Contents

1 Subject of specification 3
2 Scope of validity 3
2.1 Order of precedence 3
2.2 Local regulations 3
2.3 Standards/norms 3
2.4 Deviations 3
3 Design Criteria 4
4 Mechanical Design Requirements 5
4.1 General 5
4.2 Ejectors 5
4.3 Condenser 5
4.4 Castings 5
4.5 Bolting 6
4.6 Piping 6
4.7 Structural Design and Fabrication 6
4.8 Welding 6
4.9 Materials of Construction 7
4.10 Sound level requirements 7
5 Electrical Requirements 7
6 Controls and Instrumentation 8
7 Painting 8
7.1 General 8
7.2 Quality of painting coats 8
8 Nameplate 8

This document is the property of Grupa LOTOS SA.. Coping and giving it to other are forbidden without express written authority by Grupa LOTOS SA

9 Inspection and Testing 9
9.1 General 9
9.2 Tests 9
9.3 Inspection 9
10 Relevant documents 9
10.1 Grupa LOTOS S.A. specifications 9
11 Record of changes 10

1 Subject of specification

This specification used in conjunction with other technical specifications of Grupa LOTOS S.A. establishes the minimum requirements for the design, fabrication and testing of ejectors systems.

2 Scope of validity

This specification applies to the preparation of tender documents, inquiries and contracts concerning new investments and modernization projects planned by Grupa LOTOS S.A.

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

This specification shall be considered together with specification no. 2010 – "General Mechanical Requirements".

Reference to other industrial standards for compliance shall be interpreted as an integral part of this specification.

2.1 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

2.2 Local regulations

Ejectors shall be designed, constructed and installed in compliance with all applicable national and local laws and regulations, Grupa LOTOS S.A. specifications and current technical standards referred to in purchase order documents.

2.3 Standards/norms

Ejectors shall be designed and tested in accordance with applicable HEI standards including requirements stated herein. Other standards may be used if agreed with Grupa LOTOS S.A.

Applicable standard shall be stated in data sheets.

2.4 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 Design Criteria

Ejector systems shall be designed for continuous operation, 24 hours per day, 7 days per week.

Ejector systems shall be rated and guaranteed for the operating conditions specified on the data sheets.

All equipment shall be suitable for use in the specified facility environment. The equipment shall be furnished with all necessary weather and anti-corrosion protection to prevent damage due to weather, fumes or dust from the facility. All necessary protection measures including anticorrosion protection shall be applied.

All equipment shall be designed to withstand the largest forces and moments which may be imposed by shipping, handling, operation, winds and snow.

All components shall be the manufacturer's standard for specified duty.

The equipment shall be laid out in a compact manner, but with adequate accessibility for operation and maintenance purposes. Particular attention shall be given to the layout of pipework, valves and instrumentation to ensure convenient access.

All components shall be shop-fitted, assembled and tested prior to leaving the shop.

Ejector systems shall be designed for the optimum efficiency at the rated conditions specified.

Motive power will be provided by a high pressure stream of fluid (gas or liquid), directed through a nozzle designed to produce the highest possible velocity. The motive fluid, as it exits the nozzle, shall entrain the suction fluid (gas or liquid) in the suction chamber producing a uniformly mixed stream traveling at a lower velocity. The diffuser shall be shaped to gradually reduce the velocity and convert the energy to pressure at the discharge with as little loss as possible.

An ejector (or ejector system) shall be designed so that the ejector suction (first stage) pressure is stable (free from fluctuation) throughout the range of the suction pressure specified on the data sheets. If specified on the data sheets, the ejector (or ejector system) shall also be stable at shut-off (zero suction load).

For steam jet ejectors with a gas as the suction fluid, the Supplier shall calculate the "Dry Air Equivalent" of the gas (equivalent mass flow rate of air at 20°C) used to size the ejector in accordance with the requirements and recommendations of the applicable HEI standards. The loads shown on the data sheets are the actual flow rates of the specified fluids.

If the Supplier furnishes equipment downstream of an ejector, that equipment shall be designed to prevent the real backpressure on the ejector from exceeding the design backpressure.

Condensers, if furnished, shall be surface type. Alternatively barometric type condensers can be applied as required or as specified on the data sheets.

If condensers are furnished and it is necessary to isolate the process fluid from the cooling fluid (gas or liquid) then the condensers shall be the surface type.

4 Mechanical Design Requirements

4.1 General

All equipment shall be shipped in the largest practical assembly possible. All components and subassemblies, shipped separately, shall be tagged with the respective tag numbers shown on the data sheets.

4.2 Ejectors

Each ejector shall consist of a motive fluid nozzle, motive fluid chest, suction (or mixing) chamber, diffuser and other components as required.

The motive fluid nozzles shall be replaceable and suitably abrasion and corrosion resistant. If the motive fluid is gas then the nozzle shall be diverging - if liquid then converging.

If the motive fluid is steam and the ejector is designed to operate with a suction pressure of 5.0 mm Hg (absolute) or less, a steam jacket shall be furnished to heat the nozzle and diffuser to prevent icing. Steam jackets shall be furnished with safety valves and drains.

Multiple ejectors, connected in parallel, shall be furnished; when required to accommodate variable loads or when installed spares are specified.

Suction and discharge valves shall be furnished for all ejectors in a packaged system which are installed in parallel.

Ejectors handling gases shall have plugged pressure taps on the suction chambers.

4.3 Condenser

Surface (shell and tube) type condensers shall be furnished in accordance with applicable ASME code, TEMA class (as specified on the data sheet), HEI standard and Grupa LOTOS S.A. specification.

Barometric type condensers shall be furnished in accordance with the applicable HEI standard.

All process and water piping connections on condensers shall be flanged.

4.4 Castings

Castings shall be sound and free of shrink holes, blow holes, cracks, scale, blisters or other similar injurious defects. Surfaces of castings shall be cleaned by sandblasting, shotblasting, pickling, or any other standard method. All mold-parting fins and remains of gates and risers shall be chipped, filed or ground flush.

The use of chaplets in pressure castings shall be held to a minimum. They shall be clean and corrosion-free (plating permitted) and of a composition compatible with the casting.

Ferrous castings shall not be repaired by welding, peening, plugging, burning-in or impregnating, except weldable grades of steel castings may be repaired by welding, using a qualified welding procedure based on the requirements of applicable sections of the ASME code. Repair procedure shall be agreed with Grupa LOTOS S.A.

Studded connections shall be furnished with studs installed. Blind stud holes shall only be drilled deep enough to allow a preferred tap depth of one and one-half (1-1/2) times the major diameter of the stud. The first one and one-half (1-1/2) threads at both ends of each stud shall be removed.

4.5 Bolting

Details of threading shall conform to applicable ANSI standard.

Studs are preferred to cap screws.

Clearance shall be provided at bolting locations to permit the use of socket or box-type wrenches.

Connections, welded to the main bodies of the equipment, shall meet the material requirements, including impact strength values, of the body rather than the requirement of the connected auxiliary piping.

Tapped holes in pressure parts shall be held to a minimum. Sufficient metal along with the metal allowance for corrosion shall be left around and below the bottom of drilled and tapped holes in pressure sections to prevent leakage.

Tapped openings, not connected to piping, shall be plugged with solid steel, round-shank plugs furnished in accordance with applicable ANSI standards. Plugs that later may require removal shall be of corrosion-resistant material. Threads shall be lubricated.

4.6 Piping

All necessary interconnecting piping between components shall be furnished.

Allowable forces and moments which can be imposed on piping furnished by the Supplier shall be shown on the Supplier's drawings.

All piping, flanges and threaded connections shall be designed, fabricated, tested and inspected in accordance with applicable ANSI standards.

The piping on an assembly shall be designed and arranged for easy disassembly, to permit maintenance and cleaning. The piping shall also be properly supported to prevent vibration and damage.

Threaded joints that are to be seal welded shall be made up dry, i.e., with no thread lubricants, tape or compound. The seal weld shall consist of at least two passes, with the throat of the finished weld 10 mm minimum. The seal weld shall cover all exposed threads.

4.7 Structural Design and Fabrication

The Supplier shall provide all necessary insulation clips for all equipment which Grupa LOTOS S.A. will insulate.

Lifting lugs, or other suitable provisions for lifting, shall be furnished on all equipment components weighing 20 kg (44 pounds) or more when necessary for maintenance or erection.

All necessary supports for skid mounted or packaged equipment shall be included and shop-fabricated.

Skid-mounted equipment shall be sufficiently rigid to permit lifting of the entire assembly from lift points on the skid and installation of the assembly with the skid supported on two horizontal beams.

Methods of lifting the assembled system shall be described by the Supplier.

Design of all structural steel shall be in accordance with the applicable AISC standard and Grupa LOTOS S.A. specification.

4.8 Welding

All welding, where not covered by other applicable codes, shall be in accordance with the AWS code.

All welding shall be in accordance with the applicable Grupa LOTOS S.A. Specification.

4.9 Materials of Construction

Materials shall be as specified in the data sheets. Where not specified, materials shall be the Supplier's standard, but suitable for the intended service and at least of the quality specified by the applicable HEI Standards.

Materials for pressure or vacuum containing parts shall be identified in the proposal with their applicable ASTM, AISI or ASME numbers and shall include material grade. When no such designation is available, Supplier's material specification, giving physical properties, chemical composition and test requirements, shall be included in the proposal.

The Supplier shall specify ASTM or ASME optional tests and inspection procedures when necessary to ensure that materials are satisfactory for the service. Such tests and inspections shall be listed in the proposal.

The material used for minor parts (bolts, nuts, springs, washers, gaskets, keys, and other parts not normally identified by the Supplier) shall be at least equal in corrosion resistance to those materials required for major parts exposed to the same environment.

If parts made from austenitic stainless steels are exposed to a motive, process, or environmental condition that promotes intergranular corrosion and they could be fabricated, hard-surfaced, repaired, or overlayed by welding, then stabilized or extra-low carbon grades are required. Austenitic steels shall not be used in services where stress-corrosion cracking is a possibility.

For temperatures below -29°C a suitable low temperature bolting material as specified in the applicable ASTM standard shall be used.

Studs, bolts, and nuts of austenitic stainless steel (or other materials having similar galling tendencies) shall be lubricated with a suitable antiseize compound.

For operating or ambient temperatures below -29 °C steels shall have an impact strength at the lowest temperature sufficient to qualify under the minimum Charpy V-notch impact energy requirements of the applicable ASME code. For materials and thickness not covered by the applicable code, the Supplier shall specify the requirements on the data sheet.

4.10 Sound level requirements

Noise generated by the ejector or ejector system shall not be greater than max. value stated in the data sheets or technical specifications of Grupa LOTOS S.A. If needed, Supplier shall deliver adequate protections to reduce the noise level to the acceptable value (e.g. noise attenuation enclosure, silencers).

If other documents do not require more stringent values then the sound pressure level is limited to 85dB(A) at 1m distance from the machine.

5 Electrical Requirements

All electrical equipment and fabrication shall be furnished in accordance with the applicable Grupa LOTOS S.A. Specification.

All required electrical parts, devices, and equipment shall be furnished to form a complete operating system.

The Supplier shall submit with his proposal a list of electrical parts and equipment to be furnished with the ejector system.

6 Controls and Instrumentation

All instrumentation shall be in accordance with the applicable Grupa LOTOS S.A. specification.

All instruments and devices shall be of industrial grade and suitable for outdoor service.

The Supplier shall submit a list of all instruments (including any control valves).

7 Painting

7.1 General

Preparation of the surface for painting shall comply with ISO 8501-1.

For mechanical surface preparation the degree of surface cleanliness St 3 shall be obtained.

For sandblasting the degree of surface cleanliness Sa $2^1/_2$ shall be obtained.

No painting work or spotting-in shall be carried out in the following weather conditions:

- ambient temperature below 5°C,
- air humidity above 85%,
- metal surface temp. 3°C below the dew point.

If special requirements have not been specified, the manufacturer's standards shall additionally apply taking into account the operating conditions (the type of the medium, temperature). Special processes and the use of special paints may be required by the project specification or the data sheet.

Grupa LOTOS S.A. reserves the right to receive and review the Supplier's painting procedure at any time during the order.

Painting system is subject to Grupa LOTOS S.A. approval.

7.2 Quality of painting coats

The coating of the equipment shall withstand the environmental and service conditions as specified in the Grupa LOTOS S.A. specifications for a minimum period of five years unless otherwise specified in the data sheets. Paint coats shall be resistant to full range of operating temperature including max. temperature of heating medium.

8 Nameplate

A stainless steel nameplate containing, at a minimum, the following information shall be permanently attached at an easily accessible point on the ejector:

- Supplier's name, serial number and type of ejector furnished
- Date of fabrication
- Grupa LOTOS S.A. purchase order number and machine tag number

9 Inspection and Testing

9.1 General

For general requirements refer to Grupa LOTOS S.A. specification no. 2400 – "General requirements for machines and drivers."

9.2 Tests

All standard factory tests shall be performed. Tests are to be witnessed or non-witnessed per Grupa LOTOS S.A. inspection plan. Additional tests will be specified in technical data sheets.

All ejectors shall be hydrostatically tested in accordance with the applicable HEI standards.

The Supplier shall conduct a shop performance test of each ejector system, each ejector type and size. Performance tests of steam operated ejectors shall be in accordance with the applicable HEI standards. Test curves shall be submitted to Grupa LOTOS S.A. for review.

9.3 Inspection

When radiography of welds, magnetic-particle, dye-penetrant or ultrasonic inspection is specified on the data sheets, radiography, magnetic particle and dye-penetrant inspections shall be in accordance with the applicable ASME code.

When ultrasonic inspection is specified on the data sheets, procedures and acceptance criteria shall be mutually agreed upon.

If specified on the data sheets, cast steel casing parts shall be examined by the magnetic-particle methods as described in the applicable ASTM standards. Acceptability of defects shall be based on a comparison with the photographs associated with applicable ASTM standards. For each type of defect, the degree of severity shall not exceed the applicable limits.

Regardless of these generalized limits, it shall be in the Supplier's responsibility to review the design limits of all castings in the event more stringent requirements are specified. Where defects exceed the limits imposed above, they shall be cleaned out to meet the quality standards referenced above as determined by additional magnetic particle inspection, prior to repair welding.

Fully identified records of any nondestructive tests and heat treatments performed in the normal course of manufacture or as part of a repair procedure, shall be retained for 5 years for Grupa LOTOS S.A. review unless otherwise specified in the data sheets or purchase order documents.

10 Relevant documents

10.1 Grupa LOTOS S.A. specifications

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

11 Record of changes

No.	Date	Description	Introduced by
1	30.11.2013 (rev.1)	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