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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, inspection and testing of positive displacement pumps.

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.

These specifications shall be considered together with specifications no. 2400 – "General requirements for Machines and Drives".

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

The Pumps units 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

Reciprocating pumps shall meet the requirements of the standard API Std 674 3rd edition or newer, rotary positive-displacement pumps shall meet the requirements of the standard API Std 676 3rd or newer including requirements stated herein. Other standards may be used if agreed with Grupa LOTOS S.A.

Applicable standard shall be stated in pump 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 SA. 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

Pump units shall be suitable for outdoor installation.

Pumps shall be protected with external pressure relief valves. If not stated otherwise the valves shall be delivered by pump Supplier.

Safety valves and pulsation dampers (if used) must meet PED requirements.

4 Mechanical Design Requirements

4.1 General

The crankcase and gear housing shall be totally enclosed and moisture tight. Suitable access openings with removable covers shall be provided for periodic inspection and maintenance of critical components.

Bearings shall be oil lubricated.

For non-pressurized oil lubricated bearings, constant level oilers, level gages, and fill and drain connections shall be provided.

Pressurized lubrication system, if required, or specified in the data sheets, shall include at least the following:

- Oil sump with level gage, filling, vent and drain connection and electric heater
- Shaft driven main oil pump
- Motor driven stand-by oil pump
- Twin oil filters, each rated for full flow
- Oil cooler with automatic TCV and oil inlet and outlet thermometers
- Low oil pressure alarm and trip switches (trip against low oil pressure)
- Oil pressure gauges
- Stand-by oil pump start alarm switch
- Instruments wired to junction boxes located at base frame.

Heating or cooling jackets for liquid end casing and valves shall be furnished, if required or specified in technical data sheet.

Design pressure of cooling jackets shall be not less than 5 bar(g).

Cast iron pressure casings for liquid end shall not be used without specific approval of Grupa LOTOS S.A.

Drain piping shall be provided up to the edge of baseplate for leakage from packing or mechanical seals.

Drain piping material shall be stainless steel as minimum.

All connections over 12 mm (1/2 inch) size shall be flanged.

All wiring from switches and probes shall terminate in junction boxes on pump baseplate.

The pump's casing shall be arranged for ready opening so that internal parts can be inspected or removed (with minimum dismantling of the pump and without moving the pump from its baseplate).

4.2 Reciprocating Pumps

Liquid end shall be fitted with renewable valve seats and cylinder liners.

Pumps fitted with plate valves are not acceptable above 24 bar(g) or pumping temperature above 180°C.

Coating of plunger is acceptable however a type of coating shall be approved by Grupa LOTOS S.A.

If required for working conditions or specified in technical data sheet, provisions for external lubricant injection into plunger packing shall be supplied. The injection flow rate (the way of injection) and pressure shall be stated by Supplier in the initial proposal.

Jacket for stuffing box cooling shall be provided for pumping temperature exceeding 150°C.

Pressurized crankcase lubrication shall be provided for pumps with drivers rated 110 kW and more unless otherwise specified in the data sheet.

Steel flexible couplings shall be used. Spacer type couplings shall be furnished for pumps handling flammable liquids.

4.3 Rotary pumps

Rotary pumps including lobe (helical, spiral or straight), rotary piston, sliding vane, screw and gear pumps shall have independently supported rotor assemblies. Rotors mounted on extended motor shafts are not acceptable.

Unless otherwise stated in the data sheet, rotary pumps shall be furnished with mechanical seals.

The shaft of each pump shall be adequate size and strength to withstand safely and continuously all stresses resulting from the weight to be supported, and from starting (including across- the- line starting), operating and temperature conditions to which it will be subjected. The critical speed of the shaft shall be such as to provide a liberal margin of safety between such speed and the range of operating speeds of the pump. Adequate provision shall be made to prevent distortion, binding, excessive leakage or thrust due to either direct or differential expansion of the rotor parts.

The rotor body shall be integral with the pump shaft.

4.4 Progressive Cavity Pumps

Unless otherwise specified in the data sheet, progressive cavity pumps shall be fitted with mechanical seals.

Pump casing shall consist of two parts as follows:

- External part to which process pipelines are connected
- Internal part (replaceable) operating together with the rotor body.

Any deviations from above rule shall be approved in writing by Grupa LOTOS S.A.

4.5 Metering Pumps

The requirements concerning proportioning pumps are indicated in Grupa LOTOS S.A. specification no. 2411.

4 Drivers, Gear and Couplings

Electric motors shall be in accordance with Grupa LOTOS S.A. electrical motor data sheet and the applicable motor specification.

Nameplate power of electrical motor drivers shall be at least 110 percent of required power consumption of pump including any transmission losses at the maximum capacity and relief valve or other overload trip setting.

Speed increasing or reducing gears shall be in accordance with the applicable AGMA standards and the gear nameplate power shall be at least equal to the motor nameplate power, including motor service factor.

Couplings shall be flexible type, grease lubricated or preferable non-lubricated design.

All couplings and belt drives shall be furnished with removable guards in compliance with applicable regulations.

5 Pulsation Dampeners

Pulsation dampers on discharge side shall be furnished for all reciprocating pumps.

If justified, to decrease pressure pulsation and vibration in pipelines, suction side pulsation dampers shall be applied.

The acceptable pulsation levels shall be according to API 674 standard.

6 Inspection and Testing

6.4 General

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

6.5 Tests

All pumps, where flowrate is controlled with speed, shall be tested for several speed values in accordance with API 674 or API 676 respectively to the pump type.

Cooling jackets shall be hydrostatically tested at 1.5 times maximum cooling liquid system pressure but not less than 8 bar(g).

All pumps shall be given manufacturer's standard shop running tests to insure smooth operation of the pump and its control accessories.

If performance testing and/or calibration tests are specified in the data sheet, the pump shall be tested for a minimum duration of 1 hour in accordance with applicable HI standards referred to in API 674 or API 676.

Test reports and calibration curves shall be submitted to Grupa LOTOS S.A.

In order to verify the proper selection of the motor, a test for the full output shall be conducted at the pressure of the safety valve setting.

7 Painting

Painting shall be in accordance with specification no. 2400.

8 Nameplate

A stainless steel nameplate containing at a minimum the following shall be provided for the pump units:

- Supplier name and serial number
- Date of manufacture
- Grupa LOTOS S.A. purchase order number and tag number
- Capacity - m^3/h
- Pump design speed - rpm
- Discharge pressure - bar(g)
- Maximum allowable working pressure - bar(g)
- Operating temperature - °C
- Bearing designations

9 Documentation

Documentation delivered with pump unit shall be in accordance with Annex B of API 674 3rd ed. or Annex D of API 676 3rd ed. depending on pump type. Documentation for auxiliary equipment delivered by pump Supplier which is not addressed in the above mentioned annexes e.g. frequency converter, shall be in accordance with applicable Grupa LOTOS S.A. specification. If such specification does not exist, manufacturer's standard documentation is acceptable.

Supplier shall ensure that the following data/documents are included in the final documentation.

Dimensional outline drawing

- total weight and the weight of the heaviest elements for repair purposes, rotor/impeller weight for rotating machines
- position of the centre of gravity for machines of a weight exceeding 1500 kG
- location of flanges and the dimensions of flanges, venting, draining openings, and of other threaded connections
- location of the lubricating points
- the values of the maximum allowable forces and torques on flanges and the maximum differences in their position during cold and hot working condition
- direction of rotation
- static and dynamic foundation loads
- tolerances for levelling the foundation plate on the foundation

- dimensions of the foundation plate (base frame) and location of the foundation bolts
- type and technical data of the mechanical (gas) seal
- type, dimensions and number of the foundation bolts
- type and the technical data of the drive
- type of the coupling, the distance between shaft faces, the length of the spacer
- type and the technical data for gear.

Pipeline documentation

Pipeline documentation within the scope of supply of the machine shall be in accordance to the requirements of specification no. 6100.

Instrumentation and electric documentation

Documentation of the instrumentation and electrical discipline shall include the following:

- list of control and measuring instruments
- technical characteristics of the instruments and their set points
- wiring diagrams and control logic diagrams
- drawing of the control panel
- assembly drawings and list of materials
- installation, operation and maintenance manuals for individual equipment.

Operation and maintenance manuals

Operation and maintenance manuals shall include the following:

- the data sheet
- the report on the factory tests of the machine with the characteristic curves from these tests
- technical description of the machine
- technical description of the auxiliary equipment
- assembly and disassembly instructions
- operation manual (start-up, adjustment/regulation, shutdown)
- the maintenance and repair manual
- cross-section drawings of the machine, its subassemblies and auxiliary equipment with a list of parts including their construction materials and the manufacturer's code numbers
- the minimum and maximum clearance for mated parts
- the torques and the sequence of bolts tightening
- List of antifriction bearings, stating their symbols, the name of the manufacturer, the place of installation and their number (i.e. quantity) in a single machine. This applies also to elements used for mounting the bearing, such as bearing housings, bearing sleeves etc.

- the maximum allowable bearing temperature
- the allowable vibration level
- lubrication and cooling diagrams
- operating parameters for oil systems (pressure and temperature)
- list of oils and greases with recommendation (identification and the name of the manufacturer) and their substitutes, if any, as well as their physical and chemical characteristics, quantities required for the first filling (the capacity of the oil system or the greasing chamber), life time till the first replacement and the replacement frequency, expected annual consumption.

Manufacturer Data Book

MDB documentation shall include the following:

- Ex certificates
- material certificates
- heat treatment reports
- NDT reports
- reports on the dynamic balancing of rotors (if applicable)
- pressure test reports
- functional test reports
- information on already applied lubricants

10 Relevant documents

10.1 Grupa LOTOS S.A. specifications

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

10.2 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:

- API Std 674 - Positive Displacement Pumps - Reciprocating
- API Std 676 - Positive Displacement Pumps - Rotary

11 Record of changes

No.	Date	Description	Introduced by
1	13.06.2006.	Changed point 6.	T. Wójcik
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