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BALUCHISTAN ENERGY COMPANY LIMITED

DEVELOPMENT OF LPG TESTING LABORATORY AT TAFTAN

Specification for Welded Steel Atmospheric Storage Tank



Office Address:

Balochistan Energy Company Limited
67-A, Main Jinnah Town Quetta,
Balochistan, Pakistan

Phone: 9281-2863711, 2863712

E-mail: cfo@becl.com.pk

shayan.ali.siddiqui@gmail.com

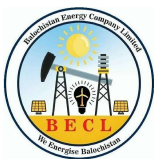
Web: www.becl.com.pk



SPECIFICATION FOR WELDED STEEL ATMOSPHERIC STORAGE TANK

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SPECIFICATION FOR WELDED STEEL ATMOSPHERIC STORAGE TANK

1.0 GENERAL

1.1 Scope

This specification covers the minimum requirements for design, supply, fabrication, erection, installation, inspection, testing, Hydrostatic testing, Commissioning calibration and painting of storage tanks.

The Contractor shall be responsible for the complete design, supply, fabrication, inspection, testing and Hydrostatic testing, Commissioning calibration of the welded steel storage tanks, in accordance with API Standard 650 latest Edition including full compliance with all applicable design codes and standards, as listed in Section 2.0 of this specification.

1.2 Definitions

PURCHASER means OWNER and CONTRACTOR mean SUPPLIER /MANUFACTURER/ SUB-CONTRACTOR. This definition shall apply throughout this specification.

1.3 Errors or Omissions

1.3.1 The review and comment by the Owner on contractor's or its manufacturer's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the Contractor of its obligations to comply with the requirements of this specification and other related parts of the contract documents.

1.3.2 Any errors or omissions noted by the Contractor in this Specification shall be immediately brought to the attention of the Owner.

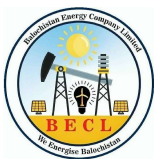
1.4 Deviations

All deviations to this Specification, other related specifications or attachments shall be brought to the knowledge of the Owner before issuing the procurement document. All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the owner prior to execution of the work. Such deviations shall be shown in the documentation prepared by the contractor.

1.5 Conflicting Requirements

In the event of conflict, inconsistency or ambiguity between the contract scope of work, this Specification, National Codes & Standards referenced in this Specification

or any other documents, the Contractor shall refer to the Owner whose decision shall prevail



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1.6 Reporting Procedure

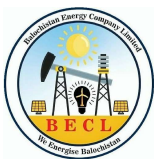
1.6.1 A reporting and documentation system shall be agreed between the owner and the contractor for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. Contractor's manufacturer shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by Owner.

1.6.2 Daily, weekly monthly and run summaries of all major aspects of the production process shall be provided as reports to the Owner.

2.0 CODES, STANDARDS & SPECIFICATIONS

Unless otherwise specified, minimum requirements are to be in accordance with latest editions of the following standards, codes and statutory regulations (where as applicable):

- **API 650** Welded Steel Tanks for Oil Storage (Latest Edition)
- **API 651** CP System of Above Ground Storage Tanks
- **API 652** Lining of Above Ground Storage Tanks
- **ASME Section-IX** Welding and Brazing qualifications (Only where referenced in API 650)
- **ASME Sec-VIII Div-1** Unfired Pressure Vessel (Only where referenced in API 650)
- **ASME Section-V** Non-destructive Examination (Only where referenced in API 650)
- **ANSI B16.5** Steel Pipe Flanges, Flanged Valves and Fittings
- **ANSI B 16.21** Non-metallic Flat Gaskets for Pipe Flanges
- **ANSI B31.4** Petroleum Refinery Piping
- **API 2000** Guide for Venting
- **API 2550** Measurement and Calibration of Storage Tanks
- **API 2555** Method for Liquid Calibration of Tanks
- **NFPA 30** National Fire Protection Association



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- **NFPA 70** National electrical code
- **ANSI B31.3** Chemical Plant and Petroleum Refinery Piping
- **API 2350** Tank overfill Protection

Other applicable codes & project specification

The services to be provided by the Contractor will include but not limited to the following, including full compliance with all applicable design codes and standards including those listed in Section 2.0 of this document.

- Preparation of working area as required to bring the equipment/material at job site.
- Supply of all consumable items required for the execution on site of tanks e.g. air, electricity, hydrostatic test water and its additives, gouging rods, welding rods and flux, cutters, gas cylinders, grinding disks, brushes, oil and grease, shims etc.
- Provision and installation of necessary cranes, hoists, poles, welding equipment, grinders, cables, scaffolding, tools and fixtures and other facilities required for fabrication, erection of tanks, and for rectification of all damages, minor modification related to the tank. Certified construction machinery / equipment / tools for hazardous area, calibrated gauges ,PSVs, arrangement of portable water with pump for hydrostatic testing, spare gaskets, consumables for commissioning
- Supply of plates, structural steel, nozzles/appurtenances, emergency vent, breather vent, flame arrestor, level gauge, paint and lighting system complete in all respect. Certified cranes with rigging tools
- Fabrication, erection, installation, testing, painting, electrical and instrument works related to storage tanks.
- Checking of dimensions of each section of tanks. NDT, hydrostatic testing, calibration, floatation test of IFR, commissioning
- Welding shall be carried out according to qualified welding procedures.
- Only qualified welders shall be allowed to work-on-the-job. Approved qualified welding procedure
- Maintenance of all inspection records.
- The Contractor shall include adequate replacement for spare materials and components such as packings and gaskets, which may be consumed during the commissioning phase.



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- Provision of equipment and measuring instruments required for tests and inspection.
- Preheating of welding rods and electrodes and their proper storage.
- Vacuum testing and Hydrostatic testing of tank (including all necessary works, like preliminary internal inspection, blinding, temporary connection for water and air lines, compressor and pumps for water and air filling, installation of temporary vents and pressure gauges etc., cleaning of tank after tests.
- Provision of any fabrication, erection, installation, inspection, testing, examination certificates specified in API 650.
- Calibration of tank with approval of local/statutory body.
- Removal of all fixtures and equipment employed in erection/fabrication and removal of all debris and waste material from site after completion of job.
- Cleaning and uplifting of area after completion of work.
- All the safety and security measures for personnel and property.
- Contractor will arrange third party inspection company approved by OWNER for inspection of tanks (for welder's qualification, inspection of various tank construction activities, testing, calibration etc)
- Contractor is fully responsible to carry out inspection and testing of tanks as specified in API standard 650 and other project specifications.
- Supply, installation, inspection, testing, commissioning of firefighting and fire alarm equipment including foam system for storage tanks.
- Supply, installation, testing commissioning of CP system and bottom leakage system.
- Supply, installation, inspection, testing, calibration, commissioning of radar type tank gauging system, tank level switches, instrument etc as per P&IDs and drawings
- Contractor is responsible to perform the soil test and confirm the tank foundation parameters are as per soil testing report.



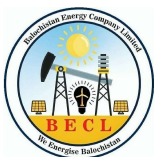
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3.0 TECHNICAL

3.1 Design

Tank Design shall be in compliance of API Standard 650 (Latest Edition)

- a) Contractor shall certify that the Storage Tank is suitable for the purpose intended, and that it will meet or exceed the owner's needs as specified in this document.
- b) The minimum plate thickness in roof, shell and bottom shall be as per API-650.
- c) Tank bottom plates shall generally be a cone-up configuration and shall be overlapped away from the tank center.
- d) Annular bottom plates shall be provided.
- e) Deflections of flat plates shall not exceed $1/150^{\text{th}}$ of the shortest width.
- f) The design membrane stress shall not exceed 70% of the specified minimum yield stress for the material.
- g) The Contractor shall make detailed calculations covering the design of tanks and shall prepare detailed shop drawings. The Contractor shall submit concurrently to the Owner, prints of fabrication drawings, weld procedures and detailed calculations for approval.
- h) Contractor shall design the ring wall foundation.
- i) Requirement of top and intermediate wind girder shall be checked.
- j) Seismic analysis/check shall be carried out.
- k) Seismic design loads shall be in accordance with Appendix E of API 650 Seismic factor shall be 2A (0.15g horizontal acceleration).
- l) The following factor shall be used for Seismic calculation:
 - Importance factor "I" = 1.0
 - Site Co-efficient "S" = 1.5
- m) Tanks shall be provided with impressed current CP system for bottom.
- n) Tank roof structure shall be supported on pipe or solid section columns. Cage type column construction is not permitted.



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- o) Contractor shall submit details of the proposed material, for different parts of the storage tank, with dimensions (length and width) of the bottom, roof and shell plates.
- p) Contractor is responsible to construct/built dyke wall around the tank as per the requirement mentioned in NFPA.

3.2 Internal Floating Roofs

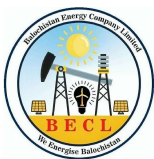
1. The roof support shall be adjustable for the following two positions:
 - a) The lower position shall permit the floating roof to go as low as possible without interfering with any internal accessories such as heaters, mixers and nozzles. If a net working capacity is specified for a tank, this lower position shall be decided not to exceed the deck height mentioned in tank data sheets.
 - b) The upper positions shall provide a clearance of 1.8 m between the lowest portion of the roof and the tank bottom. Legs of 1.8 m height should be provided to support the roof, when liquid is withdrawn to a low level to avoid contact with and damage due to the presence of internal obstruction
2. All seams in the internal floating roof that are exposed to product vapor or liquid shall be vapor-tight in accordance.
3. The minimum number and size of manhole for the fixed roof and floating roof shall be as shown in Table.

Nominal Tank Diameter (m)	Minimum Number
61	2
$61 < D \leq 91$	3
$91 < D$	4

4. Tank Inside Diameter (m) Manhole Number and Size
1-24 inches Over 30 2-24 inches (180° apart)
5. When the floating cover is of a design using floats (deck above liquid), roof drains shall be provided and extended into the product a minimum of 4 inches.
6. Vendor to take approval of Mechanical seals from Client before supply.

3.3 Materials

- a) All materials shall be in accordance with the requirement of API Std. 650.
- b) All materials shall be subject to acceptance by the Owner.



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- c) All materials shall be selected to meet service conditions.
 - d) All materials shall be listed in ASME, Section-II, and Material Specifications.
 - e) All materials shall be clearly identified and provided with Mill Test Certification.
 - f) Contractor shall provide the following material certificates/tests reports to Owner for approval:
 - Chemical analysis
 - Product analysis
- sed to the process fluid.

Or

Corrosion allowance and applied portions of a tank shall be in accordance with data sheets.

3.4 Design Loadings

The tank shall be designed for the following loads, unless otherwise specified:

- Dead loads and live load
- Tank to be designed for contents with a specific gravity of not less than 1.0.
- Internal Operating Pressure.
- Hydrostatic Test Pressure
- Wind Pressure
- Seismic loads

3.5 Manholes, Nozzles and Inspection Openings

- a) Where inspection openings are required, the minimum size shall be 8" nominal bore.
- b) Manhole requirements shall be shown on tank data sheet.
- c) The size of manholes shall also be in accordance with this specification unless otherwise stated.
- d) All tank openings shall be flanged. The minimum connection pipe size welded into a tank shall be 2" NB. Connection may be swaged down for termination in a line size flanged connection if required.
- e) Nozzle size, 1¼", 2½", 3½", 5" & 7" shall not be used.
- f) Nozzle flanges shall comply with ANSI B16.5. Weld neck flanges shall be used in preference to slip-on flanges whenever possible.
- g) All nozzles shall be flush with inside of tank when used as drains or when so located that there would be interference with tank internals.
- h) Where two or more openings are provided for installation of equipment, such as gauge glasses, they shall be set with a jig to prevent tolerance from being additive.



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- i) Each tank shall be provided with a flush cleaning out door. These flush connections should be located at the lower edge of the shell.
- j) Except for 2" NB, all nozzle openings shall be reinforced. Reinforcement shall provide full area replacement for the opening.
- k) Reinforcing plates shall be the same material as the tank plates to which they are attached.
- l) Pads on nozzles 10" dia. and smaller shall have one 6mm tapped tell-tale hole; larger nozzle pads shall have two 6mm tell-tale holes 180° apart.
- m) All bolt holes in flanges shall straddle the normal tank centerlines unless otherwise specified.
- n) Davits or hinges shall be furnished for all manholes and hand-hole covers and blind flanges weighing in excess of 25kg.
- o) Firefighting system requirement on the tank would be referred in the respective NFPA-code.

3.6 Fabrication

3.6.1 General

No fabrication shall begin until the Contractor has received approval of proper material certification, detailed fabrication drawings, calculations, weld procedures, plus welder performance and weld procedure qualifications from the Owner or the Owner's authorized representative.

Shop fabrication details shall be complete with all dimensions, thickness and details of construction including dimensional location of weld seams and nozzles. All welds and weld preparations shall be detailed and annotated to the relevant weld procedure specification.

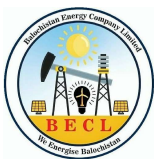
No fabrication shall be sub-contracted without the prior written approval of the Owner.

No holes shall be made in either the bottom or shell plates for the purposes of erection.

All lugs attached by welding to facilitate erection shall be removed prior to final inspection and the plate surface crack detected.

Contractor will submit work procedures for fabrication, installation, erection, testing calibration and commissioning to OWNER for approval

No construction activity will be started without approved work procedure.



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3.6.2 Welding

This specification covers the requirements and procedures for welding and does not relieve the Contractor from his responsibilities and guarantees with respect to welding results.

The layout of all welded seams shall permit both internal and external inspection of all main tank seams where possible.

All Butt welds shall be full penetration welds as shown in the applicable code or specified in this specification. No lap joints are permitted on shells.

Backing rings shall not be used on butt welds. Shop fabricated tanks shall have bottom plates Butt-welded throughout.

All welds of lugs, brackets, structural steel, etc. shall be located so as to miss all tank welds by a minimum distance between the edges of the welds of 100mm, or 3 times the thickness of the thicker part being welded, whichever is greater.

Where tanks are to be internally lined, weld joints shall be smooth and free from sharp edges and corners.

No welding shall be performed when the metal temperature is 5°C and below without the application of preheat.

All fillet welds shall be continuous.

No welding will be permitted during raining and Wind/dust storm.

i) Welding Procedures and Procedure Qualifications

The Contractor shall submit weld procedures, qualifications and weld details for all new weld types utilized for Owner's review and approval prior to commencing any production welding.

Each procedure shall be qualified in accordance with procedures previously approved by the Owner. Caulking is not permitted.

ii) Welding Processes

The scope of application of welding processes shall require the approval of the Owner. High heat input processes such as electroslag welding are prohibited. In all cases the heat input of the welding process shall be limited to a maximum of 5 KJ/mm.



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iii) Welding Consumables and Deposited Metal Properties

The deposited weld metal shall have yield strength of not less than the minimum specified for the parent material.

All consumables shall be stored and handled in accordance with manufacturer's recommendations. Any unidentifiable consumable or those showing signs of damage or deterioration shall be discarded.

Low hydrogen electrodes shall be dried or baked at the temperature level and times specified by the manufacturer and shall be used within 8 hours when stored in quivers. Electrodes stored in quivers, but not used within the specified times shall be restored in ovens.

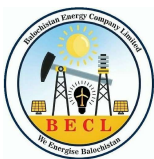
No electrodes shall be left lying about the site or in workshops. Electrodes so left shall be scrapped.

iv) Welder Performance Qualification

All welders and welding machine operators shall be qualified in accordance with ASME IX. These welders and operators shall only be allowed to weld using the approved welding process and in the position for which they are qualified.

3.6.3 Erection

- a) Contractor shall be responsible for site erection. When the Contractor is unable to provide a suitable workforce for site erection, he shall make available erection/commissioning engineer(s) to assume full responsibility for erection and commissioning in accordance with the approved requirements.
- b) Contractor shall submit full details of sequence of erection including any site welding for Owner's review.
- c) No holes shall be made in either the bottom or shell plates for the purposes of erection.
- d) All lugs attached by welding to facilitate erection, shall be removed prior to final inspection and the plate surface crack detected.
- e) Contractor shall inform the Owner at least 2 weeks prior to commencement of erection, of the site facilities required for the erection and commissioning.



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3.7 Inspection, Tests and Acceptance

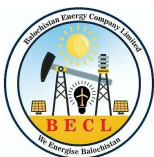
3.7.1 Inspection of Material

QA/QC procedure shall be submitted for approval. Approved QA/QC procedures shall be followed through the tank construction.

- Inspection by Owner or his representative shall not relieve the Contractor of the responsibility to replace any inadequate material and to repair any poor workmanship found on site.
- Any defective material or works found after acceptance at the time of rolling, machining or during erection and testing of tank shall be replaced without change even if it has been accepted previously.
- Material identification and certificates shall be submitted to the Owner.
- Contractor will arrange third party inspection company approved by the OWNER for material inspection and testing at manufacturer / vendor works and construction site before execution

3.7.2 Inspection of Welds

- Welding procedure qualification and welder qualification tests shall be carried out in the test facility to be approved.
- Butt welds shall be full penetration and fusion. Quality of shell welded joints shall be evidenced by radiographic inspection, as specified in API-650.
- Extent of Radiography shall be as specified in API-650 chapter 08. Owner/Owner's representative at any time reserves the right to have any joint radiographed. All welds which are unacceptable shall be repaired and re-tested radiographically at contractors expenses.
- Completed tanks shall require final approval before hand-over to Owner.
- All radiographic reports along with the films shall be submitted for approval.
- Surface preparation for painting shall have to be approved prior to the application of paint.
- Welding procedure specification shall be submitted for approval, prior to welding procedure qualification.
- All welds shall be visually inspected after completed.
- Corner joints and butt welds in tank plates shall be 100% inspected by MPI (magnetic particle inspection) methods.



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- Nozzles and reinforcing pad welds shall be subjected to 100% MPI.
- Welds joints of Bottom to first shell will be 100% MPI
- All inspection shall be conducted and interpreted by qualified persons utilizing proven techniques. Results shall be sustained by charts and reports which shall be submitted to the Owner.
- All welding works including welding procedures, procedure qualification, welders qualification, welding inspection, NDT, welds testing etc shall comply “API 650”, ASME Section IX, Project specifications and inspection by approved third party
- All welds joint of tank (bottom shell, roof, structure, nozzle, etc) shall be inspected and tested in accordance with “API 650”

3.8 Testing

As a minimum requirement the testing of tanks covered by this specification shall be in accordance with API standard 650.

3.8.1 Testing of Tank Bottom

Bottom of the tank shall be tested by applying a vacuum chamber to the plate welded joints and checking for leaks, using a suitable soap film solution. This can be done using a vacuum box, which enables any leaks in the seams to be positively located by visual examination.

The bottom plates shall in any case be tested before water is let into the tank for hydrostatic testing.

3.8.2 Tank Shell

- Testing shall be done by filling the tanks with fresh water to the level at bottom edge of the overflow nozzle.
- All connections shall be blinded off and external piping shall be connected after successful completion of shell and floatation tests.

3.8.3 Tank Roof

After the tank erection is finished, the welds of the roof shall be tested by an inner pressure, which shall not exceed roof plate weight or by vacuum chamber applied on weld outer surface. Welding seams shall be lubricated with soap solution, flax oil or other liquid suitable to detect leakage. Further Tank roof welding check by VBT.



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3.8.4 Pressure Testing

- All tanks shall be subjected to a hydrostatic test.
- All hydrostatic tests shall be carried out using potable water, in the presence of an authorized inspector and subject to his approval. After successful testing, all water shall be drained and the equipment thoroughly dried.
- Tanks shall be properly vented during filling for hydrostatic testing so as to prevent the formation of air pockets before any test pressure is applied.
- Tanks shall be re-tested if any repairs are found. The re-test shall be performed after completion of repairs. All subject to the approval and in the presence of the owner's representative.
- Pressure test of nozzles reinforcement pad
- Oil penetrate test of weld seam between tank bottom to first shell.
- Any other test specified in API 650

3.9 Tolerances

The tanks shall be within the following tolerances as required by API-650:

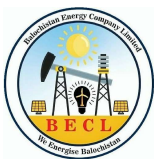
- a) Maximum deviation from vertical line (lead line) between top angle and shell bottom shall be 1/200 of total tank height.
- b) Deviation from vertical line for each shell plate shall not exceed the values specified for rolled plates in tables 14 to 15 under ASTM-A6 or in table 10 or 13 under ASTM-A20, as may be applicable.
- c) The thickness of the plate ordered shall not be less than the computed design thickness or the minimum permitted thickness. Negative mill tolerance is not permitted.
- d) Radial measurement at 300 mm above lap weld between shell and bottom shall not exceed the following tolerance:

Diameter

0 to 12.2m exclusive
12.2 to 45.7m exclusive
45.7 to 76.2m exclusive
76.2 And above

Radius Tolerance

± 12.7mm
± 19.0mm
± 25.0mm
± 32.0mm



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- e) Using a horizontal mould to radius of 1m long peaking in any area of inside shell surface shall not exceed 12.7mm
- f) With a vertical sweep board 1m long, banding shall not exceed 12.7m. Measurements for tank shell shall be performed before hydraulic test.

3.10 Tank Calibration

Upon completion of the tank, which is to be calibrated in accordance with API 2550/2552 after hydrostatic testing, tank calibration shall be carried out actual water fill before any insulation/painting work.

After successful completion of hydrostatic test, Contractor shall consult local statutory body to witness and certify the calibration work of each tank.

The actual strapping/bottom calibration work shall be performed in the presence and to the satisfaction of the owner's representative and under supervision of qualified and experienced engineer to be assigned by the Contractor at his cost.

The Contractors shall also be responsible to get approval of calibration work of each tank from local/statutory body.

3.11 Nameplate

Tank shall be identified by a nameplate similar to that shown in API-650.

3.12 Painting

Tanks shall be painted in accordance with painting specifications No. 049-001-134-PJS-004.

3.13 Box-up

After testing and calibration, all tanks shall be emptied and water disposed of as per instruction of Owner's Representative. Tanks shall be thoroughly cleaned internally and boxed-up, including mounting, fitting, fixing and bolting of all tank fittings and accessories. The cost of this work shall be considered included in the Contractor's rates for fabrication of tanks.

4.0 DRAWINGS AND DATA

- I. The following information shall be supplied to the Owner prior to any fabrication:
 - a) Storage tank design calculations.
 - b) Four complete sets of fabrication drawings, specifications, schedules, etc.
 - c) Two copies of each welding procedure.
 - d) Mill test reports (including chemical analysis, mechanical test, etc.)



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- e) Inspection and testing as called for in this specification and its attachments.
- f) List of material required of tanks
- g) Schedule for tank nozzles
- h) Work procedures
- i) General arrangement of tank with design data

II. Upon completion of the unit provide the following information:

- a) Inspection reports (i.e. x-ray logs, M.T. reports, etc.)
- b) X-ray weld location maps.
- c) Hydrotest chart.
- d) Four copies of certified as-built drawings.

III. The following drawings and data shall be provided:

- a) Equipment outline and arrangement drawings showing bottom shell and roof plate's layouts, nozzle sizes and pressure ratings.
- b) Foundation support details.
- c) Anchor bolt sizes and locations (if required)
- d) Shop drawings showing construction details, welding and weld repair procedures, material specifications of all parts, joint inspection procedure.
- e) Certified reproducible "as-built" drawings and one set of all mechanical calculations will be required on job completion.
- f) Tank calibration certificates duly signed from all concerned agencies.

4.1 Guarantee and Warranty

4.1.1 General

The Contractor will warrant the equipment to be free of defects in material and workmanship, and that it is of adequate size and capability to fulfill the design and operating conditions specified herein. The Contractor shall replace and install, without cost to the Owner, any materials, supplies, or equipment which fails under design conditions due to defects in material or workmanship, if the defect is observed and/or such failure occurs within one (1) year from the date such equipment or material is put in operation. Acceptance of this order will signify acceptance of all conditions of this guarantee.

Contractor is responsible for full compliance of guarantees and warranties as specified in contract documents and agreement.

5.0 HANDLING & STORAGE

All handling, loading and unloading shall be done in such a manner as to minimize mechanical damage and corrosion.



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All handling shall be done with slings, padded hooks or brass-lined end hooks approved by Owner.

Rail cars, trucks, lighters, ships or other conveyances shall be cleaned of debris or any substance that may damage the materials, prior to loading.

Suitable timber shall be used to protect the plates against damage in transit.

No on-deck overseas shipment shall be allowed without the prior written approval of Owner.

Finished plates to be stored for a significant period of time at the mill or marshalling yard, shall be stored in a manner such as to prevent corrosion.