

Pakistan LNG Terminal Project (Jetty)

**SPECIFICATIONS
FOR
QUAY FURNITURE**

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1. INTRODUCTION

1.1. General

Pakistan LNG Terminals Limited (PLTL) has appointed Pakistan Gasport Limited (Client); a subsidiary of the Pakistan based Associated Group (AG), for the development of a Liquefied Natural Gas (LNG) regasification (regas) import facility near to Port Qasim southeast of Karachi, Pakistan.

The objective of the Pakistan Gasport LNG Project is to establish an easy supply of high-pressure natural gas (NG) to Sui Southern Gas Company (SSGC) gas net at the connection point. The supply will be provided through a Floating Storage and Re-gasification Unit (FSRU) docked at a jetty with unloading facilities.

1.2. 1.2 Scope of Specifications

This document contains the technical specifications which covers the Quay Furniture work for the Project.

1.3. 1.3 Definitions

DRAWINGS - the Drawings referred to the construction drawings prepared by the Contractor and approved by the CLIENT.

CLIENT – means Pakistan Gasport Limited (PGPL), and CLIENT appointed CRP for the Project.

PROJECT – means Pakistan Gasport LNG. **CONTRACTOR** – means the entity awarded a CONTRACT by CLIENT to perform engineering services for the CLIENT.

VENDOR – means any and all persons, firms, partnerships, manufacturers, suppliers, companies, body entities or a combination thereof including sub-vendors and sub-suppliers from whom the supply of goods for the PLANT, as specified in the Material Requisition, is obtained by the CONTRACTOR through a Purchase Order.

1.4. 1.4 Standards and References

The following Standards and Codes of Practice are referenced within this specification. All materials, workmanship and testing shall conform to the requirements of the latest editions of the following standards and codes of practice except as explicitly vary by this specification in case of a conflict more conservative approach shall prevail:

- › BS 6349 Part 4 1994, Maritime structures: Code of practice for design of fendering and mooring systems.
- › Normal and abnormal berthing energies shall be calculated in accordance with, PIANC Report of Working Group 33, Guidelines for Design of Fender Systems (2002).

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The procedure to determine and report the performance of the fenders shall be as per PIANC Report of Working Group 33, Guidelines for Design of Fender Systems, Appendix A.

- › Elastomers as per EAU 2004 Recommendations of the Committee for Waterfront Structures Harbours and Waterways, 8th Edition.
- › Steel design for fenders as per BS 5950-1:2000.
- › ASTM E-84: Standard method of test for surface burning characteristics of building materials.
- › BS 3692 ISO: Metric precision hexagon bolts, screws and nuts.
- › BS 4190 ISO: Metric precision hexagon bolts, screws and nuts.
- › BS 4211: Specification for permanently fixed ladders.
- › BS 5950 – 2: Structural use of Steelwork in Building - Specification for materials, fabrication and erection.
- › BS 6349 – 2: Code of Practice for marine structures. Design of quay walls, jetties and dolphins.
- › BS 7371 – 6: Coatings on metal fasteners. Specification for hot dipped galvanised coatings.
- › BS 7419: Specification for holding down bolts.
- › BS EN 10029: Tolerances on dimensions, shape and mass for hot rolled steel plates 3mm thick or above.
- › BS EN ISO 7091: Plain washers. **1.4.1 Project Documents** This document is a replace version of Specification for Fender FPK16027DD-0000-M S01-SPE-06 and Specification for Ladder, Handrail and Fixed Metalwork in Concrete FPK16027DD-0000-MS01-SPE-08. The Project documents to be read in conjunction with this document are as follows:
 - › XPE, THCC (2016), Design Basis Report Marine Civil, FPK16027DD-0000-OT01-S PC-01.
 - › XPE, THCC (2016), Specification for Marinework Concrete, FPK16027DD-0000-MS 01-SPE-03.
 - › XPE, THCC (2016), Specification for Cathodic Protection System of Steel Piles, FP

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K16027DD-0000-MS01-SPE-05.

- › XPE, THCC (2016), Specification for Quick Release Hook, FPK16027DD-0000-MS 01-SPE-07.
- › XPE, THCC (2016), Specification for piling Work, FPK16027DD-0000-MS01-SPE-09.
- › XPE, THCC (2016), Specification for Quay Furniture, FPK16027DD-0000-MS01-SP E-10.
- › XPE, THCC (2016), Specification for Corrosion Protection Coating of Steel Tubular Piles, FPK16027DD-0000-MS01-SPE-11.
- › COWI (2016), Design Basis – Civil Marine, A082981-PR-001.
- › COWI (2016), Design Basis – Electromechanical, A082981-PR-002.
- › COWI (2016), Steel Work Specification, A082981-PR-001.
- › COWI (2016), Concrete Specification, A082981-PR-002.
- › COWI (2016), Piling Work Specification, A082981-PR-003.
- › COWI (2016), Dredging Work Specification, A082981-PR-004.
- › COWI (2016), Quay Furniture Specification, A082981-PR-005.
- › COWI (2016), Quick Release Hooks and Remote Release Specification, A082981-PR-006.

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2. Furniture

2.1 General

The work covered under this Specification includes the supply of all labour, materials, and equipment necessary for manufacturing, supplying, and installing the fenders, ladders, fixing metalwork and small craft landing facility in accordance with this Specification and the DRAWINGS.

2.2 Fenders

2.2.1 General

The types, basic dimensions and locations of fenders for the wharf are shown on the relevant DRAWINGS. Fenders shall be designed and installed in accordance with this Specification.

The term fender is taken to mean the complete assembly comprising a rubber fender unit, steel fender panel, low friction facing boards, chains, fixings, brackets, connections and all other items associated with design, manufacture, delivery to site, installation and certification of the complete assembly to the specified performance.

The fenders shall be manufactured by a CLIENT approved company. The fender supplier shall have minimum 10 year's proven track record in supplying fendering systems. The fender supplier shall have the equivalent of an ISO-based quality assurance certification system. A reference list of similar fender installations must be supplied to the CLIENT. Access, if required, shall be given to the CLIENT to inspect the manufacturer's factory where the fender units will be/are being produced.

The CONTRACTOR shall install the fender assemblies, including casting-in of all inserts. The CONTRACTOR shall ensure that the fender supplier timely delivers inserts, templates (for correct placement of the inserts), detailed installation manuals and specifications in time for the required installation date.

2.2.2 Design Life

Fenders shall be designed to have a design life of 30 years with a life to first maintenance of 15 years.

2.2.3 Design Specification

The CONTRACTOR/VENDOR shall verify the fender design, test certificates and details of similar installations according to the detailed calculations in support of the chosen fender system for CLIENT's approval. The design of rubber fender units must ensure that bolts/anchors do not contact the fender or the vessel during compression of up to the rated deflection.

Fender design parameters shall be derived from the design basis document and *Mooring*

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Analysis.

Normal and abnormal berthing energies are shown in the Calculation of Vessel Load and Mooring Analysis in accordance with, PIANC Report of Working Group 33, Guidelines for Design of Fender Systems (2002).

Fenders shall be designed for single fender berthing. Fenders shall be designed for the most unfavorable position of the ship's hull. Rated energy and deflections values shall be reduced, where necessary, using manufacturer's factors, to take account of berthing and flare angles.

The added mass coefficient shall be calculated using the Vasco Costa (1964) method as shown in the Calculation of Vessel Load.

Fenders shall be designed to absorb berthing energy from abnormal impacts, within the rated deflection of the fender. The fender system shall be designed for either quarter point vessel impact, or for a point of contact determined from the hull geometry and berthing angle, whichever gives the worst case.

The design shall demonstrate that the fender spacing is such that for abnormal impacts, FSRU can berth at the angles to the berthing face given in the design parameters, while maintaining a positive clearance (nominal 0.3 m clearance) between FSRU and the quay face and without the FSRU contacting the quayside equipment. Full account shall be made of the following factors as applicable:

- ⇒ Deflection characteristics of the fender system, with an appropriate allowance for variations in hull-radii.
- ⇒ Bulbous bows of vessels.
- ⇒ Bow flare up to 10 degrees.

Fender front panels shall be positioned to accommodate berthing of the FSRU at all states of the tide, values of which are given in the design basis document.

The effect of belting on FSRU hulls shall be taken into account in design of the fender system.

The design of fenders should take into account the effects on fender performance within the temperature range of:

- ⇒ Max. Ambient Temperature = 55°C.
- ⇒ Min. Ambient Temperature = 1°C.

Chains and fixings shall be designed to resist horizontal and vertical shear using a friction factor of not less than 0.2.

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Fender design shall take account of manufacturing performance tolerances for rubber by reducing the manufacturers rated energy absorption by 10% and increasing the manufacturers rated reaction by 10%.

2.2.4 Calculations

Detailed fender calculations to BS 6349: Part 4:1991 see *Calculation of Vessel Load* and *Mooring Analysis* in support of the CLIENT to choose fender system.

2.2.5 Rubber Properties

The rubber raw material shall meet or exceed the performance requirements outlined in PIANC: Guidelines for the Design of Fender Systems: 2002. A 'Type Approval' certificate as per PIANC 2002 shall be submitted to the CLIENT for approval.

Rubber for fender elements shall be resistant to deterioration by oil, grease, ozone, UV radiation, seawater and aging. Each type, size and grade of rubber for fender elements shall comply with the requirements shown below.

Table 2-1 Fender Requirements

Parameter	Standard (or equivalent)	Basic value	Aged value
Tensile Strength	DIN 3504	15 N/mm ² minimum	12.8 N/mm ² minimum for 168 hours at 70° C
Elongation at Break	DIN 3504	350% minimum	280% minimum for 168 hours at 70° C
Hardness	DIN 3505	75°Shore A maximum	+5°increase maximum for 168 hours at 70° C
Tear Resistance	DIN 3507	80 N/cm minimum	-
Abrasion Resistance	DIN 3516	100 mm ³	-
Compression Set	DIN 3517	-	40% maximum for 22 hours at 70° C
Ozone Resistance	DIN 53509	-	No cracks visible by eye (50 pphm at 20% for 40 hours at 40° C)
Seawater Resistance	DIN 86076	-	Shore A: ±10°maximum Volume: +10%/-5% maximum for 28 days at 95°C ±2°C
Dynamic Fatigue	ASTM D430-95 Method B	15,000 cycles, grade 1	-
Bond strength – Rubber to steel	ASTM D429, Method B	7 N/mm minimum	-

Manufacturing dimensional tolerances for rubber shall be within ± 2mm or ±3%, whichever the greater dimension. Manufacturing performance tolerances for rubber shall be within ± 10%.

2.2.6 Facing Boards

Steel fender panels shall be faced with an approved Ultra-High Molecular Weight

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Polyethylene (UHMW-PE) board of minimum 40 mm thickness with physical properties as per EAU (2004) 6.14.8.4 (Rubbing strips of Polyethylene). Boards shall be manufactured using double sintering process for increased abrasion resistance.

All UHMW-PE boards shall be of the same production run and the tolerance on the board size, thickness and surface shall be as specified in Section 2.2.11 below. The UHMW-PE board surface shall be isotropic. The size of the boards shall be such that they can be handled easily by one worker for future replacement.

All seaward edges of the UHMW-PE board shall be bevelled/splayed to reduce damage. Colour shall be a black, unless otherwise approved by the CLIENT.

Manufacturing tolerances UHMW-PE board are stated in the table below.

Table 2-2 Facing Board Properties Requirements

UHMW-PE Material	Tolerance
Length and width	± 5mm.
Thickness	± 0.3mm.
Out-of-straightness of the finished panel surface	

2.2.7 Fender Panels

Fender panels shall be fabricated from BS EN 10025 Grade S275 steel in accordance with the requirements listed below. The CONTRACTOR shall submit steelwork shop drawings to the CLIENT for review.

Steel fender panels shall be fully sealed of water and air tight closed box type construction. Steel fender panels shall be pressure tested prior to shipment.

The design shall comply with the following minimum steel thicknesses: › External plates exposed both faces: 12 mm minimum. › External plates exposed one face: 10 mm minimum. › Internal plates (not exposed): 8 mm minimum.

The fender supplier shall advise the unit weight of the fender panel to the CLIENT for approval.

Manufacturing tolerances for steel dimensions shall be within ± 1 mm.

The design shall consider bending, shear and local buckling associated with the maximum reaction developed by the fender unit, including the simultaneous application of a friction force (not less than 20% of the rated reaction) in either vertical or horizontal direction loads and environmental forces. Panel rib spacing is to be minimised to ensure uniform pressure distribution on the vessel hull. Deflection of the face plate is to be not greater than 2L/1000, in accordance with the Japanese Shipbuilding Quality Standards.

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Pad-eyes shall be provided for lifting and chain attachments, and shall be designed in accordance with the requirement of API RP2A Clause C.5.5. Sufficient lifting pad-eyes shall be provided to allow easy handling, and the frame shall have sufficient rigidity and strength to avoid damage during handling and installation.

Front vertical edges of the fender panels shall be splayed in order to reduce damage to facing panels (caused by vessels with intermittent belting). Minimum dimensions for front vertical edge splays shall be 100 mm by 100 mm.

Fender panels shall have a splayed bevel at the top of the panel to reduce damage to the fender panel from hull protrusions. Minimum dimensions for top edge splays shall be 300 mm by 300 mm.

All holes shall be drilled. All free edges and corners shall be rounded by grinding, with radius greater than 2mm. Washers shall be used under bolt heads in order to avoid damage to the paint. A water sealant compound shall be applied on all bolt thread connections to ensure water and air tightness of the fender panel.

2.2.8 Chains

Fender panels shall be provided with weight, shear and tension restraint chains as necessary to fulfill the requirements of the fender manufacturers design.

Anti-fouling chains shall also be provided. The size and arrangement shall allow a 40mm diameter wire mooring line and a 125 mm diameter spliced eye to be dragged over the fender system without entanglement or damaging the fender unit.

Chains shall be galvanized high tensile Grade 4 steel to BS EN 818. Chain breaking load shall be a minimum of three times the safe working load. Chains shall be open link. Special end links shall not be used. Each chain assembly shall include a shackle/chain tensioner to eliminate slack and provide a 'weak link' (i.e. to prevent damage to other components in the event of chain overload).

Chains shall be tested by an independent testing authority and certificates provided to the CLIENT.

Chains shall be galvanized in accordance with BS EN ISO 1461 to provide the required design life. As a minimum, a coating of 610 g/m² of surface is required (85 microns minimum DFT).

2.2.9 Fixings

Fender unit and chain fixings and associated nuts and washers shall conform to BS 3692:2001 and shall be centrifuge hot-dip galvanized to a minimum average thickness of 55 microns DFT, in accordance with BS EN ISO 1461:1999. After the hot-dip galvanizing, threads shall be brushed out to conform to the ISO-fitting.

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All fixings to the supporting structure shall be cast in wherever possible although resin anchored fixings may be permitted in pre-cast blocks if approved in writing by the CLIENT. Approved anchor resin shall be supplied in either cartridge or capsule form; bulk resin shall not be used.

Materials shall be delivered with certificates according to EN 10204 certificate type 3.1B or equivalent.

2.2.10 Corrosion Protection and Maintenance

Before installation the fender system shall be protected from corrosion with a high quality epoxy paint coating system conforming to a C5M classification of BS EN ISO 12944.

Corrosion protection shall be designed to provide a life to first maintenance of 15 years.

The colour of the corrosion protection system shall be a black, unless otherwise approved by the CLIENT. The corrosion protection system shall not be coal tar epoxy or bitumastic based.

All damage to painted surfaces during transport, handling, lifting and installation shall be repaired to the approval of the CLIENT with a complete coating system at CONTRACTOR's expense.

A detailed repair and maintenance manual shall be provided with details of programmed, regular maintenance at periods of five years. Where possible, units of the fender shall be demountable enabling the replacement of one part of the system.

2.2.11 Installation and Workmanship

All steel works shall be executed in accordance with the specifications. The CONTRACTOR shall submit all necessary shop drawings for the steel works. All holes shall be made by drilling. All free edges and corners shall be rounded by grinding, with radius greater than 2 mm.

Manufacturing tolerances shall be within:

- ⇒ For rubber: ± 2 mm or $\pm 3\%$, whichever the greater dimension.
- ⇒ For steel: overall dimensions: ± 1 mm.
- ⇒ For UHMW-PE board: length and width: ± 5 mm.
- ⇒ For UHMW-PE board: thickness: ± 0.3 mm.
- ⇒ For UHMW-PE board: out-of-straightness of the finished panel surface shall be less than 1/1200.
- ⇒ Positioning tolerances of the fender assembly relative to the lines and levels shown shall be within ± 20 mm.

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Washers shall be used under bolt heads in order to avoid damage to the paint.

Fender fixings shall be accurately set out to ensure that fenders are installed without distortion to the rubber.

A qualified representative of the fender supplier shall attend site to advise on fender installation methods and to verify the fender installation.

2.2.12 Testing

The fenders shall be subject to third party inspection and witnessing by an accredited agency to certify that fender performance and physical property tests conform to this Specification. The Inspection report shall be approved by the CLIENT, prior to shipment.

All fenders shall be performance tested prior to shipment. The performance testing shall be carried out in accordance with PIANC, Guidelines for the Design of Fender Systems 2002: Appendix A: Section 6: Verification /Quality Assurance Testing.

Any fender failing to meet the Specification will be rejected.

A certificate showing the manufacturers name, the date and the place of manufacturer and showing that the rubber fenders, including the rubber used in manufacturing the fenders, comply with the requirements stated in this Specification shall be submitted for each batch of rubber fenders delivered on the site.

The fender supplier shall supply either a Type Approval certificate to PIANC 2002 Appendix A, or, evidence of witnessed testing to prove the fender performance under operating conditions and environment.

Prior to shipment, all fenders shall be broken in by compressing each fender to the rated energy deflection value at least three times before shipment.

2.3 Ladders, Railing and Handgrips

2.3.1 General

Ladders, railing and handgrips shall be provided at locations shown on the DRAWINGS. They shall be fabricated in accordance with the details and dimensions shown on the DRAWINGS.

Ladders shall be recessed into the quay wall and be provided with handgrips. The lowest rung of ladders shall extend down to at least one metre below LAT.

2.3.2 Fabrication

Ladders, ladder supports, railing and handgrips shall be fabricated complying with the steel work of small craft landing facility in section 2.5.1. The CONTRACTOR shall submit steelwork shop drawings to the CLIENT for review.

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The supplied ladders, ladder supports, railing and handgrips shall include all test certificates issued by a specialized laboratory to illustrate compliance with the applicable standards.

2.3.3 Fixings

Fixings for ladders, ladder supports, railing and handgrips shall be by percussion drilling and resin grouting as shown on the DRAWINGS or by cast in fixings. The dimensions of fixings and nuts and washers shall be as shown on the DRAWINGS.

Fixings and associated nuts and washers shall conform to BS 3692:2001 and shall be centrifuge hot-dip galvanized to a minimum average thickness of 45 microns DFT, in accordance with BS EN ISO 1461:1999. After the hot-dip galvanizing, threads shall be brushed out to conform to the ISO-fitting.

2.3.4 Installation

The CONTRACTOR shall install the ladders at the front of the quay wall, as shown on the DRAWINGS. The ladders shall be placed at the location of the embedded fixings, and fixed and tightened with all the fixings.

2.4 Fixing Metalwork in Concrete

Bolts, cast-in sockets, frames etc to be fixed in situ to concrete shall be set accurately in the shuttering or hung from special supports in their correct positions. They shall be firmly fixed so that they cannot be displaced during the placing of surrounding concrete. Unless otherwise specified, all such steelwork which is to be cast into concrete shall receive corrosion protection as specified in this specification.

Where approved, holes for bolts may be drilled in concrete after it is hardened. Care shall be taken to ensure that damage to steel reinforcement does not occur. The holes shall be drilled using a rotary percussive drill employing air or water flushing of the hole. All dirt shall be removed prior to grouting in the bolt.

The use of diamond drilled holes will not be permitted, unless the Contractor can demonstrate to the Engineer that reinforcement has been accurately displaced and will not therefore be cut by the drilling. In the event that approval for diamond drilling is given and reinforcement is subsequently cut, Contractor shall carry out any additional remedial works to the satisfaction of Engineer at Contractor's expense. Any diamond drilled holes to accommodate grouted anchor bolts shall be thoroughly roughened as recommended by the bolt manufacturer and to the satisfaction of the Engineer.

Preformed holes for foundation and holding down bolts shall be formed by boxes of approved type which can be struck cleanly or which are suitable to be left in or by expanded metal sleeves. Polystyrene shall not be removed by burning. After the concrete surrounding the boxes or sleeves has hardened and the form stripped if necessary, the holes shall be cleaned out and temporarily plugged until the bolts are to be fixed. Any damage to holes shall

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be made good by the Contractor.

All rag bolts or indented bolts shall be of approved type and shall be accurately set in position with the shank extending so that two threads will protrude past the nuts. They shall be set before the concrete is placed and care shall be taken to protect the bolt threads. Galvanised rag bolts or indented bolts shall be used with galvanised steel sections. Before bolts are grouted in, the holes shall be thoroughly cleaned. Grout of the type indicated or otherwise approved shall be placed in the hole and around the bolt and the surface shall be finished to present a uniform appearance with its surroundings.

Angles forming frames or edges to pits and trenches shall be given an approved protective system. They shall be fixed to the concrete with fish-tailed lugs.

Patent fixing arrangements shall be fitted in accordance with manufacturer's recommendations.

Cartridge driven pins shall only be used when approved and shall not be used for any fixing subject to tensile stress.

All fixings into concrete shall be electrically isolated from the reinforcing steel to avoid bimetallic corrosion. Where fixings are of dissimilar metal to the items being fixed, they shall include suitable isolating sleeves and washers to ensure that there is no electrical contact between the fixing and item.

2.5 Small Craft Landing Facility

2.5.1 Fabrication

Fabrication shall comply with the requirements of BS 5950 – 2 after the approval of fabrication drawings by CLIENT.

All sharp edges shall be removed from holes and cut faces.

Welded fabrications which are to be subsequently galvanised shall have continuous welding in order to avoid crevices. Tubular construction which is to be galvanised shall be provided with vent holes in positions subject to the CLIENT for approval.

Fabrication accuracy shall be within the following limits: › Length: 3 mm.

› Twist and Deviation: 1 in 1000.

2.5.2 Detailing of Connections

Detailing of connections shall ensure that inaccessible pockets/gaps are avoided. respect, back-to-back angles with spacers and similar details which would prevent full accessibility for painting are not acceptable.

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Where cope holes are required to allow completion of butt-welding they shall be of adequate size to allow fillet welding to seal the connection, while still allowing full accessibility for subsequent painting.

Sniping of stiffeners at the root radii of rolled members is not acceptable. Stiffeners shall be cut to the required profile to fit closely into all such radii, and seal welded in accordance with the welding requirements hereafter.

2.5.3 Submissions

The CONTRACTOR shall submit shop drawing for approval of the CLIENT. Materials shall not be ordered nor fabrication commenced until shop drawings are approved.

The CONTRACTOR shall submit for approval details of erection procedures.

2.5.4 Welding

Metal-arc welding of steel to BS EN 10025 shall be in accordance with the requirements of BS EN 1011-1:1998 and BS EN 1011-2:2001.

Run-on/run-off plates shall be used during butt-welding. Fillet welds shall be continuous to form a complete seal where two members join or abut. **2.5.5 Electrodes for Welding**

The CONTRACTOR shall obtain approval of the types of electrodes proposed for use. Welding electrodes shall comply with BS EN 499:1995 and shall give a weld deposit with mechanical properties not less than minimum specified for the parent metal. Hydrogen-controlled electrodes shall be used for butt-welding of steel over 25 mm thick.

2.5.6 Welding Operators

Welders employed on the work shall be tested to BS 4871 and BS 4872: Part 1. Welding shall be carried out under the supervision of a competent welding technologist and the test pieces shall be tested in accordance with BS EN 288-3:1992.

2.5.7 Testing of Butt Fillet Welds

The CONTRACTOR shall make radiographic examination of butt welds in accordance with Section 8 of American Petroleum Industry (API) Standard 1104 and shall carry out dye-penetrant accordance with BS EN 571-1:1997.

In general, 10% of the length of each butt weld shall be radiographically inspected and 10% shall be tested using penetrant. 5% of the length of each fillet weld shall be tested using penetrant. The locations of lengths to be tested shall be instructed by the CLIENT.

Non-destructive testing operators shall be qualified to a minimum standard of ASNT Level 2.

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2.5.8 Site Welding

The CONTRACTOR may, subject to prior approval, use site welding as an alternative to bolted connections.

Site-welded joints shall be inspected by radiography in accordance with Section 8 of API Standard 1104. Initially 100% of each butt weld shall be inspected. At the discretion of the CLIENT, the number of inspections may subsequently be reduced.

Finished welds shall comply with Section 6 of API Standard 1104. Defective welds shall be cut out, remade and retested until approved.

2.5.9 Steel

The steel grades shall be Q345B. The parameter of material Q345B are shown as follows:

(1)Mechanic properties

Mark	quality grade	yield strength, MPa		Tensile Strength, MPa	Elongation, %				
		≤ 16 mm	16mm ~ 40mm		≤40mm	nominal thickness(Diameter, length,)			
				≤ 40mm		>40mm ~ 63mm	>63mm~ 100mm	>100mm~ 150mm	>150mm ~ 200mm
Q345	B	≥345	≥335	470~630	≥20	≥19	≥19	≥18	≥17

(2)Charpy impact test

2.5.10 Testing of Materials

The CONTRACTOR shall perform tests on and submit test certificates for the materials to be used in the work. The tests shall include the following in accordance with BS EN 10113-1:1993:

› Chemical analysis. › Tensile tests. › Bend tests. › Flattening tests.

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The tests shall be carried out by an approved independent testing authority and notice shall be given of the intended execution of any such test.

If any sample fails a test, the consignment it represents may be rejected in part or in whole.

2.5.11 Anticorrosion protection

Take the hot-dip galvanizing and coating prevention measures, with design life of 20 years.

2.5.11.1 Hot-dip galvanizing requirements

(1) Surface pretreatment and acid pickling before hot dip galvanizing steel structure. After acid pickling steel surface should have no visible oxide scale, rust, coating and fixtures.

(2) Galvanized zinc content in the tank should not be less than 98.5%

(3) The hot-dip galvanized coating weight should reach 610g/m².

2.5.11.2 Coating requirements

The matching coatings of coating systems should have good adhesion, corrosion resistance, weather resistance, abrasion resistance and impact resistance.

The primer can use epoxy paint, polyurethane paint, not with zinc-rich paint

Top finish can use polyurethane paint.

The damage of paint coating can be repaired.

The thickness of the coating should meet the design service life requirements, and shall not be less than 150µm.

Coating color is determined by the CLIENT.

2.5.12 Bolts

Bolts and nuts in ordinary bolt assemblies shall be grade 4.6 or 8.8 in accordance with BS 4190.

Metal washers shall be made in accordance with BS 4320 Section 2 and unless otherwise specified shall be black steel washers to Form E.

All lock nuts shall be in accordance with BS 4190.

Where specific coatings are required to fasteners they shall be provided by the fastener manufacturer and shall comply with the appropriate part of BS 7371-6.

2.5.13 Tolerances for Erected Steelwork

The tolerances for erected steelwork shall be:

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- › Position of first erected columns : ± 3 mm. › Linear dimensions:
 - › Upto 8m: ± 5 mm. › 8–15 m: ± 7 mm. › 15–25 m: ± 10 mm. › Over 25 m: ± 12 mm.
- › Verticality of column in 20 m height: ± 10 mm. › Level of beam at junction with column measured from transferred bench mark: ± 5 mm.
- › Levels of upper or lower surface of two or more beams meeting at a column: ± 3 mm.

2.5.14 Transportation and Storage

Steelwork and protective coatings shall be protected from damage during packing, handling, transportation and storage.

The Contractor shall ensure that members are not subjected to greater stresses than those allowed in BS 5950- 2 during fabrication, transportation, storage and erection.

Stored items shall not be in contact with each other and shall be clear of the ground.

2.5.15 Damaged Material

Steelwork deemed to be damaged beyond repair in transit shall be replaced at the CONTRACTOR's expense.

The CONTRACTOR shall obtain prior approval for remedial work to damaged material. Welded items shall be stress-relieved after fabrication.