Contents

1 Subject of specification 2
2 Scope of validity 2
2.1 Deviations 2
3 Definitions 2
3.1 Hierarchy of documents. 2
4 Technical requirements 3
4.1 General requirements 3
4.2 Materials 4
4.3 Valves, flanges and accessories 5
4.4 Vents and drains 5
4.5 Safety valves 5
4.6 Control valves 6
4.7 Utility media - stations 6
4.8 Connecting piping to machinery 6
4.9 Pipeline supports 7
4.10 Steam and condensate pipelines 8
4.11 Sight glasses. 9
4.12 Check Valves. 9
5 Technical documentation (engineering specifications) 10
6 Relevant documents 10
7 Standards and regulations 10
7.1 Designing 10
7.2 Dimensions 10
7.3 Other effective standards 11
8 Record of changes 12

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

1 Subject of specification

This specification used in conjunction with other technical specifications of Groupa LOTOS S.A. establishes the minimum requirements for the design and manufacture of pipes used in petrochemical plants.

2 Scope of validity

This specification applies to the preparation of tender documents, inquiries and contracts concerning new investments and modernization projects planned by Groupa 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 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 SA or non-compliance with the referred documents / standards and obtain a written explanation from Grupa Lotos SA

3 Definitions

- Shall – Indicate a mandatory requirement.
- GL S.A. – Grupa LOTOS S.A.
- Abbreviation JN means Jednostka Notyfikowana (Notified Body).
- Abbreviation UDT means Urząd Dozoru Technicznego (Office of Technical Inspection).
- Abbreviation ZDT means Zakładowy Dozór Techniczny (Plant Technical Inspection of Grupa LOTOS S.A.).

3.1 Hierarchy of documents.

In case of conflict 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 with GL S.A.
- Data Sheets approved by GL S.A.
- This specification
- Other Specifications
- Drawings and other documents
- Standards,

4 Technical requirements

4.1 General requirements

4.1.1 Pipelines should be designed and manufactured in compliance with the regulations and standards detailed in point 7. For non-hazardous auxiliary media (Fluid group 2 according to Directive 97/23/EC) designed and manufactured according to Directive 97/23/EC in compliance with recognised engineering practice (i.e. those not falling into hazard category I, II and III). Application of PN and DIN standards to ancillary media is allowed.

4.1.2 Classification of pipelines should be developed by the Contractor on the basis of Specifications No.6120 and given to Grupa LOTOS S.A. for approval.

4.1.3 The minimum nominal diameter of pipes within battery limits must not be less than $^1/_2$". The minimum diameter of pipes on pipe racks must not be less than $1^1/_2$".

4.1.4 For pipes of nominal diameter ≤ 2" use the minimum wall thickness corresponding to Schedule XS according to ANSI/ASME B 36.10.

4.1.5 For nozzles of nominal diameter ½" and ¾" shall use the pipes with wall thickness corresponding to Schedule 160 according to ANSI/ASME B36.10. For nozzles of nominal diameter from 1" up to 2" shall use the pipes with wall thickness corresponding to Schedule XS according to ANSI/ASME B36.10.

4.1.6 Use of nominal diameters $1^1/_4$", $2^1/_2$", $3^1/_2$", 5" and 22" is not allowed, with the exception of jacketed pipes, lined pipes and connections to equipment.

4.1.7 Pipelines in explosive areas must be protected against static electricity by:

- earthing the pipelines according to Lotos Technical Requirements no 4500,
- using only gaskets of conducting materials (e.g. spiral wound gaskets with graphite tape, graphite gaskets, metal jacketed gaskets) for flange connections.

4.1.8 Grupa Lotos has the right to inspect on every stage piping construction according to the range determined by itself.

4.1.9 Pipelines working in a creep zone should be designed for 200,000 hours of operation. The designer should propose the method for the monitoring of the condition of the material during operation.

4.1.10 Pipelines exposed to Sulfide Stress Cracking should be designed and manufactured in compliance with NACE RP 0472 and NACE MR 0103.

4.1.11 Pipelines for process media containing amine should be designed and manufactured in compliance with API RP 945.

4.1.12 Pipelines requiring pickling or other chemical treatment should be designed with an adequate number of flange connections enabling their easy dismantling and treatment.

4.1.13 All pipelines should be protected against atmospheric discharge (grounded) and electrostatic discharge according to the requirements of Specifications No. 4500.

4.1.14 All pipelines should be marked according to the requirements of Specifications No. 2620.

4.1.15 Designer of installation or pipelines unit should establish data base according speciment of GL S.A.(data base example in specification no 6600), which contain primary data of pipelines and data of regarding operating tests (wall thickness measurement with information of measuring points location, frequency of tests etc). This base should be connected in elektronic way with simplified isometric drawings of pipelines.

4.1.16 For control air pipelines the pressure water tests are not permitted. Air or nitrogen pressure tests are recommended

4.1.17 Pipelines, located on pipe racks or covered by ground, between different production divisions of Grupa LOTOS S.A. shall be identified and assign for intended end user. Pipelines assignment for intended end users shall be prepared during detail design. (Typical end users are: PZH, PZW,PZP, PZD, PZO,PZK,PZC,PZE, LOTOS Asfalt, LOTOS Oil, etc,)

If this same part or parts of pipeline has more than one end user, than pipeline shall has pipeline number and PED passport as required for servicing end user. It is allowable that one pipeline could have more than one pipeline number and PED passport.

For pipelines mentioned above all PSV located on transit pipelines between different production divisions, shall be assign to the "end user" during detail design.

4.2 Materials

4.2.1 Materials should be selected in compliance with material classes according to Specification No. 6120

4.2.2 Selection of materials for pipelines exposed to high-temperature hydrogen embrittlement should be based on API RP 941.

4.2.3 Materials should be delivered with certificates minimum 3.1. as per EN-10204.

4.2.4 All delivered materials should have permanent marking containing the grade of the material and heat number to allow their identification against certificates.

4.2.5 Use of cast iron fittings and equipment is not allowed.

4.2.6. For hazardous, flammable, caustic, toxic media and high pressure steam piping flange connections should be used the spiral wound gaskets or metallic gaskets. For sour and alkaline liquids, flanged connection leak protection collars shall be use. The flat (soft) gaskets are acceptable only for utility media as water, low pressure steam, compressed air, nitrogen.

4.2.7. Piping manufacturer has to apply positive material identification (PMI) to the welds and welding elements during prefabrication and erection phase according to below requirements:

carbon steel CS	10% of the welds,
low alloy steel AS	100% of the welds,
stainless steel SS	20% of the welds

4.2.8. Grupa Lotos additionally requires PMI and hardness test checking to be done by piping manufacturer during final examinations (by Lotos Inspector) in the scope up to 5% of total welds.

4.2.9. It is prohibited to join by welding elements made of different materials. In this cases only flanged connection is allowed.

4.2.10. Material management.

Contractor (subcontractor) shall provide quality management plan which define the system of material receiving and realising (to avoid possibilities of use material which do not match material requirements) plan shall contain at least:

- Method of material identification and tagging,
- Retention method for certificates and material manufacturer test.
- Algorithm (architecture) of computer software for material data base,
- Method of realising materials from warehouse to production, or assembly,

- Personnel liability.
- Records of additional test making during material receiving and realising.
- Description of procedures use for commissioning of steel and welding material acceptance before assembly or welding works.
- Description of procedures use for welds tagging (Identity of welder and weld) and welds recognition method on isometric drawings (as built).

Quality management plan, as described above, shall be accept by Grupa LOTOS S.A.

4.3 Valves, flanges and accessories

4.3.1 Operation of valves should be possible from the ground or platform level. The axis of the actuating element (a wheel or a lever) must not be higher than 1.8 m above the ground or platform level. If the use of stem extensions is necessary, they should be supplied with the valves. If valves are located on a pipe rack, adequate access for personnel should be provided.

4.3.2 Flange connections should be used where they are necessary to facilitate repairs, inspections and where the process conditions require their use to facilitate washing or pressure tests.

4.3.3 Spectacle blinds should be installed in places accessible from the ground or platform level. Spectacle blinds of a weight bigger than 45 kg should be, as far as possible, installed in a vertical position and if they cannot be suspended, access for mobile hoisting equipment must be secured.

4.3.4 Above ground process and utility media lines (except blow down lines), which are connected with the plant, should be furnished inside the Battery Limit with double isolating valves, a blind and a vent or drain between them, and a manometer. A typical solution is shown in Specifications No. 2020.

4.3.5 Utility media pipelines connected with a collector should be provided with isolating valves near the collector.

4.3.6 Nitrogen and air connections to process vessels or pipelines should be provided with a gate valve, a vent and a non-return valve if pressure in the process vessel or pipeline is higher than pressure in the air or nitrogen collector. Typical solutions are shown in Specifications No. 2020.

4.3.7 For flange connections stud bolts with unified screw thread along the whole length should be used. Bolts with heads may be used only for low-pressure utility media lines. Bolt shall be two (2) free bolt coils above nut after screwing.

4.4 Vents and drains

4.4.1 For the purpose of water-pressure tests vents and drains with plugs or isolating valves in the highest and the lowest points of the pipeline should be secured. After the completion of the tests the plugs should be welded. Caps with internal threading are recommended.

4.4.2 Drains and vents designed for other purposes should be provided with valves and caps (plugs) if they are not connected to the slop system.

4.4.3 Drains of process pipelines should be connected to the slop system.

4.4.4 Drains should be used upstream of every control valve and downstream of the valve if it is of the "emergency closed" type.

4.4.5 Drains and vents of high-pressure steam lines should be provided with double cut-off valves.

4.5 Safety valves

4.5.1 Safety valves should be accessible from the ground or platform level.

4.5.2 The outlet from a safety valve to the blow down collector should be located over the collector and the connection to the collector should be at a 45° angle.

4.5.3 Safety valves with outlets to the atmosphere should have the outlets extended to a safe zone minimum 2400 mm above the nearest service platform within 7500 mm.

4.5.4 For liquid gas and for easily solidifying media and media polluted with solid particles double safety valves with change-over valves at inlet and outlet should be used.

4.5.5 Expansion safety valves for pipelines should be provided with isolating valves at inlet and outlet (if discharge of the valve is connected with the slop or blow down network) locked in the open position.

4.5.6 In justified cases agreed with the investor (ZDT) other safety valves may be provided with isolating valves upstream and downstream of the safety valve locked in the open position.

4.5.7 When designing pipelines, reaction forces and vibrations occurring during the maximum discharge should be taken into account for safety valves.

4.5.8 Branch piping going from main piping to safety valves has to have the same technological number.

4.6 Control valves

4.6.1 Control valves should be accessible from the ground or platform level.

4.6.2 Control valves that are critical for the process and that operate in extreme conditions should have full-flow bypasses with hand-operated valves suitable for control, permitting the disassembly of the valve during the plant's operation. Use of gate valves in the bypass line is not permitted for nominal diameters up to and including 8”.

4.7 Utility media - stations

4.7.1 Utility media stations should have water, low-pressure steam, air and nitrogen feed connections. The need to supply particular media should be determined by the process conditions.

4.7.2 The stations should be provided with 15 m long flexible hoses with quick-release joints. CAMLOCK type guick release joints are recommended.

4.7.3 The location of the utility stations must ensure that the range of the hoses covers the whole working surface of the plant.

4.7.4 Nominal diameters for particular media:

- air $^{3}/_{4}$”
- nitrogen 1”
- steam $^{3}/_{4}$”
- water $^{3}/_{4}$”

4.7.5 A typical utility media station is shown in Specifications No. 2020.

4.8 Connecting piping to machinery

4.8.1 The system of pipelines connected with pumps, compressors and turbines should have suitable supports to minimize loads on connecting nozzles of machines and it should meet the requirements of the respective standards API 610, API 617, API 618 and NEMA SM23.

4.8.2 Adjustable supports should be used to enable aligning of machines. The foundations of the adjustable supports located near the machine should be connected with the machine foundations, if possible.

4.8.3 If the diameter of the horizontal suction connection of a pump is smaller than the pipeline diameter, the eccentric reduction should be placed as near the connection as possible.

4.8.4 In the suction pipeline of every pump between the connection and the gate valve there should be built-in a permanent strainer of a diameter equal to the pipeline diameter. The location of the strainer must ensure a possibility of dismantling the strainer basket.

4.8.5 In the suction pipeline of compressors between the connection and the gate valve there should be installed a temporary strainer in a removable pipe insert.

4.8.6 The system of pipelines connected with pumps and adjoining them should allow for easy dismantling of the pumps.

4.8.7 The design of pipelines on the suction and discharge sides of compressors should take into account the analysis of pulsation and vibrations made by the machine manufacturer.

4.8.8 Pumps suction and discharge piping have to be furnished with drain and vent.

4.9 Pipeline supports

4.9.1 Pipeline supports should be designed on the basis of an analysis of stresses, loads and thermal expansion.

4.9.2 Stress analysis should be based on the following assumptions:

- If operating temperature is higher than the minimum ambient temperature, erection (ambient) temperature t=20^{0}C should be assumed for the analysis.
- For the calculation of piping stress and compensation one of the below mentioned temperatures should be used:

a) Design temperature stated in the pipelines list.

b) In special cases, when a pipeline can reach the design temperature only for short periods of time, the maximum admissible temperature shall be taken for calculations.

c) For a pipeline in which there is no flow, such as e.g. a pipeline connected to a stand by pump, erection temperature t=20^{0}C shall be assumed.

d) Additionally, temperature for special conditions should be taken into consideration:

- start-up and stoppage,
- steam purging of pipelines and vessels,
- insolation temperature assumed for metal t=50^{0}C,
- temperature at decoking,
- other conditions specified by Process Engineer or Grupa LOTOS.

4.9.3 Stress analysis and load calculations are required for piping systems incorporating the below listed lines:

- All lines with a nominal diameter of 2" and bigger connected with rotating and piston machines such as pumps (except metering pumps), compressors, turbines
- Lines with a nominal diameter of 3" through 6" operating in a temperature exceeding 260°C
- Lines with a nominal diameter of 8" and bigger working in a temperature exceeding 150°C
- Vertical lines on columns
- Lines connected with air coolers
- All lines requiring calculation of forces or moments exerted on structures, such as lines having fixed supports on the furnace structure or on a bridge
- Jacketed pipes
- Lines comprising special elements such as expansion joints, vibration dampers, Venturi tubes
- All lines with nominal diameters ≥ 16"
- Lines working in vacuum conditions
- Lines containing toxic and explosive media

4.9.4 For pipelines which are UDT/ZDT commisioned (PED Directive regulation)) it is not allowed to use supports comprising elements, which prevent monitoring of elbow wall thickness (dummy support). It is not accepted to weld reinforcing pads on elbows, which makes impossible wall thickness measurement.

4.9.5 Contractor is obliged to provide the cold and hot setting spring supports procedure for all the piping system for commissioning and start up activities (with manuals for all spring supports).

4.10 Steam and condensate pipelines

4.10.1 Steam lines should be provided with bootlegs with steam traps upstream of vertical sections, on „blind" ends and on long pipeline sections (75 m for saturated steam and 150 m for superheated steam) to remove condensate and ensure dry steam in steam reception places.

4.10.2 Steam line branches should be located at the top of the line.

4.10.3 Every individual steam and condensate line should be provided with isolating valves at the collector and at the reception place.

4.10.4 Steam traces and fixed drains should be provided with bimetallic steam traps with built-in filters and non-return valves. The steam traps should be of the flanged type, the connected valves of the socket weld ends.

4.10.5 The steam tracing tubes should be carbon steel according to material class for steam lines. Minimal ND of tracing tubes – $^{1}/_{4}$". The recommended nominal diameter of heating pipes for pipeline tracing is $^{3}/_{4}$".

4.10.6 The steam tracing tubes should be mounted using spacing elements ensuring adequate distance between the heating tube and the wall of the heated pipe.

4.10.7 All branches of the collectors of the steam-supply and condensate-reception stations should be provided with nameplates specifying the intended use of the given branch.

4.10.8 The requirements concerning the installation of steam traps and steam-supply and condensate-draining units are shown in Specifications No. 2020.

4.11 Sight glasses.

A sight glass or water gauge is a transparent tube located on pipelines through which operator can observe or indicate the direction of flow. Sight glasses shall be manufactured and install according with standards ASME B31.1 and ASME B31.3

4.11.1 Plain

Simple construction, two way flow possible, without indicant

4.11.2 Driptube.

Drop indicator for easy recognition of laminar flow or interrupted flow.

4.11.3 Flapper.

Sight glass with indicator for flow direction.

4.11.4 Flutter

Sight glass with ribbon, easy indicates very small flow of gases and liquids

4.11.5 Rotor.

Sight glass with rotor made from PTFE or from stainless steel

Glass use for sight glasses shall be chemical and mechanical resistant against flowing medium,
One way Sight glases flow direction shall be indicate on housing
For all material use for sight glass construction attest document type 3.1.B shall be provide, if others attests are not specified.

4.12 Check Valves.

4.12.1 Swing Check Valve.

A swing check valve consists of a flap or disc of the same diameter as the pipe bore, which hangs down in the flow path. With flow in the forwards direction, the pressure of the fluid forces the disc to hinge upwards, allowing flow through the valve.

4.12.2 Lift Check Valve.

Lift check valves are similar in configuration to globe valves, except that the disc or plug is automatically operated. The inlet and outlet ports are separated by a cone shaped plug that rests on a seat. Cone shaped plug lifts up and down perpendicularly to centerline of pipe.

4.12.3 Disc Check Valve.

The disc moves in a plane at right angles to the flow of the fluid, resisted by the spring that is held in place by the retainer. The valve body is designed to act as an integral centring collar that facilitates installation between flanges.

4.12.4 Split Disc Check Valve

The flap of the swing check valve is essentially split and hinged down its centre, such that the two disc plates will only swing in one direction. The disc plates are held against the seat by a torsion spring mounted on the hinge.

4.12.5 Diaphragm Check Valve

A flexible rubber diaphragm is placed in a mesh or perforated cone with the point in the direction of flow in the pipeline. Flow in the forwards direction deflects the diaphragm inwards, allowing the free passage of the fluid. When there is no flow or a backpressure exists, the diaphragm returns to its original position, closing the valve.

5 Technical documentation (engineering specifications)

Technical documentation has to be done according to Technical Specification no 6400 point 4.3.

6 Relevant documents

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

7 Standards and regulations

Designing and manufacture of pipelines should comply with the latest editions of the standards and regulations listed below:

7.1 Designing

Designing should comply with:

- Pressure Equipment Directive 97/23/EC
- Directive 96/61/EC – with reference to requirements for the gland packings and flange connections gaskets of the isolating and control valves installed in process lines.
- ASME B.31.3. – Process Piping
- ASME B.31.1 – Power Piping
- PN-EN-13480 –„Metallic Industrial Piping" („Rurociągi Przemysłowe Metalowe")
- PN-92/M-34031 – Technical requirements for steam and hot water piping.
- UDT/ZDT requirements – acc. to Specifications No. 8800
- the requirements of these specifications

7.2 Dimensions

Dimensions should comply with:

7.2.1 Pipes

- ANSI/ASME B 36.10M – Welded and Seamless Wrought Steel Pipes (for pipes of carbon steel and alloy steel)
- ANSI/ASME B.36..19M – Stainless Steel Pipes (for high-alloy steel)

7.2.2 Flanges

- ASME/ANSI B 16.5 – Pipe Flanges and Flanged Fittings NPS $^1/_2$ ÷ NPS 24
- ASME/ANSI B16.47 – Large Diameter Steel Flanges NPS 26 ÷ NPS 60
- PN-EN 1092-1 – "Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated - Part 1: Steel flanges.
- VDI 2200 – Seals flange connection – Selection, calculation, design and assembly of bolted flange connections.

- VDI 2440 Emission control – Mineral oil refineries.

7.2.3 Fittings

- ASME/ANSI B 16.9 – Factory- Made Wrought Steel Buttwelding Fittings
- ASME B/ANSI 16.11 – Forged Fittings, Socket Welding and Threaded

7.2.4 Bolts and nuts

- ASME/ANSI B 16.5 – Stud Bolts
- ASME/ANSI B 18.2.2 – Heavy Hex Nuts

7.2.5 Valves, gate valves

- ASME/ANSI B 16.10 - Face-to-Face and End-to-End Dimensions of Valves

7.2.6 Gaskets (spiral type for process pipelines and chemicals, flat nonmetallic for ancillary media; all types made of asbestos-free materials).

- ASME/ANSI B 16.20 - Metallic Gaskets for Pipe Flanges Ring-Joint, Spiral-Wound and Jacketed
- ASME/ANSI B 16.21 – Nonmetallic Gaskets for Pipe Flanges

7.3 Other effective standards

7.3.1 Valves, gate valves

- Standards API (API 600 – Steel Gate Valves, API 602 – Compact Steel Gate Valves, etc.)
- API 598 – Valves Inspection and Testing
- ASME/ANSI B 16.34 – Valves – Flanged, Threaded and Welding Ends

7.3.2 Spring hangers and supports

- MSS SP-58 – Pipe Hangers and Spring Supports – Materials, Design and Manufacture
- MSS SP 69 - Pipe Hangers and Spring Supports – Selection and Application

7.3.3 Expansion joints

- EJMA - Standards of the Expansion Joint Manufacturers Association

7.3.4 Anticorrosive requirements

- NACE MR 0103 – Materials resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments
- NACE RP 0472 – Methods and Controls to Prevent In-Service Cracking of Carbon Steel Welds in P-1 Materials in Corrosive Refining Environments

8 Record of changes

No.	Date	Description	Introduced by
1	21.03.2006.	This specification entirely replaces the specification rev.0 Changed points 4.10.4, 4.11.1 , 7.1. and 7.3.4. Added point 4.2.6.	B. Kowalewski
2	07.08.2006	Added point 4.11.8.	B. Kowalewski
3.	17.10.2006	Changed points: 5.1, 5.2 and 6.	B. Kowalewski
4	09-05-2011	Changed points4.1.6, 4.9.4. Added points 4.2.7, 4.2.8, 4.2.9, 4.5.8, 4.8.8, 4.9.5.	S. Zajaczkowski
5	30-11-2013 (rev.5)	Review, update, standardize and changes to the Standard in scope of order No. OK/990/2012	Editorial board coordinated by T.Wróbel
-	31-08-2015	Page layout corrections, no contents changes.	T. Wróbel