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1 Subject of specification

This specification and other documents referenced herein establish the minimum requirements for the design manufacture, erection, inspection and tests for air cooled heat exchangers.

2 Scope of validity

This specification applies to preparation of tender documents, inquiries and contracts for newly planned investment or modernisation 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 Air Cooled Heat Exchangers.

In this specification only the term "air cooler(s)" which includes air cooled heat exchangers will be used.

This Specification is based on the API 661 including Annex A and referenced standards and specifications.

The air coolers to be designed, manufactured and supplied in accordance with Pressure Equipment Directive (97 / 23 / EC) and shall be marked with “CE” mark.

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 heat exchangers shall, as a minimum, meet the requirements of the API 661 including Annex A and ASME Section VIII, Division 1, or Division 2 as applicable and as specifically instructed by the drawings or/and data sheets and referenced specifications.

4.2 Design Conditions

Supplier shall be responsible for the thermal and mechanical design of the air coolers as shown by, but not limited to, information given in Grupa LOTOS S.A. air coolers specifications, data sheets and/or drawings.

4.3 Stresses

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

The basic 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.

Welds attaching non-pressure parts to the pressure shell and supports for large internals, shall be designed to the allowable stresses of pressure parts.

The calculated stresses for the design conditions shall be limited to the following:

- Erection stresses limited to the basic allowable stress at ambient temperature and uncorroded thickness
- Operation stresses limited to basic allowable stress at design temperature and corroded thickness
- Test stresses limited to 90 percent of the minimum specified yield stress at test temperature and uncorroded thickness for pressure parts For non-pressure parts, test stresses limited to 33-1/3 percent over the basic allowable stress at test temperature and uncorroded thickness
- For all design conditions the maximum allowable longitudinal compressive stress for shells and technological tubes to be in accordance with the applicable ASME Code with no permitted increase.

4.4 Design Pressure and Temperature

Air coolers shall be designed to the design pressure and design temperature specified in the drawings/data sheets.

If the minimum design metal temperature (MDMT) is not specified Manufacturer shall clarify the MDMT with Grupa LOTOS S.A.

Allowable pressure drop shall not be exceeded even when alternate operating conditions are specified.

4.5 Corrosion Protection and Weld Overlay

The corrosion allowance shall be as specified in the drawing or/and data sheet or technical requisition.

When clad plate or weld overlay is specified, the cladding or weld overlay thickness shall not be included in stress calculations, unless otherwise noted on the air cooler drawings or/and data sheets.

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 cladded surfaces shall be checked 100 % by dye penetrant examination.

4.6 Loads

Air cooler design shall consider snow and wind loads in accordance with applicable regulations. Wind and earthquake load values for the geographical area of the site of installation shall be in accordance with requirements furnished by Grupa LOTOS S.A.

Process induced loads must always be taken into account.

4.7 Tube Bundle

Maximal 8 rows of finned tubes may be arranged in each bundle to prevent fouling on the air side.

If there is a risk that the product may freeze or crystallize when the air temperature decrease, the air coolers shall have facilities to heat and recycle the air. It shall be designed for the minimum load case specified on the data sheet.

The linear velocity in the tubes of heat exchangers in wet Hydrogen Sulfide Service shall be adequate to selected material, considering high corrosivity of wet hydrogen sulfide.

All parallel installed tube bundles have to be connected by bolted spacers so that all tube bundles can move from one system fixpoint towards expansion direction.

The spacers must be designed to take over the loads resulting from thermal expansions of the tube bundles/pipes connected to the piping headers.

Required provision for lateral movement from thermal expansion of all in parallel installed bundles of the same item shall be foreseen in one direction only.

The headers should have threaded plugs opposite each tube. Other solutions may be used after a prior agreement.

The plugs must not protrude inside the chamber more than two turns of the thread.

Unless specified otherwise in the enquiry/purchase order, the side frames and cross beams shall be hot dip galvanized and the pertinent bolts shall be galvanized or chromated yellow.

Eyelets shall be provided at each bundle into which the hoists for the motors can be hung.

4.8 Tubes

The minimum tube diameter shall be 25 mm or 1 inch O.D.

Unless otherwise specified the minimum wall thickness for tubes 25mm and 30mm O. D. shall be:

- for carbon and low-alloy steels (up to 9% Cr) – 2,77 mm
- for high-alloy steels – 2,0 mm

Selection of aluminum finned tube construction type shall be selected per API 661, Annex A, section A1.1 subject to the following fin design temperatures, which are the maximum operating temperature.

- Embedded construction (G-Fin) 400 °C
- Integral construction (Bimetallic extruded) 300 °C
- Overlapped footed construction (Double wrapped L-Fin) 200 °C
- Footed construction (wrapped L-Fin) 200 °C
- Externally bonded construction (Galvanized Steel Fin) 300 °C

Details about finned tube construction type are in API 661.

When the maximum operating temperature is not specified, it shall be taken as the specified process fluid inlet temperature plus 25 °C.

Inserts (for achieving turbulent flow) in the tubes to improve heat transfer are allowed only if approved by Grupa LOTOS S.A. in writing.

Unfinned tube lengths shall be kept to a minimum.

In general the tubes shall be expanded into tube sheets grooves Only for H_2 and wet H_2S service the tubes shall be welded to the tube sheet. In wet H_2S service no expanding is required.

When welded tube joints are used, the supplier shall submit his recommended joint fabrication procedure.

The procedure shall outline welding details, testing procedures, and degree and length of rolling operations, in accordance with the following criteria.

The tubes are to be welded in two passes. At least the second pass to be made with filler metal.

Single-pass welding with automatic welding equipment may be used after written approval by. The bid is always to be based on two-pass welding.

The weld shall be free from cracks or detrimental porosity or inclusions.

When there is the risk of tube vibration the tubes must be slightly expanded after welding. The expansion extends over the tube plate thickness minus 3 mm, but does not need to exceed 30 mm starting from the back side of the tube plate. No tube rolling shall be performed in the weld area.

Upon request in the inquiry/p.o. for special cases representative sample of the tube to tubesheet weld shall be furnished by the vendor to Grupa LOTOS S.A. for review before commencing fabrication.

For the tube to tubesheet weldings through plug holes always one shear test per one air cooler to be carried out during fabrication according to ASME.

4.9 Nozzle Loads

Nozzles shall withstand the loads as specified in API 661.

The manufacturer shall make the following calculations 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 cylindrical shells due to external loadings on nozzles.

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 above 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 Nozzles and other Connections

Nozzle minimum wall thickness shall be acc. to API 661 and for stainless steel material shall be Sch. 40S.

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

Connections for vents and drains shall be couplings with plugs acc. to API 661, unless otherwise specified in the drawing/data sheet. These connections shall be flanged (1 inch NPS) for H_2S-service and Hydrogen-service with partial pressure exceeding 600 kPa (100 PSI).

These connections shall be flush inside.

The outlet and inlet nozzles of individual tube bundles should be fitted with cut-off valves to permit cleaning or replacement of the banks during the plant's operation.

The outlet and inlet nozzles of individual tube bundles should be fitted with lateral nozzle $1^1/_2$" WN 600 with blind flanges for pressure tests.

4.11 Flanges and Gaskets

Boltholes of flanged connections shall straddle the exchanger's main centerlines.

All girth joints of removable cover-plates and bonnet headers shall be of through-bolted construction. Exceptions need Grupa LOTOS S.A. permission in writing.

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

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

The complete cover gasket including the webs for the partition plates shall be made in one piece. The transition radius for web-plate seals shall not be less than 8 mm.

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:	AISI type 304 steel with a maximum Brinell hardness of 160
ASME type 316 steels:	AIST type 316 steel with a maximum Brinell hardness of 160

4.12 Bolts and Gaskets

Pressure bolting for girth and nozzle flange connections shall be stud bolts threaded full length with two 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.

Hard steel washers 6 mm thick shall be furnished under studs 1 ½ inches and larger.

Bolt sizes and threads shall conform to ASME/ANSI B1.1, Class 2A (external thread) or Class 2B (internal thread):

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

Provision shall be made to use bolt-tensioning equipment on flanged joints for the following:

- Hydrogen service for bolt sizes > 1 ¾ inches.
- All bolts > 2 ½ inches.

4.13 Fans

If fan type (forced draft or induced draft) is not specified in the data sheet, the fan type shall be proposed by the vendor but agreed by Grupa LOTOS S.A. before heat exchangers are quoted.

Solutions with forced draft fans shall be preferred.

The hubs shall be dynamically, the fan blades statically balanced at the Manufacturer's workshop. This shall be documented by a balancing record and all components belonging to the same item shall be clearly and durably marked to exclude the possibility of errors. The selected identification code shall be entered in the balancing record.

The Manufacturer /vendor of fans is responsible for specify maximum acceptable vibration level equivalent to acceptable unbalancing rotating elements, and confirmation this unbalancing value by test (after assembling of air cooler on plant)

It shall be possible to adjust manually the pitch of the fan blades while the fan is at rest. The possibility that the blades come loose from the hub during operation and change their adjustment at random shall be safely prevented.

Preferred adjustment of fans' efficiency is by the adjusting of rotational speed of fan drives (using frequency converter).

Delivery of fans with blades adjustable during operation is only possible after Grupa LOTOS S.A. approval.

Direction of change of the fan pitch with loss of control-air pressure shall be clarified for each air cooler with auto variable fan type.

Wherever the enquiry/purchase order calls for several air cooler items, efforts shall be made to provide fans of identical size.

Guards shall be provided over all rotating parts which potentially determine hazardous during operation.

Fan speed, blade angle as well as louvers opening and closing should be remotely controlled by the DCS from the control room. In justified cases the louvers opening and closing may be controlled manually.

If V-belts are used for drive transmission, they must be of the antielectrostatic type (confirmed by the manufacturer's certificate).

4.14 Noise Control

The average sound pressure level acc. to ISO 3744 shall not exceed the value given in the inquiry/purchase order documents. The measuring point to be 1 m away from the outer air chamber limit for air coolers with air recirculation, and 1 m below the fan for air coolers without air recirculation.

4.15 Drives

The drive design must allow for installation of the motors so that their shaft is directed downwards or provide a suitable rain protection if their shaft is directed upwards.

The motors shall in all cases be accommodated underneath the bundle (even if a induced draft fan is used).

Not more than three different types of V-belts may be used for all air coolers.

It must be possible to start and stop all fans separately.

4.16 Louvers

Automatically adjustable louvers shall be provided for air intake and outlet in the case of air recycling.

The Manufacturer shall specify the number of louvers. They shall be suitably dimensioned so that in the fully opened condition they will admit the maximum required air rate without exceeding a velocity of 5 m/sec.

A positioner to be provided for each actuator.

Louver should be controlled by pneumatic actuators if not stated otherwise.

If the louver position with loss of control-air pressure is not specified in the data sheet, the position shall be clarified for each air cooler.

4.17 Vibration Switch

A vibration switch for each fan to shut off the motor in case of severe vibration to be provided.

In the data sheet should be specify side responsible for scope of selection and supply of vibration switch, cables, and transmittals

4.18 Structural Design

The steel structure design of the air cooler bank (bundle frames) must consider the arrangement of a support construction above and below the bundles, which takes over the weights and moments from piping headers connected to the inlet and outlet nozzles of the air cooler bundles.

Walkways with a clearance of not less than 800 mm shall be provided for installation and operation at least at both ends of the bundle, ensuring convenient access to the channels and operating elements.

Beneath each drive assembly service platforms with walkways have to be provided.

Actuators, positioners and mechanism shall be readily accessible for maintenance from a service platform.

Steel structure design of air cooler should assure easy dismantling of tube bundle.

4.19 Plenum

The minimum clearance underneath the fan ring for forced draft resp. the bundle side frames for induced draft air coolers shall be 2200 mm.

Plenum geometric shall assure uniform airflow across the tube bundles.

5 Materials

5.1 General

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

Materials shall be selected based on the service, kind of process medium and the design temperature as well as the minimum design metal temperature (MDMT) and shall be in accordance with applicable specifications listed in the ASME Code, Section II, but shall be limited to those that are permitted in 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.

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.

Air coolers specified to be of alloy or non-ferrous material may be quoted alternatively if the use of another form of the material (e.g. solid plate, integrally bonded clad plate, 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 applicable ASME code.

Supplementary 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 air cooler 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 Headers

Welded tubes shall be subjected to a nondestructive electric test (eddy current test) over the total tube length at the mill as described in the applicable ASME code.

Tubes shall have no circumferential welds.

Internal and external non-pressure parts as welded to pressure retaining parts shall be of the same material grade or the same P number as the pressure part, unless noted otherwise. For these parts non-impact tested materials are acceptable.

5.3 Other Components

If not specified otherwise, the blades shall be made of flame-resistant reinforced plastic. The blades shall be antistatic.

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

6 Fabrication

6.1 Workmanship

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

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.

6.2 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 should be connected with the header by full penetration welds.

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 %.

Hardness of low alloy Cr-Mo materials shall be checked after heat treatment in seam area and in area of heat treatment. Hardness shall not exceed:

- 215 HB for steel with Cr < 2 %.
- 240 HB for steel with Cr > 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.

All components shall be free from grease and dry before the tubes are welded or expanded into the tube sheet.

6.3 Gaskets Contact Surfaces

For removable cover plate and removable-bonnet headers the required depth of male and female elements or grooves shall be ensured over the entire length.

6.4 Tolerances

Tolerances shall conform to the requirements of the API Standard 661 but nominally identical parts shall be interchangeable.

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

The tolerance on the thickness of integrally bounded alloy cladding (with explosion method, rolling or weld overlaid) with base plate material is given bellow:

Specified nominal thickness: minus 0,4 mm; plus 1,6 mm

Specified minimum thickness: minus 0 mm; plus 1,6 mm

7 Inspection and Testing

7.1 Testing

Radiographic examination shall be in accordance with ASME code and API standard 661.

When 100 percent 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 need be ground only when necessary to effect proper interpretation of the radiograph.

Air coolers shall be hydrostatically tested in accordance with PED requirements.

Air coolers made of stainless steel, high nickel alloy and/or clad material shall be hydraulic tested with low chloride water.

If not specified otherwise by designer, content of chloride in test water shall not exceed:

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

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

No tubes or tube holes shall be plugged without Grupa LOTOS S.A. s written approval for the method and procedure of plugging.

7.2 Inspection

The inspection and test plan shall be completed and sent 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 Grupa LOTOS S.A. shall to be observed.

A visual and dimensional spot check by Grupa LOTOS S.A. 's authorized representative will be carried out prior to the hydraulic test and/or heat treatment or coating of the heat exchanger, if any.

The manufacturer shall notify in writing (by e-mail and/or fax) Grupa LOTOS at least 10 working days in advance when the air cooler 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. s authorized 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 inspections.

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

The air coolers 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 heat exchanger and submit it to the Grupa LOTOS S.A. authorized representative. Any deviations from the specified tolerances shall be clearly marked in this record.

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

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

7.3 Records

The final records shall be acc. to the API 661 and the additional requirements listed below shall be available for examination by LOTOS Group's S.A. authorised representative at the time of inspection, so far as available

The test reports shall state the specification to which the material complies, the heat, lot or melt number, the heat treatment (if any) given the material, and the results of chemical analysis and mechanical tests. Certificates are acceptable for heat treatment information missing on mill test reports.

Pyrometer charts or other detailed records of heat treatment (postweld, normalising, heating for forming, etc.)

Certified noise data sheets for the air-cooled heat exchanger when the fans operate at rated speed at design condition.

Louver characteristic performance curve.

7.4 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. authorized representative if such conditions are discovered after acceptance of the items at the supplier's plant.

8 Nameplates

Completed heat exchangers shall have a nameplate in Polish or Polish and English language in accordance with or PED 97/23/EC and API 661. Nameplates shall be of corrosion resistant material installed on a nameplate bracket by solid stainless steel rivets. Inscriptions on the nameplate shall be engraved

9 Painting, Marking, Packing

9.1 Painting

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

Structural steel shall be hot dip galvanized as prescribed in API 661.

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 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.

9.2 Marking

The heat exchanger shall be marked with the item number. (Character height about 200 mm)

Removable heat exchanger components such as headers, etc. shall be marked acc to the API 661.

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

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.

9.3 Packing

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

Parts to be supplied loose included in the scope of supply shall be separately packed and shipped together with the heat exchanger.

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

10 Guarantees

10.1 General

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

10.2 Process

The heat exchanger manufacturer shall guarantee that the process equipment designed by him, will meet requirements specified in the purchase order. If air cooler does not fulfill requirements the heat exchanger manufacturer shall, without cost to Grupa LOTOS S.A., furnish new air cooler or redesign, and rebuild the equipment provided, so that the purchase order requirements will be met.

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

Included in the guarantee shall be the
- pressure drop
- shaft power
- product outlet temperature
- noise level

11 Spare Parts

The following precommissioning spare parts and special tools are included in supply

Gaskets (for blinded nozzles)	2 Sets*)
Bolts with nuts (for blinded nozzles)	10 %**)
Plugs for inlet and outlet header	2 %
Metal gaskets for plugs	5 %
V-Belt	2 Sets
Header gaskets	2 Sets per connection***)
Bolts and nuts for headers	10 %
Special Tools:	1 Clinometer
	1 Belt tension tester
	1 Comb to straighten fins

*) For ring joint gaskets only 1 Set

**) Minimum 1 bolt with nuts per bolt size and material grade

***) Dimensional sketches shall be prepared for all non-standard gaskets.

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
- API Std 661 Air–Cooled Heat Exchangers for General Refinery Services
- 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
- PN-EN-10204 Metallic products - Types of inspection documents
- Welding Research Council (WRC) Bulletin:
    - WRC Bulletin 537
- DIN 580 Eye bolts
- DIN 8558 Part 2 Design and workmanship of welded joints. Steel vessels and apparatus used in the chemical industry
- DIN 28085 Lifting lugs on apparatus for mounting

14 Record of changes

No.	Date	Description	Introduced by
0		This specification entirely replaces the former Grupa LOTOS S.A. standard No. PR 07 232 with the same title.	B. Kowalewski
1	17.11.2006.	Changed points: 4.8 and 4.13.	B. Kowalewski
2	30-11-2013 (rev.2)	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