flanges on equipment to be installed on offshore platforms shall be coated with the protective coating system given in 13.2.2 except for the seal surface. Care shall be taken to prevent damage of ring and gasket seal surface by covering during the blasting and coating. After the coating has cured, an anti-rust grease coating shall be applied to protect the seal surface. Apply a minimum dry film of an anti-rust grease coating as per MIL-C-161730 Amendment, 2, Grade 1 Qualified Products List.

A corrosion control material (such as inhibitor grease) should be installed correctly initially after the flange has been assembled on the offshore structure. The bolt holes and flange crevices shall be sealed off completely from the offshore corrosive environment.

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Commercially available viscous sealants, such as soft and low-molecular-weight polyolefin sealants or corrosion inhibitor greases, should be injected into the flange crevice. The sealants are very hydrophobic. A polymeric tape or SS tape should then be wrapped around the flange to enclose the flange crevice completely.

Petrolatum or wax tapes may be used for ambient to moderate temperature service applications in accordance with the product manufacturer's specification.

For maintenance, the entire flange should be overwrapped with a commercial petrolatum or wax tape, which is made of polyester felt impregnated with very hydrophobic petrolatum or wax to provide encapsulation against water. Visual inspection cannot be conducted without unwrapping the tape. However, the flange shall be wrapped again after the inspection. Tape shall be replaced if the encapsulation is broken.

All Painted Nut bolts used for flanged/bolted connection shall be protected from corrosion by providing Protective caps with inhibited grease as per recommendation of the vendor.

**13.4 SECTION C: COMPRESSORS, GAS TURBINES, GENERATORS, ENGINES, MOTORS, INSTRUMENTS AND PANEL BOARDS**


Equipment in covered/enclosed areas shall be coated as per Equipment manufacturer's standards coating suitable for offshore environment as specified in respective Specification wherever provided in Bid, otherwise Protective System given in 13.2.2 shall be followed.

All skid surfaces which can be cleaned by blasting shall be coated with one of the protective system given in 13.2.2. Protect critical moving parts, bearing surfaces, machined surfaces, nameplates, glass next to machinery, etc. from entrance of blasting dust and damage from blasting by masking with polyethylene sheeting and masking tape. Equipment in enclosed areas shall be protected with the same paint systems as for exterior surface. Panel boards shall be disassembled before cleaning and coating.

**13.4.1** When equipment manufacturer's coating is unsatisfactory and blast cleaning is not permissible. Clean and protect as follows:

- Remove coating by use of a paint and varnish remover.
- Surface preparation; solvent cleaning (SSPC-SPI) followed by power tool cleaning (SSPC-SP3 or St3) or of SIS-05-5900.
- One coat of (F-2) Self priming surface tolerant epoxy coating @ 125 Microns DFT/Coat minimum (maximum DFT-150 microns)
- Top Coat – 2 coats (F-1) High build epoxy MIO coating cured with Polyamide/polyamine hardener @ 125 microns DFT/Coat minimum (maximum DFT – 150 microns/coat) = 2 X 125 =250 microns.

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e. Finish Coat- One Topcoat of (F- 9) Gloss Aliphatic Acrylic Polyurethane 60-80 micron dry film thickness

Total DFT: Minimum: 435 microns, Maximum: 530 microns.

13.4.2 When equipment manufacturer's shop primer is sound and blast cleaning is not permissible, clean and top coat as follows (where finish coat has to be done at the yard):

- a. Surface preparation: Solvent cleaning (SSPC-SPI), followed by power tool cleaning (SSPC-SP) or St 3 of SIS-05-5900.
- b. Apply one coat of (F-2) Self priming surface tolerant epoxy coating @ 125 Microns DFT/Coat minimum (maximum DFT-150 microns)
- c. Top coat: as per 13.4.1 (d) above.

13.4.3 Painting System applicable for Equipment having surface temperature between 110°C (230°F) and 400° C (752°F), clean and protect as follows.

- a. Surface Preparation: Near white metal shot/grit blasting as per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501 –1:2001 with a 40 – 60 microns anchor pattern. Items with metal to metal joints shall be seal welded prior to blasting and coating when possible or dismantled following all fittings and welding to obtain blasting and coating of the joint surfaces
- b. Apply 1 coat inorganic zinc silicate primer coating (F-3) @ 65-75 Microns DFT minimum (maximum – 75 microns).
- c. Apply 2 coats (F- 5) of Heat resistant silicon aluminum finish paint @ minimum 20 microns DFT per coat = 2 X 20 = 40 microns (maximum 2 X 25 = 50 microns).

Total DFT: 105 Microns minimum: 125 microns maximum.

**Note** : coating having operating temperature less than 120 degree shall be coated as specified in respective Discipline Spec.

13.4.4 Equipment with surface temperature above 400°C (752°F),

- a. Surface Preparation: Near white metal shot/grit blasting as per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501 –1:2001 with a 40 – 60 microns anchor pattern. Items with metal to metal joints shall be seal welded prior to blasting and coating when possible or

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dismantled following all fittings and welding to obtain blasting and coating of the joint surfaces

**b. Apply 2-3 coats of Heat resistant silicon aluminium finish paint (F-5) (maximum 3 X 20 µm – 25 µm).**

Total DFT: 60 µm minimum: 75 µm maximum.

**13.5 SECTION D: Internal Surfaces of Tanks and Process Piping/SPM**

**Vessels/**

**13.5.1 Coating System No.6: Coating of Internal Surfaces of Tanks and Process Vessels/Piping/SPM**

Application	Surface Preparation	Coating System	DFT in µm
System No.6A: Salt Water Service (ballast tanks/internal sea water filled compartments)	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 Surface profile: 60-85µm Max.	*Two coats of Epoxy pigmented with aluminium (F-12) (See Note-3)	150 µm (each coat) Total Min DFT 300 µm.
System No.6B: Hydrocarbon Services: all internal surfaces of Welded tanks handling hydrocarbons/diesel.	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 Surface profile: 50-85µm Max.	*Two coats of Phenolic Epoxy (F-6) (See Note-1)	125 µm – 150 µm (each coat) Total Min. DFT 250 µm.
System No.6C: Fresh Water Services: all internal surfaces of Welded tanks handling potable water having NSF Certificate	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 Surface profile: 50-85µm Max	Two coats of Solvent free Epoxy. (F-10) (See Note-2)	250 µm – 300 µm (each coat) Total Min DFT 500 µm

\*Note-1: Certified to NSF / ANSI Standard.


\*Note-2: Paint shall be tested and certified according to AS/NZS4020:2005 or UL classification in accordance with ANSI/NSF Standard for potable water.

Note-3: Paint shall be for PSPC for water ballast tank according to IMO Res .MSC 215.

Note-4: Paint System 6C: Potable Water Tank made up of SS316, internal surface painting is not required.

Note-5: Paint System 6B: Pressure vessel internal painting shall be followed as per respective Spec of the item provided in the bid. In case, respective specification do not have specific requirement then Paint System 6B is to be followed.

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Note-6: Internal Surfaces of Tanks shall be coated as per intended use specified in this specification and respective Discipline Specification provided in the Bid.

13.6 **SECTION- E: Carbon steel Metal buildings**

13.6.1 **Equipment Skid**

Structural Steel: Method of surface preparation and acceptable coatings shall be followed as per Coating system No.2 Section – A (13.2.2).

Piping/Mechanical & Process: As per Section – B (13.3)

13.6.2 Structural Framing/Sheeting/Plating: Method of surface preparation and acceptable coatings shall be followed as per Coating System No.2

13.6.2.1 Exposed portions: Method of surface preparation and acceptable coatings shall be followed as per Coating system No.2 except Walkways, escape routes and lay down areas.

13.6.2.2 Unexposed portions covered by insulation, wall Panels, false roofing/ceiling and false flooring:

**Coating System No.7: Painting of Unexposed portions**


Application	Surface Preparation	Coating System	DFT in
Portions covered by insulation, wall Panels, false roofing and false flooring)	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 surface profile: 40-60 µm Max.	Primer Coat: Inorganic zinc silicate primer (F-3)	65 -85 µm
		Sealer Coat/tie coat: One coat of low volume of epoxy Primer (F- 13) as recommended by manufacturer.	25-30 µm
		Finish coat: One coat of high build epoxy with MIO pigments. (F- 1)	125 – 150 µm.
		Total DFT (Minimum)	Total Min DFT 215 µm

13.7 **Section F - Antiskid Painting**

Coating system is applicable on **Steel plated Helideck, Plated Laydown Area, Plated Walkway**, and applicable area on **plated floor**.

**Coating System No.8: Antiskid Painting.**

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Application	Surface Preparation	Coating System	DFT in $\mu\text{m}$
Topcoat of <b>Steel plated Helideck, Laydown Area, Walkway (Plated) &amp; Plated flooring</b>	Cleanliness: SSPC –SP5/ Sa 3	<b>Extra high</b> build epoxy coating. Application as recommended by paint Manufacturer. (F-8)	2500-3000 $\mu\text{m}$
	Roughness: 75 $\mu\text{m}$ to 100 $\mu\text{m}$	Top coat: one coat of Aliphatic acrylic polyurethane (F-9) (Refer General Note 1 to 4 below)	50-60 $\mu\text{m}$
		Total DFT	2550-3060 $\mu\text{m}$

**General notes:**

1. Light colour non-skid aggregates shall be used.
2. Quantity and Particle size of non-skid aggregate shall be as per recommendation of paint manufacture.
3. Aggregates shall have a uniform spread.
4. Coating system No.8 shall have adequate properties related to water absorption, impact resistance, coefficient of friction (**at least 0.65 in wetted condition**), hardness and flexibility.

**13.8 Section G : Passive Fire Protection**

The recommended use for this product is for fireproofing of steel beams below cellar deck, Deck Legs, Jacket legs & braces, pipes, vessel skirts, bulkheads etc. for fire rating as per Fire Safety Study Report.

The epoxy intumescent coating shall provide pool and jet fire protection minimum one hour for well platform & two hours for Process platform.


Coating thickness shall be as per recommended by paint Manufacturer to obtain desired Fire rating based on safety study.

Base coat & Top coating on top of the passive fire protection shall be compatible with the passive fire protection coating. No hot work shall be done after fireproofing material is installed. Procedure for application shall be as per manufacturers' quality and application manual.

**13.8.1 \*Coating System No.9:** Epoxy Based Passive Fire Protection system (Epoxy Intumescent Coating)


Applicati on	Surface Preparation	Coating System	DFT in $\mu\text{m}$
Carbon steel – Structural steel	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 surface profile : 40-60 $\mu\text{m}$ Max.	Primer Coat: Inorganic zinc silicate primer (F-3)	65 -85 $\mu\text{m}$
		Sealer Coat/tie coat: Low volume epoxy primer as recommended by paint manufacturer (F-13)	25-30 $\mu\text{m}$
		Top Coat: Thickness of Fire proofing coating shall be provided by Manufacturer for the desired Fire Rating	

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		(as per safety study). Coating material		
		F-7.		
<p>*Note: Epoxy Intumescent Coating shall be applied over a suitably primed substrate as per Recommendation of paint manufacturer. Procedure for application shall be as per Manufacture's Quality &amp; application manual.</p> <p>Epoxy Intumescent Coating shall be top coated to meet colour schemes &amp; finish and as per recommendation of paint manufacturer.</p> <p>The fire ratings of Epoxy Intumescent Coating shall be obtained from Certification Agencies like UL, LRS, DNV, BV, etc. and submitted.</p> <p>No hot work shall be carried out after completion of Fire proofing coating.</p>				
<p>13.9 Deleted</p>				
<p>13.10 <b>Section H: Miscellaneous items</b></p>				
<p>13.10.1 <b>Pipe Support: I-Rod Pipe Support System</b></p>				
<p>Corrosion Control in Piping Support &amp; anchoring Steel U- Bend shall be carried out as per NACE SP 0108 (Standard Practice – Corrosion Control of Offshore Structure by Protective Coating).</p> <p>Pipe Support shall also be so designed that there is no water accumulation beneath the pipe to avoid corrosion and deterioration of paint. Design of pipe support shall be such that there shall be enough space for recoating even at the bottom of pipe. One of method is to use semi sphere-shaped <b>Thermoplastic Pipe Support</b> Rod under the pipe to facilitate water drainage for future corrosion inspection and access to recoat. Alternative option is to overwrap the pipe wherever the pipe is being supported with a layer of fiber glass reinforced composite tape with adhesive backing. Alternatively contractor may also propose other alternative accordingly.</p> <p>The U-bend shall be protected with a carbon black pigmented polychloroprene rubber sheath. The rubber sheath shall also provide abrasion resistance. Corrosion inhibitor grease should be applied onto the steel U-bend prior to inserting in the rubber sheath.</p> <p>Contractor shall address all such aspect in Piping support standard and put up to Company for approval.</p>				
<p>13.10.2 <b>Coating System No.10:</b> Painting of carbon steel valves.</p>				
Application	Surface Preparation	Coating System	DFT in $\mu\text{m}$	

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Painting of carbon steel valves with operating temperature up to 150°C.	Cleanliness: Near white metal shot/grit blasting as Per SSPC-SP-10 or Sa 2 ½ of SIS-05-5900/ISO 8501-1 Surface profile: 40-60 µm Max.	Two coats of Phenolic Epoxy (F- 6)	150 – 175 µm (each coat) Total Min DFT 300 µm
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**13.11 Section I: Extension & Modification on Old Platform and Repair & Maintenance painting of offshore platform**

i. Extension & Modification on Existing Platform Section A to H shall be followed with following change: Thermally Spread Aluminum Coating (TSAC) System is not applicable.

ii. Repair & Maintenance Painting.

**13.11.1 Evaluation of condition monitoring**

The Principal will review the condition monitoring reports. Facility components found to be Inaccessible for coating condition inspection should be reported to the responsible Technical Authorities and Management. The barrier coating should be maintained within Two (2) years after the condition of the barrier is found to be not in accordance with the Minimum acceptance criteria. If repair work has not been carried out in time or if severe (Local) corrosion has been observed during condition monitoring, the responsible disciplines should be consulted on further actions to ensure safety and technical integrity.

The condition of all the components of an area/block, including insulation and passive Fireproofing, should be reviewed when drafting scopes of work for maintenance. Consideration should be given to whether it is justified to repair the coating barrier of a Single component only, or whether the whole area/block should be maintained. Specialist Knowledge, including insight into costs and techniques, may be required to make the choice between repair and large-scale maintenance. Specific consideration should be given to and thorough analysis made of areas and/or parts that cannot be inspected or maintained. Appropriate actions, such as risk analyses etc., to ensure long-term integrity should be instigated.

**VISIBLE CORROSION DEGREES**


The pictures given in ASTM D 610 can be used for the visual determination of the percentage of surface Rusting. These pictures are based on standards such as the European Scale of Degree of Rusting and ASTM D 610.

**13.11.2 : Maintenance Painting system (applicable for protective coating of wellhead/ process/ LQ platform projects) shall be as under:**

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				PU @ 50-75 μ.(F-9)  <b>Total DFT:</b> <b>Colour scheme shall be conforming to CAP 437 offshore helicopter landing areas.</b>	50-75 μm  <b>650-725 μm.</b>	
<u>Maintenance Protective Coating system no.4</u>	Top coat of fire/barrier walls	SSPC-SP1 to be followed by hand/power tool cleaning SSPC-SP2/ SSPC-SP3.	-	Under epoxy based fire protection system 1 coat of Surface Tolerant Epoxy @ 100 μm.(F-2)	100 μm	
				Intumescent paint as per UL 1709. (F-7) Top Coat: Thickness of Fire proofing coating shall be provided by Manufacturer for the desired Fire Rating.	As recommended by Manufacturer Please see Note-3 below.	
<u>Maintenance Protective Coating system no.5</u>	Heat resistant paint for flare boom, pedestal crane exhaust 120°C to 400 °C.	SSPC-SP-10/ Sa 2 ½	40-60 μm	Apply 3 coats of Heat resistant silicon aluminium finish paint. (F-5)  <b>Total DFT:</b>	20-25 μm (each coat)  <b>60-75 μm</b>	
<u>Maintenance Protective Coating system no.6</u>	Carbon Steel Threaded Joints, Flange Joints, Nuts & Bolts.	The surfaces, crevices and corners should be cleaned of rust and dust, loose paint etc. by manual cleaning and compressed air. After cleaning the flange joints, nuts and bolts shall be further protected by <b>anticorrosive polytetrafluoroethylene (PTFE)/Synthetic tapes</b> of size suitable for the flanges and studs of the platform as per recommendation of manufacturer.			Not Applicable	

Note: 1. Paint manufacturers to be asked to provide their best suitable paint as per the scheme made for the environment and as per warranty and paint life required by ONGC.


2. For any coating scheme, all the coats will be from same manufacturers to avoid any compatibility issues.

3. Epoxy Intumescent Coating shall be applied over a suitably primed substrate as per Recommendation of paint manufacturer. Procedure for application shall be as per Manufacture’s Quality & application manual. Epoxy Intumescent Coating shall be top coated to meet colour schemes & finish and as per recommendation of paint manufacturer. The fire ratings of Epoxy Intumescent Coating shall be obtained from Certification Agencies like UL, LRS, DNV, BV, etc. and submitted. No hot work shall be carried out after completion of Fire proofing coating.

### 13.12 Miscellaneous Accessories

Three identification boards, with name of the platforms shall be provided on North and South faces of the platforms and on the top of the helideck respectively. The details to be written

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on the boards shall be approved by the Company. The letters on the boards shall be at least 900 mm in size.

**13.13 Handling and shipping of coated items**

Coated items shall be carefully handled to avoid damage to coated surfaces. No handling shall be performed before the coating system is cured to an acceptable level. Packing, handling and storage facilities shall be of non-metallic type.

**14.0 APPLICATION OF THERMALLY SPRAYED ALUMINIUM COATING (TSAC)**

**14.1 TSAC REQUIREMENTS**

**14.1.1 Surface Preparation**

All the parts to be sprayed shall be degreased according to SSPC-SP 1. The absence of oil and grease after degreasing shall be tested by method given elsewhere in the specification. Thereafter the surface to be abrasive blasted to white metal finish as per NACE 1/SSPC-SP 5 for marine and immersion service. Using SSPC VIS 1, it is to be visually assessed that the blast cleaned surface meets requirement of SSPC-SP 5. Thereafter clear cellophane tape test as per ISO 8502-3 shall be used to confirm absence of dust on the blasted surface. Finally blasted surface shall be tested for presence of soluble salts as per method ISO8502-9. Maximum allowable salt content shall be considered 50mg/M<sup>2</sup>. (5 micrograms/cm<sup>2</sup>) .In case salt content exceeds specified limit, the contaminated surface shall be cleaned by method as per Annex –C of IS 12944-4 (Water Cleaning.) After cleaning the surface shall be retested for salt content after drying.


The blasting media shall be either chilled iron or angular steel grit as per SSPC-AB-3 of mesh size G-16 to G-40. Copper or Nickel slag or Garret as abrasive will also be suitable having mesh size in the range of G16 to G24, conforming to SSPC-AB-1. Mesh size shall be required as appropriate to the anchor tooth depth profile requirement and blasting equipment used. The blasted surface should be having angular profile depth not less than 75 microns with sharp angular shape. The profile depth shall be measured according to NACE standard RP 0287 (Replica Tape) or ASTM D 4417 method B (Profile depth gauge).

For manual blasting one profile depth measurement shall be taken every 10-20 M<sup>2</sup> of blasted surface.

Surface preparation shall be completed in one abrasive blast cleaning operation wherever possible.

If rust bloom (visual appearance of rust) appears on the blast cleaned surface before thermal spraying, the affected area shall be re-blasted to achieve specified degree of cleanliness after which only thermal spraying shall commence. Air blasting pressure at

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<p>nozzle shall be normally maintained at 100 psi. Air pressure and media size should be reduced and adjusted to preclude damage/distortion to thin gauge materials. Blasting time on work piece should be adjusted to only clean the surface and cut required anchor tooth with minimum loss of metal. Blast angle should be as close to perpendicular as possible but in no case greater than 30° from perpendicular to work surface. Blasting media must be free of debris, excessive fines, contaminants such as NaCl and sulphur salts (Ref. Clause 14.4.6.1 of this spec.).</p> <p>14.1.2 Blasting Equipment</p> <p>The TSAC applicator shall use mechanical (centrifugal wheel) or pressure pot blast cleaning equipment and procedures. Suction blasting equipment shall not be used. Clause No. 14.4.6.2 shall be used to validate clean and dry air.</p> <p>14.1.3 Feed Stock</p> <p>The feed stock shall be in the form of wire. The feed stock shall be 99.5% aluminium of commercial purity grade, its composition shall be in accordance with requirement of BS 1475 or ASTM B833 (wrought aluminium and aluminium alloys, wire).</p> <p>14.1.4 Thickness Requirement</p> <p>The nominal thickness of finished TSAC shall be 225 microns having minimum value of 200 microns at low thickness areas (valleys) and not more than 250 microns at peak areas.</p> <p>The finished thickness shall be measured using SSPC-PA 2 type 2 fixed probe gauge (Magnetic Gauge).</p> <p>14.1.5 Coating Bond Strength Requirement</p> <p>During CPT coating bond strength requirement shall be as indicated in table 14.2.1.3.</p> <p>The Minimum Tensile Bond Requirements during production shall be 7 Mpa (1000 psi) for any single measurement.</p> <p>The TSC tensile bond shall be measured according to ASTM D 4541 using a self-aligning adhesion tester.</p> <p>For non-destructive measurement: Tensile force shall be measured to the 7Mpa (1000 psi). The tensile force shall then be reduced and the tensile fixture Removed Without damaging the TSAC.</p> <p>14.1.6 Porosity</p>				

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All thermally sprayed metallic coatings will have porosity. For thermally sprayed aluminium coatings porosity shall not exceed 15% of total surface area for flame sprayed coating and 8% for arc spray coating.

## 14.2 THERMAL SPRAY APPLICATION PROCEDURE

Thermally spread Aluminium coating shall be applied by either Flame spray or Arc spray method and shall refer to Clause No. 13.2.1 for application area/zone.

### 14.2.1 Equipment set up

14.2.1.1 Thermal spray equipment shall be set up calibrated, operated (1) according to manufacturer instructions/technical manuals and also TSAC applicators refinement thereto and (2) as validated by Procedure Qualification.

### 14.2.1.2 Spray parameters

Spray parameters and thickness of each crossing pass shall be set and shall be validated with bend test.


### 14.2.1.3 Table:

Spray Parameters	Method of Application	
	Arc wire Spray	Flame Wire Spray
Arc voltage	27 V	-
Air pressure	80 psi	80 psi
Steel surface cleanliness	NACE-1 white metal	NACE-1 white metal / or Near white metal
Steel surface profile	75 microns (minimum)	75 microns (min.)
Arc current	250-280A	-
Coating thickness	225 microns (nominal)	225 microns(Nominal)
Coating adhesion	> 1500 psi (Total coating),see 3.1.4	>1000 psi
Coating porosity	Less than 8%	Less than 15%.
Spray distance (spray Gun work piece)	6-8"	5-7"
Spray Pass width	40mm	20 mm

The above parameters to be validated with a bend test by the contractor before start of work (for detail of Bend Test see clause No. 14.4.5 of this Spec.)

### 14.2.2 Post Blasting Substrate condition and thermal spraying period.

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14.2.2.1 The steel surface temperature shall be at least 5°C above dew point of ambient air temperature. Steel substrate surface temperature shall be recorded by with a contact pyrometer.

Thermal spraying should commence within 15 minutes from the time of completion of blasting

14.2.2.2 Holding Period

Time between the completion of final anchor tooth blasting and completion of thermal spraying of blasted surface should be no more than four hours.

14.2.3 Pre-Heating

For flame spraying, the initial starting area of 1-2 square feet to be preheated to approx.120° C to prevent condensation of moisture in the flame on the substrate. For arc spraying the preheating is not required.

14.2.4 Thermal spraying

Spraying should commence only after validation of equipment set up by procedure qualification test and spray parameter validation tests described in Clause No. 14.5 and 14.4.5 respectively. **Thermal spraying must commence within 15 minutes from the time of completion of blast cleaning.**

The specified coating thickness shall be applied in several crossing passes. The coating bond strength is greater when the spray passes are kept thin. Laying down an excessively thick spray pass increases the internal stresses in TSAC and decreases the bond strength of total TSAC. The suitable thickness for crossing passes shall be determined by procedure qualification test.

For manual spraying, spraying to be done in perpendicular crossing passes to minimize thin spots in coating. Approx. 75-100 microns of TSAC shall be laid down in each pass.


The surface geometry of the item or area to be sprayed should be inspected before application. The spraying pass and sequence shall be planned according to following.

- Maintain Gun as close to perpendicular as possible and within ± 30°C from perpendicular to the substrate.
- Maintain nominal stand-off distance and spray pass width as given below:

Table 14.2.4.1:


Spray method	Standoff (Inches)	Spray pass width (Inches)
Arc Wire	6 – 8	1 ½ inch ( 40mm )

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Flame wire		5 – 7	3/4 inch ( 20mm )	
14.2.4.1 Rust Bloom (Visual appearance of rust or Discoloration)				
<p>If Rust bloom appears on the blasted surface before thermal spraying, the affected area shall be re-blasted to achieve the specified level of cleanliness.</p> <p>If Rust bloom in form of discoloration, or any blistering or a degraded coating appears at any time during application of TSAC, then spraying shall be stopped and acceptable sprayed area shall be marked off. The unsatisfactory areas shall be repaired to the required degree of surface cleanliness and profile.</p> <p>Blast the edges of the TSAC to provide for 2-3" feathered area overlap of the new work into existing TSAC.</p> <p>Then apply TSAC to the newly prepared surfaces and overlap the existing TSAC to the extent of feathered edge so that overlap is a consistent thickness.</p>				
14.2.4.2 Masking				
<p>Masking all those parts and surfaces which are not required to be thermally sprayed as instructed by purchaser should be inspected by applicator to ensure that they are properly marked and covered by purchaser.</p> <p>Complex geometries (flanges, valve manifolds, intersections) shall be masked by applicator to minimize overspray i.e. TSAC applied outside spray parameters (primarily gun to substrate distance and spray angle).</p>				
14.2.4.3 TSAC Finish				
<p>The deposited TSAC shall be uniform without blisters, cracks, loose particles, or exposed steel as examined with 10 X magnification.</p>				
14.3 SEALER				
<p>Sealant shall be applied after satisfactory application of TSAC and completion of all testing and measurements of the finished TSAC as per clause No.14.4 of this specification.</p> <p>For shop work Sealer shall be applied immediately after thermal spraying and for field work sealer shall be applied within 8 hours. The sealcoat shall be thin enough to penetrate into the body of TSAC.</p> <p>The materials for sealing the metal coating shall be:</p> <ul style="list-style-type: none"><li>Two-component epoxy for operating temperatures below 120 °C (F-13).</li><li>Aluminium silicone above 120 °C (F-14).</li></ul>				


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<p>Volume solids in the sealers when applied shall be 15 % nominal. The overlay of sealer should be less than 38 µm (1.5 mil) on the TSA coating after application.</p> <p>The sealer should have a contrasting colour to the TSA to aid visual inspection.</p> <p>During application of seal coat, complete coverage shall be ensured by visual observation.</p>				
<p>14.4 TESTING AND MEASUREMENT SCHEDULE</p>				
<p>14.4.1 Surface Finish</p> <p>That the blasted cleaned surface meets the required criteria (NACE 1/SSPC-SP 5) shall be visually inspected using SSPC-VIS 1. The clear cellophane-tape test shall be used to confirm absence of dust or foreign debris on the cleaned surface.</p>				
<p>14.4.2 Blast Profile Measurement: (In-Process testing during actual production before application of TSA coating)</p> <p>The angular profile depth measurement shall be done by profile tape as per method NACE Standard RP 0287 or ASTM D 4417 method B (Profile depth gauge micrometre). Spot measurement shall be carried out every 15m<sup>2</sup> of blasted surface. At each spot three measurements shall be taken over an area of 10 cm<sup>2</sup> and average of measurements to be recorded and reported.</p> <p>If profile is &lt;75 microns blasting shall continue till greater than 75 microns depth profile is achieved.</p>				
<p>14.4.3 TSAC Thickness (In-Process Testing For finished coating during regular production)</p>				
<p>14.4.3.1 TSAC finished thickness shall be measured using SSPC-PA 2 type 2 fixed probe gauge.</p>				
<p>14.4.3.2 For flat surfaces, measurements shall be taken along a straight measurement line; one measurement line for every 15 m<sup>2</sup> of applied TSAC shall be selected along which 5 measurements to be taken at 25 mm internal and average to be reported.</p>				
<p>14.4.3.3 For curved surface or complex geometry, 5 measurements shall be taken at a spot measuring 10 cm<sup>2</sup> in area. One spot to be taken for every 15 m<sup>2</sup> of applied TSAC area.</p>				
<p>14.4.3.4 The TSAC thickness in surface changes or contour changes, welds and attachments shall be also measured and reported.</p>				
<p>14.4.3.5 If TSAC is less than specified minimum thickness, apply additional TSAC until specified thickness range is achieved.</p>				

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14.4.3.6 All locations and values of TSAC thickness measurements shall be recorded in Job Record (JR).

14.4.4 Tensile Bond Testing (In-Process testing for finished coating during regular production)

- Tensile Bond strength of the TSAC finish coat shall be determined according to ASTM D 4541 using a self-aligning adhesion tester.
- One measurement shall be made every 50 m2. If tensile bond at any individual spot is less than 1000 psi for flame sprayed coating and 1500 psi for arc sprayed coating the degraded TSAC shall completely remove and reapplied.
- The tensile bond portable test instrument to be calibrated according to ASTM C 633.

14.4.5 Bend Tests

Bend test shall be carried out at beginning of each work shift. Bend tests shall also be conducted on sample coupons before start of thermal spraying work to qualify the following as mentioned earlier in this specification.

- To qualify spray parameters and thickness of each crossing pass.


14.4.5.1 Test Procedure

- a) Five corrosion control steel coupons each of dimension 50 mm x 150 mm x 1.25 mm thick are to be prepared.
- b) Surface shall be prepared by dry abrasive blast cleaning as per this specification.
- c) TSAC shall be applied as per specified thickness range. TSAC should be sprayed in crossing passes laying down approx. 75-100 microns in each pass.
- d) TSAC applied coupons shall be bent 180° around a 13 mm diameter mandrel.
- e) Bend test shall be considered passed if, on bend radius there is
  - No cracking or spalling or lifting by a knife blade from the substrate.
  - Only minor cracking that cannot be lifted from substrate with a knife blade.
- f) Bend test fails if coating cracks with lifting from substrate.


14.4.6 Tests for blasting media, blasting air

14.4.6.1 Blasting Media (For every fresh batch of media and one random test during blasting)


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a) Blasting Media shall be visually inspected for absence of contamination and debris using 10 X magnification.				
b) Inspection for the absence of oil contamination shall be conducted using following procedure:				
- Fill a small clean 200 ml bottle half full of abrasive.				
- Fill the bottle with potable water, cap and shake the bottle.				
- Inspect water for oil film/slick. If present, the blasting media is not to be used.				
c) Soluble salt contamination if suspected shall be verified by method ASTM D 4940 if present media is to be replaced.				
d) Clean blasting equipment, especially pot and hoses and then replace blasting media and retest.				
14.4.6.2 Test for Blasting Air (Once Daily before start of blasting and once at random during blasting)				
The air for blasting shall be free from moisture and oil. The compressor air shall be checked for oil and water contamination per ASTM D 4285.				
14.4.7 Test for presence of oil/grease and contamination				
The steel substrate after degreasing as per SSPC-SP 1 shall be tested as per following procedure to validate absence of oil and grease contamination.				
a) Visual inspection - Continue degreasing until all visible signs of contamination are removed.				
b) Conduct a solvent evaporation test by applying several drops or a small splash of residue- free trichloromethane on the suspect area especially pitting, crevice corrosion areas or depressed areas. An evaporation ring formation is indicative of oil and grease contamination.				
Continue degreasing and inspection till test is passed.				
14.5 TSAC APPLICATOR QUALIFICATION				
Following tests to be carried out as part of procedure qualification test for the applicator.				
- Thickness measurement				

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<ul style="list-style-type: none"><li>- Coating bond strength</li><li>- Porosity test</li><li>- Bend strength</li></ul>				
<p>TSAC applicator's surface finishing and application process and equipment set up, calibration and operation shall be qualified by application of TSA on a reference sample which shall be used as a comparator to evaluate the suitability of application process. Only that applicator will be permitted to carry out the work when test specimens coated by the applicator meets the desired requirements as cited below.</p> <p>The sample shall be made of a steel plate measuring approx. 18"x 18" x ¼" thick. If the actual work is less than ¼" thick then the sample to be made from material of representative thickness.</p> <p>The surface preparation, TSAC application shall be made with actual field equipments and process/spray parameters and procedures as per the specification. The depth profile of blasted surface, TSAC coating thickness for each cross pass and total thickness range shall be as per specification.</p> <p>The surface preparation and thermal spraying shall be carried out in representative environmental conditions spraying with makeshift enclosure.</p> <p>14.5.1 After application of coating, thickness and tensile bond measurements shall be made in following manner.</p> <ul style="list-style-type: none"><li>- Divide the sample piece into four quadrants.</li><li>- Measure thickness along the diagonal line of each quadrant.</li><li>- Four each quadrant five in-line thickness measurements at 1" interval shall be done using SSPC-PA 2 type 2 fixed probe gauge. Thus a total of four "five in line" thickness measurements are to be done for the whole sample.</li><li>- One tensile bond measurement using ASTM D 4541 type III or IV portable self-aligning test instrument to be done at centre of each quadrant. Total of 4 measurements for the sample.</li><li>- One porosity evaluation test by Metallographic examination shall be conducted to demonstrate the achievement of porosity within the limits specified. Sample shall be prepared for Metallographic examination as per ASTM E – 3.</li><li>- The procedure shall be considered qualified if thickness and tensile bond strength and porosity values meets the specification requirement.</li></ul>				

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14.5.2 Bend test: Bend test shall be carried out as detailed at Clause No. 14.4.5 of this specification.

- Applicators thermal spray equipment set-up, operation and procedure of application including in-process QC checkpoints adopted during procedure qualification as described above should be always subsequently followed during entire duration of work.

14.6 Documentation

The following information shall be provided by TSAC applicator before award of work.

- TSAC application process consisting of equipment capabilities and their technical parameters, feed stock material and source of procurement.
- Detailed application procedure and in-process quality control check points for (a) surface preparation (b) thermal spraying (c) seal coats.
- Type and specification of instruments to be deployed for measurement of blast profile depth, TSAC thickness and tensile bond.
- Paint manufacturer data sheet for the selected sealing coat to be applied.

14.7 RECORDS

- The TSAC applicator shall maintain job record to record production and QC information. All the results of the tests and quality control checks shall be entered in the record for each component/part thermally sprayed. All the result of tests (thickness, tensile bond, bend tests) and other validation tests (e.g. procedure qualification test, test for surface cleanliness after abrasive blasting, test for cleanliness of abrasives and air) shall also be recorded and duly signed by owner.
- All the information mentioned in Clause no.14.6 above should also form part of the Job record.
- Any modification affected after procedure qualification in the procedure, QC, spray parameter, equipment spec to the original information (submitted before award of the work) must also form part of Job record.

14.8 WARRANTY

The TSAC applicator shall warrant the quality of material used by providing the purchaser with a certificate of materials used to include

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- Spray feed stock: Alloy type/designation, Lot Number, wire diameter, chemical analysis, name of supplier, manufacturer.
- Sealant: Name of manufacturer, application data sheet.

#### 14.9 SAFETY

The TSAC applicator shall follow all safety procedures required by the purchaser/owner. Owner shall also give compliance requirement to be followed by applicator. The applicator shall follow all appropriate regulatory requirements.

#### 14.10 CODES AND STANDARDS

This specification shall apply in case of conflict between specification and following applicable Codes & Standard:

AWS C.2.17	Recommended Practice for Electric arc Spray.
ASTM C 633	Test Method for Adhesive/Cohesive Strength of Flame Sprayed Coatings.
ASTM D 4285	Method for indicating Oil or Water in Compressed Air.
ASTM D 4417	Test Method for Field Measurement of Surface Profile of Blasted Steel.
BS 2569	Specification for Sprayed Metal Coating.
NACE Standard RP 0287	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape.
ASTM D 4541	Test method for Pull-Off Strength of Coating Using Portable Adhesion Testers.
ANSI/AWS C2.18	Guide for the Protection of Steel with Thermal Spray Coatings of Aluminium, Zinc and Their Alloys and Composites.
NACE No. 12/AWS C2.23M/SSPC- CS	Specification for the application of thermal spray coatings (Metallizing) of aluminium, zinc, and their alloys and composites for the corrosion protection of steel.
SSPC Publication	The inspection of coatings and linings: A Handbook of Basic practice for Inspectors, Owners, and Specifiers.
SSPC-AB 1	Mineral and Slag Abrasives.
SSPC-AB 3	Ferrous Metallic Abrasives.
SSPC-PA 1	Shop, Field, and Maintenance Painting of Steel.
SSPC-PA 2	Measurement of Dry Coating Thickness with Magnetic Gages.
NACE No. 1/SSPC-SP 5	White Metal Blast Cleaning.
NACE No. 2/SSPC-SP 10	Near –White Metal Blast Cleaning.

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SSPC-VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning.
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#### 14.11 Suggested List of TSA applicators

- 1) Metallizing Equipment Corporation, Jodhpur, India
- 2) Larsen & Toubro Ltd (Eutectic division), New Delhi, India
- 3) Chemtreat India Ltd, Navi Mumbai, India
- 4) Deepwater MPE, Malaysia
- 5) Associated Thermal Spray, Ahmedabad, India
- 6) M/S PS Coatings Pvt. Ltd, New Mumbai, India
- 7) M/S NPCC, Abu Dhabi
- 8) M/S McDermott, Jebel Ali, Dubai
- 9) M/S PTSC, Vietnam

TSAC coating shall be applied to bottom of bridge including bottom of deck plating of bridge & piping.

Other applicators will also be acceptable if they qualify the applicator qualification procedure given in the specification. If any one of the above suggested applicator is selected, even then he has to perform the qualification test before commencing of the work.

## 15.0 COLOUR SCHEDULE

### 15.1 Table No.

Sr. No.	Item to be Painted	Finish Coat Colour	Colour Code No.
A	<b>SPLASH ZONE</b>		
1	All areas coated with XHB Glass flake reinforced Epoxy	Golden Yellow	RAL 1004
2	Handrails & Ladders		
B	<b>ATMOSPHERIC ZONE-I &amp; II</b>	Golden Yellow	RAL 1004
1	All areas coated with System 2 (Structural steelwork)	Golden Yellow	RAL 1004
2	Handrails and ladders	Golden Yellow	RAL 1004
3	Buildings (outside surfaces)	Spanish Tile Red	RAL 3000
4	Overhead Obstructions	Golden Yellow with Black Strip	RAL 1004 &

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			RAL 9012
5	Helideck top surface (marking colour shall be as per CAP437 ,(7 <sup>th</sup> Edition ) guideline)	Dark Green	RAL 6020
6	Walkway of Helideck	Dark Green with White side strips	RAL 6020+ RAL NO.9010
C	<b>EQUIPMENT, PIPING AND TUBING</b>	Natural Grey	RAL 7038
1	Pumps and Drivers	Dark Grey or Factory Finish	RAL 7039
2	Compressors and Drivers	Dark Grey or Factory Finish	RAL 7039
3	Generators and Drivers	Dark Grey or Factory Finish	RAL 7039
4	Water Makers	Light Blue or Factory Finish	RAL 5012
5	Tanks and Vessels	White	RAL 9003
6	Electrical Equipment incl. Cable Trays	Aluminium Grey	RAL 9007
7	Electrical Danger Points	Orange	RAL 2004
8	Instrumentation	Factory Finish	-----
9	Fire Fighting Equipment	Red	RAL 3000
10	First Aid Equipment	Signal Green	RAL 6032
11	Risers and J Tubes	Aluminium Grey	RAL 9007
12	Process Piping Systems	Refer Table 15.2 of this specification	

The name tag no. and service of all equipment should be stencilled in capital letters 40 – 50 mm in height on the equipment. The Colour shall be black or white and in contrast to the colour on which the lettering is superimposed.

### 15.2 Pipe Colour Coding


All piping shall be colour coded to identify service in accordance with the following criteria. The colour coding shall comply with the schedule in Table 15.

**TABLE No. 15.2: PIPE COLOUR CODING (PROCESS) COLOUR SCHEME FOR PRODUCT BEING PROCESSED**

Sr. No.	Description	Colour code Identification	
		Base/Ground Colour (Colour code no.)	Colour Bands 1)1 <sup>st</sup> Band 2)2 <sup>nd</sup> Band
GASES			
1	Sour Gas	Canary Yellow (RAL NO.1012)	1)Grey(RAL NO.7000) 2)Dark Violet (RAL NO.5022)
2	Sweet Gas	Canary Yellow (RAL NO.1012)	Grey (RAL NO.7000)

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3	Fuel Gas	Canary Yellow (RAL NO.1012)	1)Light Brown(RAL NO.8025) 2)White(RAL NO.9010)
4	Residue	Canary Yellow (RAL NO.1012)	1)Oxide Red(RAL NO.3009) 2)White(RAL NO.9010)
5	Flare Gas	Canary Yellow (RAL NO.1012)	Aluminum(RAL NO.9006)
6	Regenerated Gas	Canary Yellow (RAL NO.1012)	1)White(RAL NO.9010) 2)Dark Violet(RAL NO.5022)

LIQUIDS

1	Crude Oil	Light Brown (RAL NO.8025)	No Band
2	High Speed Diesel	Light Brown (RAL NO.8025)	1)Brilliant Green(RAL NO.6038, 6017) 2)White(RAL NO.9010)
3	Hydrocarbon Condensate	Dark Admiralty Grey(RAL NO.7031)	1)Signal Red (RAL NO.3020) 2)Black(RAL NO.9005)
4	Chlorine	Dark Violet(RAL NO.5022)	Signal Red(RAL NO.3020)
5	Triethylene Glycol (TEG)	Dark Admiralty Grey (RAL NO.7031)	1)Sea Green (RAL NO.6018) 2)Yellow (RAL NO.1003)
6	Oily Water	Black (RAL NO.9005)	No Band
7	Dosing Chemical	Dark Admiralty Grey (RAL NO.7031)	No Band
8	ATF	Dark Admiralty Grey(RAL NO.7031)	Black(RAL NO.9005)

UTILITY ITEMS: WATER

1	Drinking Water	Sea Green (RAL NO.6018)	1)French Blue (RAL NO.5002) 2)Signal Red(RAL NO.3020)
2	Domestic Hot Water	Sea Green (RAL NO.6018)	Light Green(RAL NO.6021)
3	Cold Water from Storage Tank	Sea Green (RAL NO.6018)	1)French Blue (RAL NO.5002) 2)Canary Yellow(RAL NO.1012)
4	Demineralized Water	Sea Green (RAL NO.6018)	Gulf Red(RAL NO.8019)
5	Cooling Water	Sea Green (RAL NO.6018)	French Blue (RAL NO.5002)
6	Condensate Water	Sea Green (RAL NO.6018)	1)Light Brown (RAL NO.3009) 2)Signal Red(RAL NO.3020)
7	Wash Water	Sea Green(RAL NO.6018)	Canary Yellow(RAL NO.1012)
8	Fire water	Fire Red(RAL NO.3000)	Crimson Red(RAL NO.3007)

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9	Sea Untreated water	Sea Green(RAL NO.6018)	White(RAL NO.9010)
10	Waste Water	Sea Green (RAL NO.6018)	1)Canary Yellow(RAL NO.1012) 2)Signal Red(RAL NO.3020)
11	Treated Water	Sea Green (RAL NO.6018)	Light Orange(RAL NO.2003)
<b>UTILITY ITEMS: COMPRESSOR</b>			
1	Compressed Air (upto 15kg/sq.cm)	Sky Blue (RAL NO.5015)	-----
2	Compressed Air (above 15kg/sq.cm)	Sky Blue(RAL NO.5015)	Signal Red(RAL NO.3020)
3	Plant Air	Sky Blue(RAL NO.5015)	Silver Grey(RAL NO.7001)
4	Instrument Air	Sky Blue(RAL NO.5015)	French Blue(RAL NO.5002)
5	Drainage	Black(RAL NO.9005)	-----
<b>UTILITY ITEMS: OILS</b>			
1	Lubricating Oil	Light Brown(RAL NO.8025)	Light Grey(RAL NO.7004)
2	Hydraulic Power	Light Brown(RAL NO.8025)	Dark Violet(RAL NO.5022)
<b>UTILITY ITEMS: GASES</b>			
1	Acetylene	Canary Yellow (RAL NO.1012)	Service Brown(RAL NO.8022)
2	Nitrogen	Canary Yellow(RAL NO.1012)	Black(RAL NO.9005)
3	Oxygen	Canary Yellow(RAL NO.1012)	White(RAL NO.9010)
4	Carbon di Oxide	Canary Yellow(RAL NO.1012)	Light Grey(RAL NO.7004)

Note: Any product which is not covered will be governed as per colour code standard IS: 2379/other standard under reference.

### 15.3 Colour Bands for Identification & Size of pipe

#### 15.3.1 Identification & Size

The Width of colour band shall confirm to the following (As per IS 2379)

Sr. No.	Nominal Pipe Size	Width : L (mm)
1	80NB and below	25

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2	Over 100 NB upto 150 NB	50
3	Over 200 NB upto 300 NB	75
4	Over 350 NB	100
The relative proportional width of first colour band to be subsequent bands shall be 4:1. Maximum stripe spacing shall be 150mm		

### 15.3.2 Application

Color Bands shall be applied at the following location as per # 7.3 of IS: 2379

- Battery Limit points
- Intersection point and change of direction points in piping ways
- Other point such as midway of each piping way, near valves, junction joints of service appliances, walls on either side of pipe culverts
- For long stretch yard piping at 50 m interval and at start and terminating points

Color bands shall be arranged in the sequence shown in table below and sequence follows the direction of flow.

For Insulation pipes, nominal pipe size means the outside diameter of insulation.

### 15.4 Colour of Valves

The Valves shall be painted as per As per IS: 2379

Table No. 15.4

Sr. No.	Condition	Colour of Valves
1	Valves on Fire fighting	Red (RAL NO.3000)
2	Valves on Pipe carrying Hazardous Material	Golden Yellow with black strips (RAL NO.1004) & (RAL NO.9005)
3	Valves on Water carrying piping (Potable or Non-Potable)	French Blue(RAL NO.5002)
4	All Other Piping	Same colour as the main piping

### 15.5 SIZE OF FLOW DIRECTION ARROWS

Pipes shall be marked with arrow to indicate flow direction as per the isometrics. Arrow markers shall be placed at starting / termination point of piping above each floor generation at a height of about 1.5m from floors. The service or the origin place shall also be marked in the same colour, stenciled in capital letters 40 - 50 mm in height. The colour or arrow shall be black or white and in contrast to the colour on which they are superimposed. The arrow indicating flow

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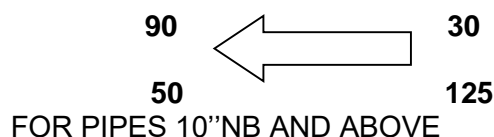
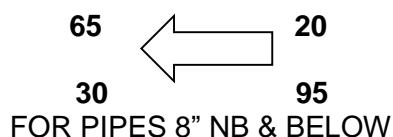
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directions as per piping isometrics shall be marked on both sides of the pipe 180 deg. apart at an interval of 3 to 6 meters or less depending on pipe length.

Size (in mm) of the arrow shall be either of the following:



### 15.6 Colour Schedule for Fire Fighting Equipment:

Fire Equipment/ Fire Fighting Equipment colour shall be in accordance with following criteria as detailed in table 15.6


Table No. 15.6

Sr. No.	Item/Application	Standard Painting Color	RAL No.
1	A. Extinguishers: Water based, foam, DCP, CO2 B. all fire tenders /jeep, fire engines(except foam tank, foam piping & nitrogen cylinder) C. Fire tender, water piping/wet risers. Fire hose reel box D. Fire tender water pump & engine/water pipeline in engine & pump E. DCP tank & DCP piping	Fire red Paint	(RAL NO.3000)
2	Foam tank & foam piping/nitrogen cylinder	Dark Admiralty Grey	(RAL NO.7031)
3	Driver compartment & inside of the lockers	Pale Cream	(RAL NO.9001)
4	Chassis & wheel arches	Black	(RAL NO.9005)
5	Fire services insignia & identity nomenclatures	Canary yellow with black border on sides of sides of the vehicle/equipment	(RAL NO. 1012) & (RAL NO. 9005)


### 16.0 RECOMMENDED LIST OF PAINT MANUFACTURERS

Refer updated Vendor List in ONGC Website.

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<b>17.0 PROCEDURE FOR APPROVAL OF NEW COATING MATERIAL</b>											
<p>Following procedure recommended is to be followed for approval materials Manufactured by new manufactures (indigenous and foreign):</p> <ol style="list-style-type: none"><li>1. The manufacturer should arrange testing of the coating materials as per the List of tests given in para 5 below from one of the reputed Government Laboratories.</li><li>2. Samples of coating materials should be submitted to the Govt. Laboratory in sealed containers with batch number and test certificate on regular format of manufacturer's testing laboratory.</li><li>3. All test panels should be prepared by the Govt. testing agency-colored photographs of test panels should be taken before and after the test and should be enclosed along with test report.</li><li>4. Sample batch number and manufacturers test certificate should be enclosed along with the report. Test report must contain detail of observations and rating if any as per the testing code. Suggested Govt. laboratories are:  RRL, Hyderabad  HBTI, Kanpur  DMSRDE, Kanur  IIT, Bombay  BIS, Laboratories  UDCT, Mumbai  Or Other International Test houses of Repute to be approved by the Company.</li><li>5. Manufacturers should intimate the company, details of sample submitted for testing, name of Govt. testing agency, date. Contact personnel of the Govt. testing agency. At the end of the test the manufacturer should submit the test reports to the Company for approval. The manufacturer(s) shall be qualified based on the results of these tests and the Company's decision in this regard -shall be Final and binding on the manufacturer. All tests required for evaluation of acceptance coating materials for offshore application shall be as per the relevant ASTM standards.</li></ol>											
<b>18.0 PAINT PERFORMANCE GUARANTEE OF PROTECTIVE COATING:</b>											

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Contractor shall provide performance Guarantee for protective coating for the period as specified in Volume – I of Bid Document.											
<p style="text-align: center;">-----END-----</p>											

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Prepared / Revised By	Reviewed By	Approved By	Total No. of Pages	Date	Rev. No.
MRS/KCD	RMK	GRP	73	27.03.2012	5
KCD	SKJ	RMK	81	21.07.2014	6
MRS	SKJ	RKJ	85	19.06.2015	7
RCS	MRS	RKJ	77	24.08.2016	8
SK	MRS	RKJ	76	04.08.2017	9
KKD	MRS	RKJ	75	06.08.2018	10
SK	KKD	SG	77	31.10.2019	11
SK	GM	KCD	75	27.06.2022	12
GG	GM	KCD	75	20.12.2022	13
MK	GM	KCD	75	05.07.2023	14

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- 2.0 FABRICATION**
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## 1. MATERIAL

### 1.0.1 Scope & General

This specification defines the minimum requirements for the manufacture and supply of structural materials for uses in the fabrication of the Platform.

If a deviation from these specifications or a substitution of material is sought, the Contractor shall submit written request to Company along with necessary supporting documents including test results, manufacturer's certificate etc., and allowing reasonable time for evaluation without disruption of the construction schedule. It shall be the Contractor's responsibility to satisfy the Company that the proposed deviation or substitution will in no way be detrimental to the quality of the works intended in the bid package. The Company may ask for additional information & testing/retesting which the Company may consider necessary, which the Contractor shall carry out at no extra time and cost to the Company.

### 1.0.2 CODES AND STANDARDS

#### 1.0.2.1 Mandatory Indian Statutory requirement.

This document has been prepared to the International standards detailed hereunder. The Contractor shall ensure that the work is executed in accordance with all mandatory Indian Statutory and regulatory requirements.

#### 1.0.2.2 Codes and Standards & Regulations

The requirements of the latest published versions of the following listed Codes, Recommended Practices, Specifications and standards shall be complied by the Contractor.


#### 1.0.2.3 American Society of Mechanical Engineers (ASME)

Sr.no.	Code no.	Description
1	ASME B1.1-2019	United Inch Screw Threads (UN, UNR & UNJ Thread Forms).
2	ASME B18.2.2 - 2015	Square and Hex Nuts Nuts for general Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
3	ASME B18.21.1 - 2009 (R2016)	Lock Washers Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series).
4	ASME A112.6.3 - 2019	Specification for floor and trench drains Floor and Trench Drains.
5	ASME A112.6.4 - 2003 (R2012)	Roof/Deck & Balcony drain Roof, Deck, and Balcony Drains.

#### 1.0.2.4 American Petroleum Institute (API)

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S.No.	Code no.	Description
1	API RP 2A	Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms – Working Stress Design.
2	API Spec 2B	API Specification for Fabrication of Structural Steel Pipe.
3	API Spec 2H	API Specification for Carbon Manganese Steel Plate for Offshore Platform.
4	API SPEC 2MT1	Specification for As Rolled carbon manganese Steel Plate with improved toughness for Offshore Structure.
5	API RP 2X 2004 Edition	Recommended Practice for Ultrasonic and Magnetic Examination of Offshore Structural Fabrication and Guideline for Qualification of Technicians.
6	API Spec 5L 46th Edition	API Specification for Line Pipe.
7	API Spec 10A 25th Edition, March 2019	Cements and Materials for Well Cementing.
8	ASTM 80	Stainless Steel Chain.
9	API Spec 2F	Specification for Mooring chain.
10	API RP 2FB	Recommended Practice for the Design of Offshore facilities against Fire and blast Loading.

#### 1.0.2.5 American Society for Testing and Materials (ASTM)

Sr.no.	Code no.	Description
1	ASTM A6	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes and Sheet Piling.
2	ASTM A36	Standard Specification for Carbon Structural Steel.
3	ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
4	ASTM A106	Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service.
5	ASTM A109	Standard Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled.
6	ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products.
7	ASTM A131	Standard Specification for Structural Steel for Ships.
8	ASTM A153	Standard Specification for Zinc-Coating (Hot-Dip) on Iron and Steel Hardware.
9	ASTM A182	Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
10	ASTM A193	Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service or High Pressure Service and Other Special Purpose Applications.

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11	ASTM A194	Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service or Both.
12	ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
13	ASTM A276	Standard Specification for Stainless steel bars & Shapes
14	ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
15	ASTM A312	Stainless Steel Pipes Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
16	ASTM F3125	Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.
17	ASTM A370	Mechanical Testing of Steel Products Standard Test Methods and Definitions for Mechanical Testing of Steel Products
18	DELETED	DELETED
19	ASTM A500	Standard Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
20	ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric).
21	ASTM A572	Standard Specification for High - Strength Low-Alloy Columbium –Vanadium Steel of Structural Steel.
22	ASTM A578	Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications.
23	ASTM A633	Standard Specification for Normalized High Strength Low Alloy Structural Steel Plates.
24	ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
25	ASTM B695	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
26	ASTM A786	Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
27	ASTM C150	Standard Specification for Portland Cement.
28	ASTM D2000	Standard Classification System for Rubber Products in Automotive Applications.
29	ASTM F436	Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
30	ASTM D4894	Standard Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials.

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### 1.0.2.6 American Welding Society (AWS)

Sr.no.	Code no.	Description
1	AWS D1.1	Structural Welding Code – Steel
2	AWS D1.3	Structural Welding Code – steel Sheet
3	AWS D1.6	Structural Welding Code – Stainless steel
4	AWS A 2.4	Standard Symbols For Welding, Brazing, And Nondestructive Examination

### 1.0.2.7 American Institute of Steel Construction (AISC)

Sr.no.	Code no.	Description
1	AISC	Manual of Steel Construction.
2	CAP 437 (Latest Edition)	Standards for Offshore Helicopter Landing Areas.

### 1.0.2.8 Indian Standards Institute (ISI)

Sr.no.	Code no.	Description
1	IS 2062	Hot Rolled Medium and High Tensile Structural Steel – Specification.
2	IS 883	Design of Structural Timber in Building - Code of Practice.
3	IS 269	Ordinary Portland Cement.
4	IS 3502	Steel Chequered Plate – Specification.
5	IS 1786	High Strength Deformed Steel Bars and Wires for Concrete reinforcement.
6	IS 4457	Ceramic Unglazed Vitreous Acid Resisting Tiles.


### 1.0.2.9 European Standard (EN-10025)

Sr.no.	Code no.	Description
1	BS 8118	Structural use of Aluminium – Parts 1 & 2.
2	EN 755 Parts 1-9	Aluminium and Aluminium alloys- Extruded rod/bar, tube and profiles.
3	EN ISO 3506 Parts 1-2	Mechanical properties of corrosion-resistant Stainless-steel fasteners.
4	EN 10025-3	Hot rolled products of structural steels- Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels.

### 1.0.2.10 NORSOK Standard

Sr.no.	Code no.	Description
1	C-001	Living Quarter Area.
2	C-002	Architectural components and Equipment.
3	M-001	Material Selection.

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#### **1.0.2.11 National Standard Plumbing code**

#### **1.0.2.12 DNV RP C204 Design against accidental Loads**

### **1.1 STRUCTURAL STEEL**

#### **1.1.1 Delivery**

Steel shall be delivered in accordance with the requirements of ASTM A6 and as specified in this document.

#### **1.1.2 Condition of Material**

Structural steel to be used shall be new, unused (not reconditioned) and free of defects. Steel plates and rolled shapes shall be free of rolling defects, burrs, rough spots and other surface imperfections. Surface finish for steel surfaces shall be such that only blasting and no grinding is required to achieve a surface acceptable for painting. Plate edges shall be even, smooth, and free of laminations. Edge shearing of plates of a thickness of 25 mm or larger shall not be permitted.

Except where requested by specific supplements, systematic Ultrasonic Testing (UT) of steel plates at fabrication time is not required. However, any delivered plate which fails to meet the maximum discontinuity requirements of AWS D1.1 Section 3.2.3 e.g. 4% rule with adjustments shall be replaced. These rules, written for edge discontinuities, shall apply to the body of the plate, since plates are generally used as rolled tubulars and must provide footprints (i.e. edges) to other tubular where small region outside footprints and edges in accordance with AWS D1.1.


#### **1.1.3 Dimensional Tolerances**

Dimensional tolerances of individual tubular sections 457 mm diameter and above shall be in accordance with API 2B. A maximum of 1.5% cold expansion shall be allowed. The use of electric resistance welded (ERW) or spiral welded pipe is prohibited. Only SAW or DSAW tubulars welded with a qualified procedure in accordance with AWS D1.1 or seamless pipe is acceptable for structural use. Hydrostatic testing of structural tubular is not required. Rolled tubulars shall not have more than one longitudinal seam.

#### **1.1.4 Material Storage**

All material, whether procured or fabricated, shall be stored above ground on pallets, timber cribbing or similar supports. The material shall be stored above

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the level of standing water and be kept free from dirt, grease, paint spray and other foreign matters.

### 1.1.5 Material Marking

All material shall be identified by marking in accordance with codes & standard and heat numbers / cast number / bloom number / product number and will be in accordance with ASTM A6 wherever applicable. All identification markings shall be clearly visible and capable of remaining intact through the completion of fabrication. The material identification and traceability procedure shall be developed by the Contractor to identify each structural member / component with Heat Number /Cast Number / bloom number / product number to correlate the test certificates. This procedure shall be applicable from its receipt and storage through sub-assembly and final erection. Unidentified material shall not be acceptable in accordance with API RP 2A.

### 1.1.6 Inspection and Testing

#### 1.1.6.1 Mill Tests and Mill Certificates

All mandatory inspection and testing listed under the basic specification to which the steel is manufactured and all supplementary and additional requirements specified in these specifications for the concerned grade shall be documented to have been satisfied through mill tests and mill test certificates both for Ladle & Product.

One set of all relevant certificates and reports, clearly legible and in the English language shall be submitted by Contractor to Company. SI Units shall be used in all documentation. The mill certificates shall be signed by Manufacturer's Quality Assurance Representative and where specified by Company, an independent Third Party acceptable to Company to state compliance with this specification.

In case of butt welded seam Tubular procured under API 5L / 2B, Mill Test Certificate of the Plate Material shall be obtained and submitted.


#### 1.1.6.2 Contents

The mill certificates and reports shall include all relevant information including, but not limited to the following:

##### a) Identification

Mill Location, Purchase Order and item Number, Date of manufacture, Method of Manufacture, steel making process, Mill Heat / Cast Numbers,

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bar or bloom number, plate number, supply condition, dimensions, specification and grade of steel (basic specification).

#### b) **Composition**

Ladle (Heat) analysis and product analysis with Carbon Equivalent. All elements used in the carbon equivalent formula shall be analyzed and reported. Elements which are not specified for any grade in the respective codes shall not be intentionally added without specific approval from Company prior to manufacture.

#### c) **Mechanical Properties**

- Tensile strength, Yield Stress, Ultimate strength and Percent elongation.
- Charpy V-notch tests results, (if required).
- Through thickness properties, (if required).
- Strain age test results, (if required).

d) Non-destructive test results, (if required).

e) Details of heat treatment, if performed.

f) Impact testing specimen size, orientation, impact values and test temperature.

g) Reports signifying meeting other specific/ supplementary requirements for the specification for the material.

h) Supplementary information relating to manufacturing process.


#### **1.1.6.3 Material Certification**

Original Mill Test Certificate shall be made available to the Company appointed Inspector for verification at the time of inspection. Material with Mill Test Certificates, that do not satisfy the specified requirements herein shall be rejected and removed from the storage area. In case of butt welded seam Tubular procured under API 5L / 2B, Mill Test Certificate of the Plate Material shall be obtained and submitted.

Copy of Original Mill Test Certificate duly signed by TPI/CA shall be submitted with material Traceability as As-Built Documentation.

#### **1.1.6.4 Material Testing**

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This section gives the minimum requirements of the materials supplied to this specification. Unless stated otherwise, all testing shall be performed in accordance with ASTM A6 "Standard Specification for General Requirements for Rolled Steel Plates, shapes, sheet piling and Bars for structural use" and ASTM A 370 "Mechanical Testing of steel products".

#### 1.1.7 Ex-Stock Steel

Steel manufactured two years prior to the actual use shall not be accepted. However, in case of any immediate requirement of any small quantity, supply of ex-stock steel in good condition and free from rust and pitting may be offered for Company's consideration. Such material should be easily identifiable with respect to its Heat / Cast number, Manufacturer's stamp, colour coding, Grade etc., as given in the mill test certificate. The mill test certificates of such material shall meet the required specification. The Contractor shall satisfy Company by means of additional tests as directed on the company's inspection at no extra time and cost to the company.

#### 1.1.8 Steel Manufacturing Process

Only product manufactured by the electric arc furnace or the basic oxygen processes is acceptable as structural steel. Bessemer process, rimmed or capped steels are not acceptable. Material for through thickness application shall be vacuum degassed or VAD or ladle refining process while molten. Rejected steels and unidentified steel are not acceptable. Specifically, rejected high strength steel (350 MPa) is not to be substituted for low strength steel (250 MPa).

#### 1.1.9 Class and Types of Structural Steel


Steel material types defined by shape and grade or strength designation consisting of the specified minimum yield strength in MPa. In the case where through thickness properties (TTP) are required for attachments and loads perpendicular to the plate surface, a suffix "Z" has been added. Chemical composition of steel shall be in accordance with the respective standards with supplementary requirements given in Sections 1.1.9.4 and supply conditions given in Section 1.1.9.5 hereunder.

##### 1.1.9.1 Class of Material

##### Class A

Class A material are suitable for critical applications involving stress concentrations, high restraint, the possibility of plastic strain and lack of redundancy. Charpy impact test in accordance with the specified Standard is

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mandatory. Carbon equivalent shall be as per respective standard and specification.

### **Class B**

Class B material are intended for less critical applications but still involve the possibility of plastic strain and therefore the need for impact testing. The material shall meet the Charpy impact test requirement of the specified Standard and in addition, carbon equivalent shall be as per respective standard and specification. The thickness of class B material shall not exceed 63mm.

### **Class C**

Class C materials are those, which have a history of successful applications in welded structures at service temperatures above 0° C, for which impact testing is not required. Applications are for primary and secondary members involving moderate forming, low restraint and modest stress concentrations. Structural redundancy should be provided by the design.

## **1.1.9.2 Types of Structural Steel**

The following is a guideline for the selection of steels for use in offshore structures. Contractor shall use steel type to suit fabrication methods, welding procedure etc., for each structural steel type as specified.

**Grades of Steel are covered in this specification are: -**


**Grade 250:** Carbon Steel of Minimum yield strength 240-250 MPa.

**Grade 350:** Intermediate Strength steel of Minimum yield Strength 340-360 MPa.

High strength steel grade, having specified minimum yield strength (SMYS) of steel exceeding 360 Mpa (52 ksi) shall not be used for offshore platform.

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**1.1.9.3 Table: STEEL TYPE, SHAPE, APPLICATION, GRADE, SPECIFICATION & CLASS**

TYPE	SHAPE	APPLICATION	GRADE	SPECIFICATION	API CLASS
1-A	Plate	Plates for minor secondary steel in top side, deck plating, toe plates, etc. Building Wall, Building Floor and Roofing. Plates grating (from cellar Deck & upwards).	250	ASTM-A 36 / IS 2062:E250 Quality – B/C	C
1-B	Plate	Plates for rolling tubular for secondary steelwork, Stiffeners. Plates for profiling for building module	250	ASTM-A-36 / IS 2062 E250 Quality – C	C
1-C	Rolled section	Steel sections with a depth up to 300 mm and used as secondary members. (Including angles, channels, etc.).	250	ASTM-A-36 / IS 2062 E250 Quality – C	C
1-D	Tubular	Seamless tubulars up to 406 mm (16") diameter for Deck truss braces and topside deck, bridge braces, ladders (from cellar deck & upwards), Jacket walkway secondary members and staircase stringer.	250	API-5L-Grade-B/ ASTM-A-106 Grade B	B/C
2-B	Plates	Non-through thickness applications less than 75 mm thick involving tubular above 406 mm diameter for primary steel throughout the structure, like Jacket legs/skirt sleeves, Deck truss, Deck legs other than joint cans, barge bumpers and helideck plating, plate girder, shim plates, bridge braces, Stiffeners, Riser Protector, Boat landing, Piles etc.	350	ASTM-A-131-DH36 / EN 10025-S355 -J2G3/ EN 10025-S355-J2+N/ EN 10025-S355-K2+N API-2H-Gr-50	A
2-C	Rolled Section	For applications of Primary and major secondary steelwork where rolled sections are to be used with a depth above 300 mm	350	ASTM-131-AH36 / EN10025-S355-J2+ AR/N EN 10025:S355J0 ASTM A 572 Gr 50	B
2-D	Tubular	seamless tubular up to 406 mm (16") diameter for use in substructure braces, truss braces and chords, energy absorbing tubulars in Boat-landing and Barge Bumpers, shock cells Supporting members.	350	API-5L-Grade-X52N, PSL-2	B

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2-Z	Plates	Typical through thickness applications ("Z") above 19 mm thickness involving primary items at critical design area like Tubular Can Joint Sections, Primary Member, Brace Node Sections, Installation Pad eyes, Crane pedestal, lifting eye and cheek plate, Pile in mudline region, diaphragm plate, beam web plate, beam flange plate, Hanger Clamp etc.	350	API-2H –50Z	A
2-CON	Tubular	Conductor Pipes of all sizes (25mm minimum wall thickness) with single seam.	350	API-5L, Grade X-52N, PSL-2	B
1-Arch	Stainless Steel plate	Exposed to weather – Doors & windows frames & shutters, handrail toe plate / kick plate, grating (in wave zone below Cellar deck).	250	AISI 316/317 *316L/317L (See note-8)	
2-Arch	Galvanized steel sheet	Not exposed to weather-Doors, internal partition, bulkheads, false ceiling	-NA-	ASTM A 653	
3-Arch	Stainless Steel tubes	Handrails & ladders (in wave zone below cellar deck)	250	ASTM A 312 Gr. 316L/317 *316L/317L (See Note-8)	


**Notes: -**

1. For handrails details, refer Table 1.4.3.3
2. Stiffeners, flange extension plates, ring stiffeners etc. shall be of the same grade as the element to which they are connected.
3. For piles, mud line region is defined as the region based on stress considerations and extends over the negative and positive bending moment regions and includes the under drive and overdrive allowances.
4. All floor plating including cellar Deck & Main Deck shall be of Chequered plates as per approved equipment plan.
5. Fabricated plate girder may be used only when design requirement of beam depth is more than 900mm. Welding of flange-web connection of plate girder shall be full penetration weld only.
6. TMCP Steel material shall not be used for conductor (2-CON)
7. All Stainless steel items wherever used shall be of SS316/ SS317.
8. \*All Stainless steel items wherever welding is required shall be of SS316L/ SS317L.

**1.1.9.4 Supplementary Requirements**


Material shall comply with the following supplementary requirements & shall be reported in Mill Test Certificate:

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- a. 1-A to 1-D Type of steel shall be killed steel.
- b. 2-B, 2-C, 2-D, 2-Z & 2-CON Type of steel shall be killed and made according to fine grain practice.
- c. Steel material used for grating & handrail shall have silicon content in the range of 0.15 &-0.22% (for good galvanizing)
- d. Charpy V-Notch Impact test shall be conducted at (-) 20°C for Type 2-B steel material with minimum 34 Joules & 24 Joules in Longitudinal & Transverse direction respectively & at 0°C for 2-C and 2-D material with minimum single value 27 Joules.
- e. Percentage elongation with specimen length 200mm shall be minimum 21% and 18% respectively for steel Grade 250 and Grade 350. The minimum percentage elongation shall be 2% more if report is made on gauge length of  $5.65 \text{ (So)}^{\frac{1}{2}}$ . The percentage elongation shall be  $(\text{Lu}-\text{Lo}) \times 100 / \text{Lo}$ , where  $\text{Lo} = 5.65 \times (\text{So})^{\frac{1}{2}}$ , So is the original cross sectional area of gauge length and Lu is the final length.
- f. For Type 2-Z, the following shall be applicable:
  - i. All plates shall be **ultrasonically** examined in the final heat treatment condition for defects and discontinuities in accordance with ASTM A-578. Acceptance standard shall be Level-A (**S1** of API Spec 2H).
  - ii. Charpy V-Notch toughness impact test at (-) 40°C in Transverse direction with minimum single value 34 Joules and average energy value 41 Joules as per Supplementary requirement **S2** of API Spec. 2H.
  - iii. Individual plate testing as per **S-3** of API-2H.
  - iv. Through Thickness (Z direction) tensile testing shall be performed as per Supplementary requirement **S4** of API Spec. 2H.
  - v. The sulphur content of steel shall be as per clause 5.2 of Supplementary requirement **S 5** of Spec. API 2H.
- g. If micro alloying elements Nb, V, Ti are used, their total shall not exceed 0.15 percent.
- h. For Thermo-Mechanical Control Processing (TMCP) or equivalent steel please refer Section 1.1.9.5 (ii) hereunder.
- i. Pitting Resistance Equivalent Number (PREN) value of stainless steel (1-Arch ) shall comply following:
  - $\text{PREN} = \text{Cr} + 3.3 \text{ Mo} + 16 \text{ N}$
  - Minimum Mo content shall be 2.5%

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#### 1.1.9.5 Supply Condition

Material shall comply with the following supply conditions:

- i. Steel Grades 2-B and 2-Z shall be supplied in Normalized Condition. Steel **Type** 1-C and 2-C (Rolled Section of flange thickness over 25 mm) shall be supplied in Normalized condition. All other steel may be supplied in as rolled condition.
- ii. If the manufacturer/supplier offers an alternative supply condition, e.g. Thermo-Mechanical Control Processing (TMCP) for steel plates (2-B, 2-D & 2-Z) and structural steel shapes (2-C), shall meet the supply conditions as under:
  - a. Conductor (2-CON) and Pile material shall not be used under this category.
  - b. Supplementary Requirement of Simulated Post-Weld Heat Treatment (S9) & Pre Production Qualification (S11) applicable to steel Type - 2B, 2C, 2D & 2Z.
  - c. Supplementary Requirement of S1, S3, S4, S5, Charpy V-Notch toughness test as per clause 1.1.9.4 above.
  - d. TMCP Steel material having Yield Strength exceeding 345MPa shall not be used for offshore structure and shall not be accepted.

#### 1.1.10 Heat Treatment

Elements subject to press or roll forming where the temperature of the steel is above 38 degree C and less than 427 degree C during forming operation shall be stress relieved by heating the element to a temperature between 590°C and 620°C and cooling after a specified time as per relevant codes & standards.


#### 1.1.11 Quality of finished Steel

The finished steel shall be presented for inspection such that the surface can be readily inspected for defects. All surfaces shall be 100% visually inspected for defects. Repair of plates by welding by Manufacturer or supplier is not permitted.

#### 1.1.12 Material Substitution

Alternative Specifications or property grades for certain material may be accepted with the prior approval of the Company, provided that it can be shown to be equivalent or superior to the specifications as per ASTM & API code listed

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in the table 1.1.9.3 and the required properties and appropriate supplements of the materials is complied with the material specified. When the proposed substitute material have variation in chemical and Mechanical properties from the listed codes, the contractor shall establish with reasoning the superiority/equivalent of the alternate material.

### 1.1.13 Steel Material Inspection

Steel Material shall be physically inspected by Company appointed inspector at Site of Works on arrival of Material with respect to Mill Test Certificate and accepted before put to use.

Mill Test Certificate along with material Traceability record shall be documented as As-Built Documentation/ record.

## 1.2 Material of Construction of Helideck

Material for Helideck shall be Aluminum unless & otherwise specified in the scope of work in the bid document.

In case provision of main cum helideck considered in the scope of work, material of construction of heli-deck shall be carbon steel.

### 1.2.1 General


Steel Helideck shall be designed for the designated Helicopter as per the Structural Design Criteria and shall comply with CAP 437 Guideline. Design analysis of helideck shall be carried out as per structural design criteria.

Aluminium Helideck shall be designed for the designated Helicopter as per the Structural Design Criteria and shall comply with CAP 437 Guideline. Helideck Purchase specification shall be generated and supported with detail design of helideck.

The Aluminum helideck beams and plating shall be made of extruded aluminium meeting the requirements of the following specification. The top pan cake aluminium structure shall be supported by the steel primary members of the helideck.

The top aluminium structure shall also cover the safety net, supports for solar panel, Cable tray, lights and drains, threshold gratings at access points, Handrails, isolation sets at all interfaces with carbon steel, access gangways and stairs, Helicopter tie-down and helicopter landing net tensioning points.

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Design Calculation & Analysis of Aluminum Helideck shall be certified by third party Certifying agency like DNV/BV. Helideck manufacturer shall obtain this certification, which along with drawing shall be part of Purchase specification.

### 1.2.2 Material Standards

The equipment shall be designed and tested in accordance with, but not limited to, the requirements of this specification and the latest editions of the following standards, codes, statutory regulations and other documents referenced therein:

BS 8118	Structural use of aluminium – Parts 1 & 2
EN 755 Parts 1-9	Aluminium and aluminium alloys. Extruded rod/bar, tube and profiles.
EN ISO 3506 Parts 1-2	Mechanical properties of corrosion-resistant stainless-steel fasteners.
BS 4592	Specification for metal open bar grating

### 1.2.3 Material Grades

The materials and grades to be used to the helidecks are tabled below:

PRODUCT	ALLOY
Aluminium Extrusions (structural)	6082 T6
Aluminium Extrusions (planking)	6005A T6
Aluminium Extrusions (other)	6063 T6
Aluminium Sheet	5083 H111
Stainless Steel Fixings	A4 – 80

#### 1.2.3.1 Alternative Grades


Alternative grades may be offered, however their use will be subject to the Company's approval.

**1.2.3.2** Stainless Steel Nuts & Bolts of Grade SS316/SS317 shall be used for bolted connections. Aluminum Helideck Bolted connections / Joints shall be sealed with suitable sealant to minimize possibility of Crevice Corrosion.

**1.2.3.3** Safety net panels shall be of Aluminum frames with Stainless Steel wire mesh.

### 1.2.4 Inspection

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The aluminium helideck supplied to this specification shall be fully inspected and verified by an approved third party verification organization. The Supplier is required to provide all drawings supported with design calculations, details and descriptions to enable the company to obtain permission to use the helideck. All Mill Test Certificate of Aluminum material, Helideck Manufacturer's QA & QC Records, Design document, Drawings and Material Inspection report shall be document as as-built documentation.

#### **1.2.4.1 Isolation**

##### **1.2.4.1.1 Electrical Isolation**

Electrical isolation between aluminum and steel structure shall be achieved by providing insulating material (hard neoprene or poly-acetyl made washers, bush & sleeves) to avoid galvanic corrosion.

##### **1.2.4.1.2 Earth Connections**

The isolation achieved by clause no.1.2.4.1.1 requires that effective earthing of the aluminium is made through earth bosses. These will be welded to the aluminium support beams local to points of support on the steel substructure.

#### **1.3 CEMENT**

##### **1.3.1 Cement Grades**


Unless otherwise stated on the bid document, all cement provided for construction shall conform to the following.

Type B              Oil well Cement as per API Specs-10A Class-G.

Cement supply to specifications equivalent to those listed above shall be considered as substitution and shall require written approval of the Company to this effect.

**1.3.2** When a specific physical or chemical property of the grout or concrete is warranted which is not achievable by controlling the proportions of the normal constituents of the cement grout or concrete, additives to the cement grout or cement concrete may be allowed. The Contractor shall submit to Company his proposal for such additives giving details of the chemical composition of the proposed additives and the specific properties of the cement grout or cement concrete, Contractor proposed to achieve together with test results and other relevant details. The Company shall within a reasonable period review and convey to the Contractor its decision on such proposal. It shall be the Contractor's responsibility to satisfy the Company that his proposal will satisfactorily meet the requirements of the works.

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### 1.3.3 Usage Summary

Usage of different grades of cement shall be as given in Table 3.1.

**TABLE - 3.1**

	CEMENT GRADE TYPE B*
Grout in Jacket leg to Pile Annulus/ Skirt Sleeves to Pile Annulus /Grout Plug in Piles	Applicable

\*Non – shrinking property is essential.

### 1.3.4 General Requirements

#### 1.3.4.1 Ex-Stock Cement

Cement supplied ex-stock shall not be accepted without proper identification and without manufacturer's Test certificates.

Cement manufactured over six months prior to actual use shall not be used for construction of these works.

In case of any doubt about the quality of cement, the Company may ask for independent testing of the cement to be used on Company's Works by a third party to be selected solely by the Company at the Contractor's cost. Non-compliance of any of these specifications shall be sufficient cause for rejection of the cement and in such case all costs of testing by a third party shall be borne by the Contractor and all such cement be removed from the work site by the Contractor

#### 1.3.4.2 Manufacturer's Test Certificate


**1.3.4.2.1** The Contractor shall submit manufacturer's test certificates to the Company for all cements Contractor intends to use for the works. The Contractor shall indicate the manufacturer's name, trade mark or other means of identification, the batch number and date of manufacture and test results covering fineness, chemical composition and compressive strength at 1 day, 3 days and 28 days, initial and final setting time, shrinkage/expansion and soundness. All test shall be carried out as specified in 1.3.4.2.2 below.

**1.3.4.2.2** All tests for the cement shall be carried out as specified in ASTM C-109 using 50mm cube specimen.

Shrinkage/expansion test shall be carried out as specified in ASTM designation C-807-87. "Restrained Expansive Cement Mortar" or by similar acceptable method.

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**1.3.4.2.3** Identification of the cement intended to be used for the works shall be co-relatable with the identification on the manufacturer's test certificate.

#### **1.3.4.3 Special Requirements**

The following requirements shall apply unless specifically waived by the Company or otherwise specified herein or on bid drawings.

For all cement used for the works where non-shrinking/expansive property is desired shall have acceptance criteria as below:

Drying Shrinkage                      - 0.08 % at 28 days (as per ASTM C-596)

Expansion                                      - 0.10% - 0.30% at 28 days.

**1.3.4.3.1** The total amount of chlorides calculated as free calcium chloride shall not exceed 0.3 percent by weight of cement.

**1.3.4.3.2** Compressive strength for Class-G HSR cement shall not be less than 2.1Mpa (300 psi) in 8 hours at 38°C.

**1.3.4.3.3** The grout shall be of non-shrinking expansive type having minimum density 1920 kg/m<sup>3</sup> with compressive strength shall not be less than 70 Kg/cm<sup>2</sup> (approximately 1000 psi, 7 MPa) in 24 hours and 281 Kg/cm<sup>2</sup> (approximately 4000 psi, 27 MPa) in 28 days at 27±2°C.


### **1.4 Miscellaneous Steel Items**

#### **1.4.1 Fasteners**

Unless shown otherwise in the Drawings, all fasteners shall conform to the following:

- a) Lag screws and bolts shall be machined with American Standard Regular Hexagonal Heads with American Standard Coarse Threads, Class-2.
- b) Nuts shall be American Standard Regular Hexagonal.
- c) Washers shall be standard round plate and/or machine lock unless shown otherwise on the drawings.
- d) All bolts for use in the submerged and splash zones and upto & including jacket walkway level shall be flouro-polymer coated (XYLAN type) or equivalent as specified in table -1.4.1.1. Coating color for all bolts and nuts shall be "Red". All nuts & bolts shall be of ASTM A-193 Grade B7 and nuts of ASTM A-194, grade 2H.

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- e) All bolts, nuts and washers above splash zone and fixed to external surfaces and internal surfaces exposed to natural ventilation, shall be of stainless steel ASTM A-193 Grade B8M and nuts of ASTM A-194, grade 8M.

**Table-1.4.1.1:** Specification for PTFE/ Xylan Coating on nut & bolts

Technical requirement of PTFE/Xylan Coating on nut & bolts		
Sr. no.	Properties	Test Requirement
i	Corrosion resistance	salt spray test up to 3000 hours (nuts not frozen) (ASTM B117)
ii	Adhesion	5B (ASTM D3359)
iii	Pencil Hardness	5H-6H (ASTM D3363)
iv	Kinetic friction coefficient	0.06-0.08
v	Elongation	35%-50%
vi	Tensile strength	27.6 Mpa (4000 psi)
vii	Operating pressure	upto 690Mpa (100,000 psi)
viii	Coating Thickness	25 µm to 40µm
ix	Impact	18.43 Nm (160 in.lb) (ASTM D2794)
x	Thread fit	Over tapping of nuts 0.25mm (0.010")
xi	Dielectric strength	500 volts per 25 µm
xii	Operating temperature	-100°C to +260°C

**Note:** PTFE /Xylan coating on fasteners will have a uniform thickness of 20 ± 5 Microns to 45± 5 microns thick.

In atmospheric zone for structural purposes the hardness and strength class shall not exceed to ISO 898 (all parts) class 10.9.

In submerged zone Low alloy steel fasteners used for structural purposes the hardness and strength class shall not exceed to ISO 898 (all parts) class 8.8 & shall be coarse threaded and Class 8.0 for nuts.

Bolts & Nuts shall be procured along the Mill Test Certificate containing Product Analysis for Chemical Composition, Mechanical Tests, etc. Ladle Analysis shall also be reported with Steel manufacturing process. Manufacturer shall inspect all Bolts & Nuts for surface cracks and certify that supplied bolts & nuts are free from defects. Test Certificate for PTFE Coating shall be provided. On arrival of Bolt at site, all Bolts & nuts shall be inspected by Company appointed Inspector with respect to Mill Test Certificates.


## 1.4.2 Grating (Electro forged grating):

### 1.4.2.1 i) Grating from Cellar Deck and above Material

Serrated flats for gratings shall conform to ASTM A-36 or IS 2062, E250 Quality – B. Cross bars shall be high strength deformed bars conforming to IS 1786 Gr. Fe 415.

Welding of grating shall be electro-forged weld.

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For gratings being fabricated by resistance welding/ electro forged welding, bearing member shall be minimum 30 mm X 6mm serrated type spaced at 30 mm center to center also. Square twisted Steel cross bar having minimum 8mm (diagonal), spaced at 75 mm center to center. Crossed bars over bearing bar shall be fully pressed into the bearing bars, flush and cross bar projection should be less than 1.5 mm. All bearing bar to frame bars shall be completely seal welded. Each bearing member shall be serrated by punching out of plain bar tops in order to provide cut edges for increased grip. The serration depth shall not be less than 2.5 mm.

The spacing of serration shall 12.5mm. The gratings shall be manufactured in accordance with BS-4592 requirements.

Grating for Treads for staircase shall also be electro- forged grating.

End fixing plate shall be provided & seal welded along the two supported ends (perpendicular to bearing plates) of treads of staircase.

All grating panels and treads of staircase shall be seal/fillet welded all around/on both the sides with the structural members.

6mm thick chequered plate Nosing shall be provided in the grating for treads of staircase.

Gratings shall be galvanized as per Functional specification no. 2005 "Protective Coating".


## **ii) Grating Below Cellar Deck Material**

Material for grating shall be of stainless steel. Serrated flats for gratings shall conform to ASTM A-484-13a Grade SS 316L. Cross bars for gratings shall conform to ASTM A276 GRADE 316L.

Welding of grating shall be Resistance weld.

For gratings being fabricated by resistance welding/ electro forged welding, bearing member shall be minimum 30 mm X 5 mm serrated type spreader at 30 mm center to center also. Square stainless Steel cross bar having minimum 8mm (diagonal), spaced at 75 mm center to center. Crossed bars over bearing bar shall be fully pressed into the bearing bars, flush and cross bar projection should be less than 1.5 mm. All bearing bar to frame bars shall be completely seal welded. Each bearing member shall be serrated by punching out of plain bar tops in order to provide cut edges for increased grip. The serration depth shall not be less than 2.5 mm. The spacing of serration shall not be less than 12.5 mm. The gratings shall be manufactured in accordance with BS-4592 requirements.

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Material for grating shall be as per Table 1.1.9.3 of this spec.

End fixing plate shall be provided & seal welded along two sides (perpendicular to bearing plates) of treads of staircase.

All grating panels and treads of staircase shall be seal/fillet welded all around/on both the sides with the structural members.

Nosing shall be provided in the grating for treads of staircase. Grating for Treads for staircase shall be electro- forged grating.

Details of gratings indicated as per 1.3.2.1(i) & (ii) above are suitable for Span of Grating upto 750mm. An intermediate support shall be provided where the span of grating exceeds 750mm.

Sr. No.	Components of grating	Gratings	
		Grating from Cellar Deck and above	Grating Below Cellar Deck
1	Material Bearing bar	ASTM A-36 or IS 2062, E250 Quality – B	ASTM A-484-13a Grade SS 316L
2	Material for cross bar	IS 1786 Gr. Fe 415.	ASTM A276
3	Bearing Bar Dimension	30x 6mm	30x5mm
4	Cross bar geometry and dimension	Square twisted having minimum 8mm (diagonals)	Square twisted having minimum 8mm (diagonals)
5	Depth of of serrations	Minimum 2.5 mm	Minimum 2.5 mm
6	Spacing of cross bar	75mm centre to centre	75mm centre to centre
7	Maximum span of grating	750mm	750mm

Note: For platform makeover and maintenance painting related works, respective project scope of work shall be referred.

### 1.4.3 Hand Rail & ladders


#### 1.4.3.1 Hand Rail below Cellar Deck (Type – I)

Stainless Steel Hand rail & ladders shall be provided on all peripheries of platform from Boat landing to Cellar deck (bottom). It shall cover sides of Jacket Walkway, Stair sides, Stair landing, Sub-Cellar Deck sides, Boat Landing and Stair to Boat Landing.

Hand rails shall have continuous weld all round joints. Removable type Or Offshore installed Hand rails shall be test fitted at yard prior to load out and shipped loose duly marked for offshore installation. Hand rail post interval shall not exceed 1.5 m (horizontal distance). Height of hand rail shall be 1.1 m. Handrail Type-I shall be designed to withstand extreme wave load. Wave slam check shall be carried out for Hand rails.

#### 1.4.3.2 Hand Rail on and above Cellar Deck (Type – II, III & IV)

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Hand rail shall be provided on all peripheries of platforms, Cellar & Main deck, modules, roofs, Lay down areas, landings & stair landings, stair sides, sides of walkway, access platforms sides, Solar Deck, etc. Hand Rail for Laydown Area shall be removable / re-fixable type.

Hand Rail shall be designed for 100 kg load applied at any point in horizontal & vertical & direction on top Rail & at handrail post. Hand rail post interval shall not exceed 1.5 m (horizontal distance) and height of hand rail shall be 1.1 m below the top rail. Two intermediate rails shall be provided in the handrail. Kick Plate/toe late shall be provided at the bottom level of Handrail with a gap of 10mm between floor plate and grating. Clear distance between two Handrail posts shall be 50mm.

Steel Handrail and kick plate shall be galvanised and over coated as per spec.2005.

Drain hole shall be provided at the bottom of collar of removable type Handrail for drainage of water


Following types of Hand rails shall be used:

- TYPE – I - Hand rail below Cellar Deck (Wave Zone) - Fixed Type.
- TYPE – II - Hand rail on and above Cellar Deck - Fixed Type.
- TYPE – III - Hand rail on and above Cellar Deck - Removable Type.
- TYPE – IV- HR with safety chain

#### 1.4.3.3 TABLE : Details of Handrails & Chains

Member	Dimensions in mm	Material Spec.
Vertical post for Type-I, II, III and IV	60.33Ø x 5.54	For Type-I: Conforming to STAINLESS STEEL : ASTM A 312 GRADE 316L
Top horizontal member for Type-I, II and III		For Type-II,III and IV: Conforming to ASTM A53 Grade-B Type-S/API-5L Grade B/ ASTM-A-106 Grade B
Other Horizontal Members for Type-I, II and III	48.3Ø x 5.08	
Kick plate for Type-I, II and III	100 x 6	For Type-I: Conforming to STAINLESS STEEL : ASTM A 240 GRADE 316L  For Type-II and III: Conforming to ASTM A36/ IS 2062: E250 Quality-B
Socket, Collar for Type III only	73.00 Ø x 5.16	Conforming to ASTM A53 Grade B Type-S/API-5L Grade B /IS 1161 / IS 1239/ ASTM-A-106 Grade B
Safety Chain for Type - IV handrail only	6 mm DIA.	Stainless steel 316L

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Note -1: The size of vertical post & top horizontal rail is minimum and indicative only. Size of vertical post & top horizontal rail shall be calculated & provided as per design calculations considering environmental and live loads during detailed engineering.  
Note-2: For platform makeover and maintenance painting related works, respective project scope of work shall be referred.

## 1.5 TIMBER

### 1.5.1 Usage

The specification for timber as per IS 883 shall govern the application of timber used in:

- a) Launch Truss runners of jackets.
- b) Mud mats

Timber to be used for each of the above application shall meet the strength, durability and dimensional requirements for the intended use. Contractor to indicate the grades of timber along with their properties and satisfy Company on their suitability for the proposed use.

### 1.5.2 Delivery & Storage

All timbers supplied for the works shall be delivered at the fabrication site in sizes and lengths as required for the works and fully seasoned and treated with preservatives.

After delivery and prior to use all structural timbers shall be stored in such a manner as to prevent decay and renewed development of defects. Preferably timbers shall be piled into stacks upon well treated and even surfaced beams, sleepers or brick pillars so as to be above ground level by at least 15 cm. The stacks shall be protected from hot dry winds or direct sun and rain and shall be accessible from all sides.


The stacks of timbers shall be appropriately marked so as to be readily identifiable and co-relatable with the purchase order, vendor's certificate or other inspection/test certificates.

### 1.5.3 Inspection & Testing

Inspection and testing of timber shall be carried out as per the grades of timber supplied as per the IS 883 requirement.

## 1.6 RUBBER

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### 1.6.1 SCOPE

Rubber products /Neoprene shall conform the Requirements of ASTM D 2000. Rubber material for fenders shall conform to the Requirements indicated in Table- 1.5.1.1 & Table -1.5.1.2.

This specification describes the minimum requirements for procurement, manufacture, testing and supply of rubber products for use on offshore platforms as required either as permanent component or as temporary installation and as listed below:

- |                             |                                                            |
|-----------------------------|------------------------------------------------------------|
| 1. Boat Landing -           | Shear Fenders                                              |
| 2. *Barge Bumper            | - Rub Strips                                               |
|                             | - Shock Cell with Rotating Bumper Rings (See Note-1 Below) |
| 3. Jacket Leg               | - Rub strips                                               |
| 4. Jacket Leg/Skirt Sleeves | - Diaphragm Closures                                       |
| 5. Jacket Leg/Skirt Sleeves | - Grout Seal/Packer                                        |
| 6. Piles -                  | Pile Closure                                               |


**\*Note-1:** A chain as per API 2F with corrosion allowance of 6mm shall be provided connecting jacket legs and shock cell to prevent the pull out of the shock cell. Size of chain and fixing arrangement shall be firmed up during detailed engineering.

**Table 1.6.1.1: Requirement of rubber material (Molded Fenders)**

Sr. no.	Property	Testing Standard	Condition	Requirement
1	Tensile	ASTM D412 Die C	Original	16.0 MPa (min.)
			Aged at 96 hours At 70° C	12.8 MPa (min.)
2	Elongation at Break	ASTM D412 Die C	Original	350%
			Aged at 96 hours At 70° C	280%
3	Hardness	ASTM D2240	Original	78°Shore A (Max.)
			Aged at 96 hours At 70° C	Original +8° Shore A (Max.)
4	Compression set	ASTM D395 Method B	22 hours at 70° C	30 % (Max.)
5	Tear Resistance	ASTM D624 Die B	Original	70 kN/mm (Min.)
6	Ozone resistance	ASTM D1149	50 pphm at 20% stain, 40° C, 100 hours	No cracks
7	Sea water Resistance	ASTM D471	28days @ 95° C	Hardness±10% Shore A (Max.) Volume +10/-5% (max.)
8	Abrasion loss	BS 903 A9 Method B	3000 Revolution	1.5 cc (max.)
9	Bond strength	ASTM D395 Method B	Rubber to steel	7 N/mm (Min.)

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10	Dynamic Fatigue	Method D430-95 Method B	15000 cycles	Grade 0-2
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**Table 1.6.1.2: Requirement of rubber material (Extruded & Wrapped Fenders)**

Sr. no.	Property	Testing Standard	Condition	Requirement
1	Tensile	ASTM D412 Die	Original	13.0 MPa (min.)
			Aged at 96 hours at 70° C	10.4 MPa (min.)
2	Elongation at Break	ASTM D412 Die	Original	280%
			Aged at 96 hours at 70° C	224%
3	Hardness	ASTM D2240	Original	78°Shore A (Max.)
			Aged at 96 hours at 70° C	Original +8° Shore A (Max.)
4	Compression set	ASTM D395 Method B	22 hours @70° C	30 % (Max.)
5	Tear Resistance	ASTM D624 Die B	Original	60kN/mm (Min.)
6	Ozone resistance	ASTM D1149	50 pphm at 20% stain, 40° C, 100 hours	No cracks
7	Sea water Resistance	ASTM D471	28days @95° C	Hardness ±10% Shore A (Max) Volume +10/-5% (max.)
8	Abrasion loss	BS 903 A9 Method B	3000 Revolution	1.5 cc (max.)

## 1.6.2 SITE CONDITIONS

Rubber compounds for the rubber products shall be able to withstand the extreme marine environment indicated in the bid document.

## 1.6.3 GENERAL REQUIREMENTS


Company requires that the offered products have had satisfactory past performance in offshore environments. For each product, a base specification/product trademark is furnished in the Technical requirement to evaluate the level of performance required. In case the Contractor wishes to propose an equivalent alternative product, approval for the same shall be obtained by him in writing from the Company after furnishing complete technical details and proven application record of the alternative offered, viz. technical properties, manufacturing process, exposure to marine environments, successful offshore use etc. The products so offered shall be supplied only from manufacturers with a proven track record of supplying identical or similar products. Only products and grades normally manufactured and listed in the manufacturers catalogues shall be supplied.

## 1.6.4 TECHNICAL REQUIREMENTS

This section details the various rubber products listed above along with their minimum general requirements. Specific requirements along with base

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specification/product trade mark for each product as given in Annexure-1. If Contractor proposes an alternate system design for any component, the specific requirements shall be suitably configured to meet the design criteria for that components.

#### **1.6.4.1 BOAT LANDING SYSTEM**

The boat landing system is planned in such a way that it meets the requirements of the Design Criteria. The boat landing is designed to be mounted on shear fenders to absorb energy of impact. A set of low friction pads/strips are provided to act as rubbing surface against the boat.

##### **1.6.4.1.1 SHEAR FENDERS**

The shear fender shall have solid rubber bonded between two parallel plates. The plates shall be bolted to the boat landing at one end and supporting member at the other end.

Testing shall be performed to 110 percent of design capacity and load deformation - energy relationship reported.

##### **1.6.4.1.2 BOAT LANDING RUBSTRIPS**

The rub strips for boat landing shall be low friction type polyurethane minimum 150 mm width and 50 mm thickness bonded to back up plate/channel as shown in the relevant drawings.


#### **1.6.4.2 BARGE BUMPER**

Boat landing cum barge bumper system mounted on a combination of shock cells and shear fenders shall be can be provided. Individual stand-alone barge bumpers may also to be provided to protect the jacket legs. The specification covers both the instances. Stand-alone barge bumper shall be fitted with Gr.3 stud-less chain of suitable dia. 42mm (min.) of sufficient length with shackle at one end attached to Jacket leg and adjustable D shackle (galvanized) at opposite end to carry the static loads.

##### **1.6.4.2.1 Shock Cells**

The shock cells shall consist of two concentrically placed steel tubes with a rubber annulus. The rubber material used in the shock cell shall be natural rubber based. Manufacturing process of shock cells shall be such that the rubber is slightly under a compressive strain rather than a tensile strain in the finished cell assembly at zero loading. The process of pouring and moulding the rubber in the annulus are not acceptable due to problem associated with shrinkage and cracking.

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Steel Tubulars used for shock cells shall be designed for environmental loads and material of tubular shall conform to 2-D of table 1.1.9.3 of this specification.

The shock cells shall have a minimum overload capacity of 10% of the rated energy. Each shock cell shall be individually tested for both axial and lateral loading at least up to 110% of rated energy, and load-deformation-energy curves shall be developed for each.

Following information shall be supplied by the shock cell vendor with his quotation.

- i. The load/deformation/energy relationship of the shock cell.
- ii. The type and quality of rubber
- iii. The manufacturing process of the shock cell

#### **1.6.4.2.2 Rotating Bumper Rings**

The function of the Rotating Rubber Rings is to transfer the lateral load to the shock cell absorbing part of the energy of impact. The rubber ring shall have a urethane facing. The rubber ring should be capable of rotating freely around the vertical pipe.

Testing shall be performed to 110% of the rated energy. The load deformation/energy characteristics of the Bumper Ring shall be obtained by testing the ring with an outer steel sleeve to simulate the actual conditions.

#### **1.6.4.3 PLATFORM RUBSTRIPS**


Platform substructure protective rub strips and rub strips on boat landing shall be an easily replaceable type so that if required, only damaged rubstrip need be replaced. They shall be manufactured by the extrusion process. There shall be no cracks or breaks in the body of the fenders. Necessary chambers must be provided to clear-up back ring.

Testing shall be performed to 110% of rated load and load-deformation energy relation reported.

#### **1.6.4.4 DIAPHRAGM CLOSURES (INSTALLATION AID)**

Diaphragm closures, where required by Contractor as part of his installation engineering, shall be made of reinforced rubber and shall be tested to a pressure equal to 1.5 times hydrostatic pressure due to Water Depth plus 10M of seawater. In case the diaphragm is required to rest on / penetrate a sandy layer, the test pressure shall be 1.5 times (hydrostatic pressure due to Water Depth + Ultimate bearing capacity of Soil).

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#### 1.6.4.5 GROUT SEAL/PACKER (INSTALLATION AID)

The grout seal packer shall be used to seal the annulus between the pile and Jacket leg (having Main Pile) / skirt pile sleeve during grouting operations. One of the following two types of seals/closures shall be used.

##### I. PASSIVE GROUT SEAL

It provides a seal with a loop under hoop tension, gripping the pile during driving/grouting.

##### II. INFLATABLE PACKER ASSEMBLY

It provides a seal by pneumatic/hydraulic inflation of a rubber torus. The inflatable packer shall be tested to a pressure of 40 bar against a pile mandrel.

#### 1.6.4.6 PILE CLOSURE PLATE (INSTALLATION AID)

The Pile Closure shall be provided if required by Contractor as part of his installation engineering. This closure shall be of easily removable type and shall not leave any protrusion of more than 25 mm after removal of the closure. This closure shall be tested to a pressure of 1.5 times the hydrostatic pressure at seabed computed at the installation site.

#### 1.6.5 DRAWINGS

- Contractor shall furnish drawings giving complete details and dimensions of the items for approval of Company at least 30 days prior to preparation of test piece, if so required. Drawing shall also include MTO along with various grade of material required for fabrication.
- Approval of drawings shall not relieve the Contractor of his responsibility to provide the products in accordance with this specification.

#### 1.6.6 QUALITY CONTROL


Contractor shall take every precaution to ensure and demonstrate, if required, adequate quality control of their products so as to provide products of uniform and required quality.

#### 1.6.7 TESTING AND INSPECTION

##### 1.6.7.1 Testing

Testing shall be carried out on each item being supplied, for all the parameters specified in the technical requirements, and test reports shall be furnished to the

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Company. Company reserves the right of witnessing all tests and declining acceptance, if necessary, because of poor standards of manufacture and/or deficiency in meeting the technical particulars. The Contractor shall notify the Company 30 days in advance to enable Company or his authorized representative to witness the testing, if so required. The results shall be furnished to Company and approval obtained prior to shipment of the products.

In case of any doubt, the Company may ask for additional information, testing or retesting which the Company may feel necessary, which the Contractor shall carry out at no extra cost to Company and with no impact on the delivery project schedule.

#### **1.6.7.2 INSPECTION**

All items intended to be installed in the works shall be subject to inspection by Company's inspectors. Contractor shall extend all facilities to the Company's inspector for such inspection at all reasonable times. Non-conformance to these specifications in the opinion of Company's Inspectors or as evident from the results of any additional tests or retesting shall be sufficient cause for rejection.

#### **1.6.7.3 MANUFACTURER'S CERTIFICATE**

The Contractor shall submit to Company, Certificate by the manufacturer for each type of product giving the following details.


- Manufacturer's Name, Trade Mark or other means of identification.
- Type and quantity of Rubber Products supplied.
- Linear dimensions of each product noting deviations from the nominal dimensions.
- Quality of rubber/Line call out no. used with test results for requirements outlined in ASTM D-2000.
- Method of manufacture
- Certified performance characteristic.

#### **1.6.8 WARRANTY**

Contractor shall have final and total responsibility for the satisfactory performance of all products to be supplied under this specification. Contractor shall warrant the equipment furnished by him and the performance of the said product in accordance with this specification and Spec. No. 1050, "General Specification Definition".

#### **1.6.9 SPECIFIC REQUIREMENT**

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The specific requirements of the various rubber products for the system design given in the bid package along with Base Specification / Product trademarks are given below:-

#### 1.6.9.1 Table: specific requirements of the rubber products

Sr. No.	Product	Minimum Design Load Carrying Capacity. (MT)	Minimum Energy Absorption (T.M)	Base Specification & Remarks
1	Shear Products.	50.0	12.5	Bridge Stone SC 500H, Grade Ro.
2	Boat Landing Rubstrips	-	-	EPI Boat Landing Rubstrip.
3	<b>Shock Cells</b>			
	<b>Case A:</b> Barge Bumper designed as an individual unit.			Regal SC 2036. (508X904 Ø mm)
	1. Axial	150	20	Minimum Capacity.
		100	12.5	Intermediate Capacity.
	2. Lateral	-	8.0	
	<b>Case B:</b> Barge Bumper designed as an integrated system.			Regal SC 1830. (457X762Ø mm)
	1. Axial	150.0	16.0	Minimum Capacity.
		100.0	9.0	Intermediate Capacity.
	2. Lateral	-	5.5	
4	Rotating Bumper Rings	136.0	4.2	Regal RBR 1931.20
5	Jacket Leg Rubstrips.	22.4 T/M	2.3 T.M/M	Bridge Stone SA 300H Grade R2.

### 1.7 Building Material and building products

#### 1.7.1 Scope


The intent of this specification is to establish the minimum Requirement for operationally complete building to be provided on offshore well platform. Architectural component and equipment for the building module shall be as per Norsok C-002. The contractor adhere to this specification

#### 1.7.2 GENERAL

##### 1.7.2.1 GENERAL REQUIREMENTS.

**1.7.2.1.1** Contractor shall fabricate a building on the platform to facilitate Switchgear Room, Telemetry Room, Battery Room & Generator Room and other necessary room as specified in the scope of work. Contractor is responsible for complete design including all structural framing.

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**1.7.2.1.2** Equipment, as specified elsewhere in bid package, shall be supplied and installed in the rooms of the building.

**1.7.2.1.3** Contractor shall furnish other facilities and equipment, both inside and outside the building as required in these specifications.

**1.7.2.1.4** All material, equipment, tools or supplies to be incorporated permanently into the building shall be new, sound, free from all defects and confirm to the size and /or capacity and quality specified. Contractor shall, when required, furnish satisfactory evidence as to the type and quality of materials, equipment, tools and supplies.

**1.7.2.1.5** Contractor shall notify Company Representative of any aspect of this specification, which in the judgment of the Contractor should be changed to improve the buildings. However, the incorporation of these changes into this specification is subject to Company's approval.

#### **1.7.2.2 BUILDING REQUIREMENT**

The intent of this specification is to establish the minimum requirements for operationally complete building to be provided on Offshore Well Platform. Architectural components and Equipment for The items listed outline the general requirement for various buildings:

**1.7.2.2.1** The building shall be suitable for occupancy and general usage in a marine environment and suitable for environmental condition as indicated in the bid.

**1.7.2.2.2** The building shall be planned and design by Contractor with suitable wall, partition, interior partitions, interior and exterior doors with frames and windows etc.

**1.7.2.2.3** The building shall have framed openings in walls and roof for equipment, piping, cables exhaust etc. as required.

**1.7.2.2.4** The buildings shall be completely wired for lighting receptacles, switches and equipment.


**1.7.2.2.5** Piping and electrical connections shall be arranged such that field connections are minimized.

**1.7.2.2.6** The building shall be furnished completely operational prior to load-out.

**1.7.2.2.7** The area classification outside/inside the building shall be as per relevant specifications.

#### **1.7.3 STRUCTURAL SPECIFICATIONS**

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### 1.7.3.1 MATERIAL

Structural Steel shall be as per specification stated in table no. 1.1.9.3 of this specification.

### 1.7.3.2 DESIGN

The building shall be designed in accordance with Section.3.4, Structural Design Criteria.

### 1.7.3.3 FABRICATION

Fabrication of the Structure shall be in accordance with clause no 2.0 of this specification.

### 1.7.3.4 COATING SYSTEM

All exposed structural steel shall be coated in accordance with General Specification No. 2005, Protective Coatings. The Contractor shall keep adequate paint material for field touch-up after installation.

### 1.7.4 ARCHITECTURAL SPECIFICATIONS (APPLICABLE FOR UNMANNED PLATFORM ONLY)

All Architectural items for unmanned platform shall be as per Functional Specification for Building Module Spec. 6011F of the bid document.

## 2. FABRICATION

### 2.1 SCOPE

These specifications provides for functional specification of fabrication of structures including few specific requirements/ guidelines.


### 2.2 GENERAL

The fabrication of platform including fit-up, welding, assembly, QA/QC pre-commissioning etc .shall be carried out as per provisions of API RP 2A, AWS D1.1 and AISC (American Institute of Steel Construction).

Contractor to furnish a detailed procedure for fabrication and assembly of structure for Company's review which shall include following as a minimum.

1. Material shall be physically Inspected by company appointed Inspector and accepted prior to start of fabrication.

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2. Steel Plates, Sections, pipes shall be transferred with heat numbers / cast number / bloom number / product number along with traceability mechanism. Traceability shall be physically inspected by company appointed Inspector.
3. Procedure for fabrication and assembly.
4. Procedure for fit-up and welding.
5. Procedure for dimension control.
6. Procedure for inspection and testing
7. QA/QC plan.
8. Procedure for Pre-commissioning.
9. Procedure for post installation checks.
10. Health Safety & Environment Manual.
11. Procedure for Painting and galvanization
12. Procedure for Post weld heat treatment
13. Procedure for Defect repair and Distortion control
14. Procedure for material traceability
15. Procedure for material receipt, Inspection and storage.
16. Weighing procedure

## 2.3 SPECIFIC REQUIREMENT

Following specific requirement shall be complied with:

### 2.3.1 Manufacture of tubular for structural members

Tubular of diameter greater than 406 mm shall be rolled, welded & fabricated from plates in accordance with **API Spec. 2B & API Spec. 5L**.

The tubular shall be rolled in an **API** approved mill and shall carry the **API** monogram.


The tubular shall be longitudinal seam welded by electric submerged arc process. Electric resistance welded or spiral welded pipes will not be accepted. Pipes shall have only one longitudinal seam weld. The welding and weld inspection shall be as per the Specification No.2009 and relevant Codes and Standards.

The tubular shall meet the requirements of **API Spec. 2B** with the following exceptions:

- a. The wall thickness and weight tolerances for tubular members shall be governed by the requirements of the code under which the plates are rolled.
- b. For girth joints with offsets greater than 1.5 mm, the following shall apply:
  - i. When cans are of different thickness the higher thickness shall be ground smooth or machined to provide a 4: 1 taper transition.

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- ii. When cans are of same thickness, the offset shall be tapered to a slope of 4: 1 by deposit of additional weld metal and ground smooth.

In no case shall the metal thickness be less than the nominal thickness of the thinner can. Maximum offset permissible shall be governed by Clause 3.7 of the **API Spec. 2B**.

**Note:** API Spec 5L / API Spec 2B Tubular shall be rolled & manufactured under API license and shall carry the API monogram on the product. Mill Test Certificate of the Plate Material (Ladle & Product) shall be obtained and submitted along with pipe rolling Mill Test Certificate for inspection.

### 2.3.2 Galvanizing.

Following structural shall be galvanized as per General Specification No. 2005 "Protective coating".

Gratings.  
Handrails.  
Stair Treads, Ladders and ladder cages.  
Helideck Safety Net System (For Steel Helideck)  
Piping spools  
Equipment supports  
Miscellaneous hardware.

Galvanizing shall be done after completion of all cutting, drilling and punching operations and after welding but before final assembly in place.


Painting: All painting shall be done as per General Specification No. 2005 "Protective coating".

Contractor shall mark levels suitably with paints to facilitate assessment of levels during and after upending and placement of sub-structure at location. Jacket and Pile shall be foot marked at 120° apart which should cover at least half the circumference. This is to facilitate the checking during the upending of the Jacket and pile driving. All under water clamps shall be painted with white paint.

### 2.3.3 Marking of low-fatigue joint (If Applicable)

Marking of low fatigue life joints for future inspection shall be carried out as described in Design Criteria Structural. The marking panel of neoprene based cupronickel embedded sheets shall be at least 400 mm wide and shall have a length corresponding to number of letters in the marking. Each letter shall be located in the space of 200 mm x 200 mm size with a letter width of 40 mm. Lettering shall be with a medium suitable to withstand marine environment. A border of 100 mm shall be provided all round the lettering. Marking shall be provided in the form of a strip.

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## 2.3.4 Repair and remedial measures

Repair of defects and acceptability shall be as per **API RP-2A**. Welding repair, if any, shall be performed only after approval of the Company.

## 2.3.5 Connections

### 2.3.5.1 Welded Connections

All structural welds shall be full penetration welds unless otherwise specifically shown in the drawing. Partial penetration welds are not permitted.

### 2.3.5.2 Bolted Connections

As a general rule bolted connections shall not be used unless specifically indicated. Use of bolted connections for temporary works may be permitted by the Company's representative at site at his sole discretion. Contractor shall submit detail procedure for bolting for approval of Company.

All bolted connection shall be provided with protective caps with inhibited grease & sealed with suitable sealant to minimize possibility of crevice corrosion.

## 2.3.6 Splices

- a. Tubular member of the same diameter and wall thickness may be spliced by girth butt weld, as per provisions of API Spec. 2B with the following additions:

All joint cans length up to 3 M shall be rolled in one section. Joint cans with a length greater than 3 m must be made-up of sections limited to 1.5 m minimum length. In no case shall the girth weld/fall within 75 mm on either side of crown and saddle point.


- b. Beam splices shall be as per API RP 2A with the following additions:

Splices for deck beams must be staggered i.e. the splices in any two adjacent beams shall not lie in a line perpendicular to the beam axis.

- c. Joints in bar gratings and deck plate in the span direction shall occur only at points of structural support. All plating & end plates of gratings shall be continuously seal welded to supporting members.

- d. Deck plating shall be welded in place using a low heat, short arc welding process. This requirement is to minimize potential warping of the deck plates and to obtain optimum levelness of the deck surface. Other low heat, time saving or automatic welding procedure may be considered but must be qualified.

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### 2.3.7 Stress relieving.

1. Welded assemblies, where the thickness of one of the elements exceeds 65 mm, or where the thickness of weld exceeds 50 mm shall be stress relieved after assembly.
2. Any other element/assembly specifically noted in the drawings shall be stress relieved.

All stress relief shall be achieved by thermal methods by heating the element or assembly to a temperature between 590°C and 620°C. The use of furnaces is desirable for all stress relief operations. A detailed procedure shall be developed and Company's approval obtained prior to performing the operations.

### 2.3.8 Fabrication tolerances


Fabrication tolerances shall be as per API-RP-2A, AWS D.1, AISC, API 5L and API 2B wherever applicable. Fabrication tolerances for structural shapes fabricated from plates shall conform to the requirements of ASTM A6

Contractor shall use his best efforts to provide a flat deck surface. All high or low spots that result during the installation of deck plating/grating and after installing skids and equipment shall be eliminated to reduce water holding valleys to a maximum of 3 mm.

### 2.3.9 Inspection And Testing For Structural Fabrication

- a. The Company shall inspect fabrication and assembly of structures stage wise and after final completion.
- b. The Company shall have the right to inspect the materials, fabrication and erection of all items concerned with the works without limitation.
- c. The Company shall have free access at all times to any part of Contractor's yard that concerns the work. When in the Company judgment, any working area or section should be inspected, the Contractor must thoroughly clean it of all excess and waste materials such as sand , slag, welding rods etc, and allow adequate time for proper inspection .
- d. The Company shall be informed at least ten days prior to starting of any work by Contractor or any sub-Contractor such as assembling or fabrication of any section, grit blasting, painting etc. The Company shall be informed before any repairs are made to the welds when defects are found and not after same defects have been rectified. Whenever any piece is to be assembled that will prevent inspection of the area,

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Company shall be informed, the area inspected and any defects rectified before proceeding with the assembly.

- e. The Company shall have the right to inspect at any time tools or equipments to be used in any part of the work and shall have the right to condemn any equipment or work which do not conform to the specification or the drawings. Defective work or work not conforming to the specifications or the drawing shall be re-done by the Contractor at his cost.
- f. Company shall approve all phases of the testing including leak repair or defects and replacement of materials and equipments found to be defective during testing and shall sign all Test Certificates, if testing is witnessed by the Company.
- g. The Company shall have the right to request any additional inspection to ensure that the Work conforms to the specifications, at no extra cot to the Company.
- h. The Contractor shall furnish, install and maintain in a safe operating condition all scaffolding, ladders, walk ways, adequate lighting etc. necessary for safe and thorough inspection by Company. The safety and condition of above scaffolding, ladders, lighting etc. must conform to OSHA & local industrial safety codes for such operations.
- i. The Contractor must ensure that all valves and removable plugs on jacket legs are closed prior to load out and shall give written certification for the same.
- j. After the fabrication is completed, the jacket legs and skirt sleeves, pre-installed conductors and pile sections, launch truss chords and buoyancy tank, if any, shall be pressure tested for leaks through top and bottom closures. The applied pressure shall be 1.5 Kg/cm<sup>2</sup> minimum/as recommended by MWS/Installation Contractor and maintained for four hours. A soap test shall be conducted to detect any leakage between the rubber diaphragm and the flange and top closure plates and welds or any other joints. A nominal positive pressure shall be left in the jacket and skirt sleeve to ensure no leak condition before launching. All inflatable packers shall be pressure tested again at the yard to the test pressure specified.

The manufacturer's test certificate shall be furnished to the Company.

- k. All grout and air lines for the jacket grouting system shall be cleaned by blowing clean air to ensure their operability. These shall be pressure tested at 40 Kg/cm<sup>2</sup> for one hour. The protective housing at the bottom of

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jacket for the inflate lines shall also be pressure tested to the above pressure.

### 2.3.10 Pre-commissioning checks


After the fabrication yard erection and hook-up has been completed, the Contractor shall start the pre-commissioning checks. It may not be possible to complete all the pre-commissioning checks in the fabrication yard. A detailed list of pre-commissioning checks required to be performed by the Contractor are specified in the bid documents. However, the Company desires that at least the following pre-commissioning checks/tests shall be completed in the fabrication yard.

Contractor to note that installation check as called out in the following list shall include the following

1. Name - plates and/ or certificates of equipment are correct and visible. Name plate of equipment shall be seal welded with the equipment.
2. Equipments are properly installed in accordance with drawings and foundations are proper.
3. All necessary supports are attached and are in acceptable condition.
4. All connections of equipment to piping, tubing and wiring, are made in accordance with drawings and specifications.
5. All low fatigue joints are properly marked. (If applicable).
6. List of out of tolerance reports.
7. All gratings & handrails and ladders, equipment supports, piping spools are welded and fixed to structural members as per drawing.
8. All welded joints are painted as per spec .2005
9. Stopper at the end of monorails
10. Safety net 1.5 m width all around helideck / 1.0 m width perimeter walkway below helideck
11. Providing chain connecting shock cell and jacket legs and shall be tight.
12. Lifting equipment (Cranes, Hoists etc.)
  1. Installation check.
  2. Loads tests.
  3. Function check of alarm points in the control cab.
13. Decks, Building and Accessories.
  1. Installation check.
  2. Water flood check of flooring/Floor Drains and roof slope & drainage arrangement against leaks and stagnation.
  3. Adequate Floor drains are installed with removable type 3mm thick stainless steel removable sediment bucket with handle as per ASME A112.6.3 to prevent stagnation of water on the floor.

### 2.3.11 Weighing of decks/modules and other top sides facilities.

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The Contractor, prior to load out, shall accurately weight all Deck structures, topside modules & buildings, and other topsides facilities etc. Contractor shall include in his proposal the basic details of the weighing procedure and equipments intended to be used. Detailed weighing procedures shall be developed and submitted for Company's approval upon award of Contract. Load cells used shall have valid calibration Certificates.

While weighing it shall be noted that the point of application of the load cells shall be in such a manner that based on the results of the weighing it shall be possible to devise the reactions at each support point as well as the center of gravity of the component being weighed.

**Contractor shall prepare a procedure for final weighing report for every lift containing.**

- i. Weighing Results.
- ii. Theoretical Prediction.
- iii. Item schedule for all items which are yet to be installed prior to lifting, together with any items, which are to be removed i.e. rigging platform etc.

Contractor shall assume full responsibility for all remedial measures required as a result of weight escalation beyond the weights budgeted for sea-transport, offshore lifting and final service operations. This responsibility shall include but not be limited to revision of the marine spread, strengthening and stiffening of the structures, off loading components in that lift etc.

### 3. INSTALLATION

#### 3.1 SCOPE


The specification assumes that piled steel jacket structures for the Platform Structure has been proposed by the Contractor and approved by the Company.

This specification described the minimum technical requirements for the engineering, marine and construction equipment spreads and operations required for the load out, transportation and installation of the Platform and facilities.

The Contractor shall assume entire responsibility for the successful load out, sea-fastening and transportation to site of all material, structures, components, equipment and other items necessary for installation and for satisfactorily completing all installations including hook-up and commissioning work, notwithstanding any review by the Company.

#### 3.2 QUALITY MANAGEMENT AND DOCUMENTATION

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### 3.2.1 Project Planning and Execution

Load out, transportation and installation operations shall be planned and executed in accordance with the requirements of the Contract and the DNV Rules for planning and Execution of Marine Operations. Release Note of Inspection agency, on behalf of Company, at fabrication yard shall be obtained and which shall be made available to Company at Offshore Installation site.

### 3.2.2 Verification

The verification record control and retention system shall ensure documents relevant to obtaining Certifying Authority approvals are retained.

### 3.2.3 Installation Engineering Manual

An Installation Engineering Manual shall be compiled, covering all aspects of the transportation and installation of the platform component structures, including mobilization of transportation and installation vessels spreads. The installation Manual shall contain detailed information on each stage of the operation, including contingency procedures and shall identify temporary works, equipment and personnel requirements.

The installation Manual shall include but not be limited to the following contents, as appropriate

#### a) General

- Organization charts for Load out site(s) and offshore site.
- Vessel utilization schedule
- Schedule for transportation and installation operations
- Offshore support base details.
- Mobilization and Demobilization activities.

#### b) Vessel Data


- Derrick Vessels
- Support Vessels
- Transportation vessels (Cargo barges and tow vessels or HLV)

#### c) Load out

- Load out site details and activities
- Planning for the load out phase
- Ballasting execution plans

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- Barge strengthening or reinforcement (if required)
- Load distribution mats (if required)
- Sea fastenings

d) Transportation

- Pre-Sail away inspection checklists
- Towing/transit plans, towing arrangements, ballast arrangements, navigational aids, communications procedures, contingency procedures, etc.
- Tow/ transit routes, including any alternative and proposed safe refuges.
- Proposed dates for sail away, tow/transit, and installation.
- Weather forecasting and weather limits for sail away and tow/transit.
- Repair procedures during tow/transit and at completion of tow/transit
- Post tow/transit inspection checklists.

e) Installation


- Offshore site Preparations
- Locations for existing subsea pipelines
- Location and orientation of existing jackets and other structures
- Installation equipment spread details
- Detailed installation procedures and checklists for structures, including tow/transportation vessel handling, derrick vessel anchor plans, survey, drilling and grouting procedures etc.
- Maximum sea states and weather conditions for weather installation operations
- Jacket launch/lift and up - ending, pile installation, jacket leveling procedures.
- Installing boat landing, barge bumpers, fitting and welding pump casing, sumps etc.
- Topsides module installation procedures
- Removing temporary braces, lift trunnions, sea fastenings
- Installing all jackets to deck piping and utilities shown on drawings.
- Post – installation activities and inspection check lists.
- Platform hookup activities.

f) Contingency Plans

- Procedures for bad weather conditions
- Contingency procedures for piling operations, including storm ballast plan for the jacket if piling must be abandoned due to weather before storm safe.

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g) Quality

- Site – specific Quality plan, including ITPs.
- Qualified weld procedures and welder qualification records
- Installation activity proformas (pile driving records, grouting records etc.)

h) Health, Safety & Environment

- Contractor HSE Plan, including JHA action sheets
- Emergency Response Plan for the offshore site.

i) Drawings and Calculations

- Installation Schematics
- Derrick vessels equipment layouts
- Cargo barge stability and ballasting calculations and details
- Temporary works layout
- Cargo barge or HLV layouts
- Anchor patterns and existing subsea pipeline locations
- Sea fastening and grillage layouts and details
- Jacket on-bottom weight and mud mat reaction pressures
- Weight and Centre of Gravity data for all installed items
- Relevant structure drawings

### 3.2.4 Certification

Material Certificates shall be provided for all materials used for both temporary and permanent works, including at least for the following


- Temporary load bearing attachments
- Lift rigging
- Welding consumables
- Cement
- Coatings

### 3.2.5 Traceability

Traceability records shall be provided and maintained for –

- Steel Plate Material heat /cast numbers shall be Transfer to Primary & secondary Structural Members
- Welding consumable batch numbers
- Weld procedure numbers

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- Welder identification numbers
- NDT reference
- Post weld heat treatment records
- Weld repairs

### 3.2.6 Manufactures Data Report

Documentation for welding to any part of a structure and all over as-built data shall be compiled into a MDR, which shall contain the following as a minimum, an appropriate –


- Approved welding procedures
- Welder qualification records
- Approved NDT procedures and NDT personnel qualification records
- Traceability records
- Plate Material test certificates
- Pipe Material (API 5L or API 2B) Rolling Mill Test Certificate as well Plate Material Mill Test Certificate.
- Welding consumable test certificates
- NDT records
- Post weld heat treatment records
- Dimensional control records
- Site preparation details
- Survey and inspection records
- Underwater inspection records (including video if available)
- Pile diving records
- Grouting records
- Hook-up activities quality records
- Engineering calculations and analysis results
- Technical manuals
- Basis of Design
- Barge Crane log shall be submitted for Jacket, Deck, Top Side Modules and Piles (single section pile). Same shall be the part of Manufacturing Data Book.

### 3.2.7 As-Built Report

The Offshore platform As-Built Report shall comprise the MDR and a summary of all work performed. Non-MDR documentation shall include but not limited to the following –

- Daily Tow/Transit Reports
- Daily progress Reports from derrick vessels at the offshore site.

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- Transportation and installation program (actual versus planned)
- Record of mobilization activities
- Record of loadout site activities
- Vessel utilization schedule (actual)
- HSE Report
- Contract Variations

In each section, manning levels, durations, problems, encountered, highlights and the like shall be included.

### 3.3 HEALTH & SAFETY AND ENVIRONMENTAL MANAGEMENT

- All transportation and installation activities shall be planned and executed to minimize risk to personnel health and safety and to the environment, in compliance with the HSE Plan.

All statutory regulations at the load out site, along the tow/transit route and at the offshore site shall be complied with, including –

- SOLAS requirements
  - IMO Convention on the international Regulations for Preventing Collisions at Sea (COLREG), 1972 and Amendments.
  - IMO MARPOL 73/78 and Amendments (including The International Convention for the Prevention of Pollution from Ships).
- Contractor shall submit the copies of following documents and latest/valid survey certificates in respect of all vessels proposed by the Contractor for transportation/installation/towing in compliance with General Condition of Contract.


Certificate of Registry, Certification of Classification, Certificate of Class, Cargo Ship Safety Construction Certificate, Cargo Ship Safety Equipment Certificate, Cargo Ship Safety Radio Certificate, Safety Management Certificate, International Oil Pollution Prevention Certificate, International Load Line Certificate, International Tonnage Certificate, DG Shipping License and Insurance Certificate.

### 3.4 LOADOUT

#### 3.4.1 General

The method of loadout may involve skidding, trolleying or lifting of structures. The structural integrity of the structures must be maintained during loadout. Detailed

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structural analysis for loadout or lift analysis for each loadout structure shall be undertaken to verify that structural member stresses do not exceed API and AISC basic allowable during any stage of the loadout. The loadout analyses shall include studies to determine the allowable differential deflections at the structures support point, which shall become the basis for deflections tolerances during loadout. If Contractor proposes any change in the parameters or procedures from those considered in the design, he shall carry out necessary engineering as detailed in Structural Design Criteria to ensure that his procedures are workable.

Structural strength of barge shall also be checked.

### 3.4.2 Barge Ballasting and Structure Motions

The Loadout Supervisor shall have the authority to direct all barge ballasting and structure motions during loadout.

### 3.4.3 Loadout Systems

Contractor shall furnish to Company, at least 30 days prior to commencement of any load out operation, a load out procedure describing in detail the procedure, supported by calculation and analysis to ensure the compliance of design requirements, for the load out, including requirement of equipment and accessories. Contractor shall also furnish to Company the contingency pull back arrangement for retrieval of the structure during load out if the load out requires to be suspended due to some emergency reasons. Contractor shall also submit 30 days prior to commencement of load out, details of the shipment plan and final transportation analysis and sea-fastening design as described in design criteria.


The design or specification of all load out system components and temporary works items required for the operation, including, as appropriate the following–

- Winch systems
- Jacking systems
- Anchor points
- Onshore Skid beams
- Barge strengthening
- Cranes
- Transporters
- Lift points and lift rigging
- Barge mooring system

### 3.4.4 Cargo Barge

The adequacy of the cargo barge for stresses caused by load-out shall be verified, as will compatibility of dockside and barge arrangements for the proposed load out.

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The ballasting procedure shall include pump discharge requirements and considerations of tidal variations during load out.

### 3.4.5 Equipment

All equipment and accessories involved in the skidding/lifting/trolleying of the structures shall have the proper rating and are free of damage. Critical mechanical equipment, such as ballast pumps, shall have 100% backup system on standby.

### 3.4.6 Skid Beams

The procurement, fabrication and installation of any onshore runway beams/skids and bulkhead barge transition beams shall be suitable to loadout the structures onto the barge, as necessary.

### 3.4.7 Load-out plan

The Loadout Plan shall include barge ballasting requirements during loadout and a step-by-step schedule of the loadout. Allowances for actual tidal changes and current shall be included in the Loadout Plan.

### 3.4.8 Verification of lifts

Where loadout is executed by lifting, the padeyes, hook shackles slings, sling platforms or frames and the structural integrity of the lifted item shall be verified. The Contractor shall procure, fabricate and install all padeyes, slings and other aids necessary for lifting.

### 3.4.9 Weight Monitoring


The weight and center of gravity of the structures shall be accurately reported during construction and weight monitoring reports shall be submitted to the Company on a regular basis. The final weight control report and the results of the weighing operation shall also be submitted. Any weighing undertaken prior to loadout shall achieve accuracy better than  $\pm 2\%$ . The center of gravity shall also be determined from these monitoring.

### 3.4.10 Cargo Manifest

An inventory list of all items to be loaded out shall be prepared by Contractor.

### 3.4.11 Post Loadout Inspections

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After loadout onto cargo or launch barge is completed, if the component has been lifted, all critical joint intersections near the padeye/lifting points on the component shall be MPI/ dye-penetrant checked to ensure that no cracks have occurred during loadout. Any defects shall be repaired.

### 3.5 GRILLAGE AND SEA-FASTENING

#### 3.5.1 Design

All sea fastening and support grillage design shall be in accordance with the provisions specified in Structural Design Criteria Section 3.4 of Bid and of API RP 2A supported with following.

- Design calculations of the sea fastening and grillages.
- Drawings showing layouts and details of grillage and sea fastening.
- Details of any barge strengthening required for loadout or transportation.

#### 3.5.2 Grillage and Sea fastening Installation

Grillages and sea fastening shall be welded in accordance with relevant specification and shall be subject to 100% ultrasonic and magnetic particle inspection for full penetration welds.

### 3.6 LOADOUT AND SEAFASTENING INSPECTION

The Contractor and MWS shall conduct pre and post load out tests and inspections.

#### 3.6.1 Pre Loadout Testing

Pre loadout testing of flood, buoyancy and vent systems of the jacket shall be executed in accordance with specification.


Prior and following loadout sea fastening, where possible, all vent and flood valves shall be checked several times by the Contractor to ensure easy operation. Any interference shall be eliminated. Vent and floods valves shall be left in the closed position and the valve handles shall be positively secured to the jacket.

#### 3.6.2 Post Loadout Inspection

All structures shall be visually checked after loadout to ensure no damage has occurred during loadout operations.

#### 3.6.3 Patch and Repair Damage

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The Contractor shall patch and repair all damage to the structure and its protective coatings, which occur during loadout and sea fastening.

### 3.6.4 Loadout Operation

An appropriate ballast system shall be provided and experienced personnel shall supervise the ballasting operation. The cargo barge shall be protected from excessive motions due to environmental loading or wave action from other vessels on the waterway during loadout. Following loadout, the cargo barge shall be ballasted to its design trim and draft for tow.

## 3.7 TRANSPORTATION

### 3.7.1 General


The cargo barge and tow vessel shall be classified for unrestricted ocean service and assigned loadline with a marine Classification Society. All statutory documents, including those listed in Section 3.3(ii) above, in support of sea worthiness of entire Marine spread shall be submitted to the company 30 days prior to the mobilization to the site. All vessels and equipment shall be maintained and operated in a safe and professional manner. A comprehensive stock of spares and consumables shall be carried at all times to support the independent day to day operation of the spread. Contractor shall appoint a Company approved Marine Warrantee Surveyor (MWS) at their expense who shall review the loadout and transportation analysis and sea fastening design and review and approve the sea fastening proposed by the Contractor. The marine surveyor's scope of approval shall include verifying the adequacy of the strength of the barge deck and framing to withstand the load due to load out, transportation of the cargo and sea fastening and launching of jacket.

The cargo barge and tow vessel shall be inspected and approved for the tow by the MWS prior to mobilizing to the fabrication site. The survey shall include all aspects of the vessel, manning suitability of accommodation on derrick / work barge etc. All certificates relating to the tow vessel and cargo barge, which are in accordance with the relevant statutory requirements, shall be carried onboard the tow vessel.

### 3.7.2 Cargo Barge Requirements

A dynamic motion analysis of the barge/cargo system shall be performed as per the Design criteria. The transportation barge shall have sufficient global and local strength for the loadout and transport of the cargo. Calculations shall be completed demonstrating that all barges and cargo comply with all allowable stress limits set forth by the AISC and API RP 2A codes, and the barge's classifying authority for all loading conditions encountered during loadout , transportation and launching, as applicable.

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The cargo barge shall have sufficient positive and reserve buoyancy for all proposed operations. The barge shall have an acceptable stability and buoyancy and remain floating in an acceptable manner with any one submerged or partly submerged compartment flooded.

### 3.7.3 Tow Vessel Requirements

The tow vessel shall have a rated bollard pull at least equal to the design tow resistance of the transportation barge and its cargo. The tow forces shall be calculated by CONTRACTOR based on the anticipated environmental conditions along the tow route, vessel speed, requirements of API RP 2A and Design Criteria Structural Section 3.4. As a minimum, ambient sea conditions and the design storm/stall conditions should be considered. All towing resistance forces shall be assumed to be acting concurrently against the direction of the tow.

The tow vessel shall have latest Certificate of Rated Bollard pull issued by a reputed inspection authority.

### 3.7.4 Towing Arrangements

All components of the towing arrangement shall have acceptable factors of safety against the design tow resistance. The towing arrangement shall be inspected and approved by the MWS at the same time the tow vessel is inspected, prior to mobilization to the fabrication site.

## 3.8 LIFTING

### 3.8.1 Responsibilities

The Contractor assumes complete responsibility for all lifts of platform structures and appurtenances as required for installation. The responsibilities include, but shall not be limited to –


- a) Overall installation planning
- b) Detailed engineering and providing of all labour, supervision, materials and offshore installation equipment required to perform a safe and successful lift, in accordance with the design drawings and the Installation Procedure.
- c) The Installation Procedure shall include detailed descriptions of all operations and procedures.

### 3.8.2 Design

All calculations required to confirm the adequacy of all lifting operations shall be completed. Analysis shall include a review of re-analysis of the structure for the

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proposed lift conditions, design of padeyes and other lifting appurtenances and selection of all lifting hardware, rigging, slings etc. All components shall be designed so that eccentric loadings are minimized or eliminated. Final weight and center of gravity positions based on detailed weight take off and / or actual weighing shall be used in all design. Contractor shall provide following information 30 days prior to load-out/installation:

- De-rated capacity of barge crane and test record witnessed by a reputed inspection agency.
- NDT test records of all lifting equipment including lifting hooks.

### 3.8.3 Shackles

All shackles shall have valid manufacturer's load test certificates. Used shackles which are free from any visual damage/deterioration and accompanied by load test certificates and satisfactory NDT reports can be used. Load in shackles and other fittings shall not exceed the manufacturer's rated safe working load.

### 3.8.4 Slings

All slings shall have valid manufacturer's breaking strength test certificates. Used slings, free from any kinks, fraying or other visual damage with a documented history of previous lifts, storage, load test and inspections are acceptable. Load in slings shall not exceed the manufacturer's rated safe working load. Lifting slings shall be of sufficient lengths to ensure that the true angle of any sling with respected to the plane through the lifting points is not less than 60 degrees. All paired rigging elements (slings) for any one particular lift shall be of the same diameter and type. Over sized slings and slings having kinks, fraying, visual damage and deterioration shall not be used.

### 3.8.5 Protection of Equipment


All slings, spreader bars or other lifting apparatus, shall be arranged so to prevent damage to equipment and other components of the lifted item, during all phases of the lift. Adequate temporary bumpers and guides shall be provided to prevent damage during installation. Protection shall be given to both the item being installed and any previously installed items.

## 3.9 JACKET INSTALLATION

### 3.9.1 General

On arrival of Jacket at the site of Installation and before proceeding for Installation, Jacket shall be inspected by Company appointed Inspector and ensure no defect to the Structural Members. A report shall be generated and documented as as-built

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documentation. In case of defects are observed, repair work is to be taken up with approved procedure and completed before proceeding for installation.

Installation Contractor shall also inspect all installation aids to ensure safe and smooth installation.

#### **3.9.1.1 Drivability Analysis**

The Contractor shall perform pile and conductor drivability and stick up analysis using the proposed hammer(s) and the geotechnical reports in compliance to Structural Design Criteria section 3.4 of bid document.

#### **3.9.1.2 Survey Spread**

The Contractor shall engage the services of a qualified Surveyor with the appropriate survey equipment to assist with the setting of jackets within the tolerances stated in this Specification.

#### **3.9.1.3 ROV Spread / Divers**

Contractor shall provide an ROV spread and divers on the derrick vessel capable of seabed inspection and assisting with retrieval of dropped items.

#### **3.9.1.4 Anchor Handling**

The Contractor shall be responsible for all anchor operations. The Contractor shall be responsible for adjusting anchor operation to avoid damage to existing platforms, pipelines, subsea well guards or any subsea facility. Subsea care shall be exercised near existing platforms and pipelines when running anchor or anchor lines from construction barges and boats. Before placing any anchors or anchor lines, the Contractor shall clearly define to the Company and shall obtain approval of the proposed location of the anchors or anchor lines.


#### **3.9.2 Seabed Survey**

Contractor is responsible for verifying the accuracy of all survey information. Any additional seabed survey performed by the Contractor prior to installation shall cover an area extending from the outline of the jacket on the sea bottom. The survey should accurately locate all existing platforms, pipelines, subsea well guards or any subsea facility. The extent of the area should encompass the extent of all activities, including the reach of all anchors.

#### **3.9.3 Platform Location and Tolerances**

##### **3.9.3.1 Jacket Location and Orientation**

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The jacket shall be set within 2.50 M of the required location. The bearing of the jacket shall be within two (2) degrees of the required location.

The Location position & Orientation check shall be witness by Company Inspector. Report shall be generated and documented as As-built Documentation.

#### **3.9.3.1.1 Jacket Level**

The final as-built level of the jacket shall be the within 1:140 of horizontal and the extreme opposite diagonal points in the jacket top level shall be within 25 minutes with the horizontal. If at any stage of jacket and pile installation the out-of-level exceeds the above tolerance, the Contractor shall bring the jacket back to within the level tolerance by lifting, de-ballasting or jacketing on the installed piles.

The ballasting and pile installation sequence shall be such that on bottom jacket weight will not exceed a safe value determined in accordance with the results of an on bottom analysis documented in the installation Manual.

Jacket leveling activity shall be taken up during pile installation. The Location Level check shall be taken up and witness by Company Inspector. Report shall be generated and documented as As-built Documentation.

#### **3.9.3.2 Jacket Elevation**

The final jacket elevation shall be within (+/-) 750 mm of the design elevation. Following weld-out of the piles to the tops of the jacket legs, the tops of the Piles will be cut off to the required elevation. The final jacket elevation will also determine the elevation at which the boat landing is installed on the jacket.

#### **3.9.4 Jacket Launch**

If the Contractor proposes for jacket launching in their concept, the following responsibilities include, but shall not be limited to:


##### **3.9.4.1 Vent and Flood Valves**

Prior to jacket installation, the Contractor shall inspect and verify that all valves are closed and that all installation piping is intact.

##### **3.9.4.2 Weather Window**

Prior cutting sea fastening, the Contractor shall have a weather forecast sufficient to ensure it would be reasonably certain that no severe weather will occur before the jacket is secure on bottom. Installation will not be permitted unless the current sea state and its direction is less than the maximum safe values as determined by the installation analysis and included in the installation Manual.

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### 3.9.4.3 Sea fastening Removal

All cuts on brace, used for sea fastening shall be made so that brace material remains on the launch cradle/jacket member, to avoid damage to any jacket member including launch cradle. Tie-down braces on jacket members or lugs should be avoided. Where these are used they shall be removed so as to avoid cutting into any permanent structural member. To remove any stub from these areas or from painted areas tie-down brace member shall be cut and the protruding portion shall be grounded and surface shall be painted.

### 3.9.4.4 Launch and Upending

The jacket should be launched and upended at a predetermined launch site. A minimum bottom clearance should be determined by the Contractor for all phases of launch and upending operations in compliance with Design Criteria Structural, Section 3.4.

In case of installation of jacket by launch/sliding method, Adequacy of Connection of Buoyancy tanks with jacket legs shall be checked for hydrostatic collapse during launching of jacket and dog plates shall be provided for safe launching of jacket.

### 3.9.5 Jacket Setting

The jacket shall be set within tolerance given in Section 3.9.3. The Contractor shall maintain the specified location, orientation and level of jacket through completion of pile diving. The contractor shall report the as-built levels of jacket during the progress of the piling.


**3.9.5.1** On successful placing of the jacket, on the seabed (on-bottom condition at the designated location), Contractor shall carryout Mud Mat survey to check absolute and differential settlements of jacket at mud line for the entire jacket. This survey shall be witness by Company Inspector and Report shall be generated and document with Video recorded data. This shall be part of As-built Documentation.

**3.9.5.2** On successful placing of the jacket, on the seabed (on-bottom condition at the designated location), Contractor shall secure the jacket by pinning at least two main/ skirt piles. These piles shall be pinned/ driven in two diagonally opposite legs.

**3.9.5.3** Special care shall be taken so that there is no damage to the jacket during installation. Any damage to the jacket structure, to the protective coatings, or to the cathodic protection system etc. shall be repaired by the Contractor.

### 3.9.6 Pile Installation

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On successful placing of the jacket on the seabed (on-bottom condition at the designated location), Contractor shall flood the jacket legs, buoyancy tank in compliance to the On-bottom Stability Analysis consideration. Flooding condition of Jacket Legs & Buoyancy Tank shall be checked, which shall be witnessed by Company Inspector. Report shall be generated and documented as part of As-built Documentation.

Removal of Buoyancy / Stability Tank shall be taken up only after securing jacket in position by pinning at least two main/ skirt piles. These piles shall be pinned/ driven in two diagonally opposite legs. Connection of buoyancy tank/ stability tank with jacket member(s)/leg(s) shall also be designed and checked for pile driving.

### 3.9.6.1 Installation Procedure

The Pile installation procedure included in the installation manual shall include the following-

- The sequence of piles to be installed.
- Pile add-on details, if applicable.
- The effect of pile operation to on-bottom stability.
- Ballast / de-ballast required to maintain safe on-bottom stability
- Detail of pile handling, hammer handling, followers, ROV's etc.
- Derrick vessel crane reach and capacity values.
- Pile remedial procedure for refusal of pile.
- Use of Front follower with hydraulic hammer for driving of vertical skirt pile using under water hammer

### 3.9.6.2 Pile Driving


#### EQUIPMENT

Prior to commencement of pile driving, hammers and other equipment shall be certified to be in good working condition. Hammers shall be maintained and operated safely at all times.

#### CUSHION BLOCK

A cushion block shall be provided at the base of the hammer. Cushion block material shall be of a type compatible with the hammer and acceptable to the hammer manufacturer. Cushion material shall be of sufficient size to fill recess in anvil to full diameter, but not to exceed thickness recommended by manufacturer. The cushion material shall not be allowed to compress to the point that the cushioning effect is lost. Cushion performance criteria (i.e. maximum number of blows for a given cushion and hammer type) shall be recorded. Cushions shall be replaced in accordance with these criteria.

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## HAMMER

Designated Hammer and Refusal mitigation Hammers shall be deployed in compliance to Pile Drivability Analysis approved by Company. Driving activity shall only be taken up upon availability of workable hammers (Designated & Refusal mitigation)

## PILE MONITORING & RE-STRIKE TEST DEVICE

Contractor shall deploy Qualified Agency along with Pile Monitoring & Re-Strike Test Device in compliance to following Para.

### 3.9.6.3 HAMMER, PILE MONITORING AND RE-STRIKE TESTING

Contractor will provide details of 'pile monitoring devices' proposed prior to installation of jacket and shall be included in installation procedure

#### A. Hammer Monitoring


The Hammer Monitoring shall include, but not be limited to the following: -

- a) Hammer monitoring shall be performed for all hammer operations. CONTRACTOR shall ensure that the hammer spread used complies with Drivability Analysis and also with the following requirement.
- b) CONTRACTOR shall provide person(s) who are fully competent and experienced in operating the hammers, to supervise and obtain all hammer monitoring data.
- c) In the event that Contractor's hammer fails to deliver sufficient energy or breaks down, Contractor shall complete the pile being driven with another appropriate hammer in the spread. Pile driving shall not commence on any pile without appropriate back up hammer.
- d) Standby of the construction and transportation spreads shall be at Contractor's cost if piling cannot commence or continue due to hammer inefficiency, malfunction or unavailability.
- e) Hammer monitoring and pile monitoring shall form part of a coherent and coordinated pile installation strategy. CONTRACTOR shall identify key personnel in this regard and define the communication channels to facilitate successful pile installation.
- f) Energy applied through Hammer shall be compared with the energy recorded through the Pile Monitoring to work-out the effectiveness of Hammer.

#### B. Pile Monitoring and Re-strike Testing

The Pile Monitoring re-strike Test shall include, but not be limited to the following: -

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i. CONTRACTOR shall provide pile monitoring services for the piles of each of the jacket structures. All the piles of each platform shall be monitored (the last two sections of each pile shall be instrumented for this purpose) unless specifically advised otherwise by the Company.

ii. CONTRACTOR shall engage a **Specialist Geotechnical Engineering Consultant** for the work, approved by the Company, having relevant experience in pile monitoring, re-strike testing and interpretation. CONTRACTOR shall submit the prospectus of the said consultant firm, for approval of the Company, complete with details of previous experience and resume of the engineers who will be involved in the actual performance of the instrumentation; monitoring and interpretation.

iii. CONTRACTOR shall determine, provide/supply and test all necessary equipment/accessories/ facilities that are required for Pile Monitoring and re-strike testing.

iv. Contractor shall submit to the company details of pile monitoring and re-strike procedures which shall include but not be limited to:

a) Details of Pile Monitoring Equipment Spread to be made available during pile installation with sufficient spare strain gauges, accelerometer, Pile Driving Analyser, required software for data interpretation e.g. CAPWAP including all necessary hardware and software.

b) Details of proposed procedure for re-strike testing.

c) Method of data analysis and interpretation.

d) Operational aspects of installing instrumentation, data acquisition and removal of instrumentation.

e) Calibration details of instrumentation and equipment.

v. CONTRACTOR shall provide continuous pile monitoring services and shall make available during driving, in real time, the following information to COMPANY.

a) Soil resistance to driving.

b) Magnitude of maximum pile stresses during driving.

c) Hammer blows per foot of penetration.

d) Hammer stroke.


e) Hammer blow rate.

f) Hammer efficiency (defined as ram energy at impact as a ratio of hammer rated energy).

g) System Efficiency (defined as energy actually transmitted to pile as a ratio of the hammer rated energy).

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- vi. CONTRACTOR shall provide the following information at the end of driving of each pile if pile meets acceptance criteria:
- Blow count per feet of penetration for entire depth of penetration (immediately after pile driving).
  - Hammer and system efficiency.
  - Soil resistance to driving.

- vii. If piles meet refusal (before pile reaching design penetration), CONTRACTOR shall provide the following information immediately after pile driving:

- Blow count per feet of penetration for depth till point of refusal.
- Hammer and system efficiency.
- Soil resistance to driving.
- Recommendations on remedial action.


**viii. Criteria for Re-strike Testing**

The Re-strike Testing shall include, but not be limited to the following:

- Re-strike Test shall be carried out after a minimum 24- hour set-up period.
- Piles driven with target penetration, Re-strike Test shall be performed normally for two (02) piles (fitted with the re-strike test instrumentation) for jackets having up-to 12 Piles. Jacket having more than 12 Piles, Re-strike Test shall be performed on four (04) Piles. These Piles shall be selected from Piles excluding pile driven last.
- Piles encountering refusal, re-strike test shall be performed on all of the refused piles.
- Pile re-strike length shall be minimum 0.5 m over the overdrive allowance.
- During actual re-strike Test period, Pile driving for other pile cannot be carried out. But during preparation of Re-strike Test, Pile driving for other pile is permitted.
- Cost on account of re-strike test shall be included in the project cost. Any additional re-strike test other than specified above shall be paid in terms of barge day rate charges only for the duration of re-strike test but not for the duration for preparation time for re-strike test.

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### **C. Responsibilities of the Specialist Geotechnical Engineering Consultant**


- a) Consultant shall review hammer, pile and soil information as well as proposed installation procedure and drivability in co-relation to Soil Report.
- b) Consultant shall carry out the drilling and tapping instrumentation holes near the pile top of the sections of the piles to be monitored at the fabrication yard.
- c) Consultant shall install required gauges on the pile sections and shall observe lifting, upending and stabbing operations and advise the Contractor's personnel during the activities so as to avoid damage to the installed instrumentation.
- d) In case of damage to the instrumentation during these activities, the Consultant shall replace gages through use of steel man basket after the pile welding activity is completed.
- e) Consultant shall observe the pile driving and take all necessary steps in coordination with installation contractor to avoid damage to the installed instrumentation.
- f) All activities at the offshore site not covered above, but essential for successful data acquisition, monitoring, re-strike testing and interpretation.

### **D. Document Generation & On-Board Report:**

As minimum following records & On-board reports for Pile Driving related to Hammers and Pile Monitoring and Re-Strike Test shall be documented and issued to the Company Design Consultant with 24 hours of driving each pile:

- i. Blow count record for every feet of pile driving duly witnessed by Company appointed Inspector.
- ii. Hydraulic Hammer computerized input data (like Date, time, identification of pile/pile segment, Hammer efficiency applied, Stroke length, Blows per minutes) & output data (Oil Pressure, Blow counts, Soil Resistance, Energy applied, etc.) print out duly witnessed by Company appointed Inspector.
- iii. Details of stoppage of Pile Driving supported with valid reasons.

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- iv. Submission of Pile Driving Analyzer (PDA) Data File soft copy.
- v. Print outs from Pile Driving Analyzer data duly signed by geotechnical consultant, contractor's representative and Company appointed Inspector.
- vi. Pile monitoring Records like Hammer Blows, Maximum Force, Maximum Energy, and Maximum Stress at gauge location.
- vii. Comparison of Energy recorded by Pile Analyzer Vs Energy applied by Hammer to establishing Hammer performances.

Pile Driving Records after driving each segment of Pile data recorded daily vide point no. ii , iv, v, vi above shall be submitted to the Company within two hours (after completing the driving each segment of pile or re-strike activity) of driving through Documentation system (OPMAC), by Fax and Mail.

#### **E. Post Installation Pile Driving, Monitoring and Re-strike Test Report**


A post-installation pile monitoring report shall be submitted to COMPANY within thirty (30) days after completion of piling activity and shall include but not be limited to the following:

Successive interim report for Pile capacity achieved and long term Capacity estimation within 2 days of every pile driving till target penetration shall be submitted. Complete Pile Monitoring report with pile capacity achieved and long term capacity along with Factor of Safety estimation shall be submitted to Company within one week after completion of pile driving activities and shall include but not be limited to the following:

- a) Details of Scope of Work.
- b) Summary of hammer performances (complete with hammer numbers with traceability).
- c) Details of stoppages and their reasons.
- d) Pile stresses during driving.
- e) Computation of soil resistance to driving using CAPWAP software.
- f) Presentation of CAPWAP results – Soil dynamic parameters, Skin friction resistance distribution & Max. Compressive & tensile stresses.
- g) Comparison of predicted and measured/computed soil resistance to driving.
- h) Estimation of long term static pile capacity.

#### **3.9.6.4 FIELD SPLICES OF PILES**

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Welding shall be according to Specification “Structural Welding and inspection for Offshore Platforms’. If the Contractor wishes to reduce the forty-eight (48) hours waiting period for flux core welding inspection, procedures which address the avoidance of hydrogen induced cracking shall be submitted to Company. Reduction in the waiting period shall only be allowed if approved in writing by Company.

Contractor shall 100 % ultrasonically inspect all field splices. Ultrasonic examination will follow the procedures and acceptance criteria of API RP 2X. Defect acceptance will be in accordance with level ‘C’ inspection. Each field butt weld in all piles shall be allowed to cool to a temperature below 120°F before ultrasonic examination or advancing of pile in any manner, either by diving or by free fall.


### 3.9.6.5 DRIVING RECORDS

Company appointed Inspector shall physically witness the Energy application on the Driving Control Unit of the Hydraulic Hammer and record same on the report. The Contractor shall keep complete and accurate pile driving records on each pile driven and shall furnish a copy of these records to Company’s designated Office within two (2) hours after driving that pile duly witness by the Company appointed Inspector. All pile driving records shall be documented as part of As-built Documentation. In case of Pile Monitoring device is adopted, data obtained using same shall be document as as-built documentation.

These records shall include dates, times, drilling and / or jetting operations, shutdown and reasons for same and all other pertinent information including, but no limited to, the following-

- Platform & Pile identification
- Actual length of each pile section and cut-offs.
- Penetration of pile under its own weight.
- Blows per foot and penetrations during all pile driving with hammer identification.
- Date and Times of start and end of driving for all sections of all piles and time spent for add on piles on welding operations.
- Final penetrations of all piles.
- Driving Control Unit input Data & Output data print shall be provided for Hydraulic Hammer.
- All time lost during bad weather and status of pile driving at that time including any interruptions.
- Steam pressure (if applicable).
- Hydraulic pressure (if applicable)
- Blows per minute and penetration.

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- Stroke height.
- Cushion block data (total blows on cushion).
- Hammer used (make and model).
- All necessary data to determine the energy output oil either the steam of hydraulic hammer.
- Elevation of soil plug after driving each add-on and internal water surface after driving each pile.
- Pertinent data of a similar nature covering driving, drilling and grouting.
- Any unusual phenomena or occurrence during driving.

**3.9.6.6** The lead sections and subsequent add-ons of piles shall be installed as per the piling sequence developed during engineering. The jacket leg in which the rubber diaphragm is to be punctured shall be completely flooded before puncturing.

**3.9.6.7** Contractor shall take every precaution to prevent damage to grout seals during pile stabbing and driving. All lifting eyes, etc., shall be removed and the outside face of the pile ground smooth prior to driving the pile section.

**3.9.6.8** If the level of jacket is outside the specified tolerances, the leveling of the jacket shall be performed at the dog-off stage. The dog plates shall have a holding capacity of at least 1.5 times the jacking load applied for leveling. The dogs shall be retained in position in all main piles other than the pile being driven and shall be welded back after driving is completed.

**3.9.6.9** Jacket level measurements shall be taken at regular intervals during piping and reported to Company. Should any tilt take place during pile driving, it shall be corrected before further driving of the pile. No leveling operation shall be carried out after any pile has reached design penetration, unless specifically approval by Company.


**3.9.6.10** The piles shall be sequentially driven to the design penetration, taking one pile at a time with minimum delay during welding of add-ons to avoid refusal due to soil set up.

**3.9.6.11** Skirt piles, if any, shall be installed after all main pile driving operations are completed.

**3.9.6.12** In case of platforms with only skirt piles and no main piles, specific procedures for leveling the jacket shall be developed by the Contractor.

### **3.9.6.13 Refusal**

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- a. The refusal criteria for piles and conductors shall be as per API RP-2A or hammer's manufacturers criteria which shall be decided during detailed engineering.
- b. In case of Pile met refusal, as per Bid Document Clause no. 5.6 of Volume -1, Contractor shall deploy higher capacity hammer (designated as **Refusal Mitigation Hammer**) as first remedial measure. Pile Drivability Analysis shall be carried out from the Design Stage of Engineering for the Refusal Mitigation Hammer as Plugged Pile and Soil partial Set up condition (considering clay soil develop full strength in 7 days' time) up to full depth of Pile.
- c. If refusal takes place on account of soil set-up caused by delays due to malfunctioning, breakdowns of Contractor's equipment or any other cause attributable to the Contractor, it shall be the Contractor's responsibility to take measures to develop the required capacity of the pile without any effect on time and cost to the Company.
- d. In case of refusal as specified in c) above, it shall be the Contractor's responsibility to employ other acceptable means of attaining the desired penetration, by driving the pile after removing the soil plug by jetting and or pile top drilling and putting back the equivalent soil plug with concrete layer at top after Pile Driving to the Design penetration. Company's approval of all pile remedial procedures shall be obtained prior to taking up such work.

A detailed investigation to ascertain the reasons for pile refusal shall be carried out by Contractor at no extra cost and time effect to Company. Detailed report of the findings shall be submitted to Company for review.


#### 3.9.6.14 Penetration

Piles shall be driven to the design penetration by normal driving methods. The Contractor shall operate and maintain pile driving equipment in accordance with manufacturer's recommendations and accepted construction practices, the intent being to advance piles expeditiously to achieve design penetration. If required, pile cut-offs shall be made as detailed on the drawings.

#### 3.9.7 Mechanical Pile Connectors

If mechanical pile connectors are used, the Contractor shall be responsible for procurement of all specialty materials and pieces of equipment. Back-up/standby shall be required offshore for all essential equipments. All procedures shall be accordance with specifications of the manufacturer. The use of mechanical pile connectors shall be subject to approval by Company.

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### 3.9.8 Jacket to Pile Connection

Jacket to pile connections shall be made as specified in the design. Any adjustments necessary to correct discrepancies in jacket setting elevations, deck leg length etc. shall be taken up by means of either over / under lengths of legs or pile tops or by transition pieces, depending upon the design.

Shim plates shall be used for connecting main piles with the jacket.

### 3.9.9 Pile Cut-off Report

The Contractor shall furnish to Company a pile and conductor cut-off report. This report shall include the exact length for the pile when stabbed, the cut-off measurement, the total length of pile actually driven and the total amount of cut-offs made.

### 3.9.10 Post Installation Inspection


Following completion of the jacket installation, Contractor shall perform a visual underwater survey of the jacket, the seabed location at the pile locations, pile sleeves (if any), anodes etc. The report, shall record the inspection and any sustained damage, shall be provided to Company.

### 3.9.11 Post Piling Operations

The following operations shall be carried out by the Contractor after completion of all piling.

- The substructure/jacket to pile shim connection in case of main pile, if any, shall be installed only after all pile driving including the skirt piles is completed.
- All installation aids such as temporary guider/ bumpers, grout line, vent line etc., skirt piles guides, including their supports up to and including elevation of (-) 25.00 M shall be removed. Buoyancy tanks, if provided, shall completely be removed. However, removal of buoyancy tank(s) shall also be in compliance to clause no. 3.9.6 of this functional specification.
- The contractor may use front follower to drive skirt piles & to keep maximum length of pile upto 5.0 m above skirt sleeve during driving of skirt piles.
- Excess length beyond 5.0 m above skirt sleeve shall be cut by the contractor. Under water cutting of excess length of pile shall be in the scope of the contractor with no extra time & cost to the company.

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- e) Soundings shall be taken to determine the level of the soil plug inside the pile. In case the soil plug has gone down appreciably and if it is found necessary as a result of engineering calculations, it shall be Contractor's responsibility to provide grout plug of adequate length, to develop full end bearing without any cost and time effect to the Company.

**3.9.12** Calibration certificate shall be obtained from the Manufacturer of the respective equipment. Original copy of Calibration certificate shall be submitted one month prior to mobilization for Installation for following Equipment:

- i. Installation Barge Crane,
- ii. Hammers for Pile & Conductor driving,
- iii. Drilling Equipment,
- iv. Jetting Equipment, Grouting Equipment.
- v. Internal Lifting Tool (ILT) for lifting of piles

### **3.10 Grouting:**

All grouting shall be done immediately after piling is completed. In cases where the piling & grouting are not done immediately after placement of jacket on the seabed, the annulus between the pile and jacket leg shall be thoroughly cleaned by means of approved chemicals/procedure prior to commencement of grouting. Grouting

Methodology from Bottom of Jacket or from top of Jacket shall be specified during detail Engineering and accordingly Drawing shall be developed:


**3.10.1 Grouting from Bottom of Jacket (applicable for Main Legs & Skirt Legs):** Methodology described below:

#### **3.10.1.1 Grout**

The cement used for grout shall be as specified in General Specification No 6001F. The grout shall be of a non-shrinking expansive type with minimum compressive strength of 70 kg/cm<sup>2</sup> (1000 psi, 7 MPa) at 24 hours and 281 kg/cm<sup>2</sup> (4000 psi, 27 MPa) at 28 days at 27 ± 2 degrees C. A target grout density of 1920 kg/cu m (16 lbs/gallon) shall be maintained during placing of any grout. The Contractor shall furnish results of tests made on samples of cement taken at the time of shipment and certify that the applicable requirement of this specification have been met including the minimum compressive strength for 24 hours and 28 days. This test shall closely simulate, the field conditions, i.e. admixture contents, sea water maximum water content ratio etc. The laboratory test procedure shall be in accordance with ASTM 109. Contractor shall transport for the purpose of construction at site the same batch of cement and ingredients for which the tests are performed.

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Contractor shall provide adequate number of metal cube moulds of 10 cm size for preparing samples during grouting of subsequent compression tests. A minimum six samples per stage of grouting or pile shall be taken for testing. The Contractor shall also provide on barge a compression testing machine and shall conduct compression tests after 24 hours curing period of cube samples taken during grouting. The results of these tests shall be submitted to Company's representative immediately after completion of tests. A suitable tank shall be provided for storing and curing cubes prior to testing. The Contractor shall carry out the 28 days compression tests either on the barge or on a short based compression testing machine and submit the results to the Company. If the test result does not satisfy the minimum compressive strength requirements, Contractor shall be responsible for making suitable rectification measures to ensure adequate load transfer to the pile.

### 3.10.1.2 Grouting Procedure

- a) Grouting operations shall start only after jacket to pile shim connections are completed.
- b) Prior to grouting, all grout lines and annulus of Pile – Leg/skirt leg shall be flushed with sea-water, at a rate of not over 950 liters per minute, to assure free passage of the grout and cleanliness of the annulus. Flushing shall be carried out from bottom most point and shall be continued till clear water cones out. A report shall be generated for this activity duly witness by company appointed inspector.
- c) Grout shall be mixed in a high speed mechanical or jet mixer and then passed through a strainer into pumping equipment, which is provided for recirculation. Grout shall be pumped into the annulus as soon as possible after mixing.
- d) Contractor shall mix and pump a volume of grout equal to one and one half times the theoretical volume of the annular space to be filled. A report shall be generated for this activity duly witness by company appointed inspector.
- e) In the event of blockage or an interruption of grouting, Company reserves the right to require Contractor to remove all grout from the annuli by flushing with water under pressure, and to have the grouting procedure repeated.

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- f) Slurry density shall be monitored during grouting operations. If the Contractor proposes to use a continuous mixing process, an automatic density-meter recorder shall be used. If he proposes batch mixing the density of slurry of each batch shall be measured. A report shall be generated for this activity duly witness by company appointed inspector.

If the measured slurry density is less than 1800 kg/cu.m. (15 lb/gal.), the grout shall be diverted on board into the disposal tank until the slurry density has returned to the specific value. A volume of grout equal to the volume diverted away shall be added to the volume of the slurry to be pumped in order to maintain the correct volume.

- g) The Contractor shall use inflatable or passive grout seals and grout the annuli if he proposes a single stage grouting system. The procedure shall be as follows:
- i) If water is used as the inflation medium, a pump capable of filling the inflate lines and pressurizing them upto 35 kg./cm and a manifold system with multiple pressure gauges for inflating and monitoring individual piling seals shall be used.
  - ii) If air is used as the inflation medium, a separate cylinder with a pressure regulator and gauge for each piling seal shall be used. Cylinders shall be capable of inflation pressure as predetermined from the manufacturer's recommended air inflation chart for the particular seal, grout density, and water depth.
  - iii) When water is used as the inflation medium, the inflation pressure (measured at surface) shall be as recommended by the grout seal manufacturer and shall be maintained within  $\pm 10\%$  variation throughout the grouting operation.
  - iv) When air is used as the inflation medium, the inflation pressure (measured at surface) shall be as recommended by the grout seal manufacturer, and shall be maintained within  $\pm 5\%$  variation throughout the grouting operation.
  - v) When water is used as the inflation medium, the inflate line shall be filled with water slowly at intervals to allow sufficient time for air inside


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the line to bleed back. Sufficient measures and precautions are to be taken to ensure that all air is bleed out from inside the inflate line before the line is fully pressurized.

- vi) After the grout seal is properly inflated and prior to grouting, the annulus and the grout line shall be flushed with sea-water at a rate of not over 950 liters per minute in order to ensure free passage of grout and to establish circulation.
  - vii) After grouting is completed, the inflate pressure in the grout seals shall be maintained for a minimum period of 24 hours.
  - viii) Contractor shall specify a back-up system he proposes to employ for completing the installation job in case of failure of the packers, inflation lines, or grout lines.
  - h) The density of the returned grout at the top of the jacket shall be measured to have a minimum to have a minimum density of 1920 kg/cu m. The jacket pile annulus can be considered to be completely grouted only when this criterion is satisfied.
- Two openings one on the high side and the other on the low side shall be left open for purposes of monitoring return grout. The remaining seal plates shall be welded only after two hours of completion of grouting during which the grout level in the annulus shall be monitored and topped up by grout if required.
- i) If at any stage of grouting, any of the grout lines clog, the remainder of the annulus shall be filled using diver operated grout ports provided in the legs.
  - j) Care shall be taken, during and after the grouting to clear grout splatter, overflow and drippings from the structure.
  - k) Contractor is liable for any damage to grout lines and inflate lines, which occurs as a result of installation operation.
  - l) After completion of the entire grouting operation to the satisfaction of Company's Representative, all flooding and grout lines and accessories including their supports shall be removed from top of

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jacket, upto a depth of (-) 25.00 m. A report shall be generated for this activity duly witness by company appointed inspector.

### **3.10.2 Alternative Grouting Procedure: Grouting from top of Jacket (applicable for Main Legs only):**

In this method Grouting shall be taken up from top of jacket.

Grouting operations shall start only after jacket to pile shim connections are completed.

Grout packer shall be placed at the bottom end during fabrication stage.

Prior to grouting, all grout lines and annulus of Pile – Leg/skirt leg shall be flushed with sea-water, at a rate of not over 950 liters per minute, to assure free passage of the grout and cleanliness of the annulus. Flushing shall be carried out from bottom most point and shall be continued till clear water cones out. A report shall be generated for this activity duly witness by company appointed inspector.

The annulus shall be made free from water by repealing water by applying pressurizing air from top of Pile. Repealing water from annulus shall be ensured by observing air bubble coming out from the Jacket leg bottom (i.e. gap between Pile & Jacket Leg Grout seal). In case, air bubble is not coming out, then emergency port located near mudline shall be opened to ensure repealing of water from annulus. A report shall be generated about repealing of water from annulus and duly witness by Company appointed Inspector and documented.

On completion of above stated activity, grouting methodology / procedure are similar as specified in Clause 3.10.1.

In this method of Grouting, Mudline Horizontal Framing grouted Joints (Jacket leg & pile) shall be designed as un-grouted Joint as in this procedure cleaning of contaminated annulus is not possible.


## **3.11 TOPSIDES INSTALLATION**

### **3.11.1 General**

This section will apply to the Topsides modules and any other installation other than work related to the jacket and piles.

The Contractor shall field-adjust transition pieces connecting the deck legs to jacket and shall place the superstructure/deck within the tolerances specified. The Contractor shall remove any temporary deck structure, installation guides etc. (if any) already installed. Contractor shall take all necessary measures /

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precautions to avoid damage to the Topsides and jacket while removing the temporary deck.

### 3.11.2 Anchorage

Special care shall be exercised by the Contractor near existing platforms and pipelines when running anchor or anchor lines from construction barges and boats. Refer also to Section 3.9.1.4. Before placing any anchors or anchor lines, the Contractor shall clearly define to the Company Representative the proposed location of the anchors or anchor lines and obtain approval in advance prior to deployment at site.

### 3.11.3 Tolerances

The elevation of each deck and topside module shall be within 75 mm of the elevation specified on the construction drawings. The deck and topside module shall be leveled to a tolerance of 12 mm between any two extreme diagonal points.

## 3.12 ACCESSORIES

### Navigational Aids


The appropriate temporary navigational aids shall be placed on the structure at all times when construction equipment is not alongside the structure. The aids-to-navigational system and such additional aids to navigation as are required to meet applicable government regulations shall be provided, installed and maintained.

The equipment shall be maintained in good operating condition until construction work under this contract is completed. The Contractor shall be responsible for losses or damage and shall replaced and maintain the navigational aids. Temporary navigation aids shall be put in place at the earliest possible time. At no time shall be Contractor leave any portion of the structure without operational warning devices after erection has begun. Permanent aids to navigation shall be left operating at completion of installation of the offshore facility.

## 3.13 REPAIRS AND CLEAN-UP

All damage to structural items during load out, sea fastening items during load out, sea fastening, transportation and installation shall be repaired to the original condition. All defective welds shall be repaired in accordance with relevant Specification.

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All damage to the protective coatings which occur during load out and sea fastening shall be patched and repaired in accordance with Specification 2005 'General Specification for Protective Coatings'.

All installation appurtenances including flood lines, pile guides, trunnions, supports and scaffolding shall be removed upon completion of installation work. All cuts below water shall be made so that 10 mm of steel remains on the permanent member, to avoid damage to the jacket. Above water, cuts shall be made down to 6 mm and the remainder shall be ground smooth to remove any stub.

### 3.14 POLLUTION CONTRTOL

All operations shall be conducted in a manner that will prevent pollution. All applicable laws, ordinances, rules, regulations and lease or Contract provisions regarding pollution shall be obeyed.

No garbage, trash, waste or other pollutants shall be discharged or allowed to escape, except as allowed by regulating agencies having jurisdiction. At all times the equipment shall be kept orderly and unencumbered from or below deck rubbish or debris. Personnel shall be imparted guidance and training in pollution control and shall clean up any pollution occurring during the installation operations.

### 3.15 SAFETY


Contractor shall comply with safety instructions, which may be issued by Company or given by Company representative, during offshore work concerning essentially the work being done around oil or gas wells and pipelines. Contractor shall also comply with all local ordinances governing safety and it shall be Contractor's responsibility to determine the content of these regulations.

### 3.16 VETTING OF PRESERVICE ANALYSIS & INSTALLATION ENGINEERING:

Pile & Conductor Drivability Analysis shall be vetted by Installation Contractor & MWS and approved by Company. Vetting/ Approval of following Pre-Service analysis shall be obtained from MWS and Installation contractor prior to commencement of installation of jacket and pile:

SL No	DESCRIPTION	Jacket	Deck	Module
1	Load-out Analysis	Yes	Yes	Yes
2	Sea-fastening & Transportation Analysis	Yes	Yes	Yes
3	Launching Analysis	Yes	No	No
4	Lifting Analysis	Yes	Yes	Yes

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5	Floatation & Upending Analysis	Yes	No	No
6	On-bottom Stability & Mudmat Analysis	Yes	No	No


Jacket installation procedure shall be submitted to the Company at least 10 working days before load out of jacket. Applicable Pre-Service analysis reports such as On-bottom stability and Mudmat Analysis report, etc. shall be in compliance with Jacket installation procedure. All comments of company on pre-service analysis reports shall be submitted to MWS & Installation Contractor for their consideration. Also, comments of MWS and Installation Contractor on pre-service analysis reports shall be submitted to Company.

#### 4.0 AS-BUILT DOCUMENTATION

##### A. As minimum following Structural Documents shall be documented:

1. Contractor's Structural Design Consultant shall prepare the AS-Built Structural Drawings by incorporating all subsequent design changes approved by Company, marking actual Yield Strength of material in co-relation to Material Traceability & Mill Test Certificate with Listing of Heat Numbers, Name of Mill, Mill TC Numbers, etc.
2. During advance stage of Engineering SACS Model for All Analysis shall be documented.
3. All AFC Drawings, All Structural Analysis and Design Calculations shall be documented.
4. Post completion of work SACS Model Structural Analysis (Inplace, Fatigue & Earthquake) both for Jacket & Deck (top side) shall be updated with all design changes and load-data supported with final Weight control Report.
5. All Structural Material Purchase Orders shall be documented.
6. Structural Analysis Reports (all) and Design Calculations shall be documented.
7. PS for Helideck (Aluminum) & handrails, rubber products, MGP (if applicable), architectural items shall be documented.
8. Structural Steel Material Mill Test Certificates, Material Inspection & traceability Drawings with Reports/records, Dimension control report/Records, Cement Test Certificate, Grout Mix design Report, Grout cube Test Report, Paint Material inspection report with Manufacturer's test Certificate, Painting Records, Paint application Inspection Records, Weld Joint numbering Records with Welding Inspection Reports, fabrication related all procures upto loadout stages, etc., shall be documented as Fabrication /Construction Dossier.
9. Weld joint numbering with Weld Inspection Report & Record.

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10. Painting Material Inspection Report with Paint Manufacture’s Test Certificate.

11. Paint application & Inspection activity Report with Inspect report.

12. Load-Out activity shall be documented the form of Video for fabricated position to final position on Barge duly witness by ONGC appointed Inspector.

13. Post Installation pile & Conductor Driving records / Reports & Pile monitoring record (as applicable) shall be documented daily immediately after driving of each segment of pile/Conductor.

14. Pre-engineering Survey Report, Pre-construction Survey Report & Post construction survey Reports, Installation barge activity log (during installation period), Installation related all procedures, Installation related Records like Inspection records, As-built video records of various installation stages (under water), As-built video survey of Jacket & Mud-mat, Debris clearance survey report, etc. shall be documented as Installation Dossier.

15. Activities specified elsewhere in the Bid Document but not specified above shall also be documented.

16. All similar data shall be documented for PLEM, SSIV, Mooring Buoy, Bridge & Top side Modules.

17. Report for painting area in deck and jacket, entire deck and jacket handrail length, chequered plate area, total grating area shall be documented.

18. WCR shall include structural steel tonnage for jacket, deck, conductors (if applicable) and pile separately.

19. The Excel and/ or Mathcad spreadsheet files used by the contractor for various design calculations shall be submitted to the company in unlocked editable mode.

**B. As minimum following Architectural Documents shall be Documented:**

1. Contractor’s Architectural Design Consultant shall prepare the As-Built Architectural Drawings by incorporating all subsequent design changes approved by Company.

2. As-Built Documentation for Architectural items shall be carried out similar to items specified for Structural items stated above.

3. As-Built Documentation for Structural items shall be carried out for all Architectural Buildings as stated above.

**C. Fabrication / Construction Dossier as As-Built Documentation for structural Fabrication & Installation Dossier shall be carried progressively during fabrication stage till installation so that As-Built documentation is complete with 60 days of Installation. Post completion of Work (Installation) As Built Drawings shall be prepared incorporation of Design changes and other activities specified which shall be approved by ONGC appointed Inspector.**

FORMAT No. OES/SOF/028	Ref. PROCEDURE No.	ISSUE No. 03	REV. No. 00	REV. DATE: 26.02.2018
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**OFFSHORE  
DESIGN  
SECTION  
MUMBAI  
REGION**

**GENERAL  
SPECIFICATION  
FOR  
MATERIALS,  
FABRICATION AND  
INSTALLATION OF  
STRUCTURE**

SPEC. No.	6001F
Rev. No.	14
Discipline:	Structural
Page: Page 75 of 75	

As-Built Documentation activity shall be the DCI Document having following parts as minimum requirement:

**Fabrication / Construction Dossier shall have following parts:**

- Pre-Engineering Survey reports, Pre-Installation Survey Report, As-Built Video Survey Reports. These documents shall be documented at the end of activity.
- Material Purchase Order. These documents shall be documented weekly and shall be submitted every Monday.
- Material Inspection Report along with Mill Test Certificate with acceptance of Material. These documents shall be documented weekly and shall be submitted every Monday.
- Material Traceability Report with respect to Mill TC. These documents shall be documented weekly and shall be submitted every Monday.
- Dimension Control checks. These documents shall be documented weekly and shall be submitted every Monday.
- Welding Inspection Reports & Records. These documents shall be documented weekly and shall be submitted every Monday.
- Weighing report of jacket & topside in the yard prior to load out.
- Painting material Inspection with Manufacturer's test Certificate.
- Painting Inspection Report & Record.
- Load-out activity shall be document as as-built video.

**Installation Dossier shall have following Parts and document daily & as specified elsewhere:**

- Inspection of Item post Transportation and before Installation.
- Jacket Leveling & Co-ordinate Report.
- Pile Driving Record & Report
- Conductor Driving Record & Report.
- Transition Piece Elevation & dimension control Record.
- Deck Installation Report & Record.
- Welding Inspection Report & Record.
- Field Painting Record for application Priming Coat, mid coat & Top Coats.

----- END -----

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
OES/SOF/028		03	00	26.02.2018



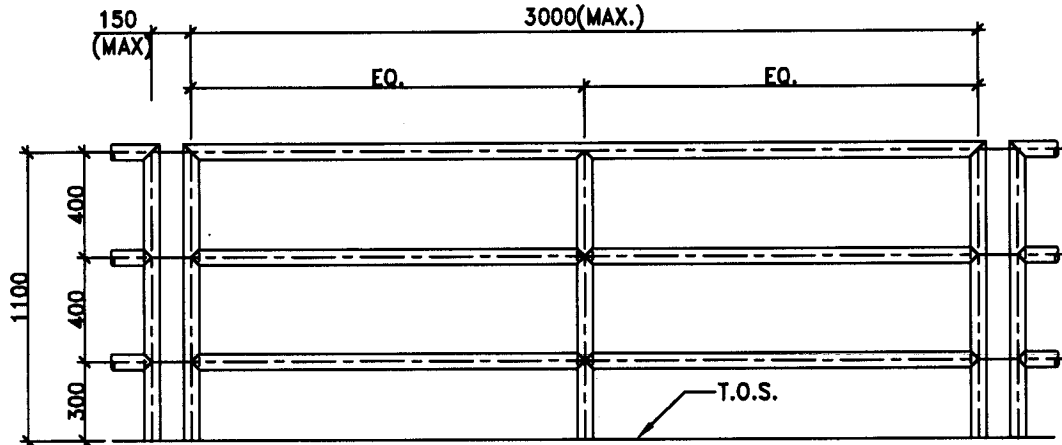
**NOTES:—**

- HANDRAILS SHALL BE PROVIDED ON ALL PERIPHERIES OF PLATFORMS, DECKS, MODULES, ROOFS AND LANDINGS AS SHOWN IN PLATING, GRATING & HANDRAIL LAYOUT DRAWINGS. INDEPENDENT WALKWAYS AND STAIRS SHALL HAVE HANDRAILS ON BOTH SIDES.
- THIS STANDARD GIVES DETAILS FOR THE FOLLOWING TYPES OF HANDRAILS  
 TYPE I – HANDRAIL BELOW CELLAR DECK (WAVE ZONE) FIXED TYPE  
 TYPE II – HANDRAIL ON AND ABOVE CELLAR DECK– FIXED TYPE  
 TYPE III – HANDRAIL ON AND ABOVE CELLAR DECK– REMOVABLE TYPE
- ALL DIMENSIONS ARE IN mm
- MEMBER SIZES & MATERIAL OF HANDRAIL SHALL BE AS FOLLOWS:

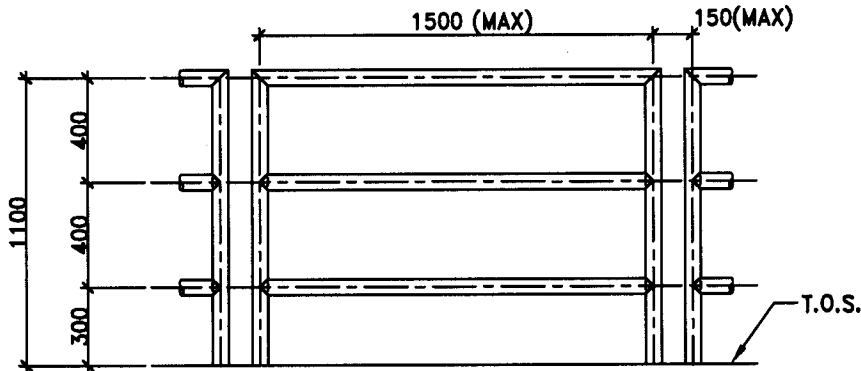
MEMBER	INDIAN STANDARD	INTERNATIONAL STD.	MATERIAL
TYPE I VERTICAL POST AND HORIZONTAL (TOP)	60.8 $\phi$ x4.5	60.3 $\phi$ x5.5	IS:1239/API-5L GR.B OR EQUIVALENT
TYPE I OTHER HORIZONTALS	48.8 $\phi$ x4.0	48.3 $\phi$ x5.1	–DO–
TYPE II,III VERT. POST AND HORIZONTALS	48.8 $\phi$ x4.0	48.3 $\phi$ x5.1	–DO–
TYPE III SOCKET, COLLAR	60.8 $\phi$ x4.5	60.3 $\phi$ x3.9	–DO–
KICK PLATE	100x6	100x6	IS:2062 GR 'BR'/ASTM A36 OR EQUIVALENT
COAMING ANGLE	100x100x8	100x75x8	–DO–
SAFETY CHAIN	6.3mm DIA	6mm DIA	IS:2429/BS:6405 OR EQUIVALENT

- ALL WELDS SHALL BE 5mm FILLET & CONTINUOUS ALROUND, UNLESS OTHERWISE NOTED.
- ALL HANDRAILS AND SOCKETS FOR REMOVABLE HANDRAILS SHALL BE HOT DIP GALVANISED. THE WEIGHT OF ZINC COATING SHALL BE AVERAGE 915 gms PER SQUARE METRE (3 OUNCES PER SQUARE FOOT) AND NO SPECIMEN SHALL SHOW LESS THAN 710 gms PER SQUARE METRE (2.33 OUNCES PER SQUARE FOOT). IN CASE OF CONFLICT WITH JOB SPECIFICATIONS FOR PROTECTIVE COATING, THE MORE STRINGENT REQUIREMENTS SHALL APPLY.
- ALL REMOVABLE OR OFFSHORE INSTALLED HANDRAILS SHALL BE TEST FITTED AT YARD PRIOR TO LOADOUT AND SHIPPED LOOSE DULY MARKED FOR OFFSHORE INSTALLATION.
- COAMING ANGLE SHALL BE CONTINUOUSLY SEAL WELDED TO CHQD. PLATE OR SUPPORTING MEMBER FOR PROTECTIVE COATING. ON BOTH SIDES.
- THE HANDRAIL HAVE BEEN DESIGNED FOR HORIZONTAL OR VERTICAL CONCENTRATED LOAD OF 100Kg APPLIED AT ANY POINT. HANDRAIL TYPE-I HAS ALSO BEEN DESIGNED FOR A WAVE PRESSURE OF 1.900 T/m<sup>2</sup>(MAX)
- THE POST SPACING CAN BE ADJUSTED AS PER THE FIELD REQUIREMENT.
- HEIGHT OF HANDRAIL FOR THE FIRE FIGHTING/SOLAR PANEL PLATFORM OF HELIDECK SHALL BE RESTRICTED TO BE WITHIN T.O.S. OF HELIDECK/SOLAR PANEL HEIGHT.
- HANDRAIL ON JACKET WALKWAY SHALL BE OFFSHORE INSTALLED U.N.O. ON THE DRAWINGS.
- SAFETY CHAIN SHALL BE USED WITH TYPE II HANDRAIL POSTS. THE SAFETY CHAIN SHALL BE GALVANISED.
- HANDRAILS ON STAIR TREADS SHALL NOT HAVE KICK PLATE. REFER EIL STANDARD 7-60-0803

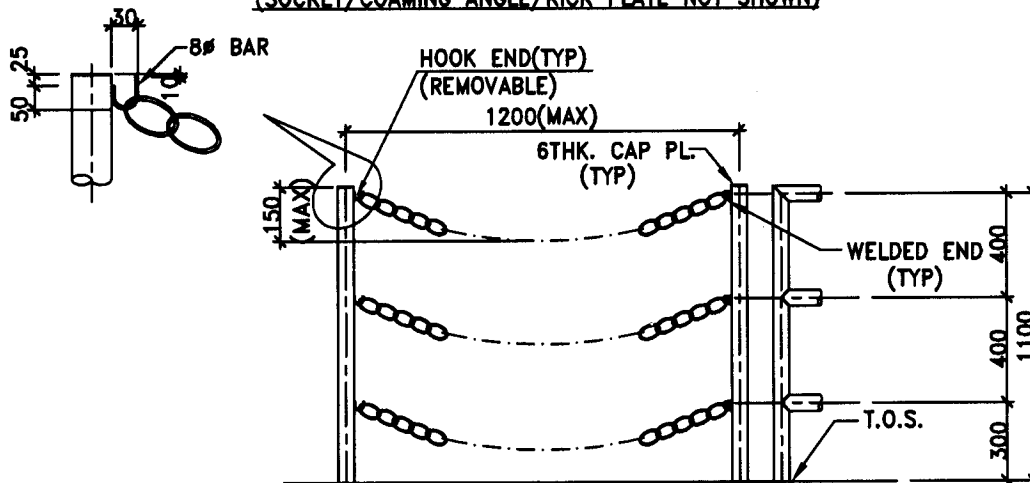
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3	03.11.16	REVISED & RE-ISSUED AS STANDARD	AMARJIT SINGH	BHASKARA M	BHASKAR PAL	RAKESH NANDA
2	04.03.13	REVISED & RE-ISSUED AS STANDARD	AMARJIT SINGH	MATHEW SIMON	B. VIJAYA KUMAR	D. MALHOTRA
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	



**TYPICAL DETAIL OF DOUBLE PANEL HANDRAIL**  
(SOCKET/COAMING ANGLE/KICK PLATE NOT SHOWN)

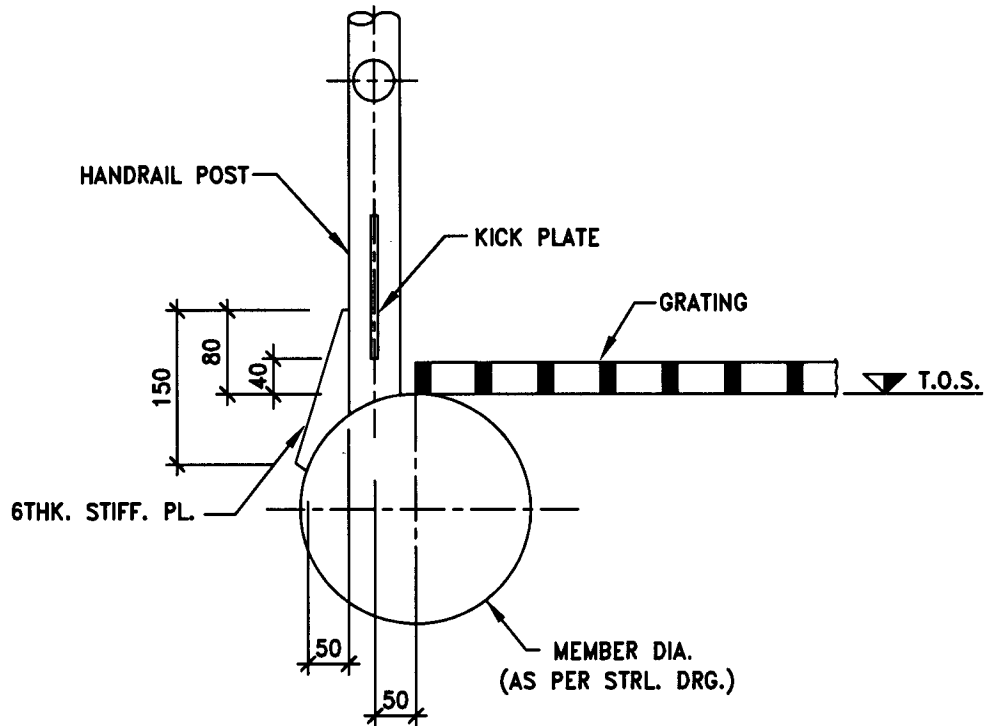


**TYPICAL DETAIL OF SINGLE PANEL HANDRAIL**  
(SOCKET/COAMING ANGLE/KICK PLATE NOT SHOWN)

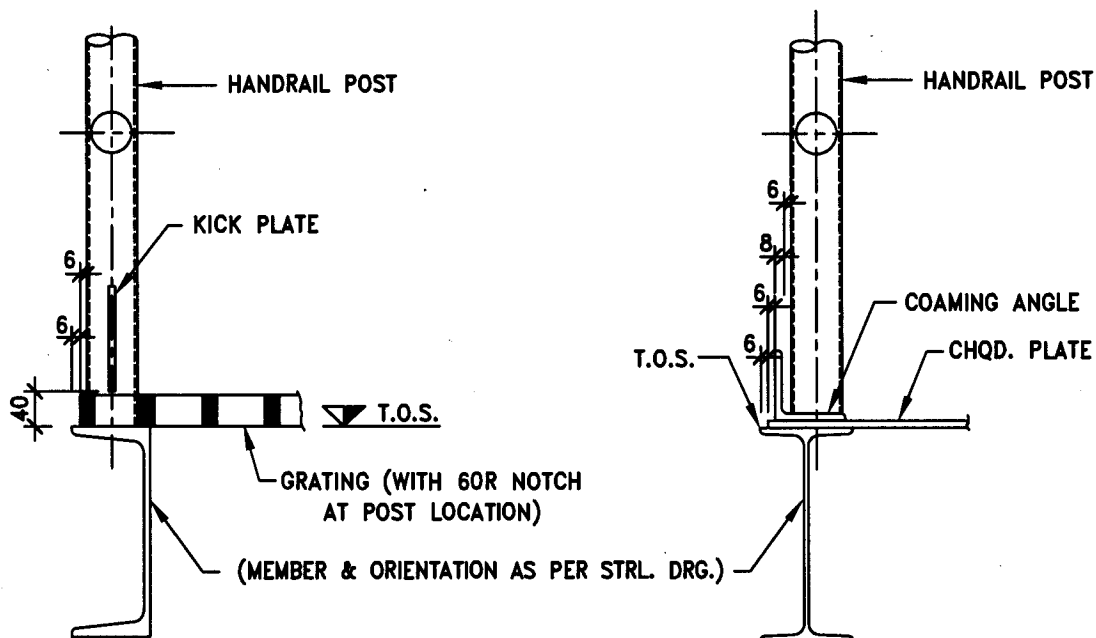


**TYPICAL DETAIL OF SAFETY CHAIN**

4	24.01.22	REVISED & RE-ISSUED AS STANDARD	MUNISH GAUBA	BHASKARA M	BHASKAR PAL	SAHJAY MAZUMDAR
3	03.11.16	REVISED & RE-ISSUED AS STANDARD	AMARJEET SINGH	BHASKARA M	BHASKAR PAL	RAKESH NANDA
2	04.03.13	REVISED & RE-ISSUED AS STANDARD	AMARJEET SINGH	MATHEW SIMON	B. V. KUMAR	D. MALHOTRA
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	



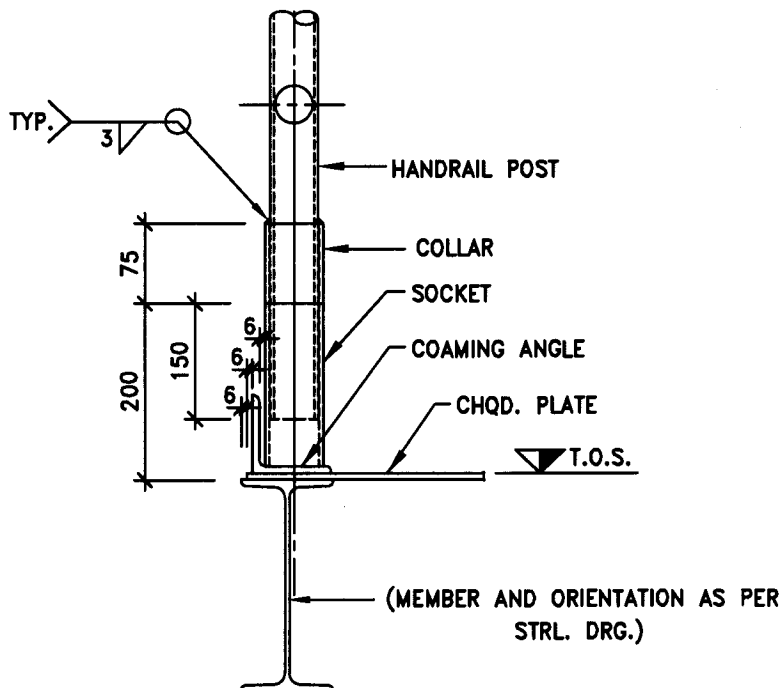
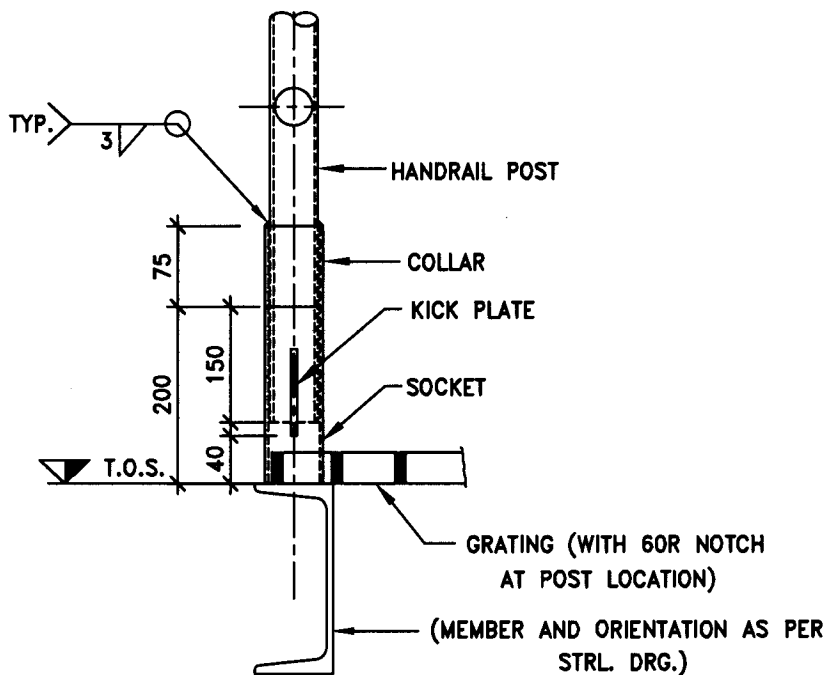
**HANDRAIL TYPE-I**



**HANDRAIL TYPE-II**

4	24.01.22	REVISED & RE-ISSUED AS STANDARD	MUNSH GAUBA	BHASKARA M	BHASKAR PAL	SANJAY MAZUMDAR
3	03.11.16	REVISED & RE-ISSUED AS STANDARD	AMARNR SINGH	BHASKARA M	BHASKAR PAL	RAKESH NANDA
2	04.03.13	REVISED & RE-ISSUED AS STANDARD	AMARNR SINGH	MATHEW SIMON	R.VIJAYA KUMAR	D. MALHOTRA
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman

Approved by



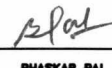



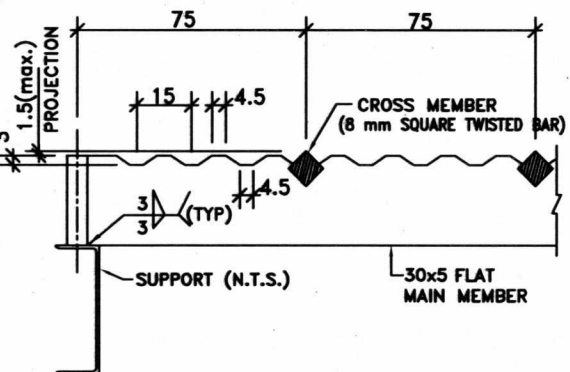
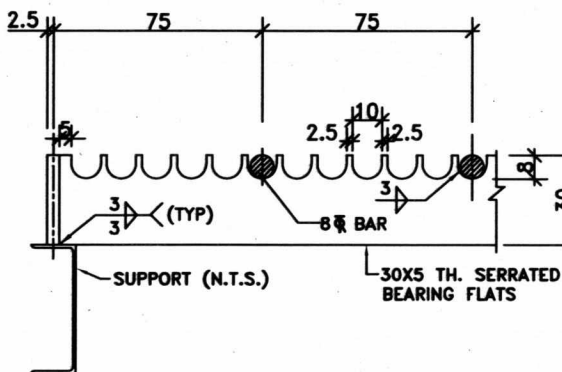
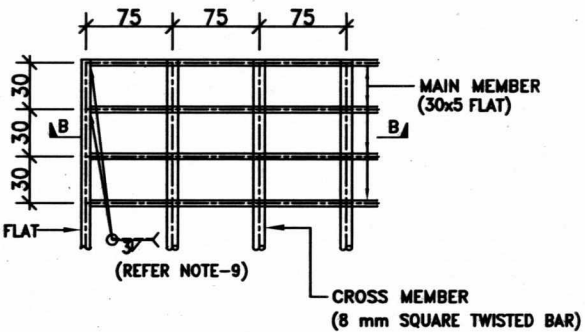
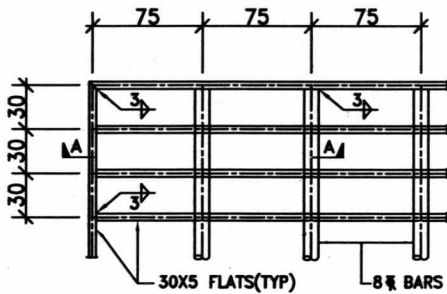
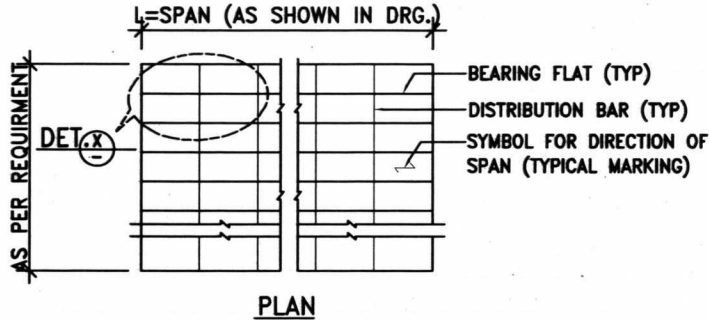
**HANDRAIL TYPE-III**

4	24.01.22	REVISED & RE-ISSUED AS STANDARD	MUNISH GAUBA	BHASKARA M	BHASKAR PAL	JANJAY MAZUMDAR
3	03.11.16	REVISED & RE-ISSUED AS STANDARD	AMARNIR SINGH	BHASKARA M	BHASKAR PAL	RAKESH NANDA
2	04.03.13	REVISED & RE-ISSUED AS STANDARD	AMARNIR SINGH	MATHEW SIMON	B.VIJAYA KUMAR	D. MALHOTRA
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						

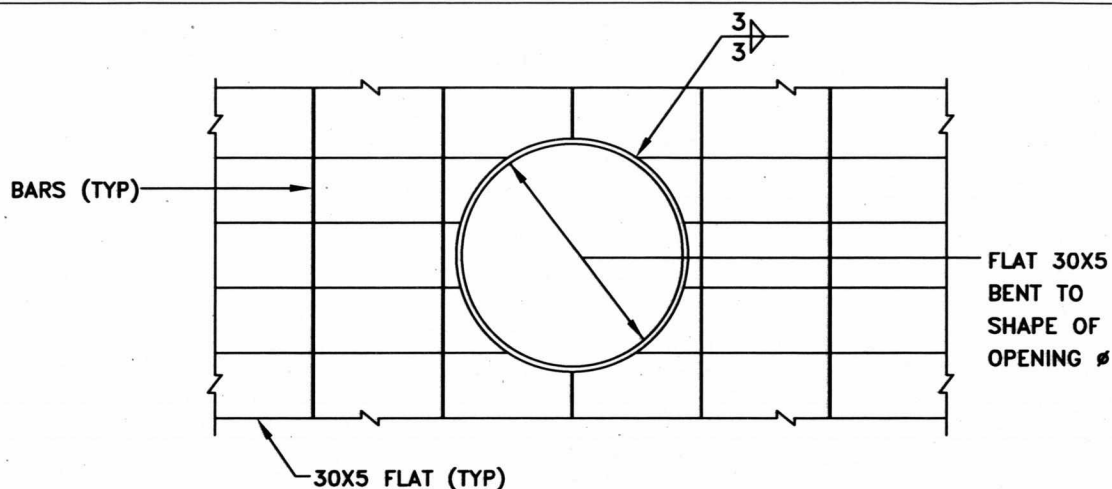
## NOTES:—

1. ALL DIMENSIONS ARE IN mm.
2. THE GRATING MATERIAL SHALL BE AS FOLLOWS:  
FLAT 30x5, 8 mm SQUARE TWISTED BAR, 8  $\phi$  BAR : ASTM A36 OR IS:2062 E250 SUB QUALITY BR/BO.
3. DESIGN IS VALID FOR A UDL OF 500kg/m<sup>2</sup> WITH A MAXIMUM DEFLECTION RESTRICTION OF L/200.
4. THE GRATING SPANS SHALL NOT EXCEED 1200mm. GRATING SPAN DIRECTIONS SHALL BE AS SHOWN IN THE DESIGN DRAWINGS.
5. IN CASE OF PANELS WITH CUT-OUTS, ADEQUATE WORKING LOAD CAPACITY SHALL BE ENSURED BY PROVISION OF ADDITIONAL SUPPORTING MEMBERS, AS REQUIRED.
6. THE GRATING SHALL BE HOT DIP GALVANISED. THE WEIGHT OF ZINC COATING SHALL BE AVERAGE 915 gms PER SQUARE METRE (3 OUNCES PER SQUARE FOOT) AND NO SPECIMEN SHALL SHOW LESS 710 gms (2.5 OUNCES PER SQUARE FOOT). IN CASE OF CONFLICT WITH JOB SPECIFICATIONS FOR PROTECTIVE COATING, THE MORE STRINGENT REQUIREMENTS SHALL APPLY.
7. GRATING SHALL BE CONTINUOUSLY WELDED TO SUPPORT MEMBERS, WELDED AREAS SHALL BE TOUCH-UP PAINTED.
8. WALKWAY & STAIRS GRATINGS SHALL NOT HAVE OBSTRUCTIONS/PIPING PENETRATION.
9. FOR ELECTRO FORGED GRATING EVERY FIFTH MEMBER SHALL BE WELDED TO THE END FLAT FROM (ONE SIDE). HOWEVER, THE END MAIN MEMBER SHALL ALWAYS BE WELDED TO THE FLATS.

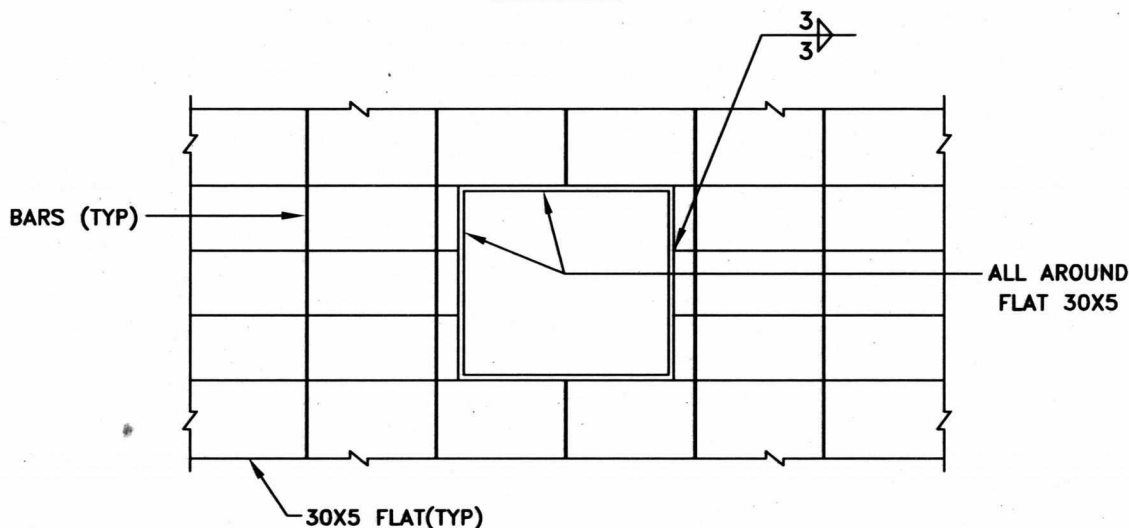
4	22.03.23	REVISED & RE-ISSUED AS STANDARD				
3	23.03.18	REVISED & RE-ISSUED AS STANDARD	AMARJIT SINGH	BHASKAR V.M	BHASKAR PAL	R.NANDA
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	



4	22.03.23	REVISED & RE-ISSUED AS STANDARD	RAJAN SINGH	CHARANJIT SINGH	BHASKAR PAL	SANJAY MAZUMDAR
3	23.03.18	REVISED & RE-ISSUED AS STANDARD	AMARJIT SINGH	BHASKAR V.M	BHASKAR PAL	R.NANDA
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						



CIRCULAR



SQUARE/RECTANGULAR

TYPICAL DETAIL AT OPENINGS





**NOTE:-**

THE DETAILS ARE VALID FOR OPENING SIZE NOT GREATER THAN 300mm.  
FOR DETAILS AT LARGER OPENINGS REFER RELEVANT STRUCTURAL DRAWING.

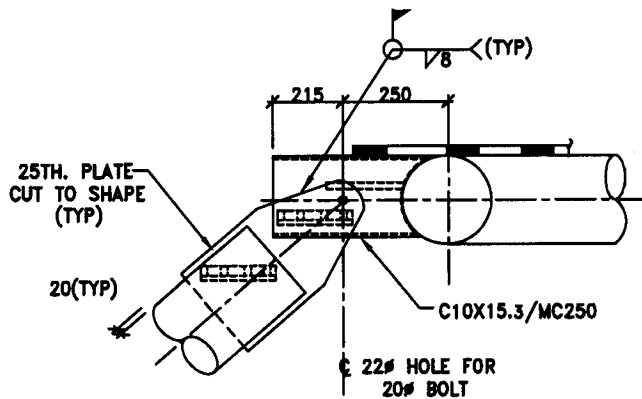
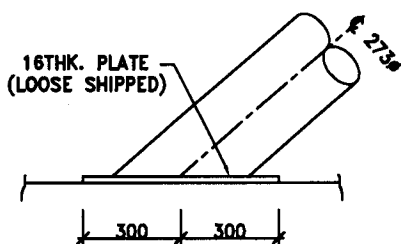
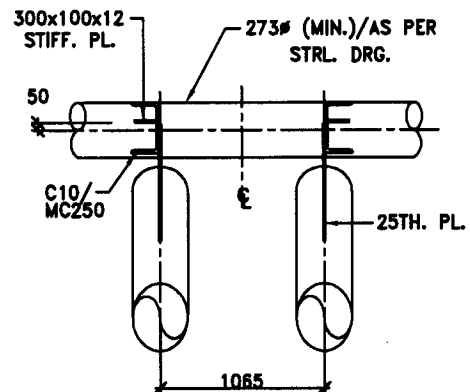
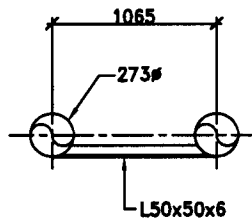
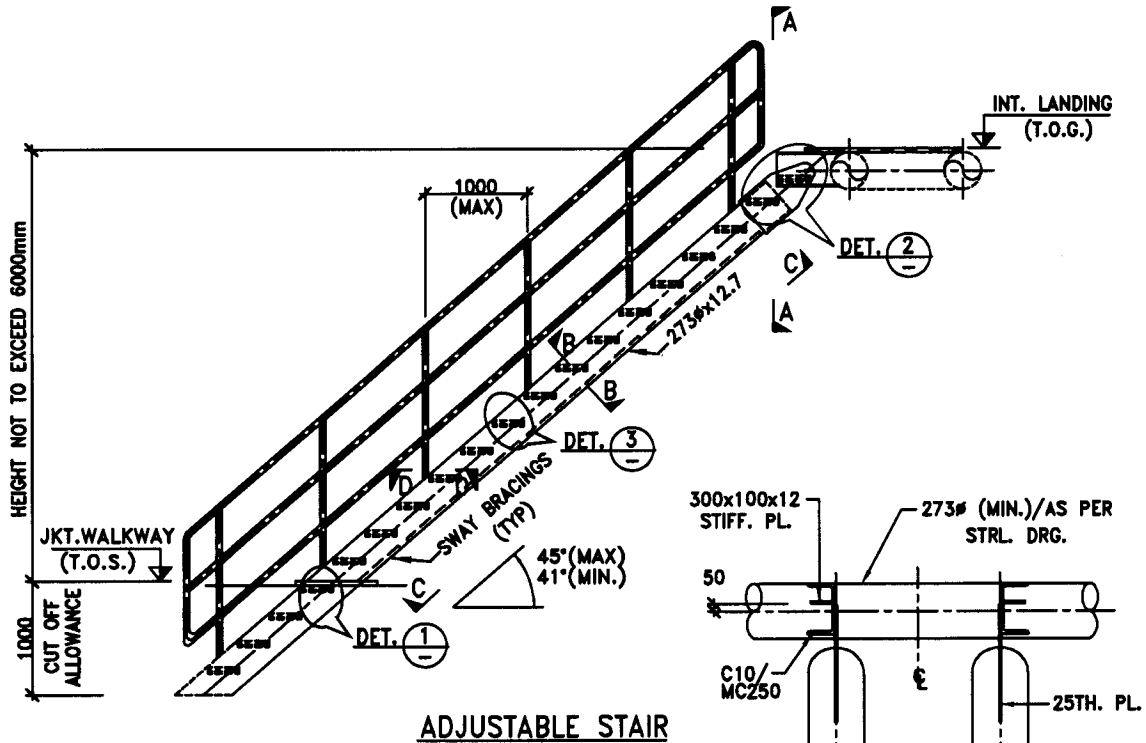
4	22.03.23	REVISED & RE-ISSUED AS STANDARD	RAJAN SINGH	CHARANJIT SINGH	BHASKAR PAL	SANJAY MAZUMDAR
3	23.03.18	REVISED & RE-ISSUED AS STANDARD	AMARJIT SINGH	BHASKAR V.M	BHASKAR PAL	R.MANDA
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						Copyrights EIL - All rights reserved

**NOTES:**

1. ALL HANDRAILS SHALL BE AS PER STD. NO. 7-60-0801
2. ALL GRATINGS SHALL BE AS PER STD. NO. 7-60-0802
3. NO SWAY BRACING SHALL BE PROVIDED IN THE ADJUSTABLE STAIR IN PORTION OF CUT-OFF ALLOWANCE.
4. SWAY BRACINGS SHALL BE PROVIDED FOR:-
  - a) ALL OFFSHORE INSTALLED STAIRS.
  - b) YARD INSTALLED STAIRS WHEN HEIGHT "H" EXCEEDS 3000mm
5. STAIR MATERIAL SHALL BE AS FOLLOWS:-
  - a) PIPES- API-5L GR. B OR EQUIVALENT.
  - b) ANGLES/CHANNELS/PLATES- IS:2062-GR 'BR'/ASTM A36 OR EQUIVALENT.
6. STAIR TREADS AND HANDRAIL SHALL BE HOT DIP GALVANISED. THE WEIGHT OF ZINC COATING SHALL BE AVERAGE 915 gms PER SQUARE METRE (3 OUNCES PER SQUARE FOOT) AND NO SPECIMEN SHALL SHOW LESS THAN 710 gms PER SQUARE METRE (2.33 OUNCES PER SQUARE FOOT). IN CASE OF CONFLICT WITH JOB SPECIFICATIONS FOR PROTECTIVE COATING, THE MORE STRINGENT REQUIREMENTS SHALL APPLY.
7. STAIR STRINGER AND SWAY BRACINGS SHALL BE PAINTED AS PER SPECIFICATION.
8. ALL WELDS SHALL BE FULL PENETRATION BUTT WELDS UNLESS NOTED OTHERWISE.
9. MINIMUM FILLET WELD SIZE SHALL BE 6 MM, UNLESS NOTED OTHERWISE.

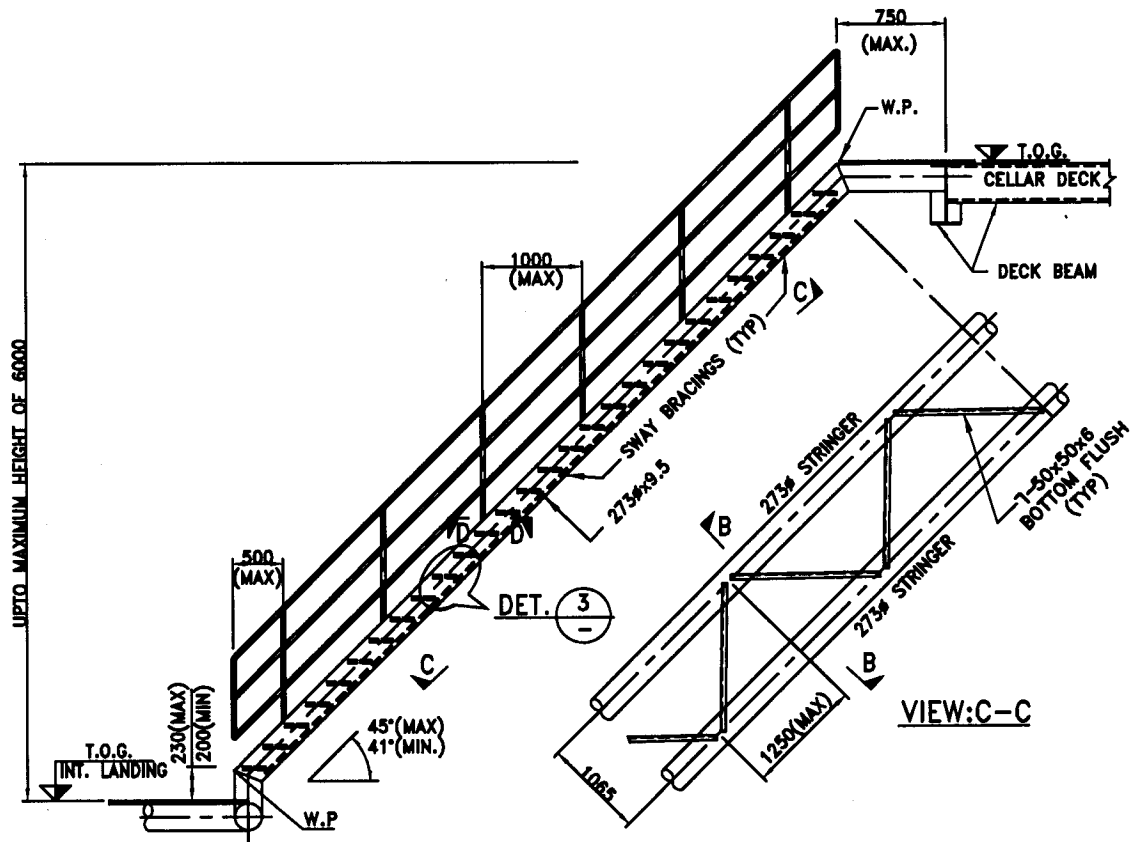
4	24.01.22	REVISED & RE-ISSUED AS STANDARD	 MUNISH GAUBA	 BHASKARA M	 BHASKAR PAL	 SANJAY MAZUMDAR
3	03.11.18	REVISED & RE-ISSUED AS STANDARD	AMARINDER SINGH	BHASKARA M	BHASKAR PAL	RAKESH NANDA
2	04.03.13	REVISED & RE-ISSUED AS STANDARD	AMARINDER SINGH	MATHEW SIMON	B.VIJAYA KUMAR	D. MALHOTRA
Rev. No.	Date	Purpose	Prepared by	Checked by	Sds. Committee Convenor	Sds. Bureau Chairman
					Approved by	



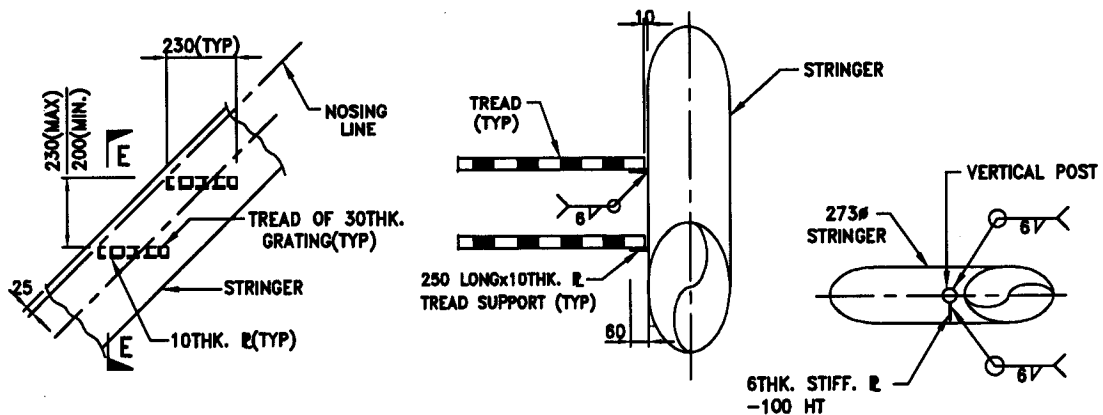


VIEW: C-C, VIEW: D-D & DETAIL-3 REFER STD. NO. 7-60-0803 SHT. 3 OF 4

4	24.01.22	REVISED & RE-ISSUED AS STANDARD	MUNISH GAUBA	BHASKARA M	BHASKAR PAL	SANJAY MAZUMDAR
3	03.11.16	REVISED & RE-ISSUED AS STANDARD	AMARBH SINGH	BHASKARA M	BHASKAR PAL	RAKESH NANDA
2	04.03.13	REVISED & RE-ISSUED AS STANDARD	AMARBH SINGH	MATHEW SIMON	B.Y. MAYA KUMAR	D. MALHOTRA
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
						Approved by



**STAIRS BETWEEN INTERMEDIATE LANDING & CELLAR DECK (TYPE-I)**



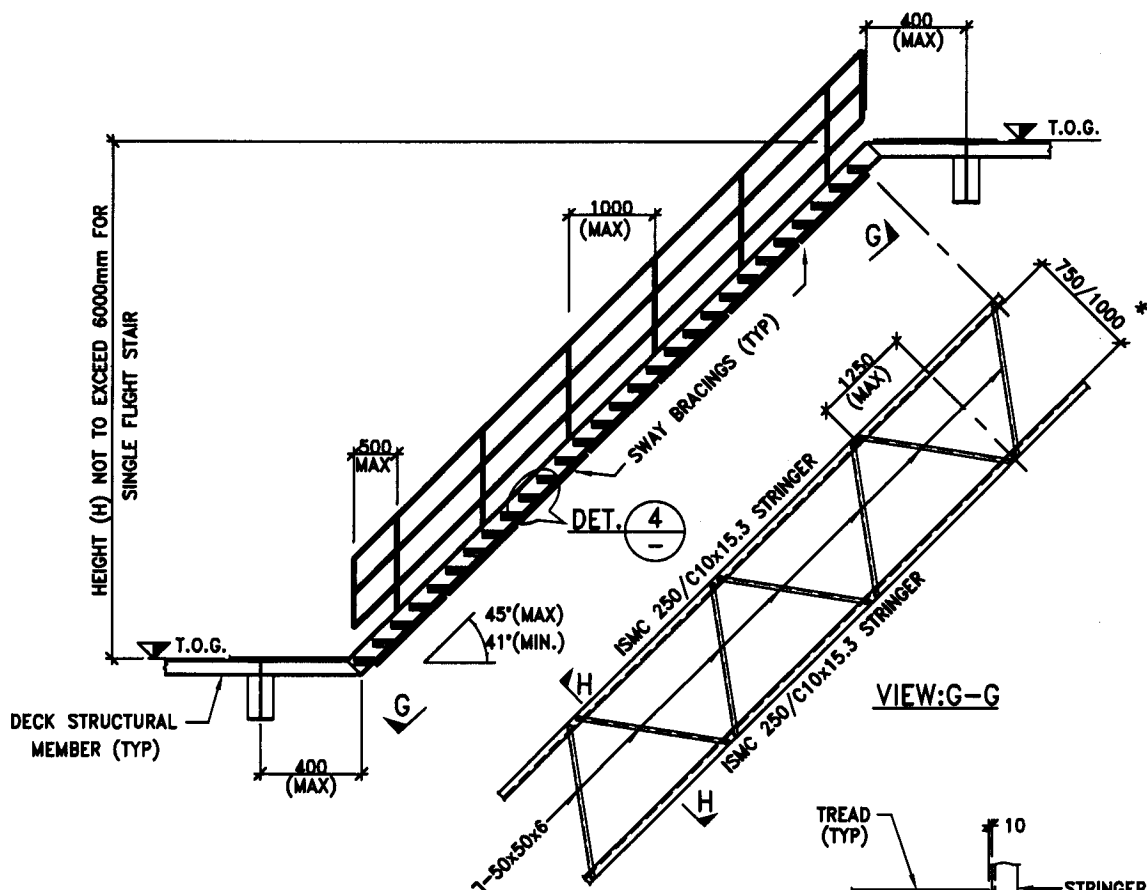
**DETAIL-3**

**SECTION: E-E**

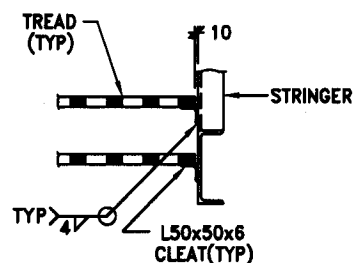
**SECTION: D-D  
(TYP. FOR ALL VERTICAL POSTS)**

FOR SEC.: B-B REFER STD. NO. 7-60-0803 SHT. 2 OF 4

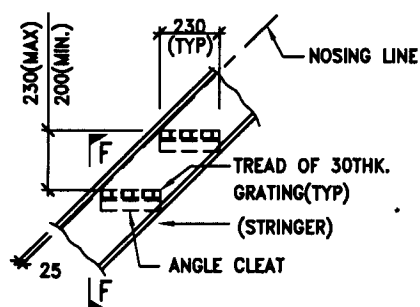
4	24.01.22	REVISED & RE-ISSUED AS STANDARD	MUNISH GAUBA	BHASKARA M	BHASKAR PAL	SAHJAY MAZUMDAR
3	03.11.16	REVISED & RE-ISSUED AS STANDARD	AMARBER SINGH	BHASKARA M	BHASKAR PAL	RAKESH NANDA
2	04.03.13	REVISED & RE-ISSUED AS STANDARD	AMARBER SINGH	MATHEW SIMON	B.VIJAYA KUMAR	D. MALHOTRA
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						



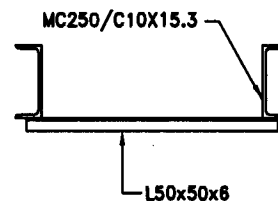
**STAIR ABOVE CELLAR DECK LEVEL (TYPE-II)**



**SECTION: F-F**



**DETAIL-4**

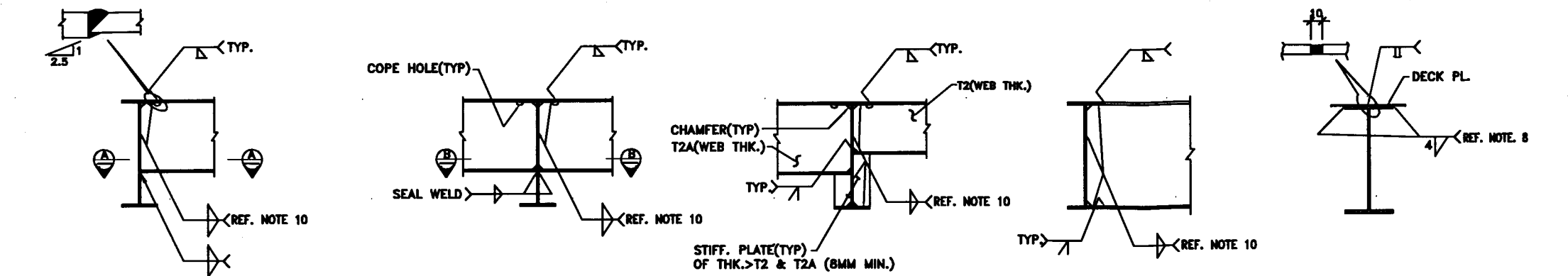


**SECTION: H-H**

\* 750 mm WIDTH SHALL BE PROVIDED FOR UNMANNED PLATFORMS  
AND 1000 mm WIDTH SHALL BE PROVIDED FOR MANNED PLATFORMS.

4	24.01.22	REVISED & RE-ISSUED AS STANDARD	MUNISH GAUBA	BHASKARA M	BHASKAR PAL	SAHJAY MAZUMDAR
3	03.11.16	REVISED & RE-ISSUED AS STANDARD	AMARNIR SINGH	BHASKARA M	BHASKAR PAL	RAKESH NANDA
2	04.03.13	REVISED & RE-ISSUED AS STANDARD	AMARNIR SINGH	MATHEW SIMON	B.VIJAYA KUMAR	D. MALHOTRA
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman





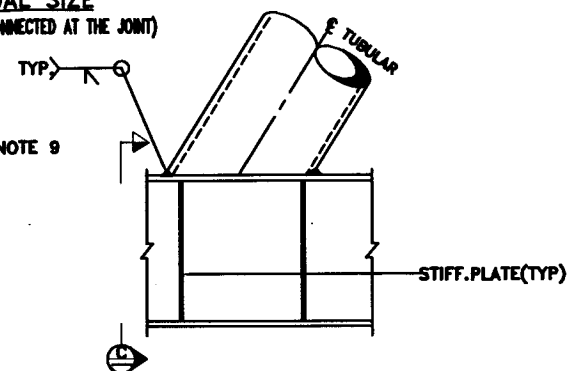
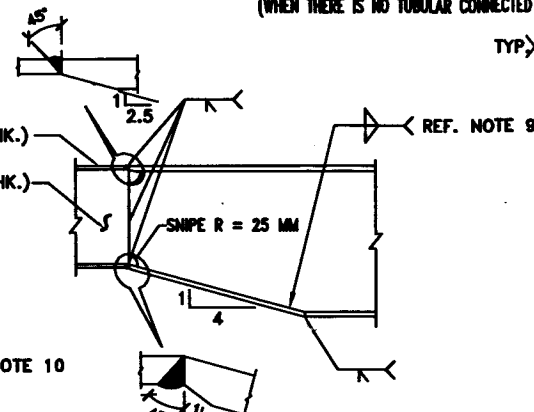
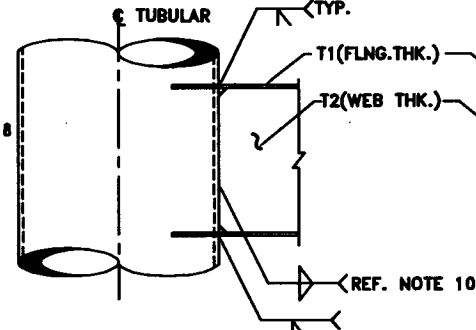
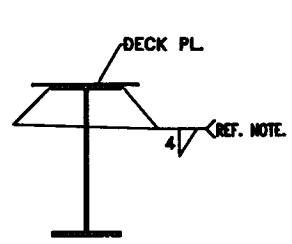
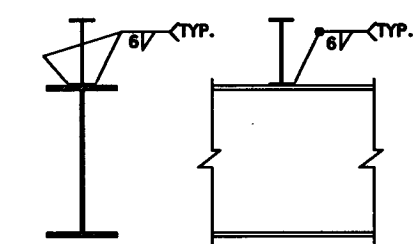
TYP. WELDING DETAIL AT END  
SUPPORTS OF SECONDARY BEAMS

TYP. WELDING DETAIL OF TWO  
EQUAL SECONDARY BEAMS

TYP. WELDING DETAIL OF  
UNEQUAL SECONDARY BEAMS

TYP. WELDING DETAIL OF  
BEAMS OF EQUAL SIZE  
(WHEN THERE IS NO TUBULAR CONNECTED AT THE JOINT)

TYP. WELDING DETAILS OF SECONDARY BEAM



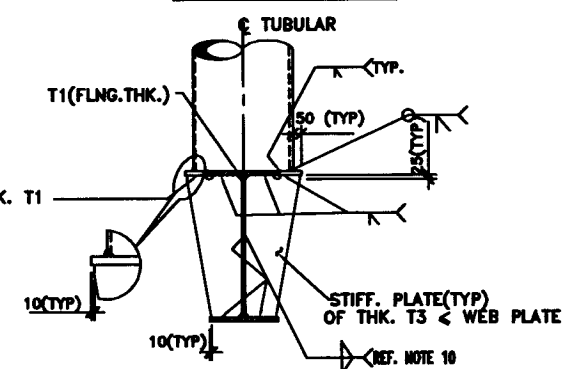
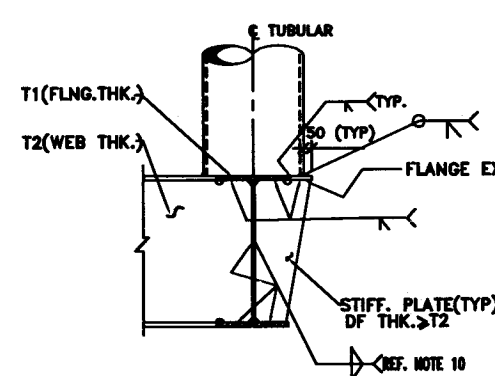
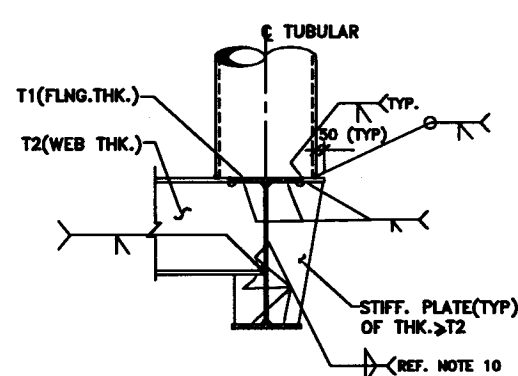
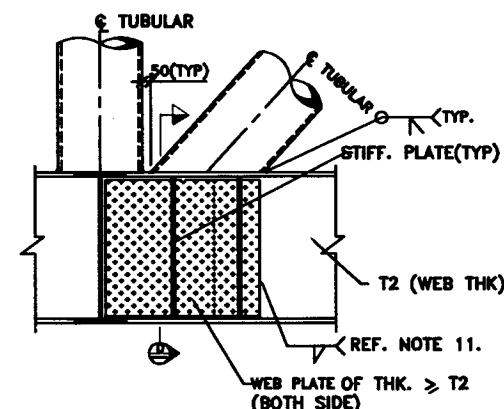
CONNECTION DETAIL OF  
SECONDARY BEAM TO MAIN BEAM

TYP. WELDING DETAIL OF  
DECK PLATE TO BEAM

TYP. WELDING DETAIL OF  
BEAM TO TUBULAR

TYP. WELDING DETAIL OF  
SPLICE FOR BEAMS OF VARYING DEPTH

TYP. WELDING DETAIL OF  
TUBULAR ON BEAM

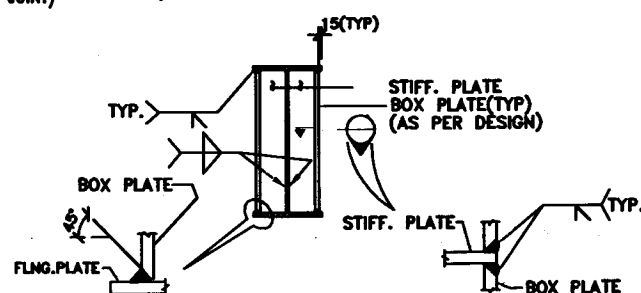
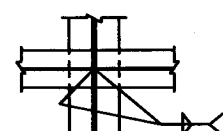
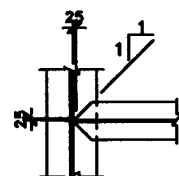
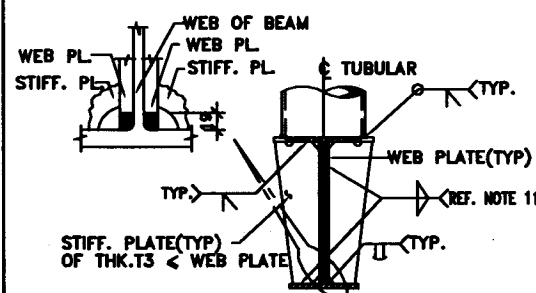


TYP. WELDING DETAIL OF WEB PLATE  
TO BEAM AND STIFFENER PLATE

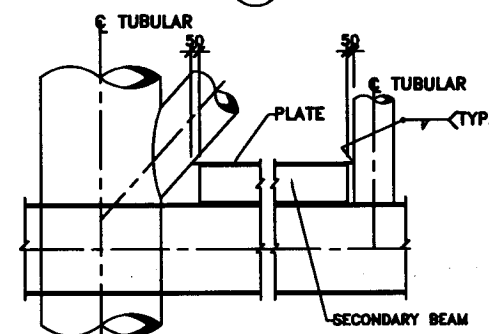
TYP. WELDING DETAIL OF  
BEAMS OF UNEQUAL SIZE  
(WHEN THERE IS TUBULAR CONNECTED AT THE JOINT)

TYP. WELDING DETAIL OF  
BEAMS OF EQUAL SIZE  
(WHEN THERE IS TUBULAR CONNECTED AT THE JOINT)

SECTION C



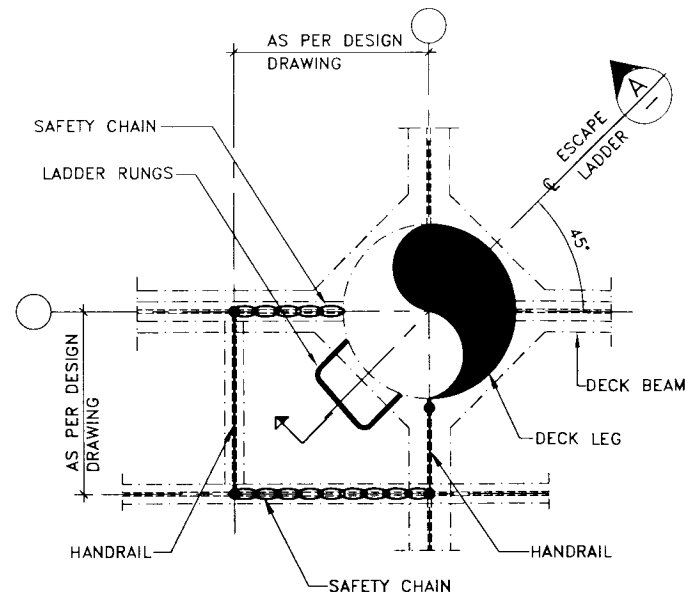
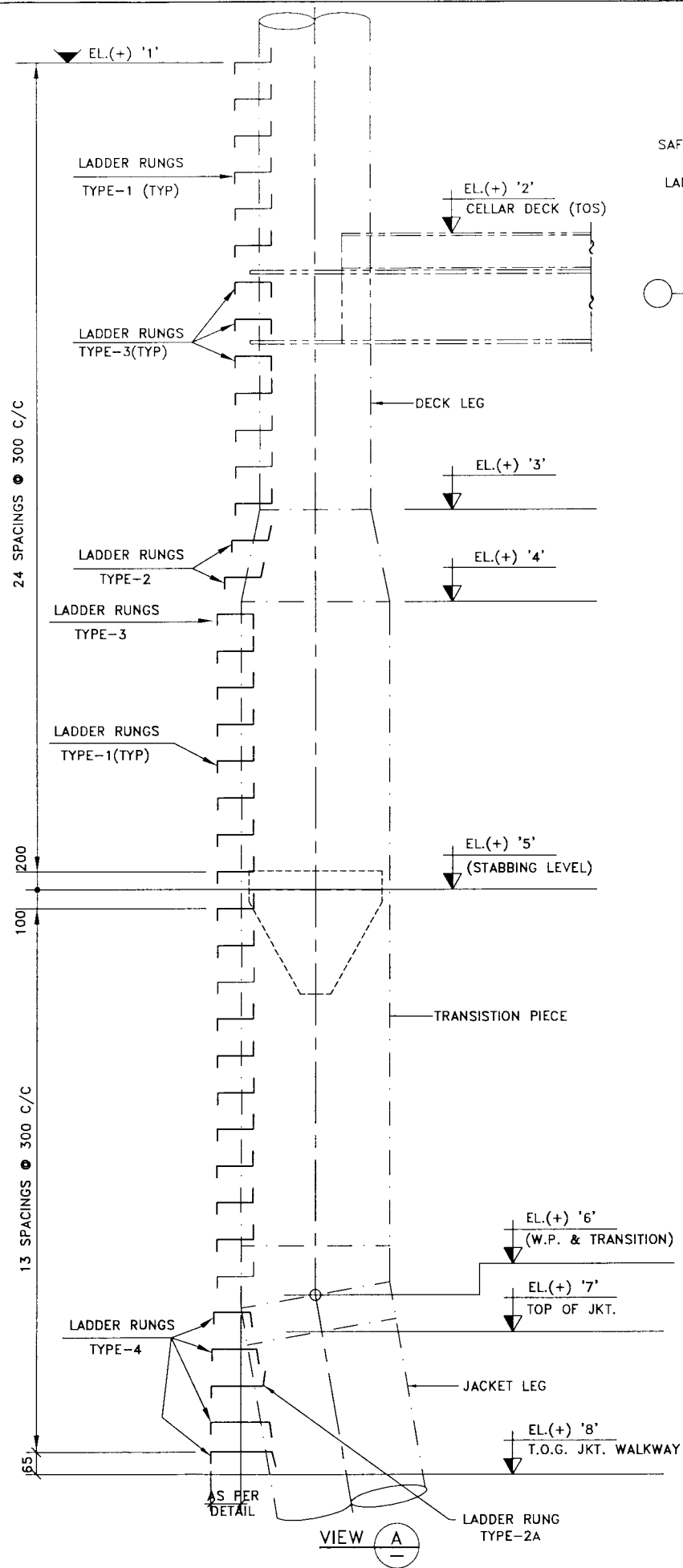
TYP. WELDING DETAIL OF  
BOX PLATE TO BEAM



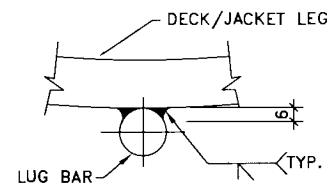
TYPICAL SECONDARY BEAM TERMINATION DETAIL

## टिप्पणियाँ: NOTES :

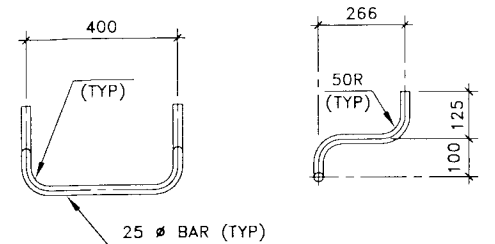
- FOR GENERAL NOTES REFER STD. NO. 7-60-0805
- ALL WELDING DETAILS TO COMPLY WITH AWS D.1.1 LATEST EDITION, API-RP-2A AND APPROVED WELDING PROCEDURE. ALL FPW SHALL BE BACK GOUGED AND BACK WELDED.
- FOR TUBULAR TO TUBULAR CONNECTION REFER STD. NO. 7-60-0806.
- UNLESS NOTED OTHERWISE, THE FOLLOWING CONNECTIONS SHALL BE OF FULL PENETRATION WELDS AND WELDED ALLROUND :
  - ALL BEAMS AND PIPE SPLICES
  - ALL BEAM FLANGE EXTENSIONS
  - ALL TUBULAR CONNECTIONS
  - ALL TRUSS MEMBER CONNECTIONS (TUBULAR TO BEAM)
- MINIMUM SIZE OF FILLET WELDS SHALL BE 6 MM UNLESS OTHERWISE SHOWN ON THE DESIGN DRAWINGS. ( ONLY SEAL WELD SHALL BE OF MIN. 4 MM. )
- WELD DETAILS DESCRIBED IN THIS DRAWING ARE APPLICABLE UNLESS EXPLICITLY NOTED OTHERWISE ON THE DESIGN DRAWINGS.
- COPE HOLES/CHAMFERS/SNIPES SHALL BE USED TO ALLOW CONTINUITY OF FULL PENETRATION BUTT WELDS DEPENDING ON FABRICATION REQUIREMENT.
- CONTINUOUS SEAL WELDING (4 MM.) SHALL BE APPLIED BETWEEN DECK PLATING AND SECONDARY BEAMS.
- THE CHOICE OF SINGLE/DOUBLE GROOVE AND WELD POSITION CAN VARY DEPENDING ON WELDING SEQUENCE IT SHALL CONFIRM TO THE WELDING PROCEDURE AND A.W.S D.1.1
- THE DOUBLE FILLET WELD CONNECTING
  - WEB OF BEAM TO WEB OF BEAM
  - WEB OF BEAM TO TUBULAR
  - STIFFENER TO WEB
  - STIFFENER TO NON LOAD BEARING FLANGE
 SHALL BE OF SIZE 0.7XCONNECTING ELEMENT SIZE OR 6 MM WHICHEVER IS HIGHER.
- THE FILLET WELD CONNECTING THE WEB PLATE TO THE BEAM AND STIFFENER PLATE WITH WEB PLATE SHALL BE OF SIZE EQUAL TO 0.7 TIMES THE WEB PLATE THICKNESS DR STIFFENER PLATE THICKNESS RESPECTIVELY SUBJECT TO A MINIMUM OF 6MM.



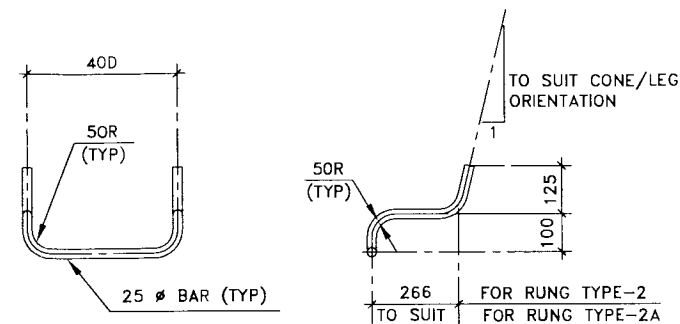
PART PLAN AT CELLAR DECK  
ESCAPE LADDER



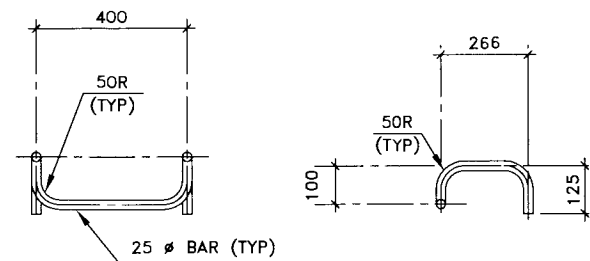
TYPICAL WELD DETAIL FOR  
RUNG WITH PLTFORM LEG



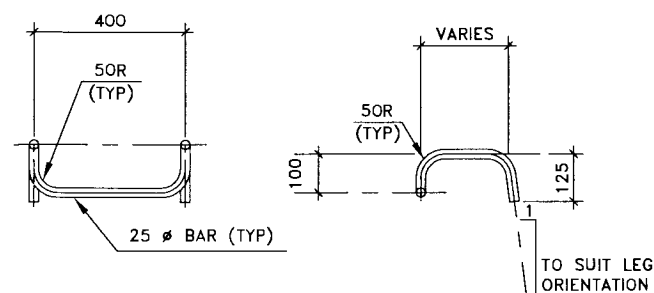
FRONT VIEW SIDE VIEW  
LADDER RUNGS DETAIL TYPE - 1



FRONT VIEW SIDE VIEW  
LADDER RUNGS DETAIL TYPE - 2 & 2A



FRONT VIEW SIDE VIEW  
LADDER RUNGS DETAIL TYPE - 3



FRONT VIEW SIDE VIEW  
LADDER RUNGS DETAIL TYPE - 4

NOTES:-

- 1 ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METERS.
- 2 THE LEVELS 1 TO 8 MARKED IN THE DRAWING SHALL BE AS PER DESIGN DRAWING.
- 3 FOR DETAILS OF HANDRAIL AND SAFETY CHAIN REFER EIL STANDARD NO. 7-60-0801.
- 4 FOR GENERAL NOTES REFER EIL STANDARD NO. 7-60-0805.
- 5 FOR WELDING DETAILS REFER EIL STANDARD NO. 7-60-0807.

2	30.03.19	REAFFIRMED AND RE-ISSUED AS STANDARD	ABS	CS	BP	RKT
1	18.11.13	REAFFIRMED AND RE-ISSUED AS STANDARD	ABS	BP	BVK	SC
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	