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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 proportioning 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

Pumps shall be designed and delivered in accordance with API standard 675 2nd ed. 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 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

If not stated otherwise in purchase order documents the pump units shall be suitable for outdoor unsheltered installation.

Proportioning (Controlled Volume) pumps shall meet the requirements of the API Standard 675.

Liquid ends of pumps shall each be as best suited to meet the required service condition as specified on the individual data sheets and may be of simplex, duplex or triplex construction.

If special type requirements have not been defined, pumps shall be of the diaphragm type. Both disc and tube diaphragms (relevant for peristaltic pumps where tube takes the role of the normal disc diaphragm) are acceptable. For toxic liquids double diaphragms are required.

Integral pump overload protection device shall be furnished.

Pumps shall be equipped with external safety valves installed on the delivery pipelines.

Pressure relief valve shall not be used on discharge side for slurry services.

Spare parts needed for commissioning and start up shall be furnished by manufacturer.

Special tools required for disassembly of the pump shall be furnished by the manufacturer.

The pumps and drivers shall be designed for continuous operation while delivering maximum capacity at relief valve set pressure or while running at the limiting torque or speed setting of a mechanical or electrical equipment protection device.

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

Proportioning pump design recommended by the Supplier shall be mutually agreed to and in compliance with applicable laws and standards. Supplier shall indicate where specifications require excessive measures that result in non-standard material supply. The Supplier is obligated to identify such deviations.

4 Mechanical Design Requirements

4.1 Proportioning pumps

Diaphragms shall be driven hydraulically.

Max. pump operating speed shall not be higher than 140 strokes/minute. For application where NPSHA is lower than 3m the maximum speed shall not exceed 100 strokes/minute.

Plunger with return springs may be used for power rating not exceeding 0.12 kW.

Oil for the hydraulic system shall be selected for the full range of ambient temperature.

Maximum seat hardness shall not exceed 200HB. The hardness of valve balls shall be more than 400HB.

Multihead pumps with common suction and discharge lines shall be equipped with external safety valve mounted at the discharge manifold.

The crankcase and gear housing shall be totally enclosed and moisture tight (modern, proved sealing systems shall be applied). Suitable access openings with removable covers shall be provided for periodic inspection and maintenance of critical components.

Bearings shall be oil lubricated.

For nonpressurized oil lubricated bearings, level gauges, 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 gauge, filling, vent and drain connection and electric heater
- Shaft driven main oil pump
- Electric motor driven stand-by oil pump
- Twin oil filters, each rated for full flow of lube oil system
- Oil cooler with automatic TCV and oil inlet and outlet thermometers
- Low oil pressure alarm and trip switches
- Oil pressure gauges
- Stand-by 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.

Design pressure of liquid 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.

Drain piping material shall be stainless steel or other suitable material if stainless steel is not corrosion resistant to pumped fluid.

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

For multihead pump or several pumps placed on common baseplate all wiring from switches and probes shall terminate in junction boxes on the edge of the baseplate.

Pumps shall be adjustable within the range of 0 ÷100% of a stroke.

Repetitive accuracy, expressed as percentage of the delivery actually measured, shall be within +/- 1% within a range from the minimum flow to the rated flow stated in the data sheet, but not narrower than 10-100% of the rated flow.

The following flowrate control methods (as specified in the data sheet) can be used:

- local manual micrometer dial type control
- speed control using frequency converters.

Above methods can be furnished as remote, manual or automatic control signal.

Adjustment devices shall be designed such as to prevent any unintentional capacity variation.

Pumps for toxic, corrosive, or offensive-smelling fluids, and whenever required by process shall be equipped with double or triple diaphragms with diaphragm rupture detectors. The detector shall be in Ex design suitable for specified hazardous area if not stated otherwise in the data sheet.

Back pressure valve to maintain minimum differential pressure shall be furnished, if required or specified.

Supplier shall furnish all auxiliary piping for lubrication, cooling and flush of packing. They shall be assembled and installed on the pump and/or baseplate.

Where lubrication of liquid end packing boxes is specified on data sheets or recommended by pump Supplier, each packing box is to be lubricated at the lantern ring by a separate feed from the lubricator, unless these boxes are lubricated by a separate seal oil system.

Glands on packing boxes of pumps handling flammable fluids shall be of spark proof material or shall have spark proof bushing.

5 Drivers, Gear and Couplings

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

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 nonlubricated design.

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

6 Pulsation Dampeners

Pulsation dampers for metering pumps shall be provided at discharge line and, when specified at suction line. Multihead pumps (pumping the same liquid) must be equipped with a pulsation damper at suction line.

The acceptable pulsation levels shall be in accordance with API 674.

7 Inspection and Testing

7.1 General

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

7.2 Tests

All pressure containing components shall be hydrostatically tested as described in API Std 675 2nd edition.

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 through whole operating range.

All pumps shall undergo performance tests in accordance with API Std 675 2nd edition.

Test reports and 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.

8 Painting

Painting shall be in accordance with specification no. 2400.

9 Nameplate

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

- Supplier name and serial number
- Date of manufacture
- Grupa LOTOS S.A. purchase order number and tag number
- Flowrate - l/h
- Pump rated speed - rpm
- Discharge pressure - bar(g)
- Maximum allowable working pressure bar - bar(g)
- Operating temperature - °C

10 Documentation

Documentation delivered with pump unit shall be in accordance with Appendix D of API Std 675 2nd edition. Documentation for auxiliary equipment delivered by pump Supplier which is not addressed in the above mentioned appendix e.g. frequency converter, shall be in accordance with applicable Grupa LOTOS S.A. specification. If such specification does not exist, manufacturer's (subsupplier'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
- 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
- pressure test reports
- functional test reports
- information on already applied lubricants

11 Relevant documents

11.1 Grupa LOTOS S.A. specifications

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

11.2 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 675 – Positive Displacement Pumps – Controlled Volume

12 Record of changes

No.	Date	Description	Introduced by
1		This specification entirely replaces the former Grupa LOTOS S.A. standard No. PR 07 242 with the same title.	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