Table of contents

1 Subject of specification 3
2 Scope of validity 3
2.1 Deviations 3
3 General 3
3.1 Scope 3
3.2 Order of Precedence 4
4 Design Criteria 4
4.1 General Requirements 4
4.2 Design Conditions and Stresses 4
4.3 Stresses 6
4.4 Design Pressure and Temperature 6
4.5 Dead Load Definitions 6
4.6 Dynamic Loads 7
4.7 Shell and Heads 7
4.8 Reinforcement of Openings 8
4.9 Reinforcement for Nozzle Loads 9
4.10 Pipe, Manholes, Handholes and Inspection Openings 9
4.11 Flanges and Gaskets 10
4.12 Connections 11
4.13 Internals 11
4.14 Corrosion Protection and Weld Overlay 12
4.15 Supports and External Attachments 13
5 Vessel Design Requirements 14
5.1 Materials 14

5.2 Alloy lining 16
5.3 Bolts and Gaskets 16
5.4 Fabrication and Workmanship 17
5.5 Welding 18
5.6 Heat Treatment 19
5.7 Tolerances 19
6 Inspection and Testing 20
6.1 Testing 20
6.2 Inspection 21
6.3 Documents Required During Inspection 22
6.4 Rejection 22
7 Nameplates 22
8 Painting, Marking, Packing 23
8.1 Painting 23
8.2 Marking 23
8.3 Packing 23
9 Technical documentation 24
9.1 Design documentation 24
9.2 Final documentation 25
10 Manufacturer's Qualification 26
11 Guarantees 26
12 Relevant documents 27
13 Codes and standards 27
14 Record of changes 29

1 Subject of specification

This specification and other documents referenced herein establish the minimum requirements for the design, fabrication, erection, inspection and tests for pressure vessels, columns and reactors.

2 Scope of validity

This specification applies to the preparation of tender documents, inquiries and contracts for newly planned investment or modernization projects of Grupa LOTOS S.A.

It shall also be a basis for preparing both detailed specifications and inquiries for individual or package unit supplies.

2.1 Deviations

Any deviation from this specification and the relevant specifications, standards and related documents including proposals, which the bidder claims to be economically and / or technically superior solutions must be submitted in writing for review and approval by Grupa LOTOS S.A. Non-approved exceptions are not acceptable by Grupa LOTOS S.A.

The supplier must report in writing any ambiguity in this or any other specifications of Grupa LOTOS S.A. or non-compliance with the referred documents / standards and obtain a written explanation from Grupa LOTOS S.A.

3 General

3.1 Scope

This specification, used in conjunction with the purchase documents, data sheets, and/or drawings establishes the minimum requirements for the mechanical design, fabrication, inspection and testing of fusion welded pressure vessels, columns, reactors, which are subject to internal and/or external pressure. For purpose of this specification only the term "pressure vessel(s)" will be used which covers pressure vessels such as: drums, columns and reactors and other pressurised equipment.

Pressure vessels shall be designed, fabricated and furnished in accordance with Regulation of Minister of Economy - Journal of Laws No. 263, item 2200, year 2005 concerning pressure equipment, implementing provision of Directive of the European Parliament and of the Council 97/23/EC on the approximation of the law of the Member States concerning pressure equipment (PED).

This Specification is based on the ASME Boiler and Pressure Vessel codes and referenced standards and specifications.

The relevant code requirements are specified on purchase documents, data sheets or/and drawings.

3.2 Order of Precedence

In case of conflicts existing between this specification and other documents, the following order of precedence shall govern:

- The current Polish legislation
- Terms of purchase order / contract and other requirements agreed in writing Grupa LOTOS S.A.
- Data Sheets approved by Grupa LOTOS S.A.
- This specification
- Other Specifications
- Drawings and other documents
- Standards

4 Design Criteria

4.1 General Requirements

The design, construction and inspection of pressure vessels shall, as a minimum, meet the requirements of ASME Section VIII, Division 1, or Division 2 as applicable and as specified in pressure vessel data sheet or/and drawing.

Pressure vessels intended for vacuum service greater than 500 Pa (50 mm water gauge), shall be designed and fabricated in accordance with ASME Section VIII, Division 1.

For pressure vessels that are subject to cyclic service, the design criteria and rules of ASME Section VIII, Division 2 shall be employed to perform an analysis, however the allowable stresses limits for ASME VIII Division 1 shall be used in the analysis.

ASME Section VIII, Division 2 rules may be considered for the design basis and are subject to prior Grupa LOTOS S.A. permission in writing.

For each pressure vessel, the operating and maintenance instruction shall be delivered, which addresses the following: installation / erection, start-up procedures, trouble shooting guides, and inspection to result in long failure-free service.

4.2 Design Conditions and Stresses

Snow loads shall be taken into consideration when specified in pressure vessel drawings or/and data sheets.

Load Conditions:

- Operation

- Pressure loads (internal or/and external design pressure)
- Test loads (Hydrostatic test conditions)
- Operating dead load (weight of the liquid at the maximum operating level or catalyst content)

- Dead loads (weights of the vessel including internals, platform, ladders, insulation, fireproofing, refractory, piping, and other permanent attachments)
- Live loads
- Wind loads
- Thermal loads (caused bt the resistant of thermal expansion / interaction of the vessel and its supports)
- Any other operating effects such as unbalanced pressure, piping other than dead load, .and superimposed equipment, etc

- Test

- Test pressure
- Hydrostatic pressure
- Test dead load
- Equipment and external attachment test loads

- Erection 1 (Standing on foundation)

- Erection dead load
- Windload (if required, including weight of: internals, ladders, platforms, piping, insulation, etc, external mounted equipment and attachments, as well as scaffolding)

- Erection 2 (Lifting)

- Erection dead load
- If required, including weight of: internals, insulation, equipment and external attachments (platforms, ladders, piping, etc.)

A shock factor depending on the method of rigging, but minimum 1,5 shall be used.

It shall be noted that critical load conditions might also occur when the vessel is not subject to internal pressure.

Load combinations

All the loads given in the pertinent line for the load case involved shall be superimposed.

Load case		Scaffolding	Wind load	Snow load
Operation	A	no	100%	---
	B	no	100%	50%
	C	no	50%	100%
Pressure test	A	yes	70%	---
Erection 1	A	yes	70%	---

Due to wind loads acting on platform a height of 0,5 m shall be used for the calculation of the projected area of each platform.

For vertical pressure vessels with height greater than 12 m a detailed structural analysis (static calculation) shall be performed. For pressure vessels with height less than 12 mm a detailed structural analysis (static calculation) shall be performed only if the height-to-diameter (h/D) ratio is equal to 10:1 or greater.

Due to wind velocities dynamic exciting forces may arise. Therefore the fundamental periods of vibration of vertical vessels that may be critical with respect to dynamic disturbance shall be calculated. As a criterion for the necessity of dynamic design, Figure 1 of ASME Paper 58-PET-13 may be referenced. Pressure vessels falling above the envelope formed by the L/D = 15 line and the 0.4 to 0.8 period line shall be designed as dynamic structures. If necessary D/h values may be extrapolated.

4.3 Stresses

The allowable stress for pressure parts shall be the as specified in the applicable code.

The allowable stresses for non-pressure parts, except as listed below, shall be 33-1/3 percent of the ultimate tensile strength, 66-2/3 percent of the yield strength, or that producing a creep rate of 1 percent in 10,000 hours, whichever is lower.

- Welds attaching non-pressure parts to the pressure shell and supports for large internals shall be designed to the allowable stresses of pressure parts.
- Anchor bolting shall be designed to the allowable tension and shear stresses specified in the applicable Design Standard for anchor bolts.

Stresses for the design conditions shall be limited to the following:

- Erection stresses limited to the basic allowable stress at ambient temperature and thickness without corrosion allowance.
- Operation stresses limited to basic allowable stress at design temperature and thickness with corrosion allowance.
- Test stresses limited to 90 percent of the minimum specified yield stress at test temperature and thickness without corrosion allowance (in case of test at workshop) or with corrosion allowance (in case of test at site) for pressure parts.
- For non-pressure parts, test stresses limited to 33-1/3 percent over the basic allowable stress at test temperature and thickness with corrosion allowance.
- For all design conditions the maximum allowable longitudinal compressive stress for shells including skirt to be in accordance with the applicable ASME Code with no permitted increase.

4.4 Design Pressure and Temperature

Pressure vessels shall be designed to the design pressure and design temperature as specified in the vessel drawings or/and data sheets.

In case several pressure-temperature combinations are specified all of them shall be taken into account.

Pressure vessels shall be designed and protected against vacuum when the pressure vessels operate under external pressure or as specified in Grupa LOTOS S.A. specification no. 2010.

4.5 Dead Load Definitions

Erection dead load of the pressure vessel shall be the weight of the empty pressure vessel without insulation, removable internals, or external attachments.

Operating dead load - shall be the weight of the empty pressure vessel, plus internals, ladders and platforms, , insulation, fireproofing, operating fluid and catalyst content weights (as applicable).

Test dead load (in the workshop) - shall be the weight of the empty pressure vessel plus weight of water, without internals and external appurtenances such as ladders and platforms, insulation, fireproofing, etc.. Water volume shall equal the volume of the vessel.

Test dead load (on the site) - shall be the weight of the empty pressure vessel with internal and external appurtenances such as ladders and platforms, insulation, fireproofing etc. plus weight of water. Water volume shall equal the volume of the vessel.

4.6 Dynamic Loads

The design for wind, snow and earthquake shall be performed for the geographical area of the installation site and shall be in accordance with applicable regulations. Dynamic loads shall be as prescribed in regulations for the area of installation, but must always take into account process induced loads or as furnished by the Grupa LOTOS S.A. The applicable technical requisition or engineering drawing / data sheet will list wind velocity, snow load and seismic requirements for the geographical location of the installation site.

External wind loads, if applicable, shall comply with PN-EN 1991-1-4 Eurocode 1, assuming for installation in Gdansk wind zone "0".

The static deflection at the top of the vertical pressure vessels due to the wind loads shall be no greater than 1/240 of the total equipment height.

4.7 Shell and Heads

The minimum nominal thickness for cylindrical / conical shells and for heads shall be as follows:

Vessel inside diameter (mm)	C-steel [1)] (mm)	stainless steel (mm)
≤ 1000	6	3
> 1000 ≤2000	7	4
> 2000 ≤3000	8	5
> 3000 ≤4000	9	6
> 4000 ≤5000	10	7
> 5000	11	8

[1)] The minimum nominal thickness includes up to 3 mm corrosion allowance.

If a reduction in wall thickness is expected in forming of a component, e.g. for dished heads and elbows, a corresponding allowance shall be provided to ensure that the finished component meets the calculated wall thickness requirements. The pressure vessel drawings specify the minimum thickness after forming including corrosion allowance.

For vertical pressure vessels with cylindrical or conical support (skirt) the thickness of the skirt should be:

- for a vessel shell thickness < 10 mm – minimum equal to the shell thickness

- for a vessel shell thickness >10 mm – minimum 10 mm.

For pressure vessels semi-ellipsoidal heads with a 2:1 ratio of major to minor axis and hemispherical heads shall be used.

A toriconical or conical heads shall be used wherever process requirements call for the use of these heads. A toriconical transition shall be used upon a cone to shell transition serves as a support point for the vessel.

All vessel seams shall be located to clear important internals and in horizontal vessels to clear saddle supports.

Longitudinal and circumferential seams in cylindrical and conical shells and all seams in spherical shells and in built-up heads shall be located to clear openings and their reinforcement by at least 3 x wall thickness or 50 mm whichever is greater.

If reinforcing pads for nozzles and other attachments are located over longitudinal and circumferential weld joints, the welded joint shall be ground smooth and radiographed for its entire covered length, plus 25 mm on each side.

Attachments shall be such located to clear seams by at least 3 x wall thickness or 50 mm whichever is greater.

Dished heads shall be preferably of seamless construction. However, dished ends with one chordal seam and 100 % radiographed are acceptable.

Pressure vessel shell courses with a diameter less than or equal to 2 m shall have only one longitudinal weld seam.

4.8 Reinforcement of Openings

The reinforcement of openings in the shell and heads shall be designed in accordance with the applicable code for the specified design pressure and temperature. Each reinforcing pad or segment thereof shall be provided with a ¼ inch diameter NPT threaded "telltale" hole.

Integral reinforcement of openings in pressure vessels shall be used when any of the following conditions exist:

- pressure vessel is in cyclic service, or the service involves rapid thermal transients
- Pressure vessel wall thickness exceeds 40 mm
- Pressure vessel design temperature is higher than 400 °C
- Large diameter openings defined by ASME Code, Section VIII, Division 1, Appendix 1, Paragraph 1.7.
- When multiple large nozzles, which require reinforcement, are located in the head.
- When the angle between any cylindrical element of a nozzle located in the vessel shell or head and a tangent to the surface of the shell or head is less than 45 ° (tangential or similar type).

Loadings impact (weight, torque and dynamic bending moments,)shall be considered in the design for pressure vessels with installed agitator.

4.9 Reinforcement for Nozzle Loads

Loads (forces and moments) as specified in the technical requisition or drawing shall be applied.

Nozzle reinforcement shall be checked for external (including piping) loads (forces and moments) as specified in the technical requisition or/and drawing.

Verification of nozzles under additional loads: - the manufacturer shall follow below points to verify that the design is adequate for the additional nozzle forces and moments:

A - Stresses due to external forces and moments

- British Standard Institution, Published Document (BSI PD) 5500 Appendix G

or

- Welding research Council Bulletin;

: 537 + Errata (WRCB 537) Local stresses in spherical and cylindrical shells due to external loads

B - Stresses due to internal pressure *

BSI PD 5500, Unfired fusion welded pressure vessels, Appendix G. G.2.3.6.2 *),

* The internal pressure shall be the design pressure at the design temperature

The total combined stress due to A and B before shall be calculated according to BSI PD 5500,Appendix G, at all the eight investigated points, with due consideration to directions and signs before the total stress intensity at each point is derived.

All nozzles with reinforcing pads shall be calculated for the stresses occurring at the perimeter of the reinforcing pad and at the nozzle as described in BSI PD 5500, Appendix G.

4.10 Pipe, Manholes, Handholes and Inspection Openings

All nozzles, manholes, handholes shall be trimmed flush with inside surface of the vessel, unless otherwise specified..

Minimum nozzle neck thickness for carbon steel and low alloy steel including up to 3 mm (1/8") corrosion allowance shall be schedule XS and for austenitic stainless steel or other high alloy shall be schedule 40S.

Nozzles necks shall be of seamless pipe. Nozzle necks may be of rolled plate when the nozzle size is NPS 16 or larger for carbon steel and NPS 8 and above for other materials.

All rolled plate nozzle necks shall be 100% radiographed

Nozzles of nominal diameter ≤ 50 mm should be additionally supported or reinforced.

Unless otherwise specified on the drawings or / and data sheets, flanges for all external nozzles 24 inch nominal size and smaller shall be in accordance with ASME B16.5 with respect to class and flange facing type and for nozzles of 26 inch nominal size through 60 inch shall be in accordance with ASME B16.47, Series A and checked per ASME Section VIII, Div. 1, Appendices 2 S.

The finish of the gasket contact surface of nozzle flange facing shall conform to ASME B16.5,unless otherwise specified. When a "raised face " (RF) is specified, the gasket contact surface roughness shall be 1.6 to 3.2 μm Ra to ISO 4287 (63 to 125 μin. AARH).

Flange facings and bolting for manholes, handholes and girth flanges shall be in line with piping class of the attached process piping.

Flange boltholes shall straddle the normal centrelines of the vessel.

Bolthole orientation shall be shown on the drawings.

All threaded connections shall conform to ASME B1.20.1.

All pressure vessels in 900 mm inside diameter and greater shall be provided with suitable manholes, handholes or other inspection openings for inspection and cleaning. Smaller diameter vessels shall be furnished with inspection openings as follows:

- Pressure vessels with internals: one end flange (girth flange).
- Pressure vessels without internals: two (2) 4 inch NPS flanged openings when the diameter is 450 mm or smaller. For inside diameter greater than 450, two (2) 6 inch NPS flanged openings. Flanged connections for instruments or piping with sizes as specified above or greater may be considered as inspections openings.
- All manholes, handholes and other inspection openings shall be provided with blind flanges, gaskets and bolting.

Pressure vessels containing trays shall be furnished with the following number of manholes. When frequent cleaning is necessary, the number of manholes shall be increased as required by the service to a maximum of one (1) for every four (4) trays. The distance between these manholes should not exceed 8 m.

Number of Trays	Number of Manholes
Up to 20	2
21 to 40	3
41 to 60	4
61 to 80	5
81 to 100	6

Minimum size of inspection openings shall be as follows, unless otherwise specified:

- Manholes: 500 mm (20 inches)
- Handholes: as specified in ASME

Manholes should be located on the top of horizontal drums if practicable and in the shells of vertical vessels. Manholes in vertical vessels with trays shall be placed one above the top tray and one as low as possible above the bottom head seam. When more manholes are required, they shall be located at feed points and internal piping and shall provide approximately equal access to the trays.

Davits and lifting lugs shall be provided for blind flanges and covers weighing 20 kg and over.

Side entry manholes shall have internal hand grips and ladder rungs, if specified on the vessels drawing or/and data sheet, to enableto get to the bottom of the vessel.

4.11 Flanges and Gaskets

Forged steel welding neck flanges or long weld neck flanges shall be used.

Slip-on type flanges shall not be used for class 300 and higher or for the design temperature above 250 °C and also when the service is designated to be hydrogen, hydrogen sulphide, sour water, cyclic or corrosion allowance is more than 3 mm.

Lap joint stub, studded connections or threaded are permitted only if specified in requirements or after a special permission granted by Grupa LOTOS S.A. in writing.

Flange facings and gaskets for piping and instrument connections shall conform to the requirements of the piping class and instrument specifications.

All flange facings shall be adequately protected against damage during fabrication, storage and/or heat treatment.

Oval type gaskets shall be used with ring joint flanges.

Internal flanges may be ASME B16.5, Class 150 slip-on type or may be fabricated from steel plate (if not exposed to differential pressure) and machine-faced to 12,5 mm, minimum thickness.

4.12 Connections

All connections shall be flanged, 1 inch NPS minimum with nozzle necks of minimum of 2 inch NPS welded to the shell of the pressure vessel, except as follows:

Flanged connections shall not be installed inside the skirt,.

The minimum nozzle size is 2 inch NPS for claded nozzles.

4.13 Internals

Internal pressure piping shall be as required by the service.

Packing support plates and their support rings and beams shall be designed for a load equal to the sum of:

- Dry packing weight
- Equivalent in water weight of 35 % of the packing free volume
- Pressure drop across the packing bed (if downward gas flow)

The design shall provide not less than 65 % support plate free area.

Removable internals parts shall be shall be sized to pass through the nearest or designated manhole opening.

Vertical pressure vessels, which have internals, and columns of a diameter less than 900 mm should have girth flange connections in the shell to allow for the erection of internals.

Columns and vertical vessels, which have internals such as trays or packing, shall be furnished with a davit placed at the top of the pressure vessel.

Tray, packing design and construction shall be in accordance with the requirements of Grupa LOTOS S.A. specification o. 2230.

The pressure vessel Supplier shall furnish tray support clips and rings as well as downcomer bars and other parts which are to be welded to the inside of the pressure vessel.

If required by the purchase order pressure vessel Supplier shall install trays, baffles, pans, etc. in his shop. Details for trays, baffles, pans, support clips and rings installation, shall be in accordance with the tray support drawings and specifications listed on the purchase order. The following requirements shall apply:

- Grupa LOTOS S.A. shall be notified prior to start of tray installation.

- Trays shall not be installed prior to completion of any required postwelded heat treatment.
- Adjustable weirs shall be installed at the weir height specified on the tray Manufacturer's drawings.
- Tray manway covers shall not be installed until Grupa LOTOS S.A. authorised representative has completed all inspections. All manway covers and gaskets shall be installed and the bolting fully tightened prior to shipment.

Demister shall have bolted construction.

Internal bolts shall be protected against loosening. They shall be either double nutted, anti-loose washers or tack welded to the clip

4.14 Corrosion Protection and Weld Overlay

The corrosion protection required for each pressure vessel depending on service will be specified in the pressure vessel drawing or/and data sheet.

All surfaces of pressure parts in the following vessels or vessel sections shall be protected as indicated.

Unlined: Surfaces shall be fabricated of or protected by the material required for the vessel or vessel section and shall have the required vessel or vessel section corrosion allowance, or they shall be fabricated of a corrosion resistant material.

Lined: Surfaces shall be fabricated of or protected by the alloy lining material required for the vessel or vessel section.

When cladding or weld overlay is specified, the entire thickness of any applied cladding or weld overlay shall not be considered as pressure retaining material and shall not be included in stress calculations, unless otherwise noted on the pressure vessel drawings or/and data sheet.

The specified minimum thickness (depth) of the cladding or weld overlay shall have complete chemical analysis and shall meet the chemical requirements of the specified stainless steel grade or other special alloy. Weld overlay surfaces shall be examined 100 % by dye penetrant.

Material of non-removable internal parts in solid high alloy steel pressure vessels or/and in high alloy cladded vessels, shall be the same nominal composition as the solid high alloy, cladding, weld overlay, to which it is attached.

The specified corrosion allowance shall be applied to all exposed internal surfaces of the pressure vessel.

Corrosion allowance on removable internal parts, except for trays and stainless steel components, shall be 1/2 of the pressure vessel corrosion allowance applied to all exposed surfaces. Corrosion allowance on non-removable internal parts shall be the same as the pressure vessel corrosion allowance applied to all exposed surfaces, except when specified otherwise.

The minimum thickness of removable and non-removable internals before corrosion allowance is added shall be 3 mm (1/8 inch).

4.15 Supports and External Attachments

Vertical pressure vessels shall be supported on skirts, legs, or lugs. When a pressure vessel is supported on a skirt attached to the underside of the head, the centre line of the skirt and the centre line of the shell plate, after deducting corrosion allowance, shall be approximately coincident.

For vessel supported by skirt the minimum distance between nozzles flange, projecting from skirt, outer diameter and the top surface of skirt anchoring chair top ring shall be of four (4) x the anchor bolt diameter.

All skirts shall have vent holes to remove trapped gases and access openings as shown in the relevant DIN standards.

For pressure vessels of stainless steel, the skirt material attached to the vessel shall be of the same grade material as the tank part to which it is attached. Thickness of this section of the skirt shall be calculated taking into account vessel design temperature. The remainder of the skirt may be carbon steel.

The length of this skirt stainless section shall be of 600 mm minimum for vessels with design temperature of minus (-) 50 °C or greater and 900 mm if the design temperature is lower than minus (-) 50 °C.

For all grades of austenitic stainless steel heads, the section may be of 304L stainless steel.

For pressure vessels of solid stainless steel, having shell thickness less than 10 mm and supported on legs or saddles, the carbon steel supports shall not be welded directly to the pressure vessel.. Stainless steel “poison pads” shall be employed between the vessel shell and the carbon steel support. The “poison pads” shall be made of the same material grade as the vessel shell, except that for all grades of austenitic stainless steel shells, the “poison pads” may be of 304L stainless steel. The “poison pads” thickness shall be of the same as the shell to which it is attached, extending 50 mm all around the support unless shell strength calculations call for greater thickness and/or size. The “poison” or reinforcing pads, whichever applicable shall be continuously welded to the pressure vessel shell. Each ”poison pads” shall be provided with ¼ inch diameter NPT threaded "telltale" hole

Pressure vessel manufacturer shall deliver two (2) templates of base plate bolt holes for each skirt-supported pressure vessel with more than four (4) anchor bolts.

One template shall be delivered in due time as specified in purchase order prior to start of foundation work. Notification shall be given to Grupa LOTOS S.A. at least five (5) working days prior to shipment of template so that Grupa LOTOS S.A. authorised representative can perform a dimensional check.

The second template shall remain in the Manufacturer’s workshop and shall be attached to the pressure vessel skirt base ring for dimensional control by Grupa LOTOS S.A. during pressure vessel inspection.

Skirts, legs or brackets for vertical equipment shall be in accordance DIN 28082-1, DIN28082-2, DIN 28081, DIN 28083..

Saddles for horizontal equipment shall be in accordance with DIN28080 type: AV, BV, D,. Stress analysis in shell due to saddle supports – based on BSI PD 5500 and L.P. Zick’s method – shall be performed.

Where horizontal vessels are installed on concrete foundation sliding plate shall be furnished under sliding saddle. Sliding saddle shall have slotted holes for shell expansion.

Pressure Vessels shall be furnished with anchor bolts, unless otherwise specified.

Platform support clips, ladder support and guide clips and piping support clips shall be provided and attached to pressure vessels when required. Shell and/or head to which such support clips are attached shall be checked for local stresses induced by external moments and forces.

Large carbon steel attachments such as jacket closures, platforms and piping support clips, shall not be directly welded to vessels built of solid alloy steels, but shall be welded to an "poison pad" of the same material grade as the shell and/or head. Such pads shall be continuously welded to the pressure vessel.

All vertical shop fabricated vessels with an empty weight of over 100 kg shall be provided with lifting devices. Lifting lugs attached to the top of the vessel on the shell side or lifting trunnions attached to the shell above the vessel gravity centre shall be used depending on the vessel size and field erection capabilities. The construction shall be in accordance with DIN Standard:

- Trunnions DIN 28085 or vessel manufacturer's standard agreed with Grupa LOTOS S.A.
- Lugs DIN 28086 or vessel manufacturer's standard agreed with Grupa LOTOS S.A.

The lifting devices shall be capable to lift the equipment in any position.

No lifting devices shall be provided on horizontal vessels, unless noted otherwise.

All vessel supports shall be provided with at least two (2) earthing lugs (for horizontal equipment one at each saddle). For vertical equipment higher than 30m, four (4) earthing lugs shall be provided.

Insulation rings, clips shall be provided for insulated vertical pressure vessels.

Skirts shall be provided with a tailing lug. Dimensions shall be calculated by Manufacturer.

Saddle and reinforcement plates.

- All saddles and reinforcement plates (weir plates), which are welded to the shell, shall be made of the same material grade as the shell. They shall be provided with at least one (1) ¼ inch diameter NPT threaded "telltale" hole..
- Whenever possible, saddles and reinforcement plates consisting of several sections shall be welded together prior to being attached to the pressure vessel wall. If it is not possible each plate section shall be provided with a ¼ inch diameter NPT threaded "telltale" hole.
- The cutting of edges of saddle reinforcement plates shall be trimmed and the corners shall be rounded using a minimum radius of 15 mm.

5 Vessel Design Requirements

5.1 Materials

Materials used for pressure retaining parts shall meet Pressure Equipment Directive (97 / 23 / EC) requirements.

Materials shall be selected based on the service and the design temperature as well as the Minimum Design Metal Temperature (MDMT) and shall be in accordance with any of the applicable specifications listed in the ASME Code, Section II but shall be limited to those that are permitted in ASME Section VIII.

Carbon steel shall be killed for pressure parts and components welded to the pressure parts. Carbon content shall not exceed::

- 0,23% for plates and pipes
- 0,25% for forgings

and carbon equivalent describe with the following formula:

CEV=C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15 shall not exceed 0,43 %.

Plates 50 mm thick and above shall be 100 % ultrasonic tested per ASTM A 435 in steel work.

Clad plates shall be 100 % ultrasonic tested per ASTM A 578 (in accordance with SA-263, SA-264 and SA-265 additional requirements S12) – acceptance level class 3 (in accordance with SA-263, SA-264, SA-265) and shall pass shear test. Minimum shear strength of the alloy cladding and base metals shall be 140 N/mm^2.

After forming, heads made of clad plate shall be ultrasonic tested per ASTM A 578 – additional requirement S12 in accordance with SA-263, SA-264, SA-265 acceptance level class 3.

Main components materials shall comply with those specified in the data sheets / drawing.

Structural shapes shall be fabricated from the same material P number as the shell to which are attached.

Internal and external non-pressure parts are defined as components, which transmit loads during operation. Typical parts are tray supports, support saddles, legs, and structural and platform lugs. Internal and external non-pressure parts as well as insulation fasteners and manhole davit assemblies shall be of the same material grade or the same P number as the pressure plate, unless noted otherwise. For these parts non-impact tested materials are acceptable.

For bolts and nuts the process of manufacture, heat treatment, chemical and mechanical requirements, coatings and marking shall be in accordance with the requirements of applicable codes and specifications. The applicable "Identification Symbol" shall be stamped on bolts and nuts as required by the material codes and specifications. Material and test certificates shall be provided to Grupa LOTOS S.A. upon request.

Gaskets shall be of asbestos free material suitable for the process and service conditions.

All materials shall be new and unused.

Pressure vessels specified to be of solid alloy or non-ferrous material may be quoted alternatively if the use of these the material (e.g. solid plate, clad plates, weld overlay or combination of these) will result in a more economical construction.

The mechanical properties of materials shall be determined on test specimens prepared from each plate, pipe or forging (or lot*) in the specified heat-treated condition.

** A lot is defined as material of the same heat whose thickness is within plus or minus 20 % (however no more than 12,5 mm) of the specified thickness and which is simultaneously heat treated.*

All plates, forgings, and pressure parts shall be stamped in a permanent and legible manner with the steel supplier's heat, slab, and serial number designating the part. Light die marking shall be used on 6 mm (1/4 inch) and thinner steel and alloy steel and on 13 mm (1/2 inch) and thinner non-ferrous plates and forgings. All other provisions shall be as specified in the applicable ASME code.

Additional requirements will be specified in the purchase order documents.

Resistance to intergranular corrosion of stainless steel in an oxidizing service of sulphuric acid, nitric acid shall be checked per ASTM A262. A report shall be provided.

Material substitutions prior to vessel fabrication commence or during fabrication shall be approved in writing by Grupa LOTOS S.A..

Manufacturer shall submit for approval, the complete description of the chemical and mechanical properties of all material substitutions proposed prior to purchase.

5.2 Alloy lining

In this specification the term "Alloy lining" is a general term that does not imply a specific fabrication or manufacturing process. Sheet or sleeve lining is not allowed, unless specified otherwise.

Alloy lining for shells and heads shall be integrally bonded cladding or weld deposit overlay. The specified lining thickness shall be the minimum undiluted cladding or weld overlay thickness.

When integrally clad pressure vessels are used, a minimum of 10% of the clad surface, including no less than 0,1 m^2 in each 1 m^2 or fraction thereof, shall be ultrasonic examined for lack of bond after forming. The cladding shall be 100% ultrasonically examined in areas where attachments are to be welded directly to the cladding. Unbounded areas exceeding 75 mm circle shall be repaired by weld deposit overlay. When repairs in excess of 5% of the total examined area are required, the vessel shall be 100% ultrasonic examined.

Repaired areas and weld deposit overlay at weld seams shall be 100% liquid dye penetrant examined.

Nozzles and manholes in alloy-lined portions of vessels shall be weld overlay. The facing shall be made with weld overlay deposit and machined to the thickness of clad.

For pressure vessels made from ferritic or martensitic stainless steel type 410S or 405 integrally clad plates, the corresponding nozzles, flanges weld overlay and clad restoring shall be made with type R/ER309L filler material.

In case of clad restoring and/or austenitic stainless steel weld overlay, the first layer shall be deposited with a higher alloyed filler material, while next layers shall be made with filler material of the same or similar chemical composition as the clad material.

The method of lining connections, nozzles and manholes shall be by integrally bonded cladding or weld deposit overlay. Tubular liners or/and sleeves are not acceptable.

5.3 Bolts and Gaskets

External pressure bolting for girth, nozzles or blind flanges shall be stud bolts, with two (2) heavy hex nuts each.

The strength of studs shall be based on the cross-section of the smallest diameter.

Stud bolts should protrude two (2) threads beyond nuts.

Bolt sizes (including studs and nuts), threads and marking shall conform to ASME B1.1 with threads Class 2A External and 2B Internal:

- Bolts in 1 inch diameter and smaller shall be coarse threads series (UNC),
- Bolts over 1 inch diameter shall be 8 thread series (8UN).

For connections of internal equipment elements metric threads are allowed.

In case of bolts of a diameter greater than $1^1/_2$ inch the location of the bolts and the design of the joint must permit use of hydraulic bolt tensioners. Also the plant plot plan shall include sufficient access for bolt tensioner operation..

Manufacturer shall define the torque and the procedure of tightening the bolts of the blinded/main flanges of the vessel.

All internal bolting shall be of the same material type as the vessel inside.

The threads of external studs and nuts shall be coated with a suitable thread grease (e.g. containing molybdenum disulphide) to prevent galling.

Gaskets shall be as specified on the vessel drawing or/and data sheet.

Gaskets for ring joint flanges shall be of the oval type conforming to the requirements of ASME B16.20. The Brinell hardness of metal gaskets and metal-jacketed gaskets shall be about 25 HB lower than that of the flange facing material. Gasket materials shall generally be as follows for the indicated flange, flange lining, or flange cladding material.

- Carbon and carbon 1/2 percent Mo steels: low carbon iron or low carbon steel with a maximum Brinell hardness of 120
- 1/2 to 10 percent Cr-Mo and 11 to 13 percent Cr steels: 5 percent Cr - 1/2 percent Mo steel with a maximum Brinell hardness of 130
- ASME type 304, 321, and 347 steels: ASME type 304 steel with a max. Brinell hardness of 160
- ASME type 316 steels: ASME type 316 steel with a maximum Brinell hardness of 160

Except for ring joint gaskets, two spare gaskets and 10 % bolts with nuts (min. 1 bolt with nuts per bolt size and per material grade) shall be furnished for each flanged connection with installed gasket.

All gaskets furnished shall be new and shall be installed before the vessel is shipped. Gaskets used for shop test purposes shall be replaced with new materials (excluding ring joint type gaskets).

Gasket materials for internal non-pressure connections shall be as required for the service.

Gaskets and bolts for nozzle flange connections shall be in accordance with the piping class specifications.

5.4 Fabrication and Workmanship

All workmanship shall be in accordance with best modern shop practice.

All weld procedures including non-pressure welds shall be identified by number and shall be referenced in weld details on fabrication drawings.

Longitudinal and circumferential welded seams shall not interfere with nozzle openings, reinforcement plates and saddle pads.

Circumferentially weld seams shall clear all internal tray support rings, and external vacuum stiffeners and insulation support rings.

Manufacturere's fabrication drawings for each vessel shall indicate a permanent reference work line, which shall be marked on vessel.

Marking shall be on both outside and inside of pressure vessel except for that clad or weld overlay pressure vessel and pressure vessels under sour service shall be marked on outside only. For marking low stress multi-dot stamping may be used.

Besides the general requirements of this specification the following extra requirements are applicable to stainless steel. In storage areas, stainless steel and high alloy materials shall be stored together and physically separated from carbon steel materials. There shall be no contact between stainless steel / high alloy material and carbon steel.

Fabrication of stainless steel shall be carried out in clean workshop conditions dedicated to stainless steel working. There shall be no contamination from carbon steel. Only stainless steel tools, which have not previously been used for carbon steel work, may be used for stainless steel fabrication.

When rolling stainless steel or clad plate, stainless steel rolls or covered non-stainless steel rolls shall be used to prevent carbon and iron pick-up. The use of carbon steel bridges for fit-ups is not permitted.

5.5 Welding

Welding preparation shall be conducted in accordance with the applicable codes and standards.

All welded joints should be made by arc welding.

Covered electrodes shall comply with the relevant AWS-ASME specifications, and the electrode covering shall be basic type. Low-hydrogen electrodes shall be used to avoid cold cracking (hydrogen cracking)

Nozzles and their reinforcements shall be connected with the shell by full penetration welds, unless otherwise noted.

If post welding heat treatment (PWHT) is required, all welding must be completed prior to PWHT.

If heat treatment is required than all welding has to be finished earlier. In case of clad material, plate shall be 100 % ultrasonic tested to check cladding adherence to the base material. Weld overlay shall be checked with liquid penetrant. If 100 % weld overlayed surface was checked with penetrant before heat treatment than after heat treatment the surface shall be randomly tested, however not less than 10 %. For low-alloy steels Cr-Mo verification of hardness after heat treatment in the weld area and in the area subjected to treatment is required. Hardness shall not exceed:

215 HB for steel of Cr content < 2%

240 HB for steel of Cr content > 2%

When austenitic stainless steel is welded to carbon steel or low alloy steel, if working temperature is less than 350 °C welding consumables 309(L) or 309Mo(L) (for austenitic steel with Molybdenum for example 316L) shall be used. For higher working temperature a nickel based electrodes should be used for example ENiCrFe-3.

Welding of equipment parts made of carbon steel to stainless steel needs every time Grupa LOTOS S.A. permission in writing.

5.6 Heat Treatment

The mandatory requirements of the ASME code shall be interpreted as minimum requirements.

Post forming heat treatment shall be performed for carbon steel, carbon manganese steel and low alloy steel as follows:

- Hot formed material, if it was heated above normalising temperature, shall be normalised;
- Cold formed material shall be stress relieved when required by code;

This heat treatment shall be performed after final forming.

Pressure parts made of austenitic stainless steel, formed at temperature less that solution annealing temperature shall be subject to solution annealing in accordance with ASME Section VIII, UHA-44.

Brinell hardness readings, whenever possible, shall be taken on the inside (process contacted side) of the pressure vessel for each longitudinal and circumferential weld, nozzle weld, and Heat Affected Zone (HAZ). The readings shall be taken after final heat treatment, no reading shall exceed the limits given in the code / specifications.

Special consideration shall be given to the forming temperature to avoid possibility of "hot cracking" when hot forming is proposed for austenitic materials.

All materials shall be mechanically certified in the final heat treated condition.

Ordered material shall have 3 cycles of heat treatment simulation. Mechanical properties of materials tested after a simulated PWHT shall meet the minimum strength requirements for the material grade.

After PWHT of pressure vessels no welding, hammering, grinding or deformation shall be permitted. On two sides of the vessel shell shall be painted in 75 mm high letters in Polish or English / Polish language: "POST WELD HEAT TREATED, DO NOT HAMMER OR WELD ON THIS VESSEL". (PODDANY OBRÓBCE CIEPLNEJ. SPAWANIE I UDERZANIE ZABRONIONE).

Local heat treatment is not permitted without Grupa LOTOS S.A. written approval.

Flange faces and other machined surfaces shall be suitably protected against oxidation during heat treatment and shall be checked after treatment for warpage and distortion.

5.7 Tolerances

Tolerances shall conform to the requirements of the applicable code, design standard listed in the list of applicable specifications and standards, data sheets, and drawings.

The tolerance on the thickness specified for the alloy cladding on integrally clad plate shall be as follows:

- Specified nominal thickness: minus 0.4 mm; plus 1.6 mm
- Specified minimum thickness: minus 0 mm; plus 1.6 mm

All flange surfaces for gasket contact and other machined surfaces shall be checked after heat treatment and / or fabrication for warpage and distortion.

For column tray attachments the tolerances as given in the tray Manufacturer's standard shall apply.

The maximum out of roundness variance of vessel with internal trays - any diameter may not vary plus or minus ½ % from the nominal diameter, with a maximum variation in diameter from nominal of 13 mm or as specified in the tray manufacturer's drawing whichever is less.

6 Inspection and Testing

6.1 Testing

Radiographic examination shall be in accordance with the ASME code.

When 100% radiography is specified, the root passes and the finished fillet welds of all nozzle attachment welds shall be inspected by magnetic particle, liquid penetrant or ultrasonic method approved by Grupa LOTOS S.A. Welds may be grinded only when necessary to effect proper interpretation of the radiograph.

When practicable, all vessels shall be subjected to a hydrostatic test in accordance with the code. Hydraulic test pressure shall be maintained for at least 1 hour.

When a field fabricated pressure vessel is to be pneumatically tested, the vessel seams shall be subjected to a 100 percent radiographic examination and all nozzle and attachment welds except welds attaching welding pins or studs shall be subjected to either a magnetic particle or liquid penetrant examination on all exposed surfaces before the pneumatic test is performed.

Equipment shall be hydrostatically tested in accordance with PED requirements.

Stainless steel and/or high nickel alloy, including clad materials shall be tested with low chloride water.

If not stated otherwise, content of chloride in test water shall not exceed:

- Carbon steel < 500 ppm
- Austenitic SS and high nickel alloy material < 25 ppm

All external or internal coils in vessels shall be hydrotested to the maximum pressure permitted by the relevant technical standards.

All reinforcing pads shall be given an air and bubble solution pressure test before the test of the pressure vessel. The test pressure shall be at 30÷50 kPa g. The test holes in pads shall be left open for use as telltale holes. They shall be filled with corrosion inhibiting grease after testing of vessel.

Austenitic steel bolts shall not be used during the shop tests.

Service gaskets and service bolting shall be used for shop tests. Any materials damaged during the tests shall be replaced by the Manufacturer with new material.

This does not apply to manholes and covers. For such flanged connections the pressure testing gaskets will not be replaced for delivery to site. The new gaskets required for these connections shall be separately supplied and installed at site by others.

For each vessel operating in a temperature in excess of 500 ºC the manufacturer shall deliver one coupon, size 200 x 200 mm, of each thickness and from each heat of the plates used to fabricate the shell, in the same heat treatment condition as the pressure vessel shell. The coupons shall be permanently marked with the symbol of the vessel, grade of the material and the heat number.

6.2 Inspection

The Inspection and Test Plan (ITP) shall be completed and submitted to Grupa LOTOS S.A. for fixing the notification, review, witness and hold points.

All mandatory inspection requirements of applicable national, regional, local laws and regulations for the area of installation or as furnished by the Grupa LOTOS S.A. have to be observed.

Also a visual and dimensional spot check by Grupa LOTOS S.A. authorised representative will be carried out prior to the hydraulic test and/or heat treatment or coating of the pressure vessel.

The Manufacturer shall notify in writing (by e-mail and/or fax) Grupa LOTOS S.A. at least 10 working days in advance when the pressure vessel will be ready for inspection.

Inspection by Grupa LOTOS S.A. shall in no way relieve the Manufacturer from the responsibility to meet the requirements of the purchase documents.

Grupa LOTOS S.A. authorised representative shall have the right to inspect all work in progress, to insure that proper workmanship, orientation, welding, testing, painting, etc. are being obtained.

Grupa LOTOS S.A. reserves the right to make preliminary intermediate and final inspection.

The vessel as made available for the inspection shall be free from slag, dirt, oil, welding spatter and other foreign matter.

The pressure vessels presented for the inspection shall be subjected to a previous dimensional check by the Manufacturer. The Manufacturer shall prepare a dimensional record indicating the actual dimensions for each vessel (including out of roundness; offset in welded joints, deviations from true alignment) and submit it to the Grupa LOTOS S.A. authorised representative. Any deviation from the specified tolerances shall be clearly marked in this record.

All loose components included in the scope of supply of the vessels shall be kept ready for the inspection.

Welds attaching welding pins or studs shall be tested by tapping with a light hammer.

The Manufacturer shall bear all additional costs arising from subsequent inspections, if the pressure vessels or vessel components to be inspected are not ready to the expected extent or in the specified quality at the scheduled date.

After specified hold points have been reached, Manufacturer shall not proceed with performing the activity until authorization is received from Grupa LOTOS S.A.

In case of the following problems, Grupa LOTOS S.A. shall be informed in writing without any delay:

- Deviations from the standard
- Rejected or insufficient test results
- Objections raised in connection with the checking of drawings
- Failure to comply with the specified tolerances
- Fabrication defects / repairs
- All events resulting in fabrication delays and thus jeopardising the delivery date.

6.3 Documents Required During Inspection

Grupa LOTOS S.A. authorized representatives at the time quality surveillance activities are being conducted at Manufacturer premises shall have available a complete set of below listed documents related to the purchase order:

- Confirmed purchase orders for materials
- Material certificates together with part list for which they will be used
- Welding procedures approved by Notified Body
- Welder's qualification records
- Weld map
- Certificates of performed tests of welds
- Certificates of heat treatment
- Plan of marking of materials on the equipment (main pressure parts
- Certificates of manufacturer's pressure tests
- Certificates of first pressure tests issued by Notified Body
- Manufacturer's dimensional check record
- Manufacturer's certificate of conformity, that equipment was manufactured in accordance with:

- relevant code agreed in purchase order and PED 97/23/EC
- norms
- technical documentation

- Notified Body certificate of conformity, that equipment was manufactured in accordance with relevant code and PED 97/23/EC.

6.4 Rejection

Equipment or parts thereof and materials entering therein, indicating irremediable or injurious defect, improper fabrication, excessive repairs, or that they are not in accordance with the requirements of this specification shall be subject to rejection. They shall be subject to rejection at any time or place by the Grupa LOTOS S.A. authorised representative if such conditions are discovered after acceptance of the items at the Manufacturer's plant.

7 Nameplates

Completed vessels shall have a nameplate in Polish or Polish and English language in accordance with PED 97/23/EC. Nameplates shall be of corrosion resistant material installed on a nameplate bracket by solid stainless steel rivets. Inscriptions on the nameplate shall be engraved. The nameplate on vertical vessels shall be located on the shell above the lowest manhole, and on horizontal vessels it shall be located above the fixed support saddle.

8 Painting, Marking, Packing

8.1 Painting

Painting shall be in accordance with Grupa LOTOS S.A. specification no. 1190.

Unless otherwise noted on the drawings or/and data sheets, vessels shall be painted on outside surfaces only.

Shop painting shall not be applied within 150 mm (6 inches) of any weld before Grupa LOTOS S.A. inspection.

Stainless steel and high nickel alloy (inconel, hastelloy, etc.) are not to be painted, unless noted otherwise. Only stainless steel brushes, clean, iron free sand or stainless grit shall be used for cleaning alloy surfaces. All welding flux shall be completely removed. Solvents used to clean or remove scale or oil shall be free of organic and inorganic chlorides.

Derusting, painting as well as preservation of the pressure vessels shall be carried out after hydrostatic testing and the inspection by Grupa LOTOS S.A.

Exposed machined parts for example: flange facing, threads shall be protected during fabrication/ blasting and painting.

Stainless steel equipment, which does not require painting, shall have the outside surface pickled and passivated.

8.2 Marking

Vertical pressure vessels shall be marked on the base and with 300 mm high vertical stripes and letter on the skirt, clearly indicating the north, south, east and west co-ordinates. The marking may be made on the shell near the bottom tangent line if the vessel is supported on legs or lugs.

Horizontal pressure vessels shall have one end marked north, south, east or west to indicate vessel orientation.

The pressure vessels shall be marked with the item number (character height about 200 mm). Removable pressure vessel components such as covers, hoods, bundles, floating heads, filter elements etc. shall be durably marked with the item number.

Care shall be taken to ensure that water insoluble ink or paint is used for markings.

When austenitic and high nickel alloy (Inconel, Hastelloy, etc.) steels are to be marked with fabrication or shipping information, the marking shall be done with water insoluble ink that does not contain sulphur, chlorides or metallic pigments.

Parts to be supplied loose such as spare parts, separate supplied internals etc. shall be identified by means of a tag indicating the relevant part number as per the workshop drawing as well as the item number.

8.3 Packing

All openings shall be sealed watertight and in such a way as to avoid damage to the connecting faces.

Telltale and vent holes in saddles and reinforcing plates shall be filled with corrosion-inhibiting grease.

Sundries and spare parts included in the scope of supply shall be separately packed and shipped together with the vessel.

Further information on packing and transport are included in the packing and shipping instructions.

Unless otherwise specified the vessel interior shall be thoroughly cleaned and dried.

If specified in relevant purchase order documents; stainless steel pressure vessels (including stainless steel clad vessels) shall be filled with nitrogen and provided with nitrogen cylinder, 3-way valve, gauge and stainless steel shroud. The required overpressure shall be written on the shroud.

Nozzles for welding on site shall be bevelled and protected with steel or plastic caps.

9 Technical documentation

9.1 Design documentation

Technical documentation shall conform to purchase order requirements and shall include the following, as a minimum:

- Assembly drawing of the pressure vessel. Drawing will include as minimum following:

  - Regulations applied for designing
  - Working pressure [bar g]
  - The highest / the lowest allowable pressure [bar g]
  - Test pressure [bar g]
  - Working temperature [°C]
  - The highest / the lowest allowable temperature [°C]
  - Medium
  - Flow
  - Pressure drops
  - Condensation curve (if applicable)
  - Capacity [L - litres]
  - Corrosion allowance [mm]
  - The weight of the vessel (during operation, when empty, during a water pressure test) [kg]
  - For columns – type and number of trays or packing quantity
  - Type and thickness of insulation
  - Dimensions necessary to verify the strength analysis
  - Welding connection details
  - Type and scope of non-destructive examinations
  - Type of heat treatment
  - Specification of materials with a definition of grades and standards

- Fluid group/ Category / Module according to PED 97/23/EC
- Strength analysis in accordance with the regulations applied
- Risk Analysis
- Operating and Maintenance Instruction – in Polish language (if original in English is available it must be included)

9.2 Final documentation

General Requirements

- Documentation supplied with the vessel shall be in number copies as specified in purchase order, including 1 copy of original documents signed by Notified Body. Additionally documentation shall be delivered in an editable (native) electronic form. Requirements for electronic form of documents are included in Grupa LOTOS S.A. specification no. 6200

Scope of final documentation:

- Design documentation (drawings and analyses/calculations) agreed with Notified Body
- Safety equipment data – only if supplied together with the equipment. The scope of this documentation is defined in Grupa LOTOS S.A. specification 8400
- Fittings data – only if supplied together with the equipment
- Instruments for measurement, control, signalling and automatic blocks – only if supplied together with the equipment
- Feed equipment – only if supplied together with the equipment
- Measurement card (protocol) of main parts of the pressure vessel
- NDE reports with NDE plan and certificates of qualified NDT personnel
- Mechanical test run report – if required
- Heat Treatment Certificate with heat treatment plan and temperature vs. time chart– if requiredCertificate of performed anticorrosion protection in accordance with EN ISO 12944-8
- Certificate of pressure test and certificate of water used for pressure test
- Certificate of conformity issued by Manufacturer
- Certificate of conformity issued by Notified Body
- List of materials for pressure parts
- Information card (protocol) about the marking place of every part of vessel
- Material certificates including welding consumables followed by the list of the names of the vessel parts with the indication of: item no. acc. to the drawing, grade of material, material std., heat number, certificate number and successive number of the certificate acc. to the list - certificates required according to EN 10204 / 3.1.
- Welding plan map including welders' identification numbers for each weld. List of welders including welders' qualifications. Certificates of Qualified Welders
- WPS, PQR

- Report of documentation approval by Notified Body
- Certificate on the inspection of the construction and first pressure test issued by Notified Body
- Assembly drawings " as built "
- Risk analysis.

Any change must be clearly indicated. "As built" must be stamped on the drawing. If the changes have any influence on the results of strength calculations the "as built" drawing must be again approved by Notified Body.

Other documents - when required

- Instruction for transport, preservation, storage and erection
- Maintenance, repair and tests during operation instructions. They must be in Polish language (if original in English is available it must be included)
- Instructions for erections (notes on erection, heat insulation as well as testing and test run of equipment items)
- Certificate of design examination EC or certificate of type examination EC issued by Notified Body

10 Manufacturer's Qualification

Upon request, the Manufacturer shall furnish evidence that he is able to fulfil the requirements for fabrication, testing and inspection of pressure vessels as specified in the relevant codes and regulations.

Should valid qualification records for the welding procedures and welders not be available at time of the bid or should the qualification records available fail to cover one or several criteria to be met, this has to be indicated in the bid. Any difficult fabrication activities or special manufacturing cases shall be considered.

Before fabrication, any welding procedure and welder's qualification records required shall be duly checked and approved by third party as required by PED 97/23/WE and purchase order.

11 Guarantees

All materials, design and construction shall be subject to the conditions and guarantees required by the purchase order.

The Vessel Manufacturer shall guarantee that the vessel designed by him, will meet requirements specified in the purchase order. If vessel does not fulfill requirements the vessel Manufacturer shall, without cost to Grupa LOTOS S.A., furnish new vessel or redesign, and rebuild the vessel provided, so that the purchase order requirements will be met.

Drawings review, intermediate and final inspections of vessels carried out by Grupa LOTOS S.A., and also Release Note do not relieve Manufacturer from his responsibility to fulfill requirements of purchase order.

12 Relevant documents

Any "Technical Specification" issued by Grupa LOTOS S.A. listed in Contract Files.

13 Codes and standards

Codes and standards listed below form part of this specification. Each publication shall be the latest revision and addendum in effect at the Contract award, unless otherwise specified:

- 97/23/WE (PED) Directive of the European Parliament and of the Council on the approximation of the law of the Member States concerning pressure equipment
- 2009/105/EC Directive of the European Parliament and of the Council relating to simple pressure vessels (replaces Directive 87/404/EEC of 25 June 1987)
- ASME BPVC ASME Boiler & Pressure Vessels Code – Sections I through X
- ASME B16.5 Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
- ASME B16.47 Large Diameter Steel Flanges NPS 26 Through NPS 60
- ASME B16.20 Metallic Gaskets for Pipe Flanges Ring-Joint, Spiral-Wound, and Jacketed
- ASME B16.21 Nonmetallic Flat Gaskets for Pipe Flanges
- ASME B 1.1 Unified Inch Screw Threads (UN and UNR Thread Form)
- ASTM A 435 Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates
- ASTM A 578 Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications
- ASTM A 262 Standard practice for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steel
- ASTM A 263 Standard Specification for Stainless Chromium Steel-Clad Plate
- ASTM A 264 Standard Specification for Stainless Chromium-Nickel Steel-Clad Plate
- ASTM A 265 Standard Specification for Nickel and Nickel-Base Alloy-Clad Steel Plate
- British Standard BS 5500, Appendix G
- Research Reports:
  - WRC Bulletin 537
  - WRC Bulletin 297
- Stresses in Large horizontal cylindrical pressure Vessels on 2 saddled supports by L.P. Zick
- PN-EN 10204 Metallic products - Types of inspection documents
- DIN 28005 Part 1 General tolerances for vessels; general-purpose vessels
- DIN 28007 Part 1 General tolerances for columns; columns for general use
- DIN 28080 Saddle supports for horizontal cylindrical vessels
- DIN 28081 Part 1 Tubular supports for vessels – Dimensions

- DIN 28081 Part 2 Vessel supports made of steel sections; dimensions, material and design
- DIN 28081 Part 3 Type B tubular vessel supports; maximum permissible loads on tubular supports for dished ends
- DIN 28082 Part 1 Skirts for apparatus; part 1: with simple bottom ring; dimensions
- DIN 28082 Part 2 Skirts for apparatus - Part 2: Bottom ring with bracket supports
- DIN 28083 Part 1 Bracket supports; dimensions and maximum loads
- DIN 28083 Part 2 Bracket supports; maximum bending moments imposed on the vessel wall resulting from type A bracket support loads
- DIN 28085 Lifting lugs on apparatus for mounting
- DIN 28086 Lugs on vessels for use in process engineering
- DIN 28087 Top head type lifting lugs on apparatuses for mounting; dimensions and allowable loadings
- PIP VEFV 1117 Manway Vertical Davits
- PIP VEFV 1118 Manway Horizontal Davit
- PN-EN 1991-1-4 (Eurocode 1) Actions on structures. General – Wind actions

14 Record of changes

No.	Date	Description	Introduced by
1	22.03.2006.	This specification entirely replaces the specification rev.0. Changed points 4.4., 4.5. and 4.7.	B. Kowalewski
2	09-05-2011	Changed points 4.9, 5.3.	S. Zajączkowski
3	30-11-2013 (rev. 3)	Review, update, standardize and changes to the Standard within scope of order No. OK/990/2012	Editorial board coordinated by T.Wróbel
-	31-08-2015	Page layout corrections, no contents changes.	T. Wróbel