



**HELLENIC GAS
TRANSMISSION
SYSTEM OPERATOR**

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**TECHNICAL JOB
SPECIFICATION**

130/1

REVISION 0

DATE 29/06/2011

LNG PLANT

**UNFIRED PRESSURE
VESSELS**

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REVISIONS LOG

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REFERENCE DOCUMENTS

EU Directive 97/23/EC "of the European Parliament and of the Council of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment" (PED)

Job Spec. No. 800/2
[Thermal and acoustic insulation]

Job Spec. No. 830/1
[External Painting]

Job Spec. No. 840/1
[Fireproofing]

REFERENCE DOCUMENTS (contd./...)

ELOT EN 1092-1 (harmonised with EU Directive 97/23/EC- PED)
[Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated – Part1: steel flanges]

ELOT EN 1514
[Flanges and their joints - Dimensions of gaskets for PN -designated flanges]

ELOT EN 1591-1
[Flanges and their joints - Design rules for gasketed circular flange connections – Part 1: Calculation method]

ELOT EN 10204 (harmonised with EU Directive 97/23/EC- PED)
[Metallic products - Types of inspection documents]

ELOT EN 12560
[Flanges and their joints - Gaskets for class-designated flanges]

ELOT EN 13445-1 (harmonised with EU Directive 97/23/EC- PED)
[Unfired pressure vessels – Part 1: General]

ELOT EN 13445-2 (harmonised with EU Directive 97/23/EC- PED)
[Unfired pressure vessels – Part 2: Materials]

ELOT EN 13445-3 (harmonised with EU Directive 97/23/EC- PED)
[Unfired pressure vessels – Part 3: Design]

ELOT EN 13445-4 (harmonised with EU Directive 97/23/EC- PED)
[Unfired pressure vessels – Part 4: Fabrication]

ELOT EN 13445-5 (harmonised with EU Directive 97/23/EC- PED)
[Unfired pressure vessels – Part 5: Inspection and Testing]

1.0 SCOPE

Welded Unfired Pressure Vessels shall be designed, constructed, inspected and tested in accordance with this Job Specification, unless otherwise noted on the drawings, individual requisitions or supplementary design data for each particular vessel.

Details not included in applicable specification and/or in vessel drawing(s) shall be by Vessel Vendor.

Any conflict between requirements of this Job Specification, drawings, requisitions or Standards shall be referred to Owner Representative for clarification before proceeding with fabrication of the affected part.

Vendor shall be responsible to design vessels and their components in accordance with requirements of applicable documents. In no event, however, are thickness, etc. to be less than those shown on vessel drawing(s).

2.0 BASIS OF DESIGN

2.1 STANDARD REQUIREMENTS

The design of unfired pressure vessels shall be according to the following:

- a) **EU Directive 97/23/EC**
- b) **ELOT EN 13445** (this European standard is **mandated to EU Directive 97/23/EC**) unless otherwise specified on drawings or requisitions, which shall be referred to herein as the "Standard".
- c) Requirements mandatory or accepted by the National or Local Authorities where the vessel is to be located.
- d) Insurance requirements

2.2 SHELL AND HEAD THICKNESS

Vessel shells and heads shall have minimum thickness of not less than the requirements of the **EU Directive 97/23/EC** and **ELOT EN 13445** using design temperature, design pressure and corrosion allowance as specified on the drawings. In any event the minimum thickness, exclusive of corrosion allowance, shall not be less than the larger of the following values:

$(I.D. + 2500) / 1000$ or 5 mm (I.D. = Internal diameter mm)

for carbon and low-alloy steel vessels, and

$(I.D. + 2500) / 1000$ or 3 mm (I.D. = Internal diameter mm)

for high alloys (12% Cr. or higher) and non ferrous vessels.

For clad vessels, the backing material only shall be used in strength calculations. The cladding shall be used as corrosion allowance. Exception to this requirement shall only be allowed in special cases upon approval by Owner.

2.3 HEADS AND CONICAL SECTIONS

All heads shall conform to permissible Standard shapes.

Ellipsoidal heads shall have a ratio of the inside major axis to the inside minor axis of 2:1.

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When used as the bottom head of a skirt supported vessel, the radius of the toroid section shall be not less than 16.5% of the inside diameter of the adjoining cylindrical shell.

Apex angle of the conical portion of toriconical heads shall not exceed 60 degrees, unless otherwise noted on vessel drawing(s)

2.4 **NOZZLE AND MANWAY NECK THICKNESS AND FLANGE RATING**

Nozzle and manway necks shall have minimum thickness not less than the requirements of **ELOT EN 13445**, using design temperature, design pressure and corrosion allowance as specified on the drawings.

Flanged manways and nozzles may be of forged long welding neck or built up construction except that all connections in vessel wall with thickness higher than 50 mm or in cyclic service shall be self reinforced.

All nozzle connections DN 750 and smaller shall be flanged; larger connections shall be butt-welded.

Flanges shall be of raised face welded neck type.

Threaded or socket welded connections shall not be used unless otherwise specified on the drawing(s).

Flanges for nozzles in accordance with **ELOT EN 1092-1**.

For nozzle loads **ELOT EN 13445** shall be applied.

2.5 **ACCESS OPENINGS AND VENTS**

Vessels up to and including DN 600 should be provided with inspection openings. For vessels DN 600 to DN 900, handholes should normally be provided except in those cases where manways are specified; alternatively the use of girth flanges instead of manways may be considered. Vessels above DN 900 should be provided with at least one manway, as specified below:

- a) For towers with trays there should be the following:
 - One manway in vessel shell below bottom tray.
 - One manway in vessel shell above top tray.
 - One manway at each elevation where internal distributor pipes are provided plus additional manways to give 10 tray max spacing.
 - All manways should be DN 500 (minimum).
- b) For packed towers, it is recommended that there be one (1) DN 500 (min) manway above each bed for catalyst loading, and one (1) dump connection at the bottom of each bed, above the bed support.
This latter connection should be sized according to the requirements of the particular packing but should be a minimum of 250 size.
- c) For horizontal drums one DN 450 manway located in the vessel head below or on the centreline or vessel shall in a horizontal position. Only if layout dictates otherwise should it be located in the top of the vessel.
- d) For vertical drums one DN 450 manway located in the shell near the bottom tangent line.

Vessels provided with skirts shall have a reinforced opening in the skirt for each connection on the bottom head. Such opening shall be two sizes larger than the

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connecting pipe plus twice the thickness of insulation, unless otherwise noted on the drawings. Where flanged nozzles occur inside the skirt, the opening in the skirt shall be of such a size as to permit the removal of the flanged connecting piping.

A vent shall be provided at or near the top of the vessel on all vessels with manways. The vent may be another manway or a flanged process nozzle, which can be disconnected from the vessel.

All vessel skirts shall have a minimum of DN 100 pipe vents and one DN 450 access opening.

2.6 BLIND FLANGES

Blind flanges shall have dimensions, including corrosion allowance, from DN50 to DN600 **ELOT EN 1092-1** applies to satisfy design conditions.

Blind flanges over 600 DN shall be designed as per **ELOT EN 1591** using plate or forging, unless specified differently on drawings.

2.7 SUPPORTS

Vertical vessels shall normally be supported on skirts, legs or brackets, as specified in relevant STD Drawing and on individual vessel drawings.

Skirt supports are recommended for tall and/or large vertical vessels to avoid concentrated local loads on the shell that can arise from legs or brackets. Minimum skirt thickness shall never be less than:

- a) For Vertical Vessels less than 1800 mm diameter, 6mm
- b) For Vertical Vessels 1800 mm diameter and over, 8mm.

On alloy steel vessels and carbon steel vessels with design temperatures over 325°C, the top 900 mm of skirt is to be equivalent material to the shell.

2.8 LIFTING LUGS

Vertical vessels shall be provided with lifting lugs to facilitate handling during transport and erection at site.

Vessels shall be calculated also for loads imposed during shipment.

2.9 CORROSION ALLOWANCE

Unless otherwise specified on drawings, minimum corrosion allowance shall be as follows:

MATERIALS OF CONSTRUCTION	MINIM. CORROSION ALLOWANCE
Carbon and Low Alloy Steels	1,5
High alloy steels All non-ferrous materials	0,25

For all parts of vessels where sizes or thickness are given, the specified corrosion allowance shall be included in the thickness specified. If other sizes or thickness need to be determined, the corrosion allowance specified shall be included as

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follows:

- On the inside of shells, heads, nozzles, manholes and covers: the full corrosion allowance.
- On internal parts welded to the inside of the vessel: the full corrosion allowance added to each face in contact with the vessel contents.
- On bolted removable parts: one half corrosion allowance added to each face in contact with the vessel contents, except as specified herein below a), b), c).
- On fillet and seal welds on internal attachments: the full corrosion allowance added to the thickness necessary for strength or tightness measurement across the throat (but not to exceed 10 mm throat thickness).

Base material of clad plates where applicable shall require no corrosion allowance over strength requirements.

Internal gratings, where used are to be specified as follows:

- a) For 3 mm corrosion, standard size carbon steel grating of double the load capacity as the one required for actual load and spacing is to be provided.
- b) For 6 mm corrosion, a standard size grating of four (4) times the loading capacity as the one required is to be provided.
- c) For corrosion above 6 mm special consideration should be given.

If found more economical, where corrosion in the vessel exceeds 3 mm Vendor may substitute the alloy material for all gratings with a higher quality one, provided prior written approval is obtained from Owner.

2.10 ADDITIONAL DESIGN CRITERIA

Vessels and their components shall also comply with all applicable requirements for the following load combinations:

- a) $Wt(E) + (W \text{ or } E)$
 - b) $Wt(Op) + D(P/T) + (W \text{ or } E) + M$
 - c) $Wt(Op) + (W \text{ or } E) + M$
 - d) $Wt(T) + T(P/T) + 1/2 W$ (with vessel in operating position).
 - e) Any other load combination required by the applicable European standards and/or by vessel drawing(s).
- where :

D(P/T) : Design pressure-temperature condition(s) shown on vessel drawing(s). When loads due to internals or up flow is specified, the loads shall be added to D(P/T), as well any static head is determining the design pressure at the bottom of the vessel.

T(P/T) : Test pressure-temperature condition referred to the case under consideration, which may involve corroded or uncorroded thickness.

Wt(E) : This is the weight of the vessel during erection to its foundation. It includes weight of shell and heads including mill tolerances, supports, connections, and any other internal or external attachments that will be part of vessel during erection. It normally does not include weight of ladders, platforms, external piping and catalyst.

Wt(T) : This is the test weight and represents the sum of "erection weight" plus weight of ladders, platforms, external piping, test fluid, fireproofing.

Wt(Op) : This is the weight of the vessel during normal operation and includes "erection weight" plus weight of ladders, platforms, external piping, insulation, refractory, operating fluid, catalyst and/or packing present during operation.

W : Design Wind load assuming all external appurtenances are attached to vessel.

E : Design earthquake load corresponding to weight condition under consideration.

M : Miscellaneous applicable loads such as piping reactions, moments induced by components supported eccentrically from vessel, etc.

Vertical vessels shall be designed to have a maximum deflection at the top under load combination $Wt(Op) + D(P/T) + W + M$, of 200 mm per 30 m of height. (Earthquake must not be considered).

Vertical vessels with an L/D ratio in excess of 15 and $Wt(Op)/DLW$ ratio less than 400, in which:

L : Total vessel height, m

D : Average inside diameter for top half of vessel, m

Wt(OP) : Operating weight, kg

DLW : Dead Load Weight of vessel

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Shall be analyzed for vibration.

Calculation must guarantee against resonance condition.

During hydrotest 1/2 of Design wind speed shall be considered in the design of vessel and components.

For vessel designed to operate under external pressure stiffening rings shall be in preference fabricated from structural sections, as per **ELOT EN 13445** requirements.

External mechanical loads on shell or thrust loads on nozzles shall be investigated.

For vessel in hydrogen service with a hydrogen partial pressure above 7 bar the following must be taken into account.

- a) The maximum carbon content in the fabrication materials must not be higher than 0.25%.
- b) Material having yield strength greater than 490 N/mm² shall not be employed.
- c) All attachments and pads welded on vessel wall shall have a vent hole.
- d) All internal and external welds on vessel must be full penetration and shall be fully magnetic particle inspected.
- e) The internal lining of nozzle obtained by sleeve is not permitted.
- f) Threaded connection shall not be used.
- g) Support skirts must have a course, 900 mm in height, welded to the vessel bottom head, of the same material of shell.

3.0 MATERIALS

Unless otherwise approved in writing by Owner, the same plate material standard, i.e. **ELOT EN 13445** shall be used for reinforcing pads as for the vessel parts to which they are attached.

Any heat treatment operations performed by vessel Vendor and intended to enhance mechanical properties, shall obtain Owner approval.

When normalized and tempered materials are specified, the tempering shall be performed prior to any welding unless specifically otherwise authorized in writing by Owner.

The tempering temperature shall be 10°C higher than that required for post weld heat treatment, unless otherwise specified on vessel drawing(s).

Casting shall not be used without written approval from Owner. Plate material according to **ELOT EN 13445**.

Welding fittings for pressure parts shall be of seamless steel. Materials shall conform to **ELOT EN 13445** requirements.

3.1 HIGH-ALLOY MATERIALS

All nozzles and manways in clad sections of vessels shall be lined and faced with 2 mm minimum thickness alloy of the same material as the cladding, in accordance with the drawings.

3.2 GASKETS

Gaskets shall be as specified on the drawings.

No gaskets shall contain asbestos fibers in any form.

3.3 EXTERNAL BOLTING

Threads for stud bolts and nuts are to be coarse pitch up to the including diameter DN 100. Above DN 100, eight (8) thread series shall be furnished. Nuts shall be semi finished and hexagonal shape.

All pressure bolting shall conform to the requirements of the Standard.

Bolting for external access manways shall be not less than DN 20.

3.4 INTERNAL BOLTING

All internal bolting shall be selected with due regard for the materials of construction of internals.

4.0 SUBSTITUTIONS

When vessel fabrication and shipment can be expedited by the substitution of materials, shapes or dimensions for those specified, such substitutions shall be made only with the full knowledge and prior written consent of Owner.

5.0 FABRICATION

Fabrication shall be as per **ELOT EN 13445-4**, and the additional requirements as stated in this specification.

Large vessels which cannot be completely shop fabricated shall be designed to minimize the amount of field welding, radiography and heat treatment. Adjacent pieces, which are to be assembled in the field, shall be shop fitted and match marked to ensure proper field fit up.

Such shop fitting must be witnessed and approved by Owner.

Vessel Vendor shall supply welders test plates, run-off plates, wedges, keys, etc. for field welding and easy erection.

5.1 TOLERANCES

Tolerances on out-of-roundness of vessels shall conform to the Standard, Owner requirements and with the limitation that the maximum difference of diameters of any vessel provided with trays shall not exceed 19 mm at any cross section. All tolerances must be referred to the completed vessel, after heat treatment if required.

Support rings or angles for baffles shall be set in planes perpendicular to the vertical axis of the vessel.

Baffles and other internals shall be installed with a level tolerance of 2.5 mm per meter of diameter with a maximum of 6 mm taken over the full diameter of the vessel.

5.2 HEADS

Heads shall be spun or pressed from blanks of sufficient thickness, to obtain the minimum thickness as shown on the drawings.

5.3 NOZZLES, MANWAYS AND VENTS

Flanged nozzles through DN 50 2" size inclusive shall be forged steel long welding necks. Built-up nozzles may be accepted in special cases upon approval by Owner.

Manways and nozzles over DN 50 2" size may be built-up using forged steel welding neck or slip-on type flanges, with rolled plate or pipe necks.

Flanges for internal piping shall be furnished with nuts, bolts and gaskets. For non-pressure parts, plate flanges may be used.

Bolt holes in flanges shall straddle the centerline of the vessel for nozzles located in shell, and the normal center line for nozzles located in heads.

All nozzles' projection lengths will be deriving from the relevant mechanical calculations of the vessel.

Nozzles are to be measured and dimensioned from centerline or tangent line of vessel.

Nozzles and manholes shall be flush with the inside contour of the vessel where protrusion will interfere with internals or the flow of process fluids will be affected, with exceptions of drain connections which shall always be flush.

All flanges included as a part of the equipment or piping shall have gasket surfaces finished in accordance with **ELOT EN 13445, ELOT EN 1092-1, ELOT EN 1514 series, ELOT EN 12560** and according to the following table:

Flange Face	Gasket Type	Face Finish
Raised & full face	1,5 mm soft ring	"Stock"
Raised face	Spiral wound (>3,2µm Ra)	Smooth
Raised face	Metal jacketed Very smooth (<1,6µm Ra)	
Ring joint	Oval ring (<1,6µm Ra)	Very smooth

5.4 SEAMS IN SUPPORT SKIRTS

Seams in support skirts shall be made with full penetration butt welds. Connecting welds between skirt and head shall be flush ground and have a width equal to skirt thickness and length twice width.

5.5 COUPLINGS

Couplings only if specified on vessel drawings shall be limited to DN 40 maximum size and maximum class pressure designation 420 bar (cold working pressure) which shall be socket weld type, except for thermowells which shall be DN 25 threaded type. Internal non-pressure threaded connections shall have a pressure class designation 210 bar. They shall be forgings conforming to **ELOT EN 1591-1** latest revision.

6.0 WELDING

6.1 LAYOUT OF PLATES

Plates layout shall be arranged so that all longitudinal weld seams shall miss all nozzles and manholes or their reinforcing pads. The same requirement applies to circumferential weld seams where possible, except that these seams are to clear all internal support rings and external stiffener or insulation support rings.

All welds of nozzles, manways and their reinforcement to equipment shell, heads and/or skirts shall be full penetration and in accordance with **ELOT EN 13445**.

Other weld details may be used provided that they afford full penetration and that written approval for their use is obtained from Owner.

7.0 VESSEL EXTERNAL ATTACHMENTS & REINFORCING PADS

Vendor supply shall complete and include the following:

- All supports such as skirts, lugs, legs or saddles.
- Davits or other suitable devices for handling relief valves, manways covers, heavy blind flanges, etc.
- Support lugs, clips and brackets for ladders, platforms, etc.
- Nozzles and manways or handholes, including manway and handhole covers, gaskets and bolting.
- Blind flanges for all blanked connections, including gaskets and bolting.
- All attachments to the vessel as required for fireproofing, shipment and erection.

Reinforcement pads shall be calculated and provided by the Vendor for all nozzles, manways or other openings and shall fulfill the requirements of the applicable European standard.

Reinforcement shall be equal to the greater of the requirements obtained from the following:

- New vessel subject to testing condition with no corrosion allowance.
- Fully corroded vessel subject to design conditions with corrosion allowance equal to that specified on the drawings.

All external attachments, such as ladder and platform clips, pipe supports, etc. shall be of the same material as the shell and heads to which they are directly attached, unless otherwise specified on drawings.

8.0 VESSEL INTERNALS

Vessels shall include the following:

- All internal attachments welded directly to the shell.
- Internal piping and bolting, with properly designed pipe supports.

All internals that are not welded to the shell shall be fabricated to pass through the vessel manway.

As a minimum requirement, internal gratings, where used, shall always be provided with one (1) layer of No. 4 wire mesh, X5CrNiMo 17-12-2 (stainless steel 1.4401), 2 mm wire diameter, individually secured to the grating sections. Where

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the requirements are more stringent, a finer wire mesh shall be noted on the vessel construction drawings.

Pressure drop across vessel component(s), as defined on vessel drawing(s), shall be used for design of such components and of their supports.

9.0 POST WELD HEAT TREATMENT

No welding shall be performed on post weld heat-treated vessels, when the heat treatment is required for process reasons.

In case that PWHT is required by other reasons, welding may be allowed only as permitted in **ELOT EN 13445-4** or by Owner written approval.

Vessels, which have been submitted to post weld heat treatment shall have a large warning notice, painted on shell, at convenient locations, stating:

STRESS RELIEVED VESSEL NO WELDING PERMITTED

10.0 NON-DESTRUCTIVE EXAMINATION

Radiography shall be performed as follows:

- All radiographic examination procedure and acceptance criteria shall be in accordance with **ELOT EN 13445-5**.
- All intersections of the longitudinal and circumferential seams and all the starting and stopping points of weld heads shall be radiographed.
- When radiographic inspection is required, the welds that are not examinable by x-ray shall be subjected to magnetic particle or ultrasonic examination or dye check, whichever is applicable, under Owner written approval.

Magnetic particle examination and acceptance criteria shall be per the **ELOT EN 13445-5**.

Liquid penetrant examination and acceptance criteria shall be used in place of any required magnetic particle examination.

Ultrasonic examination and acceptance criteria shall be per **ELOT EN 13445-5**.

11.0 INSPECTION

11.1 GENERAL INSPECTION

Inspection shall be per **ELOT EN 13445-5**.

11.2 SHOP INSPECTION

For shop inspection requirements refer to the Purchase Order.

12.0 TESTING

The Hydrostatic test shall be the final step in the fabrication of vessels.

All shop fabricated vessels shall be hydrostatically tested and certified by an Notified Body as per requirements of **EU Directive 97/23/EC** (PED). No provision for field hydrostatic testing for shop fabricated vessels need to be made, unless otherwise specified on the drawings.

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All field-fabricated vessels shall receive a hydrostatic test where supports, foundations or subsoil permit, or where the static head of the test fluid does not impose unreasonable thickness requirements.

Temperature of water shall never be less than 15°C. Vessel Vendor shall take all necessary precautions to avoid brittle fracture of vessels during the hydrostatic test.

Only water having less than 50 p.p.m. chloride ions shall be used during hydrotesting for all austenitic/martensitic stainless steel materials exposed to test water. In addition the equipment shall be immediately drained after hydrotesting and carefully dried by blowing with air and an absolute absence of any pocket water must be ensured.

The hydrostatic test pressure specified on drawings shall be measured at the top of the vessel.

Vertical shop fabricated vessels may be tested in the horizontal position; in this case the hydrostatic test pressure will be increased to consider the static head present when the vessel is in vertical position.

The gaskets used for the hydrotest must have physical characteristics similar to the gaskets selected for the operating conditions. Ring type joint gaskets supplied by the vendor with the vessel may be used for the hydrostatic test but must be replaced if damaged. All other type of gaskets shall be replaced, after hydrostatic test.

13.0 CERTIFICATION CONFORMING EUROPEAN LEGISLATION – CE MARK AND NAMEPLATE

Each pressure vessel shall be bearing the CE mark as per **EU Directive 97/23/EC** (PED) requirements. The nameplate shall be located on shell above the lowest manhole for vertical vessels and in center of a head or above a manhole in head for horizontal vessels. The nameplate and screws shall be of stainless steel material.

14.0 DRAWINGS

Drawings shall be provided showing complete details of the actual construction of the vessel. For field erected vessels the drawings should depict the method of field assembly.

Design data, the design and construction Standards shall be noted on these drawings.

15.0 TECHNICAL FILE (INSPECTIONS REPORTS)

Vendor's data reports shall be furnished in accordance with the provisions of the **EU Directive 97/23/EC** (PED). Such reports shall include mill test reports on the plates for shells and heads, supplementary charts and reports on pressure tests, stress relieving and X-raying.

Mill test reports or certificates for reinforcing plates, pipe, skirts, forgings and bolting shall be furnished for each vessel when the material is allocated for the job.

Clear and legible rubbings or photostats of the nameplate showing Owner name, vessel serial number, Purchaser's item number, shop or field test pressure and other data as they appear on the vessel shall be furnished. These shall be made available immediately following the affix of **CE mark**.

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Each report and nameplate rubbing shall include the Owner Item Number and Purchase Order Number.

16.0 CLEANING

After completion of fabrication, the inside and outside of vessels shall be thoroughly cleaned. Loose mill scale, droppings and debris shall be removed.

Liquid used for hydrotest or cleaning shall be entirely drained.

17.0 PAINTING

Vessels shall be painted as specified on vessel drawing(s).

Job Spec. No. 830/1 shall dictate surface preparation and painting required.

Zinc contamination of stainless steel materials and to a lesser extent of carbon steel components may result in embitterment and even in failure of the vessel. To preclude this, the following shall be observed:

Stainless steel vessels and all other vessels operating above 400°C shall not be painted with zinc rich paints nor shall they come in contact with parts either painted with zinc rich paints or hot dip galvanized.

For all other vessels, parts painted with zinc rich paints or hot dip galvanized shall not be welded to the vessel.

Machined surfaces shall not be painted.

Painting shall be deferred until vessel has been tested, inspected and accepted by Owner.

18.0 INSULATION AND FIREPROOFING

Vessel shall be insulated and fireproofed as specified on vessel drawings and **Job Spec. No. 800/2** and **Job Spec. No. 840/1**.

19.0 SPARE PARTS

As a minimum requirement two (2) spare gaskets and 10% of bolting (minimum 2 bolts) shall be supplied for each blanked nozzle, manhole and hand hole.

20.0 SHIPMENT

One piece vessels shall be completely equipped with nozzles, manways and all internal and external attachments before shipment, unless otherwise specified on the drawings.

Vessels shall be shipped in one piece, unless the weight or overall dimensions exceed the limits imposed by transportation facilities.

Where necessary, vessel and its components shall be supported by temporary stiffeners to avoid distortion and damage during transportation and erection.

All exposed machined surfaces shall be coated with a rust preventive. All flanges shall be protected with wooden covers and all threaded connections shall be plugged.

21.0 GUARANTEES

For guarantee requirements see the Purchase Order.

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22.0 DRAWINGS AND DOCUMENTATION

Contractor shall supply drawings and documentation in English language per following **TABLE**.

TYPE OF DRAWINGS	PRELIMINARY		FINAL	
	No of copies	When due	No. of copies	When due
Detail drawings.	10	3 weeks from order (note 1)	12+2R	3 weeks before final inspection
Welding procedure specifications (WPS) and Procedure Qualification Records.	6	3 weeks from order (Note 1)	12	3 weeks before final inspection
Sub-Order of materials.	6	As required by purchase Order	—	As required by purchase order
Material certificates.	—		12	As required by Purchase order
Test certificates.	—		12	As required by Purchase Order
Fabrication Schedule.	6		—	3 weeks from order

Also electronic files (word documents and or AutoCAD documents as applicable) of all Documents, Drawings and Certificates must be submitted by Contractor to the Owner.

Note :

Vendor drawings, WPS, PQR, shall be reviewed from Owner within ten (10) working days after their receipt.

Revised drawings and documents shall be submitted by Vendor to Owner two weeks from receipt of comments.

All drawings must be identified by the following information adjacent to Vendor title block:

CLIENT :
SITE :
CONTRACT No :
ITEM No :
ORDER No :

All documents shall be addressed to: AS PER PURCHASE ORDER.