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B	08-11-2019	Issued for Design	SUR	KRK	JP/KC	JMC
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1. Introduction

INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29th August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

2. Definitions & Abbreviations

Abbreviation	Definition /Expanded form
IOCL/ CLIENT	Indian Oil Corporation Limited
PMC/ CONSULTANT	Technip India Limited
LICENSOR	Party selected by IOCL for process technology ownership for any UNIT
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
EPCM	Engineering, Procurement & Construction Management Services.
LSTK	Lump Sum Turn Key portion of the work to be executed by CONTRACTOR
FEED	Front End Engineering Design
AUTHORISED REPRESENTATIVE	IOCL's/ CONSULTANT's representative authorized to act for and on behalf of them.
VENDOR	Any third party supplying the equipment/materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
SITE	Indicates Paradip Refinery in Odisha, India
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related
SRU	Sulphur Recovery Unit
BIS	Bureau of Indian Standards

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3. General

Fabrication, erection and approval of steel structures shall be in compliance with:

- 1) These general specifications and IS 800:2007
- 2) Fabrication drawings shall be prepared by CONTRACTOR based on approved "Issued for Construction" design drawings and standard drawings.

The CONTRACTOR shall prepare the shop fabrication drawings and submit to OWNER/ENGINEER IN CHARGE for approval:

- 1) List of drawings that will be prepared by the CONTRACTOR.
- 2) Schedule of rates given in this document



This JSS covers typical General specification for some standard items only and the CONTRACTOR shall comply with the requirement as given in 080557C-000-JSD-1700-001/002 for specific cases and for any other items not mentioned/specified in this JSS. The requirement for various type of Buildings /Unit / Structures etc., as specified in the document 080557C-000-JSD-1700-001/002 shall be the governing one.

The CONTRACTOR shall submit the detailed specification for the items not covered in this specification for Approval by OWNER'S/ENGINEER IN CHARGE during execution.

3.1. Codes

The workmanship, fabrication and materials provided to this specification shall comply in construction and perform with the requirements of statutory authorities having jurisdiction over-all or part of the works, together with relevant requirements of the current issues of the following specifications and standards unless specified otherwise elsewhere within this specification.

- ◆ IS: 800 Code of Practice for General Construction in Steel.
- ◆ IS: 806 Code of Practice for use of Steel tubes in general building construction
- ◆ IS: 812 Glossary of Terms Relating to Welding and Cutting of Metal.
- ◆ IS: 813 Scheme of Symbol for Welding
- ◆ IS: 814 Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Manganese Steel.
- ◆ IS: 816 Code of Practice for Use of Metal Arc Welding for General Construction in Mild steel.
- ◆ IS: 817 Code of Practice for Training and Testing of Metal Arc Welders.
- ◆ IS: 818 Code of Practice for safety and health requirements in electric and gas welding and cutting operations.
- ◆ IS: 822 Code of Practice for Inspection of Welds.
- ◆ IS: 1278 Filler Rods and Wires for Gas Welding.
- ◆ IS: 1363 Hexagonal Bolts, Screws and Nuts of Product Grade-C.

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- ◆ IS: 1364 Hexagonal Bolts, Screws and Nuts of Product Grade A & B.
- ◆ IS: 1367 Technical Supply Conditions of Threaded Steel Fasteners.
- ◆ IS: 1393 Code of Practice for Training and Testing of Oxy-acetylene Welders.
- ◆ IS: 1477 Code of Practice for Painting of Ferrous Metals in Buildings.
- ◆ IS: 1852 Rolling and cutting tolerances for hot rolled steel products.
- ◆ IS: 2016 Plain Washers
- ◆ IS: 2629 Recommended practice for Hot Dip Galvanizing on Iron & steel.
- ◆ IS: 2062 Steel for General Structural Purposes.
- ◆ IS: 3502 Steel Chequered Plates.
- ◆ IS: 3640 Hexagon fit bolts.
- ◆ IS: 3757 High strength structural bolts.
- ◆ IS: 4000 High strength structural bolts in steel structures - Code of Practice.
- ◆ IS: 5369 General Requirements of Plain Washers and Lock Washers.
- ◆ IS: 6419 Welding Rods and Bare Electrodes for Gas Shielded Arc Welding of Structural Steel.
- ◆ IS: 7025 Safety Code for Erection of Structural Steel Works.
- ◆ IS: 7215 Tolerances for Fabrication of Steel Structures.
- ◆ IS: 7307 Approval Test for Welders Working to Welding to Approved Welding Procedures.
- ◆ IS: 6610 Heavy Washers for Steel Structures.
- ◆ IS: 6623 High Strength Structural Nuts.
- ◆ IS: 8172 Vertical Steel ladder.
- ◆ IS: 3138 Specification for hexagonal bolts and nuts (M42 to M150).

In case of conflict between the clauses mentioned here and the Indian Standards, those expressed in this specification shall govern. Any special provision as shown or noted on the design drawings shall govern over the provisions of this specification.

4. Scope

This specification covers the requirements for materials, storage, preparation of fabrication drawings, fabrication, assembly, tests/examination, transportation, erection and painting of all types of bolted and/or welded structural steel works for general construction works. Fabrication of structures shall also include fabricating,

- 1) Built-up sections/plate girders made from rolled sections and/or plate.
- 2) Compound sections made out of rolled sections.

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5. Fabrication Drawings

Fabrication and erection drawings shall be prepared by the CONTRACTOR in AutoCAD/Any other software on the basis of latest "Approved for Construction" design drawings and standard drawings issued to CONTRACTOR.

Fabrication and erection drawings shall be thoroughly checked, stamped "Approved for Construction" and signed by the CONTRACTOR's own responsible engineer, to ensure the accuracy and correctness of the drawing. The CONTRACTOR shall proceed with the fabrication and erection work only after thoroughly satisfying himself in this regard.

All fabrication and erection drawings shall be Issued for Construction by the CONTRACTOR directly to his work-site. Six copies of such drawings shall be simultaneously submitted to OWNER/ENGINEER-IN-CHARGE who may review at his option some, all or none of such drawings at his sole discretion and offer his comments for incorporation in these drawings by CONTRACTOR.

However, the CONTRACTOR shall not proceed with the fabrication of such structures whose fabrication drawings are required to be reviewed before taking up the fabrication work as noted on "Approved for Construction" design drawings issued to CONTRACTOR or as conveyed by OWNER/ENGINEER-IN-CHARGE. The fabrication of such structures shall be done only as per the reviewed fabrication drawings.

Wherever such reviews are carried out the same shall be restricted to the following:



- 1) Structural layout, orientation and elevation of structures and members.
- 2) Size of members.
- 3) Critical connections and joints details.

In those cases where OWNER/ENGINEER-IN-CHARGE carries out either full or partial review, one copy of drawing submitted by the CONTRACTOR shall be returned to him and CONTRACTOR shall incorporate the amendments and submit further three copies of amended drawings for final review. In those cases where OWNER/ENGINEER-IN-CHARGE does not review the drawings, OWNER/ENGINEER-IN-CHARGE shall return one copy of drawings, stamped "Not reviewed, proceed at CONTRACTOR's responsibility" to the CONTRACTOR for further action.

Schedule for review of fabrication drawings to be worked out mutually.

Fabrication drawings shall be drawn to scale and shall include the following:

- 1) Reference to the Design Drawing No.
- 2) Structural layout, elevations and sections (with distinct erection marking of all members)
- 3) Framing plans, Sizes of structural members, orientation and elevations
- 4) Connections and joints marking
- 5) Design and detailing of structural joints for required strength and erection

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- 6) Type and dimension of welds and bolts
- 7) Shapes and sizes of edge preparation for welding
- 8) Details of shop and field joints included in the assembly
- 9) Bill of materials along with total weight for each marked member on the drawing itself.
- 10) Quality of structural steel, welding electrodes, bolts, nuts and washers to be used.
- 11) Erection assemblies identifying all transportable parts and sub-assemblies associated with special erection instructions, if required.
- 12) Method of erection and special precautions to be taken during erection as required.
- 13) Fire proofing (dense / light weight)
- 14) Notes and Legends
- 15) Friction grip / Ordinary moment connections
- 16) Grating bearing bar directions
- 17) Floor drain and safety shower pan
- 18) Sheetting, cladding, louvers, turbo ventilators, rain water downspout, gutter and penetration details

The CONTRACTOR shall additionally ensure accuracy of the following and shall be solely responsible for the same.

- 1) Provision for erection and erection clearances
- 2) Marking of members
- 3) Cut length of members
- 4) Matching of holes and joints
- 5) Provision kept in the members for other interconnected members
- 6) BOM

Review by OWNER/ENGINEER-IN-CHARGE fully / partially or non-review of fabrication drawings submitted by CONTRACTOR shall not absolve the CONTRACTOR of his responsibility and he shall modify / rectify the structures at any stage of work when pointed out by OWNER/ENGINEER-IN-CHARGE that such work is not in conformity with specification and / or standard practice without any extra cost to OWNER.

Connections, splices etc. other details not specifically detailed in design drawings shall be suitably given on fabrication drawings considering normal detailing practices and developing full member strengths. Design calculations for such connections shall be submitted to OWNER/ENGINEER-IN-CHARGE for approval along with the fabrication drawings.

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Any alternate design or change in section shall be allowed only when prior approval is obtained in writing from the OWNER/ENGINEER-IN-CHARGE. Fabrication and erection drawings shall be updated incorporating all such changes by CONTRACTOR at no extra cost to OWNER.

In case during execution of work, the OWNER/ENGINEER-IN-CHARGE on review of drawings considers any modifications/substitutions necessary to meet the design parameters / good engineering practice, these shall be brought to the notice of CONTRACTOR who shall incorporate the same in the drawings and works without any extra cost to OWNER. The CONTRACTOR will be totally responsible for the correctness of the detailed fabrication drawings and execution of work.

CONTRACTOR shall incorporate all the revisions made in the design drawings during the course of execution of work in his fabrication drawings and resubmit the drawings at no extra cost to OWNER. All fabrication shall be carried out only based on the latest AFC design drawings and corresponding fabrication drawings.

The CONTRACTOR shall supply two prints each of the final/ as-built drawings along with their transparencies to ENGINEER-IN-CHARGE for reference and records. The rate quoted shall include the same.

6. Materials

6.1. Rolled Sections, MS plates

All materials shall conform to their respective specification given in specification 080557C-000-JSS-1700-005.

6.2. Welding Material

Welding electrodes shall confirm to IS: 814.

Approval of welding procedures shall be as per IS: 823.



Welder's Performance Qualification Test shall be as per IS: 823.

6.3. Bolt, Nuts, Washers

Bolts and nuts shall be as per IS: 1367 and tested as per IS: 1608. It shall have a minimum tensile strength of 44 kg/mm² and minimum elongation of 23% on a gauge length of 5.65x□A. Where A is the original cross sectional area of the gauge length. Bolts shall be threaded in accordance with IS 4218. Washers shall be as per IS: 2016. Only Bolts & nuts for equipment erection shall be hot dip galvanised.

6.4. Non-Standard Materials

All materials shall conform to their respective specifications. The use of equivalent or higher grade or alternate materials will be considered only in special cases subject to the approval of the TP in writing. Any defective material used, pointed out at any stage of work, shall be replaced by CONTRACTOR at his own expense, care shall be taken to prevent any damage to the other portion of work during removal.

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Nuts, Bolts & Washers fixing equipment to structures, as well as those required for joints shall be deemed to be included in the rates of structural steel.

6.5. Receipt and Storing of Materials

Each section shall be marked for identification and each lot should be accompanied by manufacturer's quality certificate, conforming chemical analysis and mechanical characteristics.

All sections shall be checked, sorted out, straightened, and arranged by grades and qualities in stores. Any instruction given by ENGINEER-IN-CHARGE in this respect shall be strictly followed.

Structural steel with surface defects such as pitting, cracks, laminations etc. shall be rejected if the defects exceed the allowable tolerances specified in relevant standards. All such rejected material shall be immediately removed from store/site. The decision of ENGINEER-IN-CHARGE in this regard shall be final and binding.

Welding wire and electrodes shall be stored separately by quality (packed in their original cartons) and lots inside a dry and enclosed room in compliance with IS: 9595 and as per instructions given by ENGINEER-IN-CHARGE. Electrodes shall be kept perfectly dry to ensure satisfactory operation and weld metal soundness.

Checking of quality of bolts of any kind as well as storage of same shall be made conforming to relevant standards.

Manufacturer's quality/test certificates shall accompany each lot of electrodes, bolts, nuts etc.

All bolts (including nuts and washer) shall be checked, sorted out and arranged diameter-wise by grade and quality in store.

6.6. Material Tests



CONTRACTOR shall submit manufacturer's quality certificate for the material supplied. Wherever quality certificates are missing or incomplete or when material quality differs from standard specifications, the CONTRACTOR shall conduct all appropriate tests as directed by ENGINEER-IN-CHARGE, at no extra cost, in approved test houses and submit to ENGINEER-IN-CHARGE for his approval.

Materials for which test certificates are not available or for which results do not tally with relevant standard specification, shall not be used and shall be removed from stores/site.

7. Fabrication of Steelworks

Fabrication shall be in accordance with IS 800:2007 Section 17. Fabrication shall be done as per "Approved for Construction" fabrication drawings adhering strictly to work points and work lines on the same. The connections shall be welded or bolted as per design drawings. Work shall also include fabricating built up sections.

Prior to commencement of structural fabrication, undulations in the fabrication yard, if any shall be removed

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and area levelled and paved by CONTRACTOR.

Any defective materials used shall be replaced by CONTRACTOR at his own expense, care being taken to prevent any damage to the structure during removal.

Any faulty fabrication pointed out at any stage of work by the ENGINEER-IN-CHARGE, shall be made good or replaced by the CONTRACTOR at his own cost.

Tolerance for fabrication of steel structures shall be as per IS: 7215

7.1. Preparation Materials

All materials shall be straight and if necessary, before being worked shall be straightened and/or flattened and shall be free from twists.

Bending of rolled sections and plates shall be done by cold process to shape as shown on the drawings.

Warped members like plates and flats may be used as such only if wave like deformation does not exceed $L/1000$ but limited to 10mm (L = Length).

Surfaces of members that are to be joined by lap or fillet welding or bolting shall be even so that there is no gap between overlapping surfaces.

7.2. Marking

All members shall be properly marked showing the requisite cut length, width, connection provision, e.g. location and dimension of holes, weld, cleats etc. Marking for cutting shall be done judiciously so as to avoid wastages or unnecessary joints as far as practicable.

Marking of members shall be made on horizontal pads, or on appropriate racks or supports in order to ensure horizontal and straight placement of such members.

Each structural component shall refer to the relevant vendor drawing.

Marking accuracy shall be at least $\pm 1\text{mm}$.

7.3. Cutting

Members shall be cut mechanically (by saw or shear) or by oxyacetylene flame.



All sharp, rough or broken edges and all edges of joints that are subjected to tensile or oscillating stresses shall be ground.

No electric metal arc cutting shall be allowed.

All edges cut by oxyacetylene process shall be cleaned of impurities and slag prior to assembly.

Cutting tolerances shall be as follows:

- 1) For members connected at both ends $\pm 1\text{mm}$.
- 2) Elsewhere $\pm 3\text{mm}$.

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The edge preparation for welding of members more than 12mm thick shall be done by flame cutting and grinding. Cut faces shall not have cracks or be rough.

Edge preparation shall be as per IS: 823.

7.4. Drilling

Bolt holes shall be drilled.

Drilling shall be made to the diameter specified in drawings.

No enlarging of holes by filling, man drilling or oxyacetylene flame shall be allowed.

Allowable variations for holes (out of roundness, eccentricity, plumb-line deviation) shall be as per IS 800:2007.

- 1) Maximum deviation for spacing of two holes on the same axis shall be ± 1 mm.
- 2) Two perpendicular diameters of any oval hole shall not differ by more than 1mm.

Drilling faults in holes may be rectified by reaming holes to the next upper diameter, provided that spacing of new hole centers and distance of hole centers to the edges of members are not less than allowed and that the increases of hole diameter does not impair the structural strength. Hole reaming shall be allowed if the numbers of faulty holes does not exceed 15% of the total number of holes for one joint.

7.5. Bending

Bending of plates, flats and sections shall be carried out on bending rolls or in presses.

Cold bending may be accepted when bending radius is equal or more than:

- 1) 25 times member thickness for plates and flats.
- 2) 25h or 25b for rolled steel beams and channels according to bending plate.
- 3) 45b for angle.

Where,

h = section height and



b = flange width.

When bending radius is less bending shall be done on hot metal by heating the member up to 850-900oC light red radiance. Cooling shall be done slowly as directed by OWNER/ENGINEER-IN-CHARGE.

Bending shall be discontinued when temperature drops below 500°C.

Accuracy of bending operations shall be checked by means of templates. The clearance between member and template shall not be more than 1mm.

Bent members shall not have cracks or deep indentations from bending equipment.

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7.6. Preparation of Members for Welding

Assembly of structural members shall be made with proper jigs fixtures to ensure correct positioning of members (angles, axes, nodes etc.)

Sharp edges, rust of cut edges, notches, irregularities and fissures due to faulty cutting shall be chipped or ground or filed over the length of the affected area, deep enough to remove faults completely.

Edge preparation for welding shall be carefully and accurately made so as to facilitate a good joint.

Generally, no special edge preparation shall be required for members under 8mm thick.

Edge preparation (beveling) denotes cutting of the same so as to result in V, X, K or U seam shapes as per IS - 823.

The members to be assembled shall be clean and dry on the welding edges, under no circumstances shall wet, greasy rust or dirt covered parts be assembled. Joints shall be kept free from any foreign matter, likely to get into the gaps between members to be welded.

Before assembly, the edges to be welded as well as adjacent areas extending for at least 20mm shall be cleaned (until metallic polish is achieved).

When assembling members, proper care shall be taken of welding shrinkage and distortions, as per the drawings and dimensions cover finished dimensions of the structure.

The elements shall be got checked and approved by the OWNER/ENGINEER-IN-CHARGE of his authorized representative before assembly.

The permissible tolerances for assembly of members preparatory to welding shall be as per IS: 823.

After the assembly has been checked, temporary tack welding in position shall be done by electric welding, keeping in view finished dimensions of the structure.

Preheating of members to be joined to be carried out as per standards wherever necessary.

7.7. Welding Procedure



Welding shall be carried out only fully trained and experienced welders as tested and approved by the OWNER/ENGINEER-IN-CHARGE or his representative or the inspectors shall constitute a right by them for such tests and the cost involved there on shall be borne by the CONTRACTOR himself.

Qualification tests for welders as well as tests for approval of electrodes will be carried out as per IS: 823. The nature of test for performance qualification of welders shall commensurate with the quality of welding required on this work as judged by OWNER/ENGINEER-IN-CHARGE.

The steel structures shall be automatically, semi - automatically or manually welded.

Welding shall begin only after the checks shown under 5.6 have been carried out.

Welding procedures and tests for welders shall be conducted as per IS: 823 and approved by the

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OWNER/ENGINEER-IN-CHARGE.

The welder shall mark with his identification mark on each element welded by him.

When welding is carried out in open air, steps shall be taken to protect the place of welding against wind or rain. The electrodes, wire and parts being welded shall be dry.

Before beginning the welding operation, each joint shall be checked to assure that the parts to be welded are clean and root gaps provided as per IS: 823.

For continuing the welding of seams discontinued due to some reason, the end of the discontinued seam shall be melted in order to obtain a good continuity. Before resuming the welding operation, the groove as well as the adjacent parts shall be well cleaned for a length of approximately 50mm.

For single butt welds (in V, 1/2V or U) and double butt welds (in K, double U, etc.) the re-welding of the root butt is mandatory but only after the metal deposition on the root has been cleaned by back gouging or chipping.

The welding seams shall be left to cool slowly. The CONTRACTOR shall not be allowed to cool the welds quickly by any method.

For multi-layer welding before welding the following layer, the formally welded layer shall be cleaned metal bright by light chipping and wire brushing. Backing strips shall not be allowed.

The order and method of welding shall be so that:

- 1) No unacceptable deformation appears in the welded parts.
- 2) Due margin is provided to compensate for contraction due to welding in order to avoid any high permanent stresses.

The defects in welds must be rectified according to IS: 823 and as per instruction of OWNER/ENGINEER-IN-CHARGE.

7.8. Weld Inspection



7.8.1. The weld seams shall satisfy the following:

- 1) Shall correspond to design shapes and dimensions.
- 2) Shall not have any defects such as cracks, incomplete penetration and fusion, under-cuts, rough surfaces, burns, blowholes and porosity etc. beyond permissible limits.

During the welding operation and approval of finished elements, inspections and tests shall be made.

The mechanical characteristics of the welded joints shall be as in IS: 823.

The following inspection methods shall be carried out,

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- 1) Visual inspection
- 2) Mechanical test
- 3) Magnetic particle / dye penetration / ultrasonic examination
- 4) Radiographic examination

7.9. Preparation of Members for Bolting

The members shall be assembled for bolting with proper jigs and fixtures to sustain the assemblies without deformation and bending.

Before assembly all sharp edges, shaving, rust, dirt etc. shall be removed.

Before assembly, the contacting surfaces of the members shall be cleaned and given a coat of primer as per IS: 2074.

The member which is bolt assembled shall be set according to drawings and temporarily fastened with erection bolts (minimum 4 pieces) to check the co axiality of the holes.

The member shall be finally bolted after the deviations have been corrected, after which there shall not be gaps.

Before assembly, the member shall be checked and got approved by the OWNER/ENGINEER-IN-CHARGE.

The difference in thickness of the sections that are butt assembled shall not be more than 3% or maximum 0.8mm whichever is less. If the difference is large it shall be corrected by grinding or filing. Reaming of holes to final diameter or cleaning of these shall be done only after the parts have been check assembled.

As each hole is finished to final dimensions (reamed if necessary) it shall be set and bolted up. Erection bolts shall not be removed before other bolts are set.

7.10. Bolting Up

Final bolting of the members shall be done after the defects have been rectified and approval of joints obtained.



The bolts shall be tightened starting from the center of the joints towards the edge.

7.11. Planing of Ends

Planing of ends of members like column ends shall be done by grinding when so specified in the design. Planing of butt-welded members shall be done after these have been assembled and the sharp edges shall be removed with grinding machine or files.

The following tolerances shall be permitted on members that have been planned.

- 1) On the length of the member having ends planed, maximum $\pm 2\text{mm}$ with respect to design.
- 2) Level differences of planed surfaces, maximum 0.3mm.

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3) Deviation between planed surface and member's axis, maximum 1/1500.

7.12. Holes of Field Joints

Holes for field joints shall be drilled in the shop to final diameters and tested in the shop, with trial assemblies. Gas cutting of holes shall not be permitted.

When three-dimensional assembly is not possible in the shop, the holes for field joints may be drilled in shop and reamed on site after erection, on approval by OWNER/ENGINEER-IN-CHARGE.

For bolted steel structures, trial assembly in shop is mandatory.

The tolerances for spacing of holes shall be ± 1 mm.

7.13. Tolerance

All tolerances regarding dimensions, geometrical shapes and sections of steel structures, shall be as mentioned above and specified in the drawing.

7.14. Marking for Identification

All elements and members prior to dispatch for erection shall be shop marked.

The members shall be visibly marked with punch type marking. The size and thickness of the numbers shall be chosen as to facilitate the identification of members.

For the small members that are delivered in bundles or crates, the required marking shall be done on small metal tags securely tied to the bundle, while the crates shall be marked directly.

Each bundle of crate shall be packed with members for one and the same assembly in the same bundle or crate general utility members such as bolts, gussets etc. may be packed.

All bills of materials showing weight, quantity and dimension of contents shall be placed in the crates.

The members shall be marked with punch type in a visible location, preferably at one end of the member so that these may be easily checked during storage and erection.

The members shall be marked in the shop before inspection and acceptance and shall have reference to the relevant vendor drawing.



When the member is being painted the marking area shall not be painted but bordered with white paint.

The marking and job symbol shall be registered in all shop delivery documents (transportation, for erection etc.)

7.15. Shop Test Pre-assembly

For steel structures that have the same type of welding, the shop test pre-assembly shall be performed on one out of every 10 member's minimum.

In case one member does not meet the limiting deviations specified in the general specification in pre-

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assembly shop test, all members shall be shop tested.

For bolted steel structures, shop test pre-assembly is mandatory for all elements as well as for the entire structure in conformity with clause 7.2.

8. Shop Inspection and Approval

8.1. General

The OWNER/ENGINEER-IN-CHARGE or his representative shall have free access at all reasonable times to the CONTRACTOR's fabrication shop and shall be afforded all reasonable facilities for satisfying himself that the fabrication is being undertaken in accordance with drawings and specifications.

Technical approval of the steel structure in the shop by the OWNER/ENGINEER-IN-CHARGE is mandatory.

The CONTRACTOR shall not limit the number and kinds of tests, final as well as intermediate ones, or extra tests requested by the OWNER/ENGINEER-IN-CHARGE.

The CONTRACTOR shall furnish necessary tool gauges, instrument etc. and technical and non-technical personnel for shop tests by OWNER/ENGINEER-IN-CHARGE at free of cost and shall be borne by the CONTRACTOR.

8.2. Shop Acceptance

The following approval may be given in shop:



- 1) Intermediate approvals of work that cannot be inspected later.
- 2) Partial approvals.
- 3) Final approvals.

Intermediate approvals of work shall be given when:

- 1) A part of work is performed later
- 2) Inspection would be difficult to perform and results not be satisfactory.
- 3) Cannot be inspected later.

Partial approval in the shop is given on members and assemblies of steel structures before the primer coat is applied and includes.

- 1) Approval of material
- 2) Approval of field joints
- 3) Approval of part for correct application of surface preparation
- 4) Test erection
- 5) Approval of members based on dimensional conformity and visual aspect of the material used.

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6) Approval of marking

7) Inspection and approvals of special features, like rollers, loading platform mechanism etc.

During the partial approval, intermediate approvals as well as former approvals shall be taken into consideration.

8.3. Final Approval in the Shop

The final approval refers to all elements and assemblies of the steel structures, with shop primer coat, ready for delivery from shop to be loaded for transportation or stored.

The final approval comprises of:

- 1) Partial approvals
- 2) Approval of shop primer coat
- 3) Approval of mode of loading and transport
- 4) Approval of storage (for material stored)

9. Packing, Transportation, Delivery

After final shop acceptance and marking, the item shall be packed and loaded for transportation.

Packing must be adequate to protect items against warping during loading and unloading.

Proper lifting devices shall be used for loading, in order to protect items against warping. Slender projecting parts shall be braced with additional steel bars before loading for protection against warping during transportation.

Loading and transportation shall be done in compliance with transportation rules.

If certain parts cannot be transported in the lengths stipulated in the design, the position and type of additional splice joints shall be approved by OWNER/ENGINEER-IN-CHARGE.



Items must be carefully loaded on platforms for transportation means to prevent warping, bending or falling, during transportation.

The small parts such as fin-plates, gussets etc. shall be securely tied with wire to their respective parts.

Bolts, nuts and washers shall be packed and transported in crates, marked in at least 2 places with water-resistant paint.

The parts shall be delivered in the order stipulated by the OWNER/ENGINEER-IN-CHARGE and shall be accompanied by documents showing:

- 1) Quality and quantity of structure of members.
- 2) Position of member in the structure.

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- 3) Particulars of structures.
- 4) Identification number/job symbol.

10. Field Erection

The CONTRACTOR shall satisfy himself about the level, alignment etc. for the foundations well in advance, before starting the erection. Minor chipping etc. shall be carried out by the CONTRACTOR at his expense.

Any faulty erection done as under by the CONTRACTOR shall be made good at his cost.

- 1) Accuracy in alignment of structures
- 2) Erection according to drawings and specifications
- 3) Progress and workmanship

In case there are many deviations regarding positions of foundations, or anchor bolts, which would lead to erection deviations, the OWNER/ENGINEER-IN-CHARGE shall be informed immediately. Minor rectifications in foundations, orientation of bolt's holes etc. shall be carried out as a part of the work, at no extra cost.

The various parts of the steel structure shall be so erected as to ensure stability against inherent weight, wind and erection stresses.

The structure shall be anchored and final erection joints completed after plan and elevation positions of the structural members have been verified with corresponding drawings and approved by OWNER/ENGINEER-IN-CHARGE.



The bolted joints shall be tightened so that the entire surface of the bolt heads and nuts shall rest on the member. For parts with sloping surfaces, tapered washers shall be used.

CONTRACTOR shall prepare the field erection procedures and obtain approval from OWNER/ENGINEER-IN-CHARGE prior to the commencement of field erection.

11. Final Acceptance and Handing Over of Structure

At acceptance, the CONTRACTOR shall submit the following documents:

- 1) Shop and erection drawings - either in tracings or reproducible and compatible Auto CAD drawings in soft copy.
- 2) 6 copies of each of the following:
 - a) Shop acceptance documents
 - b) Quality certificates for structural members, plates etc. (electrodes, welding wire, bolts, nuts, washers etc.)
 - c) List of certified welders who worked on erection of structure.

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d) Acceptance and intermediate control procedure of erection operations.

12. Anchor Bolts

12.1. Material

- 1) Material for Anchor Bolts shall be as per IS: 2062 Grade A unless otherwise specified.
- 2) Nuts and lock nuts (hexagonal type) shall be of Grade C as per IS 1367 and conform to IS 1363.
- 3) Washers shall be of mild steel conforming to IS 2016.
- 4) Pipe sleeves shall be of mild steel tubes (medium duty) conforming to IS 1239.
- 5) Anchor plates and ribs shall conform to IS 2062.

12.2. Fabrication

Fabrication of anchor bolts and their complete assemblies shall be strictly in compliance with the specifications and drawings. Anchor bolts shall have coarse type threads conforming to IS 4218.

12.3. Placement

Anchor bolt assemblies shall be placed in position strictly as per drawings and securely held during pouring and vibrating of concrete with necessary templates and other dummy structures to prevent their dislocation.

12.4. Tolerances

Tolerances allowed for anchor bolts positioning shall be:

- ♦ For sleeved bolts, one tenth of the bolt nominal diameter.
- ♦ For bolts without sleeves, one twentieth of the bolt nominal diameter.



12.5. Protection

The exposed surfaces of bolts shall be properly covered (after greasing of bolts and packing of sleeves) with jute cloth so as to protect them from damage.

12.6. Special Anchors

“HILTI” anchor (or equivalent) either chemical or expansion type may be used to fasten minor steel items to concrete works.

The utilization of post installed anchor bolts shall be always submitted to ENGINEER-IN-CHARGE for approval.

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13. M.S. Inserts/ Corner angles

13.1. Material

- 1) M.S. Inserts/ corner angles shall be of mild steel conforming to IS 2062.
- 2) Lugs shall be of mild steel conforming to IS 432 Grade – I.

13.2. Fabrication

M.S. Inserts/ corner angles shall be done strictly as per drawings and in compliance with the requirements given in specifications.

13.3. Placement

M.S. Inserts/ corner angles shall be correctly embedded as per their location shown in the drawings. Care shall be taken that these are securely held in position and do not get disturbed during concreting. Where necessary, these may be welded to the reinforcement bars. Suitable templates, spacers, dummy structures and temporary staging shall be provided. Necessary cutting in the form work and adjustment of reinforcement bars shall be affected for the placement of Inserts/ corner angles where required.

14. Chequered Plates

14.1. Material

The material shall conform to IS 2062.

14.2. Fabrication

Chequered plate shall be fabricated as per AFC fabrication drawings (prepared by the CONTRACTOR based on approved design and standard drawings). These shall be perfectly flat and without any dents/ deformations and shall be cut to the required size and shape. Holes/ notches/ openings of the required size shall be provided as per the drawings.



Nosing for staircase treads shall be made by cold bending of chequered plates. All edges shall be made smooth and even. All chequered plate units shall be given distinct erection marks in accordance with the marking drawings.

Drain holes shall be provided (1 number 12mm diameter hole per 1 Sq.m area)

15. Hand Railing

15.1. Material

- 1) Top rail shall be 32 mm dia. (NB) and Mid Rail shall be 32 mm dia (NB) mild steel medium grade conforming to IS 1239.

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- 2) Toe plates shall be of mild steel conforming to IS 2062.
- 3) Upright post shall be 32 mm dia. (NB) mild steel medium grade conforming to IS 1239.

15.2.Fabrication

Hand-railing shall be fabricated strictly as per the AFC fabrication drawings prepared by the CONTRACTOR based on approved design drawings and standards. All tubes shall be straight and without any dents/ deformations. Tubes shall be cut and ends shall be prepared to a neat workman like finish. All elements shall be directly welded. Tubes shall be cold bent to shape and curvature in case of discontinuous ends of handrails. Lower ends of vertical posts shall be cut and splayed (for grouting in pockets provided in the concrete members). For removable type of hand railing, suitable base plates (with provision for bolting) shall be welded to the lower end of vertical posts. Chequered plates and gratings shall be suitably notched to accommodate vertical posts/ their base plates wherever required. All units shall be given distinct erection marks in accordance with the marking drawings.

15.3.Erection/ Fixing

Hand railing shall be fixed to the bearing members by welding/ bolting/ grouting as indicated in the drawings.

16. Mild Steel Rungs

16.1.Materials

Mild steel rounds for rungs shall be 20mm diameter conforming to IS 432 Grade-I.

16.2.Fabrication

Rungs shall be fabricated as per approved standards/ drawings. Mild steel bars shall be straightened if required, cut, bent to shape and given primer paint.



16.3.Fixing

Rungs shall be fixed in position as per approved detailed drawing and firmly tied/ welded with reinforcement to prevent their displacement during vibrating of concrete.

17. Payment (Applicable For Item Rate Tender)

Payment for steel work shall be made on the basis of admissible weight of the structure accepted, the weight being determined as described below.

The rate of fabrication and erection shall include cost of all handling and transport, delivery to store/site of work trimming, straightening, edge preparation, preparation and getting reviewed of fabrication drawings, providing scaffolding, temporary supports, tools and tackles, touching up primer coat and providing one coat of primer and two coats of approved final painting unless specified otherwise, and grouting etc. complete.

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The weight for payment will be accessed from the approved fabrication drawings and to respective bill of materials prepared by the CONTRACTOR and approved by the OWNER/ENGINEER-IN-CHARGE. The weight of structural material/plate shall be calculated wherever necessary on the basis of IS Handbook. If sections are different from IS section, then manufacturer's Handbook shall be adopted. No allowance in weight shall be made for rolling tolerance.

Sections built out of plates shall be paid on the actual weight incorporated except for gussets, which will be paid on the weight of the smallest rectangle enclosing the shape. No deduction shall be made for skew cuts in rolled steel section.

Welds, bolts, nuts, washers etc. shall not be measured. Rate for structural steel work shall be deemed to include the same.

No other payment either for temporary work connected with this contract or for any other item such as welds, shims, packing plates, etc. shall be made. Such items shall be deemed to have been allowed for in the rate quoted for steel work.

18. Grouting of Pockets / Baseplate

Grouting of pockets and under base plates will be done only after the steel work has been levelled and plumbed and the bases of stanchions are supported by steel shims. The space below the base plate and pocket shall be thoroughly cleaned.

Grouting shall be done with non-shrink grout having compressive strength not less than 40 N/mm². Non-shrink grout shall be free flow premix type and of approved quality and make.

The grout mixture shall be poured continuously by grouting pump from one side of the base plate and spread uniformly with flexible steel strips and rammed with rods, till the space is filled solidly and the grout mixture carried to the other side of the base plate.

19. Tolerances Allowed in The Erection Of Plant Building

The maximum tolerances for line and level of the steel work shall be ± 3.0 mm on any part of the structure. The structure shall not be out of plumb more than 5.0 mm on each 10M section of height and not more than 8.0 mm per 30M section height.

These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

The CONTRACTOR shall follow the QA/QC requirements, as attached elsewhere.