PBT.IO4 Technical Equipment Standard – SUT M Mechanical					
PCC ROKITA SA/SUPPORTING PROCESSES/TECHNOLOGICAL SAFETY MANAGEMENT					
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1. PURPOSE OF THE MANUAL

The purpose of the manual is to set the standard and define the minimum requirements for the supply, design and construction of technical installations and equipment, together with the associated accessories, at the GK PCC site.

The provisions of this standard and the latest editions of the legislation must be applied to the design, manufacture and installation of plant and technical equipment.

The provisions of the manual contain general requirements and apply to the technical design and selection of mechanical equipment.

The manual presents the design and/or implementation guidelines applicable in the GK PCC, which are compatible with the Technical Documentation Standard (TDS) applicable in the GK PCC.

2. SCOPE OF THE MANUAL

The manual applies to PCC group companies: PCC Rokita SA, PCC Exol SA, PCC MCAA Sp. z o.o., PCC Prodex Sp. z o.o., LabMatic Sp. z o.o., PCC Apakor Sp. z o.o., PCC Therm Sp. z o.o., PCC BD Sp. z o.o..

The manual applies to design, manufacturing and execution works, the supply of tanks, pipelines, apparatus, fittings, machinery and other technical installation equipment in the MECHANICAL field, on behalf of PCC Group Companies.

No.	Position (role)	Responsibility and authorization
1.	Technical Director	Supervision of the implementation of the manual

3. RULES OF CONDUCT

3.1. DEFINITIONS AND ABBREVIATIONS

No.	Name	Name definition
1.	OMM	Operating and Maintenance Manual
2.	TDS	Technical Documentation Standard
3.	SUT	Standard of Technical Equipment

3.2. GENERAL RULES

Refers to the purchase of materials and services, as well as the design and acceptance of mechanical engineering.

3.3. DESCRIPTION OF THE PROCEDURE

Application of the standard during the design, manufacture, procurement, overhaul and modernisation of equipment and machinery of the mechanical industry.

3.4. MACHINERY AND EQUIPMENT

3.4.1. PUMPS

A. MATERIAL AND CONSTRUCTION REQUIREMENTS

Pumps supplied to GK PCC should meet the following requirements:

- Flanged pump connection acc. to PN EN 1092-1.
- They should have a proven design with no prototype solutions or components.
- The permissible noise generated by the pumping system should not exceed 85dB at a distance of one metre from the source.
- They should be designed for continuous operation of the working medium at a temperature no lower than the highest permissible (design) temperature and no higher than the lowest permissible (design) temperature.

- The nominal operating point of the pump should lie between 65% and 100% of the maximum efficiency of the impeller supplied. In justified cases, lower values than the above may be allowed with the agreement of the PCC technical services.
- It is not permissible to use the largest diameter impeller for a given pump range.
  In duly justified cases, especially in the case of better pump efficiency, it is permissible to use the largest impeller diameter for a given range, subject to the agreement of the PCC technical services.
- When selecting a pump, the following condition NPSHa-NPSHr ≥ 0.5 m should be met.
- Pumps operating at temperatures below 100°C should be suitable for immediate start-up from ambient temperature to full operating temperature. For higher operating temperatures, the supplier should supply the start-up procedure and complete monitoring systems required to protect the pump from damage due to sudden heating.
- Pump and motor bearings should be metric.
- Pump bearings should be suitable for grease lubrication or non-pressurised oil lubrication.
- If the operating temperature of the bearing lubricating oil is higher than 180°C, an oil cooling system should be used.
- If water cooling is required, the cooling system should be enclosed so that the flow can be controlled.
- Couplings with flexible inserts are required for all pump types that require coupling.
- Clutch covers should be removable and made of non-sparking materials.
- Vibration measurements should be taken and the measurement report included in the documentation submitted to the client.
- The direction of rotation should be marked on the pump body.
- The design and corrosion protection must be matched to the pump's operating conditions (indoor/outdoor operation).
- The electric motor must be selected in accordance with the SUT- E Technical Industry Standard.
- Engraved nameplate made of acid-resistant steel.

B. SELECTION GUIDELINES

The supplier of the pump unit should ensure that the equipment supplied is as unified as possible to ensure minimum operating costs and maximise interchangeability of spare parts. To this end, the equipment and installations supplied must comply with the PCC Group's standards. The provisions of the latest editions of the following standards and regulations must be applied during design, manufacture, assembly and testing:

- PN - EN ISO 17769 - Pumps for liquids and installations - General names, definitions, sizes, letter symbols and units - Pumps for liquids.
- PN - EN ISO 9906 - Centrifugal pumps - Acceptance tests for hydraulic performance.
- PN - EN ISO 21049 - Pumps - Shaft sealing systems for centrifugal and rotary pumps.
- PN - EN ISO 809+A1 - Pumps and pump units for liquids - General safety requirements.
- PN - EN ISO 2858 - Centrifugal pumps with axial inlet - designation, nominal characteristics and dimensions.
- PN - EN ISO 14414 - Energy assessment of a pumping system.
- API 610 Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries - the need for use should be agreed with the contracting authority (if applicable) unless specified at the start of the process.
- API 674 Positive Displacement Pumps - Reciprocating.
- API 675 Positive Displacement Pumps - Controlled Volume.
- API 676 Positive Displacement Pumps – Rotary.
- API 681 Liquid Ring Vacuum Pumps and Compressors.
- API 682 Mechanical Seals - for pumps according to API 610.
- API 685 Sealless Centrifugal Pumps.
- DIN ISO 1940 Mechanical vibration - Balance quality requirements for rotors in a constant (rigid) state.
- EN ISO 9905 - Technical requirements for centrifugal pumps - Class I.
- PN–EN ISO 5199 – Technical specifications for centrifugal pumps — Class II.
- PN–EN ISO 9908 – Technical specifications for centrifugal pumps — Class III.

- EN ISO 12483 - Pumps for liquids - Pump units with frequency converter - Warranty and compliance testing.
- PN - EN ISO 12162+A1 - Pumps for liquids - Safety requirements - Hydrostatic test procedure .
- PN - EN ISO 3661 - Centrifugal pumps with axial inlet - footplate dimensions and connection dimensions.
- TDS - Technical Documentation Standard
- SUT - C - the standard for the instrumentation industry.
- SUT - E - standard for the electrical industry.
- SUT – M – standard for the mechanical industry.

C. TESTS AND TRIALS

The PCC reserves the right to inspect the pump in the manufacturer's workshop prior to delivery - unless otherwise agreed. The following tests should be carried out in the manufacturer's workshop:

- Body pressure test.
- Testing of hydraulic parameters in accordance with the latest edition of standard PN EN ISO 9906.
- NPSH test according to the standard for manufacturing with:
    - for values NPSHa - NPSHr ≤ 1m, a full NPSH test is required,
    - for 1m< NPSHa - NPSHr ≤ 2m a test is required for the rated point,
    - for NPSHa - NPSHr > 2m no test is required.
- Noise level measurements.

D. PREFERRED MANUFACTURERS

Vortex (centrifugal)	Displacement (cam, gear, screw)	Positive displacement metering (diaphragm, piston)
– Dickow Pumpen	– Boerger	– Bran Luebbe
– Duchting	– GAA-LOBEX	– Lewa
– Rheinhuette	– Tapflo	– Afros
– Grundfos	– Johnson Pump	– Kracht
– Hermetic -Munsch	– Albany	– Marzocchi
– Hydro-Vacum	– Tuthil	– Tapflo
– KSB	– Allweiler	– ARO
– Tapflo	– GlobalGear	– ProMinent
– Richter	– Netzsch	– Versamatic
– Warman		
– Lowara Vogel Series		
– Klaus Union		
– Hydro-Vacum		
– LFP		
– Powen-Wafapomp Group		
– SIHI		
– CP Pumpen		
– Geko-Pumpen		
– Hermag		
– ITT Group		
– Sulzer		
– Wilo		

E. DOCUMENTATION REQUIRED

The documentation to be supplied as part of the delivery is an integral part of the order and its absence or incompleteness will be treated as failure to meet the requirements in accordance with the order. Documentation must be provided in accordance with the guidelines of Section **3.13.2 - DOCUMENTATION.**

F. LUBRICANTS

If lubricants or oils are included in the scope of supply, the stipulations of Section **3.10** must be complied with **- LUBRICANTS** of this manual.

3.4.2. CONVEYORS

A. MATERIAL AND CONSTRUCTION REQUIREMENTS

Load-carrying construction of the conveyor:

- It should ensure a stable positioning of the conveyor during its operation.
- It should provide a symmetrically centred inlet of material onto the belt in the discharge area.
- Adequate corrosion protection according to this standard **section 3.11 - Anti-corrosion**.
- Easy access to individual conveyor components for possible repairs.
- Security elements:
  - removable covers for rotating components,
  - safety wire switch for immediate shutdown,
  - pre-start signalling.
  - the straps are fitted with buckling sensors - this may be omitted if justified from the sensors, with the approval of the PCC's technical services.
  - use speed sensors on the drives.
- Engraved nameplate made of acid-resistant steel.

Belt

- It should be run in a three-sheave trough arrangement or in a flat arrangement (depending on the intended use of the conveyor).
- The return belt should be guided along the return sheaves in a flat arrangement.
- Minimum tensile strength of 630 kN/m required.
- Textile-core tape is required:
  - polyamide (P),
  - polyester (E),
  - cellulose fibres (Z).
- The minimum number of belt dividers is 3 (for conveyors with a distance between drums of less than 2 m, use 2 dividers).
- The belt should have as few joints as possible (preferably one), be hot-glued and vulcanised.

Drive stations

- The drive unit should be placed stably on the conveyor frame which is the discharge station.
- The drum shall be driven by a geared motor selected in accordance with this **standard Section 3.4.4 - Geared** motors.
- A process is required to optimise drum weight in order to extend the life of the drive and return drum bearings and to optimise the transport of the drums to their final installation sites.
- The bearings of the tension and idler pulleys should be capable of being lubricated with grease without the need to stop or dismantle the pulley by means of ball grease nipples.

Tensioning and return stations

- Tensioning of the belt should be carried out through the use of a screw tensioner, which will allow adjustment of the belt run.
- In the case of long conveyor belts, a deflecting drum and a tension roller with counterweight are acceptable.

Sheaves and drive drums

- It is required to use sheaves with dimensions according to PN-ISO 1537, made of HDPE, with fixed axis with labyrinth seal.
- The drive and return drum must be made of steel, sheathed with a layer of rubber, vulcanised KARO, mounted to the structure on bearings in housings.
- Drive shall be by means of a geared motor selected in accordance with this standard **section 3.4.4**. **- Gearmotors**.
- Transmission to the conveyor sheaves permissible through the use of a chain, this requires the use of mountable sprockets on the rollers' shafts.
- The chain drive should be implemented in such a way that the chain tension can be compensated - tensioners.
- In the case of drive sheaves, consideration should be given to mounting drive gears.

Scrapers

- The use of a scraper and/or brushes on the return belt is required to clean the belt of residual material being transported.
- The design of the scraper and scrapers should be self-compensating, taking into account the wear of the abrasive elements - the inserts.
- Scrapers should be made of solid material.

Covers

In the case of a conveyor mounted outdoors or where there is a possibility of contamination of the material being transported, conveyor covers are required.

Aprons

Make of soft rubber without spacers.

B. DOCUMENTATION REQUIRED

The documentation to be supplied as part of the delivery is an integral part of the order and its absence or incompleteness will be treated as failure to meet the requirements in accordance with the order. Documentation must be provided in accordance with the guidelines of Section **3.13.2 - DOCUMENTATION.**

C. LUBRICANTS

If lubricants or oils are included in the scope of supply, the stipulations of Section **3.10**must be complied with **- LUBRICANTS** of this manual.

3.4.3. FANS

A. MATERIAL AND CONSTRUCTION REQUIREMENTS

Fans supplied to the PCC should meet the following requirements:

- Flanged fan connection as per PN EN 1092-1.
- They should have a proven design with no prototype solutions or components.
- The acceptable noise level generated by the fan should not exceed 85dB at a distance of one metre from the source.
- The rated operating point of the fan can vary, so a control solution based on a frequency converter is recommended.
- Fan and motor bearings should be metric, bearing housings fitted with nipples for grease lubrication.
- Couplings with flexible inserts are required for all fan types that require a coupling.
- Clutch covers should be removable and made of non-sparking materials.

- Fan impellers should be secured against unscrewing.
- For media other than air, a shaft seal (stuffing box or mechanical seal) and drainage spigot are required.
- Engraved nameplate made of acid-resistant steel.

B. SELECTION GUIDELINES

The supplier of the fan should ensure that the equipment supplied isas unified as possible to ensure minimum operating costs and maximise interchangeability of spare parts. To this end, the equipment and installations supplied must comply with the PCC's standards, in particular:

- Technical Documentation Standard
- SUT- C - the standard for the instrumentation industry.
- SUT- E - standard for the electrical industry.

C. WORKING CONDITIONS

When selecting the fan including the drive, particular attention should be paid to the environment in which it will operate and the hazards associated with it and the operating medium (confirmation of the chemical resistance of the materials) should be taken into account. Unless otherwise agreed, the fan should be suitable for continuous operation in air under climatic conditions appropriate to the location of the PCC plant, (temperature -
20°C/+50°C, UV radiation).

D. PREFERRED SUPPLIERS

- Owent Sp. z o.o.
- Nyborg-Mawent
- Fawent S.A.
- Hürner - Funken GmbH
- Venture Industries
- COLASIT
- DABROWENT
- Arivent Italiana
- L.E. FERRARI

E. STANDARDS AND REGULATIONS

The provisions of the latest editions of the following standards and regulations must be applied during design, manufacture, assembly and testing:

- EN ISO 13351 Fans - Dimensions.
- EN ISO 5802 Industrial fans - Field performance tests.
- PN-ISO 14695 Industrial fans - Method of measuring fan vibration.
- API 673 Centrifugal Fans for Petroleum, Chemical, and Gas Industry Services.

F. DOCUMENTATION REQUIRED

The documentation to be supplied as part of the delivery is an integral part of the order and its absence or incompleteness will be treated as failure to meet the requirements in accordance with the order. **Documentation** must be provided in accordance with the guidelines of Section 3.13.2 - DOCUMENTATION.

G. LUBRICANTS

If lubricants or oils are included in the scope of supply, the stipulations of Section **3.10**must be complied with **- lubricants** of this manual.

3.4.4. GEARED MOTORS

Gearmotors supplied to PCC Rokita:

- They must be sized with a power reserve of at least 15%, relative to the maximum power consumed at start-up, for worst-case start-up as well as operating conditions.
- They should have a flange fixing.
- They must be equipped with features that allow the oil level to be checked in the operating position (sight glass for checking, indicator / dipstick or other such solution).
- Gearboxes operating outdoors (outside buildings) must be suitable for atmospheric conditions (operating temperature from -20°C to +50°C) and industrial environments.
- Design solutions for electric motors according to SUT-E.
- Manufacturers of electric motors in accordance with SUT-E.
- Preferred geared motor manufacturers: NORD, Siemens, Kacperek, SEW, ANTICO,REDOR ,BEFARED.
- Engraved nameplate made of acid-resistant steel.

The use of belt transmissions in drive equipment should be kept to a minimum, and the use of this type of solution should be agreed with PCC technical services on a case-by-case basis. Where agitator speed control is required, this is to be achieved through the use of frequency converters (in accordance with the SUT- E - standard for the electrical industry). The gearbox must be selected so that the drive is capable of operating over the entire speed range required.

A. DOCUMENTATION REQUIRED

The documentation to be supplied as part of the delivery is an integral part of the order and its absence or incompleteness will be treated as failure to meet the requirements in accordance with the order. Documentation must be provided in accordance with the guidelines of Section **3.13.2 - DOCUMENTATION.**

B. LUBRICANTS

If lubricants or oils are included in the scope of supply, the stipulations of Section **3.10**must be complied with **- lubricants** of this manual.

3.4.5. AGITATORS

A. MATERIAL AND CONSTRUCTION REQUIREMENTS

Drive

Refer to **section 3.4.4 Gearmotors** for drive selection.

Agitator

- For agitators with separately mounted impellers, it is necessary to provide design solutions that prevent the assembly elements from loosening or unscrewing under normal operating conditions.
- Agitators (especially high-speed ones) should be designed in such a way that, under normal operating conditions, there is no cavitation near the impeller or the vessel walls.
- High-speed agitators must be dynamically balanced after assembly and before initial operation.
- The selection of the right type of agitator(s) should be made each time with regard to the process parameters occurring inside the vessel and the expected effects of the agitator.

Shaft

- Hollow shafts should be constructed in such a way that no working fluid or other liquids can penetrate them.
- Split shafts should be constructed in such a way that there is no possibility of their spontaneous disconnection due to spontaneous loosening of threaded joint elements.

- The selection of construction materials and the dimensioning of the shaft should be carried out for the highest possible working loads with a minimum of 15% reserve.
- Diameters and dimensions and dimensional tolerances of the mechanical seal/agitator shaft connection for enamelled double reactor seals according to DIN 28159.
- Diameters as well as dimensions and dimensional tolerances of the mechanical seal/agitator shaft connection for double seals of carbon or acid-resistant steel agitators and reactors according to DIN 28154.

Shaft sealing

For non-pressure vessels:

- Single mechanical seal or , for highly toxic or hazardous compounds, double mechanical seal.
- Flanged connections connecting the tank with a mechanical double seal for:
  - enamel mixers should be specified according to standard: DIN 28137-2,
  - mixers and reactors made of steel to standard: DIN 28137-1.
- The preferred material design for seals is in the form of labirynth seals.

For pressure vessels:

- Double mechanical seals with barrier fluid system:
  - The liquid in the double seal, in the event of a leak (inwards or outwards), will not pose a risk to the environment and will not contaminate the liquid in the tank.
  - Barrier gas - used when the selection of a barrier liquid due to the working medium is impossible (dangerous) or economically unjustified.

The use of a mechanical single seal is permitted with the approval of the PCC Technical Services .

Bottom bearing of the shaft

Bottom shaft bearings should be used for vertical agitators with long drive shafts and for media whose properties, such as high viscosity, inhomogeneity or other properties, may favour shaft vibration.

Due to the lubrication of the lower shaft support (bearing) by the working medium, the selection of materials for the friction elements of the bearing should be analysed in each case. Do not use bottom bearing on abrasive media.

B. STANDARDS AND REGULATIONS

The provisions of the latest editions of the following standards and regulations must be applied during design, manufacture, assembly and testing:

- Machinery Directive 2006/42/EC.
- PN - EN 12100 - Safety of machinery - General principles for design.
- Technical Documentation Standard
- SUT- C - the standard for the instrumentation industry.
- SUT- E - standard for the electrical industry.

C. ADDITIONAL REQUIREMENTS

Agitator drive components such as motor, gearbox, couplings, mechanical seal, etc. operating in an explosion hazardous area must have the appropriate ATEX rating for the most unfavourable parameters and explosive conditions and the operating parameters of the equipment they comprise.

D. DOCUMENTATION REQUIRED

The documentation to be supplied as part of the delivery is an integral part of the order and its absence or incompleteness will be treated as failure to meet the requirements in accordance with the order. **Documentation** must be provided in accordance with the guidelines of Section 3.13.2 - **DOCUMENTATION**.

E. LUBRICANTS

If lubricants or oils are included in the scope of supply, the stipulations of Section **3.10**must be complied with **- LUBRICANTS** of this manual.

3.4.6. ANCHORING OF MACHINERY AND EQUIPMENT

The method and material of anchoring must be agreed with PCC Technical Services in each case. It is recommended to use hot-dip galvanized anchors made of alloy steel and unalloyed steel with a strength class confirmed in each case by anchorage calculations and selection.

3.5. PRESSURE AND NON-PRESSURE VESSELS AND EQUIPMENT

A. GENERAL REQUIREMENTS

In accordance with the Regulation of the Minister of Development of11 July 2016 on the requirements for pressure equipment and assemblies of pressure equipment, the vessel's membership of a pressure or non- pressure group should be determined at the design stage, as well as the fluid membership category.

The constructor/designer of the tank should ensure that the equipment does not pose a hazard during operation and that it is as safe as possible in unstable states. The tank structure must be designed according to the relevant legislation, taking into account the possibility of increased and decreased pressures and temperatures. The constructor/designer should ensure that the supplied equipment is
protected as far as possible against leakage and damage to ensure maximum safety during operation.

The vessel and plant designer should ensure that the plant is optimally adapted to the technological requirements while complying with all technical requirements.

Technological and operational aspects such as:

- Preferred manhole diameter DN600. The final number and diameter of manholes should be confirmed with PCC Technical Services.
- Manhole suspension components should be included in the design.
- A drainage spigot and a basin in the bottom with a drain to this spigot - the "zero spigot".
- Auxiliary spigots for future installation connections (spigots blanked off at delivery stage),
- Spigots for measuring instruments.
- Ladder and service platforms to the spigots, with safety fittings and process-relevant equipment (e.g. medium supply, medium intake control).
- For spigots and top-mounted apparatus, a service platform with edging is required.
- Engraved nameplate made of acid-resistant steel, min. 1 mm thick, according to Directive 2014/68/EU.
- Heat/cold insulation (in these cases, the plate must be accessible and visible).
- The temperature at which the hydraulic leakage/pressure test is to be carried out should be assumed as a minimum of +5°C, which should be included in the design documentation.
- When selecting bolt material, the possibility of corrosion at the interface between two materials with different potentials must be taken into account to avoid galvanic corrosion.
- The manufacturer is obliged to provide a table with the permissible loads on the device spigots with the specified arrangement of forces and moments. The limit values must be agreed with PCC technical services in each case.

B. CONSTRUCTION

Tanks supplied to the PCC should be designed and constructed in accordance with the following requirements:

- In a manner specified by separate regulations, to ensure that loss of working medium is minimised in the event of changes in temperature or pressure.
- So as to limit the leakage of working medium into the environment during filling or emptying to a safe minimum.
- Made of material resistant to the working medium or lined with a suitable lining or protected with a protective coating.
- Of a material whose components, when in contact with the working medium, are incapable of producing a hazardous reaction or of visibly weakening them, in particular by accelerating ageing and increasing brittleness.
- Made of a material that is resistant to chemical compounds that cause them to deteriorate through chemical corrosion. For industrial/hydrant/cooling water, continuous resistance to chloride concentrations above 500 ppm. When selecting the material, attention should also be paid to the pH and the operating temperature.
- For the vessels made of carbon steel, a corrosion allowance of at least 2 mm should be assumed.
- In the case of vessels made of alloy steels, the following formula should be used to calculate the minimum thickness in each case, while the amount of the allowance should be agreed with the PCC technical services.

0.5 (D, mm/1,000+5) or 6 mm, where D is the diameter of the vessel

- In a manner as to prevent the build-up of potentially dangerous electrostatic charges, or they should be equipped with a system to discharge them.
- The design and components to ensure that the vessel can be emptied safely and completely and be cleaned.
- The design and components to ensure proper venting, also during the hydraulic leak test if required for it.
- The design of the platforms and ladders to ensure safe operation of the staff.
- The support structure for the associated pipelines to be primarily supported on an independent structure or , if it is not possible to support the independent structure, it is permissible to support the vessel shell by means of reinforcement caps after prior agreement with the client.
- Dimensions of connections/flanges according to **Section 3.8.2 - flanged connections** on pipe spigots excluding inspection manholes.
- In a manner that takes into account vibrations that may be transmitted to the pipework and building structures.
- When designing a vessel operating cyclically, the number of cycles must be predicted, and each time the number of cycles must be agreed with the customer.
- In the case of other vessels, its service life should be foreseen, each time the service life should be agreed with the client.
- The ovalization should be checked according to the design guidelines used according to the design standard.
- Static loads from the filling level of the vessel must be taken into account in the design.
- In accordance with the requirements set out in the separate pressure vessel regulations:
    - EN 13445 - Unheated pressure vessels.
    - PN-EN 13121 - Aboveground glass fibre reinforced plastic vessels.
    - EN 1591-1 - Design rules for gasketed circular flange connections.
    - Taylor-Forg method for the design of flanged joints.
    - WUDT- UC - WO-O/19 for the design of flange connections.
    - WUDT- UC - Conditions of the Office of Technical Inspection.
    - EN 14276 - Pressure equipment for refrigeration systems and heat pumps.
- Vessels intended for the storage of poisonous or corrosive materials in accordance with the Regulation of the Minister of Economy of 16 April 2002 on the technical conditions of technical supervision to be met by non-pressure and low-pressure tanks intended for the storage of poisonous and corrosive materials
- Vessels intended for the storage of flammable liquids in accordance with the Regulation of the Minister of Economy of 18 September 2001 on the technical conditions of technical supervision to be met by non-pressure and low-pressure vessels intended for the storage of

flammable liquids and the Regulation of the Minister of Economy of 31 March 2008 amending the regulation on the technical supervision conditions to be met by non-pressure and low-pressure vessels intended for the storage of flammable liquids.

In addition, the requirements specified for the group of vessels and pressure equipment indicated in the following subsections must also be met.

3.5.1. NON-PRESSURE AND LOW-PRESSURE VESSELS

A. WORKING CONDITIONS

Low-pressure vessels are vessels for storing materials where the working pressure, not including hydrostatic pressure, is maintained above atmospheric pressure, but does not exceed 0.5 bar g (50kPa) or a gas pressure of up to 0.5 bar g (50kPa) is used to empty or flush the tank.

Non-pressure vessels are used for storing liquids at positive pressure or atmospheric pressure varying between 0.25 kPa negative pressure and 3.5 kPa positive pressure, and do not take into account the hydrostatic pressure caused by the column of the working medium.

In order to ensure the safe operation of the vessels, the following considerations must additionally be taken into account:

- The filling of the vessel with fluid in relation to the highest operating temperature should not exceed 95% of the vessel capacity.
- The level of fluid in the vessel should be recorded, and at least two alarm thresholds should be set: I - 80% fill level alarm, II - 90% exceedance level alarm.
- The vessel should be equipped with a device to prevent the working medium from penetrating into the ground and surface and ground water.
- Safety devices should be designed and constructed so that if a leak occurs in a vessel, the leak is stopped by that device and the environment is not contaminated.
- If there isa possibility of negative pressure in the vessel, the designer should carry out strength calculations for the vessel in terms of the expected external pressure , and reinforce the structure accordingly for a negative pressure greater than 1.5 kPa than specified, as long as the negative pressure is not 0 bar abs.
- A non-pressurised and low-pressure vessel shall be equipped with at least two devices to protect the vessel from exceeding the permissible vacuum and overpressure, including at least one breathing device in accordance **with section 3.7.3 - breathing valves**. The function of a second safety device may also be fulfilled by e.g.: for non-pressure vessels, safety valves and plates according to **section 3.7.4 - safety valves**, or for low pressure vessels, hydraulic closures according to **section 3.7.5 - hydraulic closures**.
- Exceeding 0.25 kPa negative pressure and 3.5 kPa positive pressure should trigger an alarm signal, hydrostatic pressure caused by the column of the working fluid is not taken into account.
- In the case of low-pressure vessels, exceeding 0.5 bar overpressure should trigger an alarm signal; hydrostatic pressure caused by the column of the working fluid is not taken into account.
- The capacity of the breathing device should take into account the highest fluid flow rate resulting from heating or cooling the contents and filling or emptying the tank.
- The breathing apparatus should be protected so that rainwater and foreign bodies cannot enter it and it should be corrosion-resistant.
- Vessels for flammable and explosive media and others that require it should be fitted with a fire fuse. This should be agreed with the PCC's fire prevention service on each occasion.
- Do not place a barrier fitting between the vessel and the breathing device.
- The calculation of other loads for aboveground vessels, in particular snow and wind loads, should be carried out in accordance with the requirements of the Polish Standards.

B. CONSTRUCTION

Non-pressure and low-pressure vessel supplied to the PCC should be designed and constructed in accordance with the following requirements:

- Thickness of blanking flanges not less than for PN6 class in the diameter in question, while flange drilling class in accordance with PN10, PN16, PN25 or PN40 depending on requirements and arrangements with PCC technical services and the adopted standard on the basis of which the vessel will be designed . If the thickness of the blanking flange is less than the thickness of the blanking flange in the agreed spigot pressure class, but not less than in PN6, it must be confirmed by strength calculations.
- In accordance with the requirements set out in the separate regulations for non-pressure and low-pressure vessels :
    - Regulation of the Minister of Economy of16 April 2002 on the technical conditions of technical supervision to be met by non-pressure and low-pressure vessels intended for the storage of toxic and corrosive materials.
    - Regulation of the Minister of Economy of 18 September 2001 on the technical conditions of technical supervision to be met by non-pressure and low-pressure vessels intended for the storage of flammable liquids and Regulation of the Minister of Economy of 31 March 2008 amending the regulation on the technical conditions of technical supervision to be met by non-pressure and low-pressure vessels intended for the storage of flammable liquids.
    - EN 14015 - Requirements for the design and manufacture of steel aboveground, vertical, cylindrical, flat-bottomed welded vessels for the storage of liquids at ambient temperatures and above.
    - PN-EN 13121 - Aboveground glass fibre reinforced plastic vessels.
    - PN–EN 13445 – Unfired pressure vessels.
    - For plastic vessels according to WUDT-UC-UTS/01.

FOR THE DESIGN AND SUPPLY OF PLASTIC VESSELS, A MINIMUM OF 25 YEARS OF SERVICE LIFE MUST BE TAKEN INTO ACCOUNT, WHICH MUST BE CERTIFIED BY THE VESSEL MANUFACTURER. DEVIATION FROM THIS RULE REQUIRES THE APPROVAL OF PCC TECHNICAL DIRECTOR.

3.5.2. PRESSURE EQUIPMENT

A. WORKING CONDITIONS

In order to ensure the safe operation of the vessels, the following considerations must be taken into account:

- The filling of the vessel with fluid in relation to the highest operating temperature should not exceed 95% of the vessel capacity.
- The level of the operating medium should be recorded and exceeding 90% of the vessel capacity should trigger an alarm signal.
- The vessel should be equipped with a device to prevent the working medium from penetrating into the ground and surface and ground water.
- Safety devices should be designed and constructed so that if a leak occurs in a vessel, the leak is stopped by that device and the environment is not contaminated.
- If there isa possibility of negative pressure in the vessel , the designer should carry out strength calculations for the vessel in terms of the expected external pressure , and reinforce the structure accordingly for a negative pressure greater than 1.5 kPa than specified.
- The pressure inside the vessel should be recorded.
- The pressure vessel shall be equipped with a safety device to prevent the maximum allowable working pressure being exceeded in accordance with **section 3.7.4 - safety valves**.
- The selection of the capacity of the safety device should take into account the maximum gas flow rate resulting from the heating or cooling of the contents and the filling or emptying of the vessel.
- The safety device should be installed in such a way that rainwater and foreign bodies cannot enter it and it should be corrosion-resistant.

- Vessels for flammable and explosive media and others that require it should be fitted with a fire fuse. This should be agreed with the PCC's fire prevention service on each occasion.
- Do not place a shut-off fitting between the vessel and the safety device.
  Where appropriate , padlocked shut-off fittings are permitted with the approval of the PCC Technical Services.
- Load calculations for above-ground vessels, in particular snow and wind loads, should be carried out in accordance with the requirements of the Polish Standards.

B. CONSTRUCTION REQUIREMENTS

Pressure vessels supplied to the PCC shall be so designed and constructed in accordance with the following requirements:

- In accordance with the requirements set out in the separate pressure vessel regulations:
  - Regulation of the Minister of Development of 2 June 2016 on simple pressure vessels.
  - Regulation of the Minister of Transport of 20 October 2006 on the technical conditions of technical supervision with regard to the design, manufacture, operation, repair and modernisation of specialised pressure equipment.
  - Regulation of the Minister of Development of 11 July 2016 on requirements for pressure equipment and assemblies of pressure equipment, Pressure Directive 2014/68/EU.
  - Regulation of the Minister of Development of 17 December 2021 on the technical conditions of technical supervision for certain pressure equipment subject to technical supervision Journal of Laws of 2022, item 68.
  - ASME DIV VII, VIII (subject to the approval of the Technical Director).
    PN–EN 13445 – Unfired pressure vessels.
  - PN-EN 13121 - Aboveground glass fibre reinforced plastic vessels.
  - For metal vessels according to 2014/68/EU and 2014/29/EU, together with the associated harmonised standards.
  - For plastic vessel according to WUDT-UC-UTS/01.
  - Enamel-coated vessels and reactors must be manufactured in accordance with DIN 28136.

C. DOCUMENTATION REQUIRED

The documentation to be supplied as part of the delivery is an integral part of the order and its absence or incompleteness will be treated as failure to meet the requirements in accordance with the order. Documentation must be provided in accordance with the guidelines of **Section 3.13.2** - **DOCUMENTATION.**

3.5.3. FILTERS AND FILTRATION EQUIPMENT

Filters and filtering equipment as a group of pressure equipment must additionally meet the following requirements:

- Have a drain spigot to allow complete emptying of the filter.
- Have a vent spigot.
- The type of filter element used should be a standard solution - generally available.
- The use of non-standard filter elements is permitted, provided that technical - construction documentation for the attachment of the element to the filter is provided, but this type must be agreed with technical services.
- The bottom/hatch, which is used to change the filter elements, must be equipped with a crane, applies to the diameter of filters and filter units up to and including DN1000.

3.5.4. HEAT EXCHANGERS

When selecting the exchanger, the operating parameters and the environment in which it will operate must be taken into account. If at least one of the working media of the exchanger will be water, the exchanger materials in contact with the water must have resistance to chloride ion concentrations above 500 ppm. When selecting the material, attention should also be paid to the pH and the operating temperature.

The exchanger should have flanged connections in accordance with PN EN 1092-1 at the pipeline connection spigots.

A. PLATE

- A bolted, demountable design for easy servicing and cleaning of the plates is recommended.
- The gaskets should be selected taking into account the exchanger operating media and design temperatures, preferably Clip-on gaskets. The shape of the plates and the way the gaskets are fitted should allow easy removal of the old gaskets and fitting of new ones in the event of service to the exchanger.
- An exchanger design in which the plates are permanently connected to each other, e.g. by soldering or welding, is not recommended. If a heat exchanger is used whose plates are joined together in a permanent manner, the agreement and approval of the PCC Technical Services must be obtained.
- The exchanger should have flanged connections to connect to the pipework and splash guards should be installed at the plate connections, made of mat. 1.4404.
- When selecting the exchanger, a minimum thickness of 0.6 mm of the thermal plate should be assumed. Other thicknesses, unless indicated by the Employer in the technical specifications / ToR, must be agreed with the relevant PCC technical services in each case.
- The material of the exchanger gaskets is to be matched to the operating conditions of the working medium for a temperature of at least 10 deg. C higher than the maximum and by 10 deg. C lower than the minimum if the minimum temperature of the operating medium is below 0 deg. C. The temperatures of the media supplied to the exchanger (power source) must be verified.
- The manufacturer is obliged to provide a table with the permissible loads on the device spigots with the specified arrangement of forces and torques. The values specified in API 662, NORSOK R-001or ISO 15547 are acceptable. The permissible values must be agreed with PCC technical services in each case.
- For plate heat exchangers, the selection in terms of pressure is to be made on the basis of the space in which the higher pressure occurs. Thus, the value of the maximum allowable pressure PS for each space of the exchanger is to be the same, irrespective of the prevailing pressure in the space with the lower pressure.
- For pressure tests, the differential pressure must not be less than 1.1 x the maximum allowable pressure PS (0 bar g in one space, 1.1 x PS in the other space).

B. PREFERRED SUPPLIERS OF PLATE HEAT EXCHANGERS

- GEA-KELVION
- ALFALAVAL
- API SCHMIDT
- TRANTER

C. SHELL AND TUBE HEAT EXCHANGER

Where appropriate, a modular design of the exchangers is recommended - so that the tubular insert is not permanently connected to the outer shell and can be easily dismantled or repaired. Each time, the type of exchanger (according to TEMA) must be agreed with PCC Technical Services.

The exchanger should have flanged connections in accordance with PN-EN 1092-1 at the pipe connections.

The manufacturer is obliged to provide a table with the permissible loads on the device spigots with the specified arrangement of forces and torques. The values specified in API Standard 660 or NORSOK R-001 are acceptable. The permissible values must be agreed with PCC technical services in each case.

D. SPIRAL

Spiral heat exchangers are characterised by excellent heat transfer performance in many demanding industrial applications. They are suitable for viscous products and those containing solid particles, which in other types of exchangers would cause them to 'clog' or corrode excessively. This type of exchanger should only be used with the approval of the PCC's technical services.

E. DOCUMENTATION REQUIRED

The documentation to be supplied as part of the delivery is an integral part of the order and its absence or incompleteness will be treated as failure to meet the requirements in accordance with the order. Documentation must be provided in accordance with the guidelines of **Section 3.13.2 - DOCUMENTATION**.

3.5.5. ANCHORING OF PRESSURE AND NON-PRESSURE VESSELS AND EQUIPMENT

The method and material of anchoring must be agreed with PCC Technical Services in each case. It is recommended to use anchors made of alloy steel and unalloyed steel in hot-dip galvanizing with a strength class confirmed in each case by anchorage calculations and selection.

3.6. PIPING

A. WORKING CONDITIONS

in accordance with the Regulation of the Minister of Development of 11 July 2016 on requirements for pressure equipment and pressure equipment assemblies, the designer, at the design stage of the technical documentation for the pipelines, determines the categories on the basis of the group membership of the fluid (I - hazardous fluids, group II - fluids not
listed in group I), the maximum allowable pressure PS and the nominal diameter DN.

The piping categories are determined by the designer at the design stage of the technical documentation.

Pipelines should be designed in accordance with the guidelines in EN 13480. For pipelines categorised as good engineering practice, product testing and acceptance documentation as for category I of PED 2014/68/EU.

For pipework in refrigeration systems, EN 14276 - Pressure equipment for refrigeration systems and heat pumps - is acceptable.

Metallic as well as non-metallic industrial pipelines are divided into classes. It is required that the newly designed pipelines are within the pipeline classes stipulated in the standard. The pipeline classes have been created on the basis of existing assumptions of production plant technology suppliers, experience and many years of practice. These classes can be assigned to most of the utilities that occur in the PCC area. In
justified cases, a special class (S) may be used, which should be agreed with the relevant PCC services in each case.

Table No. 3.6.1 Division of pipelines into preferred materials.

Class name	**Class**	**Material**
Carbon steel 1	CS1	P235GH
Carbon steel 2	CS2	P265GH
Carbon steel 3	CS3	P355NL1/NL2 / P355NQ / P355NH
Corrosion-resistant steel 1	SS1	X 5 CrNi 18-10 (304, 1.4301)
Corrosion-resistant steel 2	SS2	X 2 CrNiMo 17-12-2 (316L, 1.4404)
Corrosion-resistant steel 3	SS3	X 6 CrNiMoTi 17-12-2 (316Ti, 1.4571)
Glass fibre reinforced plastic	GRP1	E-type GRP / Derekane 470
Glass fibre reinforced plastic 2	GRP2	E-type GRP / Derekane 411
Glass fibre reinforced plastic - lined 1	GRP3	GRP Type B / PVC-U (Dekadur/Trovidur EN) or PVC-C
Glass fibre reinforced plastic - lined 2	GRP4	GRP type B / PP
Glass fibre reinforced plastic - lined 3	GRP5	GRP type B / PVDF
Plastic 1	PP	PPH, PPR
Plastic 2	PE	PE100
Special	S	Ti,Ni, PVDF,CS/PTFE,CS/ enamel,CS/ rubberised, high-temperature steel, SS 324, other

B. MATERIAL REQUIREMENTS

Pipelines supplied to PCC Rokita must be designed and constructed in accordance with the following material requirements:

- Made of material resistant to the working medium or lined with a suitable lining or protected with a protective coating.
- Of a material whose components, when in contact with the working medium, are incapable of producing a hazardous reaction or of visibly weakening them, in particular by accelerating ageing and increasing brittleness.
- Made of a material that is resistant to chemical compounds that cause them to deteriorate through chemical corrosion.
- For pipelines made of unalloyed and alloyed steels, a corrosion allowance of at least 1.5 mm is to be assumed.
- For pipelines made of unalloyed and alloyed steels in contact with dry chlorine gas or liquid chlorine, a corrosion allowance of at least 3 mm is to be assumed.
- In the case of pipelines made of corrosion-resistant steels, the amount of corrosion allowance must be agreed with PCC Technical Services in each case.

Where a hydraulic pressure test is detrimental or impractical at the operational stage, other tests may be carried out, including pneumatic tests. Therefore, when designing the pipeline, the permissible pressure PS (calculation pressure) must be set so that it is at least 20% higher than the maximum operating pressure prevailing in the pipeline, which depends on the maximum pressure of the supply source and/or the pressure of the safety devices (safety valves, bursting discs).

For industrial, cooling and hydrant water, continuous resistance to chloride content of up to 500 ppm. In addition, the build-up of potentially dangerous electrostatic charges should be prevented or reduced, or fitted with a discharge system. When selecting the material, attention should also be paid to the pH and the operating temperature.

C. CONSTRUCTION REQUIREMENTS

Pipelines delivered to the PCC must be designed and constructed in accordance with the following construction requirements:

- The design and components to provide as much access as possible to the fitted fittings and instrumentation and to the disconnecting connections and adjustable supports/slings.
- The design and components to ensure that the vessel can be emptied safely and completely and be cleaned.
- The design and components to ensure proper venting.
- The design of the platforms and ladders to ensure safe operation of the staff.
- The pipework support structure must be designed so that it does not exceed the permissible loads on the spigots of the apparatus and equipment.
- In a way that takes into account the expansion of the material that may transfer to adjacent pipework.
- Two types of pipeline connections are permitted: flanged and welded in accordance with **Section 3.8.1 - Connection methods**.
- The dimensions of the connections are to be matched in accordance with **Section 3.8.2 - flanged connections**, type B1 butt joints as per EN 1092-1.
- The completed pipelines must be subjected to workmanship tests and a strength and tightness test of the connections.
- Have at least two engraved nameplates(start/starts/end/ends of pipeline), made of corrosion-resistant 1.4404 (316L) steel, min. 1 mm thick.
- Heat / cold insulation (in these cases, the plate must be accessible and visible).
- Construction materials used for pipelines shall comply with standards harmonised with Directive 2014/68/EU.
- The materials should be selected in accordance with the intended workmanship steps and according to the working medium and the external environment. The selection should be carried out in such a way that the pipeline can withstand both the normal operating conditions and the transient conditions occurring during transportation, testing or pressure testing accompanying commissioning.

- The inspection documents for the piping components specified in the subject standards shall be in accordance with EN 10204, acceptance certificate 3.1.
- Metallurgical products for pressure parts of the equipment must be supplied with an acceptance certificate in accordance with the construction and technical documentation or, if this is not specified, they must be supplied with an acceptance certificate 3.1 in accordance with EN 10204:2006.
- For pipelines made of stainless or corrosion-resistant steels, ASTM/ASME thicknesses are recommended.
- When selecting bolt material, the possibility of corrosion at the interface between two materials with different potentials must be taken into account to avoid galvanic corrosion. For ethylene oxide and propylene oxide pipelines, regardless of the pipeline material, use bolts made of corrosion-resistant materials.
- For steel pipelines up to and including DN350 , seamless pipes are recommended . The use of seamed pipes should be agreed with PCC Technical Services.

It is required that for all classes of pipelines the nominal diameters are within the range: DN15, DN25, DN32, DN50, DN80, DN100, DN150, DN200, DN250, DN300, DN350, DN400, DN500.

Only in justified cases is it possible to deviate from this rule, which must be agreed with the PCC's technical services in each case.

D. DOCUMENTATION REQUIRED

The documentation to be supplied as part of the delivery is an integral part of the order and its absence or incompleteness will be treated as failure to meet the requirements in accordance with the order. Documentation must be provided in accordance with the guidelines of **Section 3.13.2 - DOCUMENTATION.**

3.6.1. STEEL

The following table summarises the nominal and external diameters and the minimum required thicknesses of the pipelines.

Table No. 3.6.2. Recommended external diameters for the different type-series diameters.

Nominal diameter	Outer diameter [mm]	Minimum thickness [mm] Carbon steels and	
		Carbon steel (ISO)	ASTM/ASME acid resistant
DN 15	21.3	2.0	2.11
DN 25	33.7	2.6	2.77
DN 32	42.4	2.6	2.77
DN 50	60.3	2.9	2.77
DN 80	88.9	3.2	3.05
DN 100	114.3	3.6	3.05
DN 150	168.3	4.0	3.40
DN 200	219.1	4.5	3.76
DN 250	273.0	5.0	4.19
DN 300	323.9	5.6	4.57
DN 350	355.6	5.6	4.78
DN 400	406.4	6.3	4.78
DN 500	508.0	6.3	5.54

The minimum wall thicknesses are to be confirmed by analytical calculations for each pressure class selected (fatigue analysis if required) in accordance with EN 13480-3 or other accepted design standard and additionally a stress analysis for the designed piping system is to be provided.

Necessity and scope of stress analysis to be agreed with PCC technical services.

The applied thickness of the pipeline elements must not be less than the sum of the minimum design thickness and the accepted allowance. If this thickness is less than that indicated in Table 3.6.2, the thicknesses indicated in this table are to be used.

3.6.2. STEEL PIPELINES FOR LIQUID CHLORINE AND DRY GAS CHLORINE (EUROCHLOR REQUIREMENTS)

The following are the minimum wall thickness requirements for steel pipelines in contact with liquid chlorine or dry chlorine gas.

The minimum wall thicknesses are to be confirmed by analytical calculations for each pressure class selected (fatigue analysis if required) in accordance with EN 13480-3 or other accepted design standard and additionally a stress analysis for the designed piping system is to be provided. If the thickness is less than that indicated in Table 3.6.3, the thicknesses indicated in that table must be used.

Table No. 3.6.3. Recommended wall thicknesses for pipelines in contact with chlorine for different type-series diameters

.

Nominal diameter	Minimum thickness [mm]
DN 25	4.5
DN 40	5.0
DN 50	5.2
DN 80	5.5
DN 100	6.0
DN 150	7.1

For pipelines with diameters above DN150, the minimum wall thickness must not be less than the sum of:

- the minimum design thickness adopted for the highest design pressure, taking into account the PS (calculation/design) pressure value increased by a minimum of 20% over the maximum working pressure,
- the accepted corrosion allowance of 3 mm.

If the sum of these thicknesses is less than 7 mm, a wall thickness of not less than 8 mm should still be used.

3.6.3. PLASTIC

Pipes and fittings made of GRP (glass fibre reinforced) or GRP in addition with inner liners (PP, PVDF, PVC-C, PVC-U) must be manufactured and delivered according to standards: DIN 16965, DIN 16966 and DIN 16867.

Only Derakane 470 or Derakane 411 vinyl ester resins with using the BPO curing system are permitted for use. It is required that the structural layer and the chemically resistant layer are made of the same resin. The outer layer is to be additionally UV-resistant.

If a different type of resin is required, a written derogation must be obtained from the technical specialist. When selecting a replacement for the aforementioned resins, the HDT parameter must be taken into account, which must be at least 15oC greater than the allowable temperature of the pipe and fittings.

Spigots with loose flanges (LF) should be used. Depending on their diameter, the following material designs are permitted:

- from DN15 to DN150 - loose flange - swivel plastic,
- from DN200 upwards - loose flange - galvanised steel swivel flange.

For pipes and fittings with thermoplastic inner liners, the liner types listed below should be used, depending on the medium, chemical resistance and maximum permissible temperature:

- PP - PPH 2222 should be adopted,
- PVC-U - should be adopted according to FM DIN 7748-PVC-U or EP-076-04-28/ISO or Trovidur EN,

- PVC-C - Decadur C should be adopted,
- PVDF - Symalit SD should be adopted.

Minimum thickness of thermoplastic liners for Type B pipes and fittings:

- for diameters < DN80 not less than 3.6 mm, except for PP $D25 \geq 2.9\ m$ and $PVDF \geq 3.0\ m$,
- for diameters >=DN80 not less than 4 mm, except $PVDF \geq 3.0\ m$.

Table No. 3.6.4 Plastic materials.

Type B		Type E	
Diameter	**Performance class**	**Diameter**	**Performance class**
DN25-350	PN16	DN25-150	PN16
DN400-500	PN10	DN200-500	PN10

The permissible operating pressure for GRP pipelines is defined, depending on the operating temperature and the nominal diameter of the pipes, in DIN 16 867. The type of fitting design should be agreed with PCC Technical Services at the design stage.

3.6.4. ENAMELLED

Enamel-lined steel piping should be manufactured in accordance with DIN 2873/2876 (dimensions and tolerances of enamel components) and ISO 28721 (quality requirements for enamel components). Any fitting and pipe used, should be made for parameters not less than: PS: -1/+10 barg, TS: - 20/+200°C (even if design parameters are lower) and be marked for compliance with Pressure Directive 2014/68/EU
(PED). The thickness of the enamel layer on steel piping should be at least 0.8 mm to 2.2 mm. All fittings and pipework should include DIN 28150 split flanges. Enamelled pipelines whose parent material is carbon steel are required to be protected on the external side with anti-corrosion coatings appropriate to the conditions in which the pipeline operates.

All enamelled pipework or fittings supplied shall be fitted with a screw or bracket for earth connection. Enamelled pipelines should be subject to the following acceptance tests, which are the responsibility of the manufacturer of the enamelled pipelines or fittings:

- Tests for resistance to acids in accordance with DIN EN ISO 28706 - 2.
- Tests for alkaline resistance in accordance with DIN EN ISO 28706 - 4.
- Thermal shock test according to DIN EN ISO 13807.
- Poroscopic testing using a test voltage of 20 kV.
- Enamel layer thickness test according to DIN 2873.
- Visual test of enamel condition carried out immediately prior to shipment of materials.

The table below is a list of standard enamelled pipe sizes. **Table 3.6.5.** Recommended sizes of

enamelled pipelines

Type-series dimensions	Required minimum thickness of wall - mm	Applicable pipelines section lengths - mm
DN 25	3.6	100 - 3000 (every100 mm)
DN 50	4.0	
DN 80	5.0	
DN 100	5.0	
DN 150	5.0	
DN 200	6.3	
DN 250	6.3	
DN 300	7.1	

At the design stage of enamel-lined pipelines, the condition must be ensured that the equivalent stresses are not exceeded at any point in the pipeline:

- 50MPa for TS temperature: <120°C
- 30MPa for TS temperature: 120°C - 200°C

3.6.5. TEFLON

- Pipelines delivered to the PCC must be designed and constructed in accordance with the following requirements:
- The structural layer is a steel element designed and constructed in accordance with the requirements as for steel pipelines.
- The PTFE layer (PFA, FEP, ETFE) is a chemically resistant layer that is not responsible for the structural strength of the pipeline.
- A very important element in the selection of Teflon-lined pipelines is the correct choice, i.e. taking into account the permissible parameters: minimum pressure (especially when below atmospheric pressure) and maximum pressure, as well as minimum and maximum temperature due to the limited application possibilities.
- One of the flanges is required to be a movable (loose) flange.
- For potentially explosive media, plastomers saturated with substances that allow the dissipation of electrostatic charges (e.g. PTFE-AS or PFA-AS) should be used.
- For media with a high content of hard particles, plastics with increased mechanical strength, good corrosion and abrasion resistance are recommended: (e.g. ETFE).
- Pipeline components delivered to PCC must be pressure tested at the manufacturer's premises prior to shipment.
- A high-voltage (approx. 20 kV) puncture test is required for 'natural-primary' linings, while conductive linings are required to be tested for their ability to dissipate electrical charges.
- Each individual component of the pipeline is to be identifiable - in this context it is important that the required material certificates for the components are supplied with the delivery and that these components are marked accordingly, e.g. flange markings etc. to comply with the requirements of the Pressure Directive.
- The components supplied must be sealed on all sides with solid plugs (wooden, plastic).
- The components to be supplied are to comply with ISO 9080.

3.6.6. SUPPORTS AND SLINGS

A. CONSTRUCTION REQUIREMENTS

To ensure safe operation, the following considerations must be taken into account when designing and installing the pipelines:

- The support structure should be designed to carry static, dynamic and occasional loads (climatic, strength test).
- Fixed and adjustable supports and/or slings should be selected to ensure self-compensation.
- Load calculations must take into account the conditions of external factors, in particular snow and wind loads, and must be carried out in accordance with the requirements of the Polish Standards.
- For the calculation, the weights of the fittings to be installed must be assumed; in the event of increased loads, fittings and accessories must be supported/suspended individually.
- Made of a material whose components are incapable of weakening them significantly, in particular by accelerating ageing, creep and increasing brittleness.
- No slings attached to other pipelines are permitted.
- When installing the pipelines, use flat insulation spacers that are selected for the weather and the operating conditions of the pipeline.
- If NBR spacers are used, the hardness of the rubber should be 50°-70° Shore A (dimensions in the table below).
- Mount supports and slings on cold-insulated pipelines on insulation using rubber-coated polyurethane inserts.
- The use of system supports and slings (e.g. SIKLA, HILTI, Witzenmann, Lisega) is permitted.

Table No. 3.6.6. Recommended sizes of the clamps.

Diameter of GNI	Clamp		Rubber pad		
	Clamp width [mm]	-ness of the s [mm]	Screw	Thickness [mm]	Width [mm]
25 – 100	60	6	M12	5	58
150 – 200	70	8	M16		68
250 – 500	80		M20		78

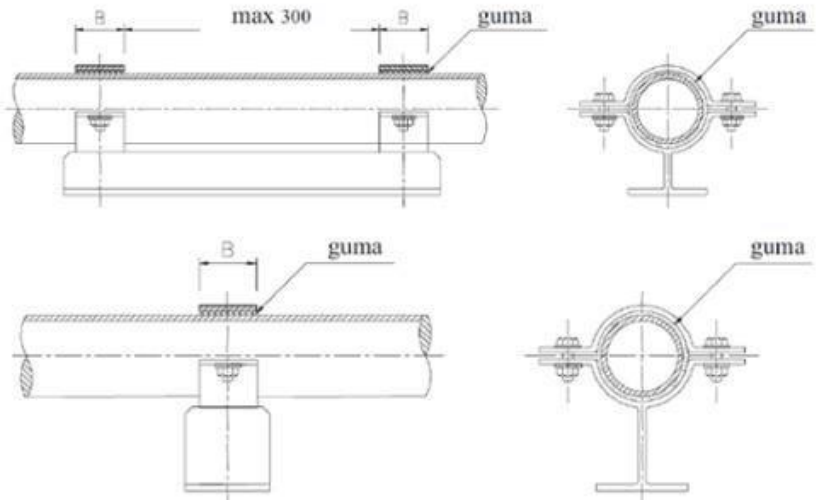

Fig. 3.6.1 Fixed support for pipelines: 1) above DN250, 2) below DN250

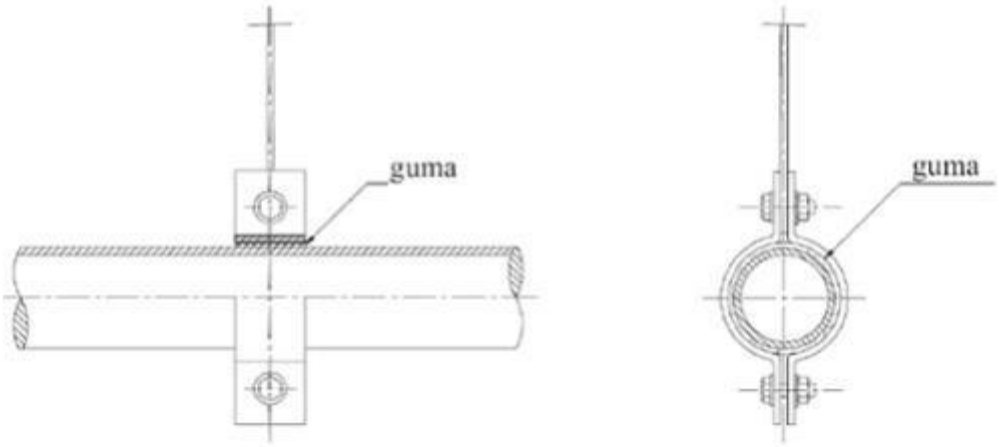

Figure 3.6.2: Suspension for pipelines.

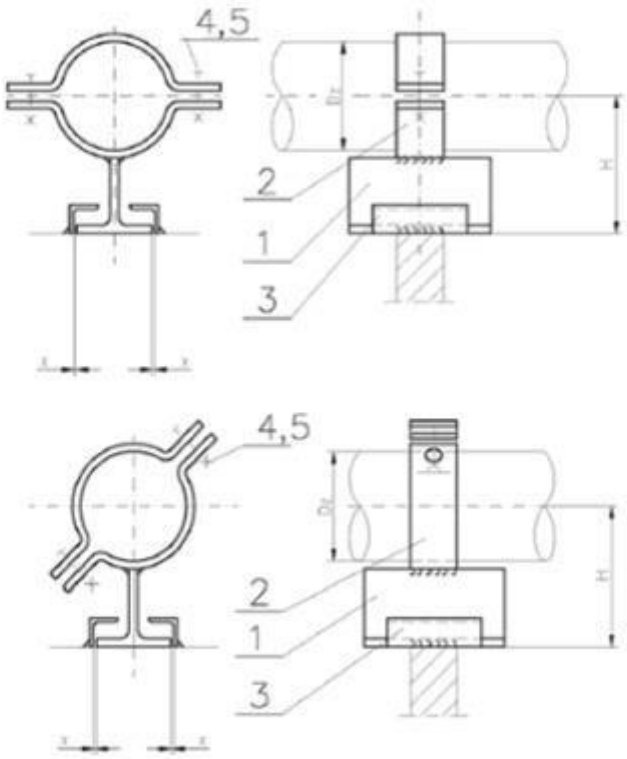

Fig. 3.6.3 "T" type sliding support: 1 - T-bar; 2 - bracket bent from flat bar; 3 - angle bar; 4 - bolt; 5 - nut.

B. DOCUMENTATION REQUIRED

The documentation to be supplied as part of the delivery is an integral part of the order and its absence or incompleteness will be treated as failure to meet the requirements in accordance with the order. Documentation must be provided in accordance with the guidelines of **Section 3.12 - DOCUMENTATION.**

C. STANDARDS AND REGULATIONS

- PN - EN 13480 - Metallic industrial piping.
- EN 14276 - Pressure equipment for refrigeration systems and heat pumps.
- PN - EN ISO 1127 - Stainless steel tubes. Dimensions, tolerances and theoretical weights per unit length.
- PN - ISO 1127 - Stainless steel tubes. Dimensions, tolerances and theoretical weights per unit length.
- PN - ISO 4200 - Seamless and seamed steel tubes with smooth ends. Dimensions and weights per unit length.
- PN - ISO 5252 - Steel pipes.
- PN - EN ISO 6708 - Piping components.
- PN - EN 3183 - Steel line pipes for flammable media.
- PN - EN 10210 - Hot-formed hollow sections made of unalloyed and fine-grained structural steels.
- PN - EN 10216 - Seamless steel pipes for pressure applications.
- PN - EN 10217 - Welded steel pipes for pressure applications.
- PN - EN 10219 - Welded cold-formed hollow sections made of unalloyed and fine-grained structural steels.
- PN - EN 10220 - Seamless and welded steel pipes.
- PN - EN 10224 - Non-alloy steel pipes and fittings for the transport of aqueous liquids including water for human consumption.
- PN - EN 10253 - Pipe fittings for butt welding.
- EN 10204 - Metal products - Types of inspection documents.

- PZB.PR.03.I02 Marking method for pipelines, chemical storage areas, sampling sites, containers and storage tanks for chemicals

3.7. FITTINGS

The following parameters must be taken into account when selecting barrier fittings:

- Fitting type.
- Installation length.
- Type of connection: flanged, welded or threaded.
- Maximum allowable pressure - PS [bar].
- Highest or lowest permissible TS temperature [°C].
- Medium.
- Material execution .
- Drive type.
- Type of seal.
- Existence of explosion danger zone - EX design.
- Additional equipment or special designs.

Fittings should meet the requirements of the relevant subject standards for the issues listed above.

The fittings must be so selected and installed as to ensure fault-free operation within the permissible parameters of the installation on which they will be used.

A.MATERIAL REQUIREMENTS

- The materials used for the fittings must have at least the same or greater resistance to the working medium as the parent material of the pipelines or apparatus to which they are connected.
- The materials used for the fittings must be selected on the basis of the strength characteristics of the design pressure/temperature relationship, meeting the mechanical strength condition, allowing safe operation over the full range of specified design temperatures and pressures.
- The materials used for the fittings must undergo an impact test at the lowest temperature of -29°C and the required KV value is 27 J.
- No material made of aluminium or its derivatives is allowed.
- It is preferred that manual mixers with diameters above DN100 are fitted with a worm gear, the final selection should be discussed with PCC technical services.
- Manual fittings must be equipped with a position indicator.
- The fittings must be of demountable construction, in such a way that they can be regenerated.
- They should be of a design with an extended shank to allow the installation of thermal insulation.
- For fittings to be mounted on apparatus, insulated pipework, the appropriate stem length must be taken into account.

The following sequence should be used on process installations:

- Flanged joints in accordance with **Section 3.8.2 - Flanged joints**.
- Welded - for safety reasons or the requirements of legislation and industry standards for hazardous parameters and mediums. In addition, welded fittings must be suitably matched in terms of the weldability of the body with the pipeline.
- Threaded - to be considered in each case with PCC technical services.

3.7.1. CUT-OFF

A. POPPET VALVES

- Required installation length for series 1 poppet valves in accordance with EN 558 (DIN 3202-1 series F1).

- Valves with stuffing box seals must be able to adjust the sealing pack pressure.
- Poppet valves for operation on liquid or gaseous dry chlorine must be EUROCHLOR approved according to GEST 17/492. Cancellation of EUROCHLOR only with the approval of the Technical Director.
- Valves designed to regulate flow, must have a design suitable for this purpose (suitable plug and seat design).
- There should be a marking on the valves clearly indicating the closed/open position and a permanently marked direction of flow.

B. BALL VALVES

- The required installation length for ball valves is:
  - for diameters up to DN 50 series 1 to EN 558-1 (DIN 3202-1 series F1),
  - for diameters over DN 50, series 1 acc. to EN 558-1 (DIN 3202-1 series F1) or the recommended series

  27 in accordance with EN 558-1 (DIN 3202-1 series F4),
  for the entire diameter range of pressure class PN63 series 1 to EN558-1(DIN 3202-1series F1).
- Ball valves must be of demountable construction and characterised by full flow.
- It is not permissible to use a ball valve as a flow regulator except for valves designed for this purpose.
- Valves with a relieved ball should be used for media that, when enclosed in the dead space of the valve, can cause a significant increase in pressure and damage to the valve.

C. WEDGE GATE VALVES

- The required installation length for wedge gate valves is:
  - for diameters up to DN 150, series 26 to EN 558 (ANSI B16.10, tab.9 col.4),
  - for diameters over DN 150, series 15 to EN 558 (DIN 3202-1 series F5),
  - 14 series in accordance with EN 558 (DIN 3202-1 series F4).
- Gate valves with stuffing box must be able to adjust the sealing pack pressure.
- Wedge gate valves should be of demountable construction and have full passage.
- Wedge gate valves are designed to open or close the medium flow. They must not be used to throttle the flow.

D. KNIFE GATE VALVES

- Required installation length series 20 according to EN 558.
- Knife gate valves are preferred for shutting off bulk media (e.g. granules), liquids with suspended solids, slurries and sludge, where tightness and the ability to regulate/restrict the flow are required.
- LUG type knife gate valves are required. The WAFER gate valve may only be used after consultation with and approval of the PCC Technical Services.
- One-way tight gate valves must have their flow direction clearly indicated by an arrow on the body.

E. DAMPERS

- Recommended installation length for dampers with a single eccentric in accordance with EN 558series20.
- Requires installation length for PN63 dampers in accordance with EN 558 series 16.
- LUG type dampers are required. A WAFER damper may only be used after consultation with and approval of PCC Technical Services.
- For dampers for hazardous media, TA-Luft-certified dampers (VDI 2440) must be used.
  The use of dampers without TA-Luft certification (VDI 2440) is permitted with the exclusive agreement of the PCC Technical Services.

3.7.2. NON-RETURN VALVES

- Required installation length for non-return valves:
  poppetflange - series 1 acc. to PN-EN 588 (DIN 3202 1 series F1) for PN63 - series 2 acc. to PN-EN 558 (DIN 3202-1 series F2),
  plate inter-flange - series 49 to EN 558 (DIN 3202-3 series F4), for PN63 series 52 to EN 558.
- Non-return valves connecting pipelines made of different materials (e.g. to secure the flow of a medium to a pipeline supplying nitrogen for purging) must be made of materials chemically resistant to both media in the highest parameters occurring at both ends of the valves and the direction of flow should be permanently marked.
- When selecting a non-return valve, the opening pressure of the valve must be taken into account.

3.7.3. BREATHER VALVES

Breather valves protect tanks from rising and/or falling internal pressure. They must be selected to meet the condition of higher throughput than the utility inflow taking into account:

- changes in temperature/atmospheric pressure,
- filling or emptying the tank,
- rapid heating or cooling of the tank contents,
- pressure build-up due to external fire,
- inert gas supply (mainly nitrogen),
- properties of the working medium during normal operation and in an emergency situation,
- made of materials chemically resistant to all media in the highest parameters found in the tank
- the flow direction should be permanently marked on the valve body,
- type, type and diameter of flanged connection in accordance with Section 3.8.2 - flanged connections,
- breather valves for flammable / explosive media vessels should be selected with an integrated flame arrester,
- for media that solidify or polymerise at low temperatures, breather valves should be specified with (electrical) heating.

For breather valves protecting non-pressure or low-pressure vessels, the guidelines of EN ISO 28300 should be applied.

3.7.4. SAFETY VALVES

Safety valves and pressure relief plates (pressure inserts) protect equipment and apparatus from excessive internal pressure build-up. They must be selected in order to protect the equipment from an excessive increase in pressure above the allowable pressure. The selection of the safety device takes into account:

- physical and chemical properties of the media,
- temperature and back-pressure variations downstream of the safety valve,
- filling the tank,
- rapid heating of the tank contents,
- pressure build-up due to external fire,
- inert gas supply (mainly nitrogen),
- properties of the working medium during normal operation and in an emergency situation,
- material design for the highest performance in the tank. SYR-type diaphragm

safety valves are not permitted.

A. SELECTION OF OVERPRESSURE PROTECTION DEVICES

In the selection of the installation and operation of safety valves and pressure relief plates(pressure inserts) , the following should be followed: the WUDT guidelines or the requirements of the EN ISO 4126series of standards for overpressure protection devices. API 520 and EN 13136 may be used, after

prior agreement with PCC technical services. Regardless of the standard or conditions adopted/applied, the requirements of Pressure Directive 2014/68/EU must be met at the same time.

The rule of thumb is to make the line supplying the working medium to the safety valve as short as possible, so that the pressure loss in this line (at maximum [flow]) does not exceed 3% of the pressure difference between the pressure at which the valve starts to open and the foreign counter-pressure, if any. In addition, the lines should be designed to compensate for thermal elongation,
and the attachment of the safety valve and lines should take into account the static and dynamic effects of the operating medium.

Safety valve discharge pipework:

1. The permissible pressure drop across the discharge line from the safety valve must be in accordance with the safety valve manufacturer's declaration.
2. If you are dealing with group 1 media(dangerous media) according to the PED
   and with diameters greater than DN25, the flow resistance and hydrostatic pressure in the discharge pipeline (outlet from the safety valve) must be taken into account when selecting the outlet diameter of the safety valve .
3. Efforts should be made to design the discharge pipeline such that its maximum allowable pressure PS does not exceed 0.5 bar(g). Higher pressure will entail the need to prepare a full documentation required by the Pressure Directive.
4. In order to make correct calculations of pressure drops in discharge pipelines, it must be remembered that the pressure after the safety valve, is not equal to its opening pressure.

B. CALCULATION AND SELECTION

Selection and verification calculations for safety fittings (safety valves, safety plates,) include:

- the place of installation and the function of the safety fittings,
- calculation rules for safety fittings preferably according to WUDT or PN - EN ISO 4126 (with approval also API 510 and EN 13136) - no matter which standard or conditions are adopted/applied, the requirements of the Pressure Directive 2014/68/EU must be met at the same time,
- calculation of the required capacity of the safety fittings for the target system,
- calculation of the required diameter and cross-sectional area of the inlet channel and the maximum pressure drop at the valve inlet,
- calculation of the effect of back-pressures downstream of the safety device on the capacity of the safety system,
- checking the capacity of the safety fittings with the conclusion that the capacity of the selected fittings is greater than the required capacity,
- data sheet with design assumptions / data sheet.

The selection and calculation of safety devices (safety valves and pressure inserts) must also take into account the expansion condition. Furthermore, in the case of heat exchanger protection, the case of tube/plate breakage must additionally be considered (only if the PS difference on both sides is greater than 10%).

C. CONSTRUCTION REQUIREMENTS

Valves supplied to PCC:

- must have a demountable structure,
- must have a (factory/identification) name plate,
- must have flanged connections in accordance with Section 3.8.2 - flanged connections, threaded or welded connections are permitted with prior approval from the PCC Technical Services.

3.7.5. HYDRAULIC CLOSURES

Vessel hydraulic closures can act as an overflow for non-pressurised or low-pressure vessels, or to protect them from internal pressure build-up, with the proviso that they must not

be the only safety device for the vessel in question. The use of one apparatus to perform both functions at the same time is inadvisable, but may be considered in the case of continuous liquid level monitoring with a DCS.

Vessels hydraulic closures are to be considered as vessels, so the provisions of Section 3.5 PRESSURE AND NON-PRESSURE VESSELS AND EQUIPMENT must be taken into account. In addition, the selection of the device takes into account:

- compatibility of the fluid in the hydraulic vessel with the fluid in the protected vessel,
- properties of both media during normal operation, in an emergency situation and under extreme weather conditions,
- made of chemically resistant materials for all media in the highest parameters found in the vessel,
- securing the vessel hydraulic closure against the ingress of rainwater and foreign bodies and protecting it against corrosion.

Vessel hydraulic closures and siphon traps used as overflows must be selected on the basis of the highest media inflow capacity, taking into account the maximum capacity of the pumping system.

Vessel hydraulic closures used as protection must be selected to meet the highest capacity condition for a single case or a combination of possible cases:

- filling the tank, taking into account the maximum capacity of the pumping system,
- inert gas supply (mainly nitrogen), using the guidelines of PN - EN ISO 28300.

Design requirements of vessel hydraulic closures:

- a simple design, as close as possible to the diagram in Fig. 3.7.1 (where by the drain connection marked3 should, as far as possible, be located at the lowest point of the vessel to allow complete drainage),
- the inlet spigot of the hydraulic closure is to have a cross-section at least equal to the sum of the cross-sections of all the inlet spigots of the protected vessel,
- clear marking of the required liquid level on the vessel hydraulic closure (in the case of overflow min/max level indication),
- visible and easy-to-read current level of liquid in the vessel hydraulic closure,
- a detachable top head is required,
- a rating plate with the following information:
    - technological number ,
    - the name and assumed density of the medium in the vessel hydraulic closure,
    - setting pressure,
- A0 or D0 (the smallest cross-section or diameter of the piping in the section between the outlet port of the protected vessel and the inlet port of the vessel hydraulic closure, expressed in mm2 or mm).

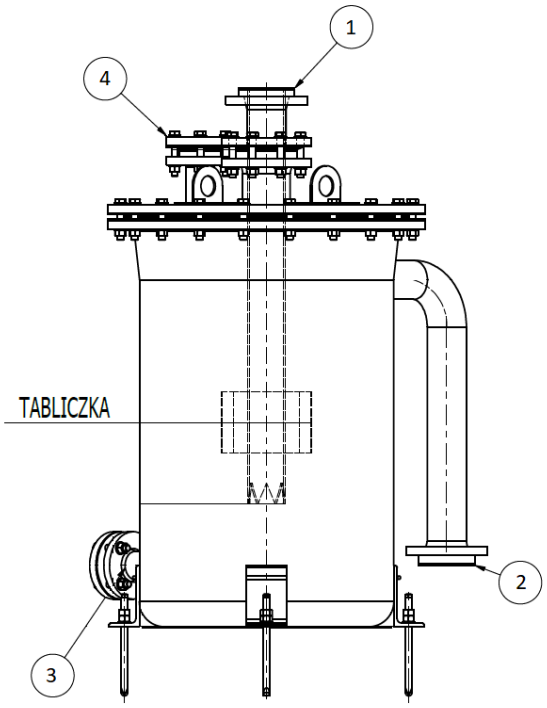

Fig. 3.7.1 Vessel hydraulic closure: 1 - inlet spigot, 2 - overflow, 3 - drain spigot, 4 - filling/refilling of liquid in the tank vessel hydraulic closure.

3.7.6. SIGHT GLASSES

- Preferred installation length of the sight glass - series 1 according to PN - EN 558-1 (DIN 3202 - 1 series F1).
- The design of the sight glasses must allow for the removal and replacement of seals and lenses.
- Preferred flat glass material for general purpose sight glasses - borosilicate glass.
- The glass material must be resistant and selected to a class equal to or higher for the working medium.

3.7.7. FILTERS AND FITTINGS

- Required installation length - series 1 according to EN 558 - 1 (DIN 3202 - 1 series F1)
- Filters must be of demountable construction with the ability to quickly change/clean the basket without removing the filter, Y-type preferred.
- The mesh size of the filter element and the pressure drop should be agreed at the design stage with PCC Technical Services.
- The direction of flow of the medium must be permanently marked on the filter body.

A. PREFERRED FITTING MANUFACTURERS

Fittings	Type	Selected suppliers
Cut-off	Ball valves	Kingdom
		Andrex
		Chemitex Zetkama
		Efar
		FLOWSERVE
		XOMOX
		PEKOS
	Cone taps	Az-Armaturen
		Xomox
	Plastic valves	GF

		Safi
		Marley
	Wedge valves	Zetkama
		Arma-Pol
		EBRO
		Wakmet
		Małapanew
		Hawle
	Knife valves	EBRO
		Larox
Sight glasses	Sight glasses	Andrex
		Kluge
		Chemitex
		ATOMAC - FLOWSERVE
		Xomox
		Az-Armaturen
Return	Flanged and Inter-flanged	Zetkama
		EBRO
		Andrex
		Wakmet
		XOMOX
		SISTO
		ATOMAC-FLOWSERWE
Security	Safety valves	Armak
		Leser
		LDM
		Chemar
		ARI-Armaturen
		Richter Chemie
	Safety heads / plates	Fike
		REMBE GmbH
		Bs&B
	Breather valves	Protego
		RMG
Self-cleaning filters		OMC Envag
		ChemTech
		Eaton
Settling tanks	Slant	Andrex
		Sferaco

B. DOCUMENTATION REQUIRED

The documentation to be supplied as part of the delivery is an integral part of the order and its absence or incompleteness will be treated as failure to meet the requirements in accordance with the order. **Documentation** must be provided in accordance with the guidelines of **Section 3.13 - DOCUMENTATION**.

3.7.8. EXPANSION JOINTS

In duly justified cases, with the approval of the PCC technical services, the use of expansion joints is permitted.

The preferred solution is flanged expansion joints (minimum one rotating flange) in PN drilling class. Weld-on expansion joints are only possible with additional agreement from PCC Technical Services.

The expansion joints provide four types of displacement:

- axial displacement (compression, tension),
- angular displacement,
- lateral displacement,
- torsional displacement.

Depending on the type of bellows material, expansion joints are divided into:

- steel expansion joints,
- rubber expansion joints with synthetic braided rubber or steel reinforcement,
- teflon expansion joints,
- fabric expansion joints made of glass fabric, which may additionally be coated with a layer of e.g. silicone or Teflon.

The appropriate type of expansion joint should be selected according to the operating parameters, taking particular account of:

- the dimension of the diameter DN or, in the case of a rectangular/square expansion joint, its sides A and B,
- installation length dimension [mm],
- the type of medium (chemical name, pH and other requirements affect the selection - e.g. solids, abrasiveness, etc.),
- bellow material,
- flow rate,
- direction of installation (vertical, horizontal, sloping),
- operating pressures,
- PS permissible pressure,
- operating temperature,
- TS permissible temperature,
- installation location and ambient temperature,
- occurrence of pressure pulsations,
- minimum number of operating cycles,
- type and extent of displacement:
    - axial [+/- mm],
    - transverse [+/- mm],
        - angular [+/-°],
- material and type of corrosion protection for the connection.

If a weld-on expansion joint is accepted by PCC Technical Services, the size of the weld-on connection - outside diameter and thickness of the pipeline - must be specified).

In addition, additional equipment such as stops, protective hoods, flame-retardant covers, inner/outer protective sleeves, guide sleeves, safety rings for vacuum operation should be considered.

Metal expansion joints should be made in accordance with EN 14917 - Metal bellows expansion joints for pressure applications.

3.8. CONNECTIONS

3.8.1. JOINING METHODS

Two types of connection are used in the PCC area:

- detachable flange connections:
    - on metal piping,
    - on plastic piping,
    - when connecting devices and appliances,

- inseparable:
    - welded on metal piping,
    - welded, pressure-welded, laminated and glued on plastic piping,
- other (only by agreement with PCC technical services):
    - threaded,
    - soldered.

3.8.2. FLANGE

Acceptable types of flanges used:

- type 01 - flat flange with type B1 rebate,
- type 11 - neck flange with type B1 rebate,
- type 05 - flat flange with type B1 rebate,
- Type 02 - loose flange with type 32 flat ring for welding, with type B1 rebate.

Due to the operating pressures, the following flanges are used: PN10, PN16, PN25, PN40 and PN63 according to the table below.

Table No. 3.8.1: Comparison of the twistability of flanges in given pressure classes.

<table>
<tr><th rowspan="2">Diameter</th><th colspan="5">Flange type of working pressure</th></tr>
<tr><td>PN10</td><td>PN16</td><td>PN25</td><td>PN40</td><td>PN63</td></tr>
<tr><td>DN25</td><td colspan="4" rowspan="4">PN40</td><td rowspan="11">PN63</td></tr>
<tr><td>DN32</td></tr>
<tr><td>DN50</td></tr>
<tr><td>DN80</td></tr>
<tr><td>DN100</td><td rowspan="2">PN16</td><td rowspan="6">PN16</td><td colspan="2" rowspan="2">PN40</td></tr>
<tr><td>DN150</td></tr>
<tr><td>DN200</td><td rowspan="5">PN10</td><td rowspan="5">PN25</td><td rowspan="5">PN40</td></tr>
<tr><td>DN250</td></tr>
<tr><td>DN300</td></tr>
<tr><td>DN350</td></tr>
<tr><td>DN400</td></tr>
</table>

The surfaces of the interfaces must be parallel to each other and the permissible deviation from perpendicularity to the axis of the pipeline measured at the external diameter of the interface should not exceed 0.01 of this diameter, but not more than 2 mm.

Fasteners (flanges, bolts, nuts, washers, gaskets, alignment sleeves) should correspond to the technical documentation and material standards.

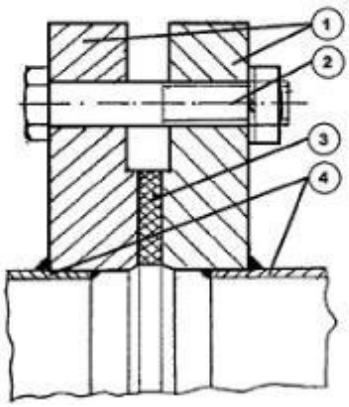

Fig. 3.8.1 Type 01 B-1 flange connection: 1 - flange; 2 - bolt, nut and washer; 3 - gasket; 4 - pipe.

Tightening of bolts in a flange-bolt joint should be carried out using a torque spanner or other methods with controlled thrust according to the calculated torque for the flange joint in question.

The calculation of flanged joints on pipelines is to be carried out according to WUDT-UC-WO-O/19 - Strength calculations of a flange-screw joint or according to EN 1591-1 - Design rules for gasketed circular flange joints , while meeting the requirements of the Pressure Directive 2014/68/EU.

In the case of machinery and equipment, flanged joint calculations are carried out according to the design regulations of the machine or equipment in question.

Flanged connections for hazardous media must have splash guards made of material that is resistant to the medium and the weather. Not applicable to insulated pipelines and gas pipelines.

The size of the thread protruding beyond the nut is to be between 2-3 turns. Bolt threads must be

protected against corrosion with lubricants.

Flanged connections of piping and process apparatus located in potentially explosive atmospheres should have adequate electrical conductivity. The conductivity of the flanged connections is to be ensured by using at least two bolts with a total cross-section of not less than 50 mm2 , fitted with spring washers or crown washers. Bolt heads on which spring washers or crown washers are used
should be painted red. In the event that the aforementioned screw cross-section requirement cannot be fulfilled, conductivity is to be ensured by means of a deviation using galvanised steel strip of min. 20 x 3 mm.

Where appropriate (by prior agreement with PCC Technical Services), plastic protective caps should be used in particularly corrosive areas.

When selecting bolts, consideration should be given to, among other things:

- the range and variability of temperatures in which the bolted connection will operate (applies to both low and high temperatures - embrittlement at low temperatures, creep at higher temperatures),
- the range and variability of pressures and temperatures (cyclicality),
- hydraulic shocks ,
- loads due to thermal expansion of piping, apparatus and equipment,
- other, resulting from the specifics of the designed/manufactured connection.

A. MATERIAL REQUIREMENTS

- The bolt material should be homogeneous, without surface defects.
- Bolts should be free of contamination in the form of grease, which may indicate previous use.
- The mechanical and chemical properties should comply with the relevant directives and standards, and the mechanical properties R_m and R_e (yield strength is particularly important).
- They should provide a secure and safe connection.
- Fasteners made using cold forging technology should be supplied in the tempered or heat-treated condition.
- The bolt and nut material should be subjected to an impact test at the lowest metal temperature TM and the required KV value should be in accordance with Table 4 or 5 of EN 1515-4.
- Each batch of bolts should be marked and supplied with a material certificate 3.1 according to EN 10204.
- The screws to be supplied must be manufactured in accordance with EN ISO 4014 or EN ISO 4017 or in accordance with
equivalent standards.
- Bolts without heads must be marked at one end in such a way that they can be identified on the certificates of origin provided.

- Hexagon-head bolts and nuts should be marked with the property class and the manufacturer's identification mark.
- The gaskets used must be resistant to the medium and have a mechanical strength higher than that calculated for the flange connection in question.
- The material is to be selected according to **Section**3. 9.1 - gaskets for flanged joints.

B. TESTING THE PROPERTIES OF BOLTS

- Bolts with hexagonal heads should be tested in accordance with EN ISO 898 - 1.
- The number of bolts used for the test should meet the requirements of PN - EN ISO 3269.
- The nuts should be tested in accordance with PN - EN ISO 898 - 2 point 8.
- The number of nuts used for the test should meet the requirements of PN - EN ISO 3269.

C. FLANGED PIPE CONNECTIONS

Three types of flanged connections are permitted when connecting plastic and plastic pipelines to steel pipelines, as shown in the figure below.

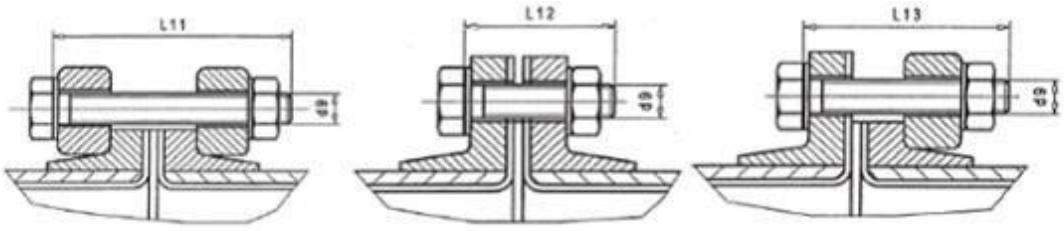

Fig. 3.8.2 Types of flange connections. Seen from right: loose flange - fixed flange (FL-FF), fixed flange - fixed flange (FF-FF) and loose flange - loose flange (FL-FL).

GRP flanged connections must always be used:

- washers between the laminate and the bolt nut,
- loose flanges made of GRP - for pipelines with diameters DN <200,
- loose flanges made of steel - for pipelines with diameters DN ≥200.

The tightening torque values apply to flanged connections made

of GRP using flat seals made of elastomers with a Shore hardness of approx. 60ş are shown in the table below. If elastomer profile seals are used, the specified torque values can be reduced by approximately 20 %. The screws should be tightened evenly "crosswise" using a torque spanner. Avoid exceeding the specified torque values.

3.8.3. WELDED

Welded connections must be documented in accordance with DIN EN 13480 for pipelines, EN 13445 for pressure vessels andEN14015for non-pressure vessels, as well as the requirements specified in the detailed design.

The following guidelines must be adhered to for the design, production and acceptance of goods.

A. QUALITY REQUIREMENTS FOR WELDING

- PN - EN ISO 3834 - Polish version - Quality requirements for welding of metallic materials.
- PN - EN ISO 9001 - Polish version - Quality management systems.

3.9. SEALS

3.9.1. SEALS FORFLANGE CONNECTIONS

For pipelines made of plastic (GRP, thermoplastics), the use of profiled seals is recommended. It is a flanged ring with a metal insert. Due to the spherical form of the rubber part, even low pressure exerted on the flange results in good sealing.

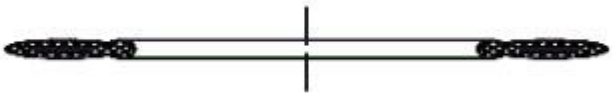

Fig. 3.9.1 Profile seal cross-section

For enamelled pipelines, the use of non-metallic seals with PTFE sheathing according to EN 1514- 3 (envelope gaskets) is recommended.

The choice of a particular type of seal should be agreed with PCC technical services and the plant operator. When selecting resting seals, it is required to determine the values of the design factors of the seal material required by the calculation algorithm (WUDT, Teylor-Forg method, EN 1591). Method of calculation must be selected so that it meets the legal requirements set out in the design regulations.

Table 3.9.1 Summary of preferred seals for example media

SEALS TABLE	
Seal material	**Application medium**
Graphite	Steam; Steam condensate; Propylene oxide;; Ethylene oxide; Reaction mass - Alkali crude polyether; Isocyanates; MDI; KOH; Thermal oil; MPA; Phthalic acid anhydride; MRS; liquid sulphur; Sodium lye above 60%; Oil heat carrier; Hydrogen chloride (T>150°C); Heating salts; Oxyalkylates
EPDM	Catolith; Sodium lye below 35%; Alphacellulose solution; Anolith; Nitrogen; Bisulfite; Wet chlorine; Hydrochloric acid 7;5%; 15%; 30%; 32%-37% Chlorine condensates; Chlorine degasses; Sodium hypochlorite; Air; Calcium chloride solution; Sodium sulphide; Brine (crude; pure; prepared; ultra-pure; dechlorinated; acidified; used); DEMI water; Hydrogen; cooling water; acid water; soda ash
FKM	Sulphuric acid; Hydrochloric acid
PTFE	Propylene oxide; Propylene; Chlorohydrin; Dichloropropane; Milk of lime; Lime leach; Polyesters; Polyurethane systems; Acrylonitrile; TDI; Ortho-TDA; Phosphorus trichloride; Phosphorus oxychloride; Phosphorus; Isopropylphenol; Phenol; Roflexes; Roflams; Rostabil; Oxygen; Oskar dispersant; R dispersant; Sodium lye 30%; Sulphuric acid; Rocamine K30 K40; ABS acid;
ePTFE	Sodium lye 32% - 50%; Process condensate; Sodium hypochlorite; Chlorobenzene; Dichlorobenzenes; Hydrochloric acid 32%-37%; Hydrogen chloride; Benzene
Aramid/NBR	Ammonia; Dry chlorine and liquid chlorine in certain applications (in equipment supplies from abroad); Glycol; Hydrogen condensate; Hydrogen; Chlorobenzene; Dichlorobenzenes; Nitrogen; Liquid chlorine; Chlorine gas dry; Chlorine gas dry; Measuring air; Process air; Refrigeration water; Industrial water; Rocryls; Rocrylamines; Styrene; Sulphorocanol; Rocanols; Solution of
Envelope seal graphite/ aramid	Enamelled connections

3.9.2. CORDS

The use of cord seals is permitted with the sole approval of PCC Technical Services.

3.10. LUBRICANTS

In PCC, lubricants are only allowed to be used with specific properties and applications.

The following summary provides a specification of the required properties for each group of the most commonly used lubricants and penetrants:

1. Multi-purpose spray lubricant:
    a. It must have very good penetration and lubrication properties.
    b. It should not interact with metals and their alloys, plastics, rubber and painted surfaces.
    c. It should have the ability to displace moisture from electrical and ignition systems.
    d. It should have the ability to loosen rusted threaded connections.
    e. Minimum thermal resistance from -25°C to +150°C.
2. Degreaser:
    a. It must not leave a residue after evaporation.
    b. It must not have a corrosive effect on metals.
    c. It must not cause damage to plastics.
    d. It must have high dielectric resistance.
    e. It must have a high flash point.
3. Dry spray lubricant:
    a. It must have resistance to chemicals, oil and water.
    b. Operating temperature -50/+200°C.
    c. It must be characterised by a short evaporation time of the liquid substance.
4. Anti-slip preparation for drive belts and stripes:
    a. It must be characterised by a short evaporation time of the liquid substance.
    b. It should reduce squeaks and improve grip.
    c. It must not adversely affect rubber, leather or canvas.
5. Sprayable fastener loosener:
    a. It should be highly effective in loosening fixings.
    b. It must have very good penetration properties.
    c. It should be characterized by high speed of operation.
6. Anti-friction preparation:
    a. High-temperature >1000°C.
    b. It must be able to be used in a highly aggressive chemical environment.
    c. Preferably in paste form.
7. Cleaner and degreaser for electrotechnical equipment:
    a. It should allow the removal of oxide and sulphur layers.
    b. It should remove combustion deposits and soot.
    c. It should effectively remove resin soiling.
    d. It should allow for a reduction in voltage losses.
    e. It must not have a corrosive effect.
    f. It must not be conductive.
    g. Complete evaporation of the agent must take place within several minutes. After evaporation, must leave no residue.
    h. The product must be neutral towards: metals, plastics, rubbers and paints, varnishes and electro-insulating coatings.

The product cannot be classified as dangerous for humans or the environment. Indicate in what packaging it is to be delivered. If these will be refill packs, the supplies must also include applicators.

When delivering lubricants to a PCC site, the CN code of the lubricant to be delivered must be stated each time. In the

case where the lubricant will be covered by the Act Journal of Laws 2004, No. 54, item 535, Journal of Laws 2009, No.

3, item 11
and Journal of Laws 2006, No. 169, item 1199, as amended, and has a CN code from the aforementioned list and will be supplied from abroad , either as an independent delivery or as part of a device, e.g. oil in a device) , it is obligatory to report such fact to the PCC technical service before the delivery of a lubricant/ device.

The products referred to in the above paragraph are:

1) Covered by CN items 1507 to 1518 00, if they are intended for fuel or propulsion purposes.

2) Covered by CN items 2701, 2702 and 2704 to 2715.
3) Covered by CN items 2901 and 2902.
4) Covered by CN code 2905 11 00, not of synthetic origin, when intended for fuel or propellant purposes.
5) Covered by CN item 3403.
6) Covered by CN item 3811.
7) Covered by CN item 3817.
8) Designated by CN codes: 3824 99 86, 3824 99 92, 3824 99 93, 3824 99 96, 3826 00 10 and 3826 00 90 if intended for heating or propulsion purposes.
9) Other articles, excluding substances used for marking and colouring as referred to in Art. 90(1), intended for use, offered for sale or used as engine fuels or as additives or admixtures for engine fuels - irrespective of CN code.
10) Other products which are hydrocarbons, excluding peat, intended for use, offered for sale or used as heating fuels or as additives or admixtures for heating fuels, irrespective of CN code.

3.11. ANTICOROSION

3.11.1. PAINTING SYSTEMS

The corrosion protection system is to be selected in accordance with EN ISO 12944-2, the way to protect the surface of the steel elements is to be adopted according to the table of corrosivity categories (table below) for a service life of at least 15 years in class H (high).

Table 3.11.1 Corrosivity categories (according to EN ISO 12944-2)**.**

Corrosivity category		**Examples of environments in the PCC**	
		Indoor	**Outdoor**
C4	Large	Chemical plant	Industrial area.
C5	Very large	Areas with almost continuous condensation and high	Industrial area with high humidity and aggressive atmosphere.
CX	Extreme		

The colour scheme of the pipelines must be agreed with PCC Technical Services - Technologist in each case.

The selection of markings should be applied in accordance with Instruction PZB.PR.03.I02 Method of marking pipelines, chemical storage areas, sampling locations and chemical storage containers and tanks(point 8 tab 4).

Table 4 of Section 8 of instruction PZB.PR.03.I02 is pasted in this study as Table 3.11.2.

Table 3.11.2 List of identification colours for agents transferred by pipeline or stored in vessels.

L.p.	Rodzaj czynnika	Oznakowanie rurociągów oraz zbiorników			
		Nazwa barwy (tło)/ wg RAL	Nazwa barwy (pas)/ wg RAL	Nazwa barwy (kontur, napisy) / wg RAL	Wzór oznakowania
1	Niebezpieczne substancje	Nie dotyczy	Żółta RAL 1003	Nie dotyczy	
2	Gazy w stanie gazowym lub skroplonym (para, chlor, tlen)	Srebrnoszara RAL 7001	Żółta RAL 1003 (o ile dotyczy)	Czarny RAL 9004	
3	Płyny i materiały stałe (proszek, granulaty)	Czarna RAL 9004	Żółta RAL 1003 (o ile dotyczy)	Biały RAL 9003	
4	Kwasy oraz ich roztwory	Pomarańcz RAL 2003	Żółta RAL 1003	Czarny RAL 9004	
5	Zasady oraz ich roztwory	Fioletowa RAL 4001	Żółta RAL 1003	Biały RAL 9003	
6	Woda; Wodne roztwory związków chemicznych niestwarzających dla obsługi zagrożenia chemicznego	Zielona RAL 6018	Nie dotyczy	Biały RAL 9003	
7	Powietrze	Błękitna RAL 5015	Nie dotyczy	Biały RAL 9003	

3.11.2. SURFACE PREPARATION

Steel surfaces should be dry, clean and free from grease, oil, moisture, dust and other contaminants. in accordance with the requirements of EN ISO 12944-4; EN ISO 8501-1. When cleaning metallized steel, special care must be taken not to remove a layer of undamaged metal during cleaning. Surfaces should be prepared in accordance with the paint kit manufacturer's recommendations given in the technical data sheets of the materials used.

Prepared surfaces for painting should be of the Sa2 or St3 class - if blasting methods cannot be used (according to EN ISO 8501-1).

Any thick layers of rust must be removed (by scraping off) before cleaning (whether by blasting or hand and power hand tools). Visible oil, grease and dust should also be removed.

Waste materials, e.g. used abrasive, rust, old coatings, should be collected and treated in accordance with the relevant national regulations and prior agreements of the parties concerned.

3.11.3. HOD-DIP GALVANIZATION

Anti-corrosion coatings made using the hot-dip galvanization process should be characterised by the absence of thickening, blisters, rough spots and sharp edges.

A properly executed coating is also required to maintain continuity of the coating.

The occurrence of "white corrosion" (mainly zinc hydroxide oxides) on galvanised surfaces is permissible, but special attention should be paid to ensure that the minimum thickness of the coating is observed. "White rust" must absolutely be removed if it is present on surfaces to which additional coatings will be applied.

Coating thickness testing shall be carried out using one of the methods listed in Annex D of PN EN ISO 1461:2011.

The test surfaces should be approximately in the centre of the product (in the case of long products, the test surfaces should not be less than 100 mm from the edge of the product). Number of areas

of reference is dependent on the size of the individual products tested in the control sample. The number of samples is determined in accordance with Table 3.11.3.

Table 3.11.3 Number of reference surfaces required for the test.

Category	Size of significantly important area	Number of reference surfaces to be tested on the product
a	> 2 m2	≥3
b	> 100 cm2 to ≤ 2 m2	≥1
c	> 10 cm2 to ≤ 100 cm2	1
d	≤ 10 cm2	1 for every N products

Table 3.11.4. Minimum coating thickness and weight on samples that have not been centrifuged.

Material	Local thickness of the coating (minimum value) [µm]	Local coating weight (minimum value) [g/m2].	Average film thickness (minimum value) [µm]	Average coating weight (minimum value) [$^{g/m2}$]
Steel > 6 mm	70	505	85	610
Steel > 3 to ≤ 6 mm	55	395	70	505
Steel ≥ 1.5 to ≤ 3 mm	45	325	55	395
Steel < 1.5 mm	35	250	45	325
Cast iron ≥ 6 mm	70	505	80	575
Cast iron < 6 mm	60	430	70	505

Table 3.11.5 Minimum coating thickness and weight on samples that have been centrifuged.

Material	Local thickness of the coating (minimum value) [µm]	Local coating weight (minimum value) [g/m2].	Average film thickness (minimum value) [µm]	Average coating weight (minimum value) [$^{g/m2}$]
Threaded > 6 mm ≤ 6 mm	40 20	285 145	50 25	360 180
Other products (including > 3 mm ≤ 3 mm	45 35	325 250	55 45	395 325

Exact guidelines for the place of measurement and the number of reference surfaces can be found in PN EN ISO 1461:2011.

It is permissible to repair an uncoated surface, but the repaired area should not exceed 0.5% of the total area of the component. A single uncoated area should not exceed 10 cm2.

The repair should be carried out by thermal spraying with zinc or by using a paint with a high zinc content. Zinc flake coatings, zinc pastes and zinc-based solder alloys are also acceptable. Before carrying out the repair, remove all contaminants and prepare the surface to ensure adequate adhesion. The thickness of the coating on the area to be repaired should be at least 100 µm (unless otherwise agreed), the coating applied should provide adequate cathodic protection of the product surface).

3.11.4. ELECTROPLATED ZINK COATING

The thickness of the electroplated zinc coating should be 25 μm. Zinc plating is recommended for products for which the appearance of swelling or sprues is not desirable (e.g. screws, nuts).

3.12. INSULATIONS

Thermal insulation is subdivided into heat insulation and cold insulation. Insulation on pipelines is used to avoid heat loss, to prevent water condensing on pipelines (condensation), and for safety reasons (direct contact with high-temperature pipelines).

Properties of insulating materials that should be considered during selection:

- thermal conductivity coefficient - ë,
- porosity - %,
- mechanical strength,
- absorbability,
- flammability,
- water vapour diffusion coefficient - ě.

Thermal insulation should be used:

- Over the entire surface of straight sections, fittings and duct connections.
- As far as technically feasible, on all or part of the surface of equipment used for heat exchange or storage.

Thermal insulation shall be applied, as far as technically feasible, to all or part of the surface of fittings installed on the aforementioned pipes. Thermal insulation should not be used on the surface of safety valves, pump motors and control valve actuators.

3.12.1. HEAT INSULATION

Mineral wool should be used for pipe insulation

- Requirements for the heat insulation used:
- Thermal resistance: >400°C.
- Volumetric density: $^{>80kg/m3}$.
- Thermal conductivity tolerance: +0 / -10 %.
- Flammability: >B2 (according to DIN 4102).
- Braided mesh: hexagonal, wire >0.7mm.
- Screen foil: 0.08mm aluminium foil for electrically heated pipework.

Table 3.12.1 Minimum thicknesses of heat insulation depending on pipeline diameter and operating temperature.

Nominal diameter	**Media temperature ranges in °C**			
	0–100	100–200	200–300	>300
	Insulation thickness in			
DN15	50	50	50	50
DN25	50	50	50	50
DN32	50	50	50	50
DN50	50	50	50	50
DN80	50	50	50	70
DN100	50	50	70	70
DN150	70	70	70	70
DN200	70	70	70	70
DN250	80	80	80	80
DN300	80	80	80	100

DN400	80	80	100	100
DN500	80	100	100	100
DN600	100	100	100	100
>DN600	100	100	100	100
Vessels <1000	50	50	70	80
Vessels >1000	50	70	100	120

Table 3.12.2 Required thermal conductivity for heat insulation, measured at a given temperature.

	100°C	150°C	200°C	250°C	300°C	350°C
W/mK (mats)	0.052–0.047	0.061–0.055	0.074–0.067	0.088–0.080	0.106–0.096	0.126–0.114
W/mK (slates)	0.048–0.044	0.057–0.051	0.068–0.061	0.081–0.073	0.097–0.087	

3.12.2. COLD INSULATION

Insulation material to be used to insulate the pipelines - foamed plastics (polyurethane foam, polyethylene foam, synthetic rubber-based foam). For apparatus for flammable media, foamed cellular glass should be used as an insulating material.

Requirements for the cold insulation used:

- Water vapour diffusion coefficient: > 7000.
- Thermal conductivity tolerance: +0 / -10 %.
- Flammability: >B2 (according to DIN 4102).
- Application temperature range (medium) -50°C to +110°C.

Table 3.12.3 Minimum thicknesses of cold insulation depending on pipeline diameter.

Nominal diameter	**Media temperature ranges in °C**			
	+30 -4	-5 -18	-19 -32	-33 -46
	Insulation thickness in			
DN15	25	40	40	50
DN25	30	35	40	45
DN32	30	35	40	45
DN50	30	35	45	50
DN80	30	40	45	55
DN100	30	40	50	60
DN150	30	45	55	65
DN200	35	45	55	65
DN250	35	45	55	70
DN300	35	45	60	70
DN400	35	45	60	70
DN500	35	50	60	75
DN600	35	50	60	75
>DN600	35	50	60	75

Table 3.12.4 Required thermal conductivity for cold insulation, measured at a given temperature (acc. to EN ISO 13787, EN12667, EN ISO 8497).

	–20°C	+/–0°C	+10°C	+20°C	+40°C	+70°C
W/mK	0.031–0.034	0.033–0.036	0.034–0.037	0.035–0.038	0.037–0.040	0.040–0.043

3.12.3. PROTECTIVE JACKET, INSTALLATION OF INSULATION

A. PROTECTIVE JACKET

The protective jacket should be laid evenly over the entire external surface of the insulation proper. The outer surface of the protective jacket shall be smooth, without cracks, kinks or indentations and shall be of a shape suitable for the cable or device being insulated. Two conductors located close to each other (so that their respective insulation layers are in contact) may share a common insulating jacket, provided that
the ability of the pipes to move freely in relation to one another in ensured. Protective jackets, made of water- and vapour-impermeable material, on ducts or equipment in underground ducts should be fitted with ventilation bands or spacers, located at the transverse laps of the jacket elements, to allow the insulation proper to dry out if it becomes damp.

The jacketing elements (sheets) should be applied to the surface of the insulation proper with an overlap at both the longitudinal and transverse joints of the individual sheets. The longitudinal and transverse laps of the jacketing elements (sheets) should be positioned in such a way as to prevent the infiltration (leakage) of rainwater. Self-tapping stainless steel screws should be used to join adjacent sheets.

- Material: aluzinc-coated sheet metal on both sides or stainless steel
- Coating material: Aluzinc alloy (55%AL, 43.4%Zc, 1.5%Si)
- Coat thickness >20um
- Coating weight: >150 $g/m2$

Table 3.12.5 The thickness of the sheet used depends on the perimeter of the insulation on the pipelines.

<400mm (<DN25)	400-1000mm (DN25-DN200)	1000-2000mm (DN200-DN600)	>2000mm (>DN600)
0.6	0.7	0.8	0.8

B. INSULATION OF FITTINGS AND FLANGE CONNECTIONS

For the thermal insulation of fittings and flange connections, it is recommended to use two-piece or multi-piece fittings (hoods). The individual fittings are to be fastened with ties, made of e.g. galvanised steel sheet or plastic tape, in such a way that they can be repeatedly installed and removed. Spindles, valve stems and gate valves should be brought outside the fittings. Their surfaces should not be insulated. Caps should be assembled in such a way that fittings or flanged connections that they protect can be removed and reassembled.

C. INSTALLATION OF INSULATION

The surface of pipelines, fittings and equipment should be clean, dry. It is not permissible to install thermal insulation on surfaces contaminated with media, grease, fat, etc. or on surfaces with an incompletely dried or damaged corrosion protection coating. Materials for thermal insulation should also be dry and clean and undamaged. The storage of materials at the workstation should
exclude the possibility of them becoming damp or damaged. Pay attention to the tools (knives and punches should be sharp and the brushes
clean).

The completed insulation must be protected with a protective coating on an ongoing basis, i.e. on the same day that it is installed. Thermal insulation should not be carried out during precipitation. If an electrical heating system is to be installed on the pipeline, the pipeline must be wrapped with aluminium foil after the heating cable has been laid.

- Mineral wool mats should always be tightly bonded together. When making multilayer insulation, successive layers should cover the joints of the previous layers. Make the insulation as waterproof.
- Insulation materials (lagging, rolls, boards) should be installed "in compression", i.e. the lagging along its length should be slightly compressed. In this way, constant pressure on the bonded joints is ensured. All installation work should be carried out at ambient temperature (optimum temperature is +15°C to +20°C). The ambient temperature during installation should not be below 0°C.

- The termination of the insulation and the expansion joints in the cable jackets should be protected against mechanical damage and moisture. Blunting/bending of the sharp edges of the cover plate is required.
- Figures 1-6 show the recommended design solutions for insulating flanged joints on vertical and horizontal pipelines, fittings and elbows and pipelines.

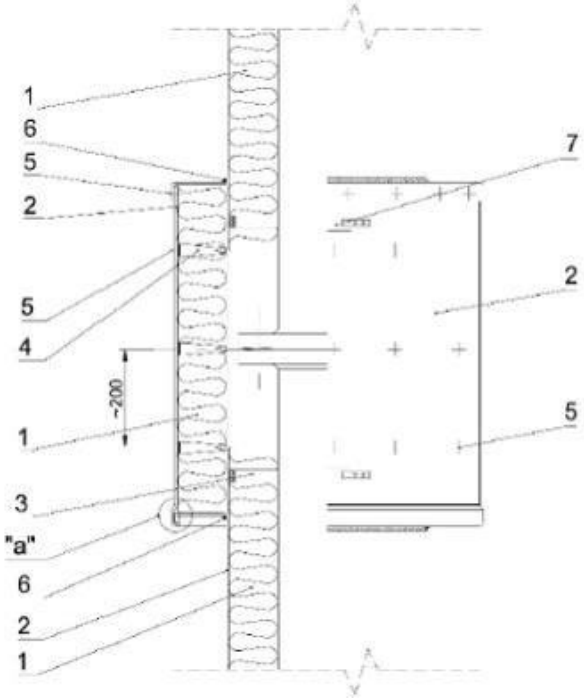

Figure 3.12.1: Insulation of flanged joints on vertical pipelines. 1 - Insulation mat, 2 - Insulation jacketing, 3 - Supporting structure, 4 - Insulation fixing element, 5 - Tube rivet with fixing core, 6 - Sealing with silicone putty, 7 - Cap lock.

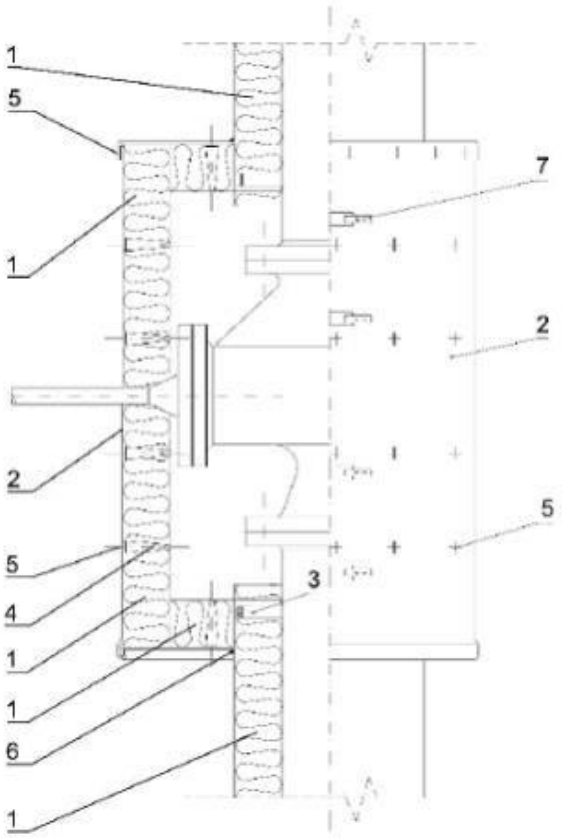

Figure 3.12.2: Insulation of a flanged valve on vertical pipework. 1 - Insulation mat, 2 - Insulation jacket, 3 - Supporting structure, 4 - Insulation fastener, 5 - Tube rivet with fastening core, 6 - Sealing with silicone putty, 7 - Cap lock.

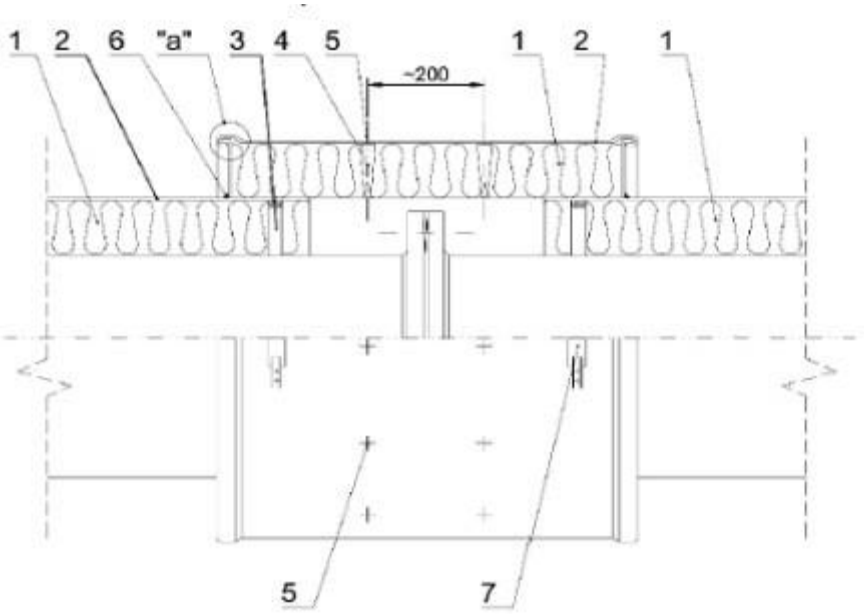

Figure 3.12.3: Insulation of flanged joints on horizontal pipelines. 1 - Insulation mat, 2 - Insulation jacket, 3 - Supporting structure, 4 - Insulation fastener, 5 - Tube rivet with fastening core.

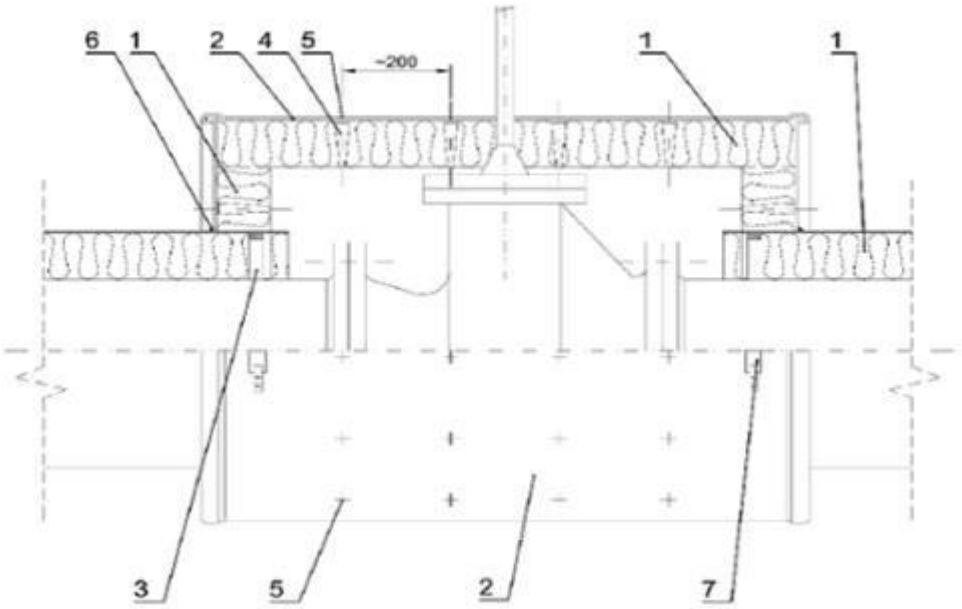

Figure 3.12.4, Flanged valve insulation on horizontal pipework. 1 - Insulation mat, 2 - Insulation jacket, 3 - Supporting structure, 4 - Insulation fastener, 5 - Tube rivet with fastening core, 6 - Sealing with silicone putty, 7 - Cap lock.

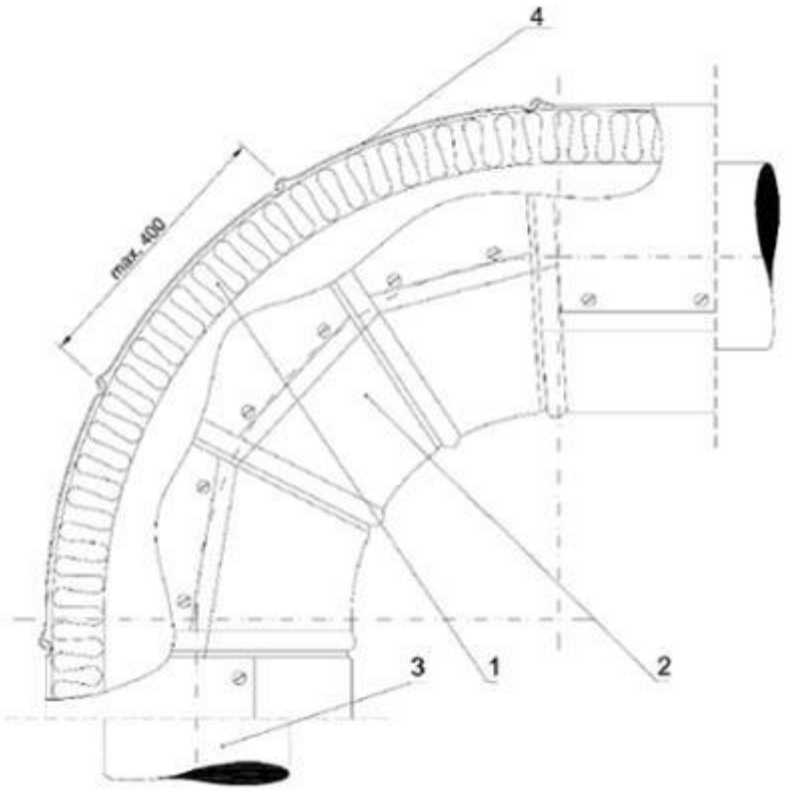

Figure 3.12.5: Elbow insulation. 1 - Insulation mat, 2 - Knee casing segment, 3 - Support pipe, 4 - Insulation casing jacket.

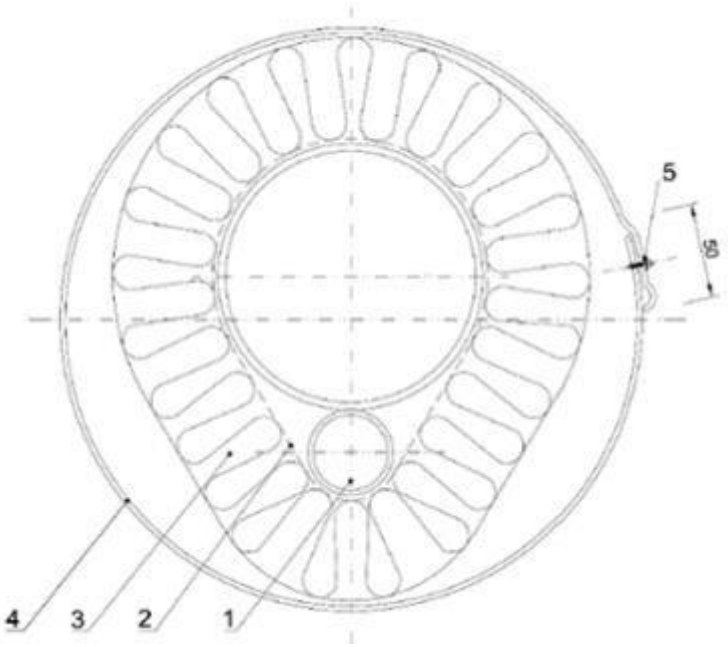

Figure 3.12.6: Insulation of the pipeline with heating cable. 1 - Heating cable, 2 - Galvanised wire mesh, 3 - Insulation mat, 4 - Insulation jacketing, 5 - Self-tapping stainless steel screw.

D. REGULATIONS AND STANDARDS

- EN ISO 1461- Zinc coatings applied to steel and cast iron products by immersion.
- EN ISO 12944-2 - "Paints and varnishes - Corrosion protection of steel structures by protective paint systems.
- EN ISO 8501-1 - "Preparation of steel substrates prior to the application of paints and similar products.

3.13. DOCUMENTATION

The scope of documentation set out in the following subsections is an example of the set of documents that can be provided by the Manufacturer and/or Designer. The scope of the documentation mandatorily provided for each of the following subsections is defined in each case by the PCC Technical Services - Technical Specialist.

The documentation supplied as part of the design, execution and delivery task is an integral part of the order and its absence or incompleteness will be treated as a failure to meet the requirements in accordance with the order or delivery.

Each piece of equipment delivered to the PCC or assembled on the installation must have a set of documents necessary for its safe and correct operation.

3.13.1. DESIGN DOCUMENTATION

The detailed design documentation should be prepared in a clear manner, in the Polish language and in the metric system, and should be provided for each branch separately, in the number of 2 copies in paper form, 1 copy in electronic form, and should include (the design prepared according to the template documents - appendix to the SDT mechanical branch):

- P&ID (with details of equipment, piping and fittings - tech. No.., DN diameters, insulation, heating, etc.).
- 3D models in CAD format with the possibility of activating individual components/systems.
- Technical description of equipment and apparatus.
- Technical data sheets for equipment and apparatus.
- Material specifications of the installation and its components (pipes, fittings, flanges, bolts, etc.).
- Site plans (including existing plant components).

- Installation drawings of plant, equipment and fittings (including fittings and apparatus).
- Isometrics with material specifications and marking of connections, supports and slings.
- Strength calculations:
    a) analytical calculation of pipe wall thickness,
    b) analytical calculation of shaped components (bends, tapers, tees, bottoms).
- Flange connection calculations (gasket selection according to PCC SUT-M standard).
- Calculation of pipe bore weakness (if any).
- Analysis of the stress distribution in the pipework and the impact of piping effects on the tanks and other equipment of the proposed installation.
- Analysis of the impact of the newly designed installation on the existing pipework.
- Analysis of the impact of rotating equipment on pipework (analysis of pipeline vibrations caused by rotating equipment).
- Calculations for the selection of safety devices (safety and breather valves).
- Durability calculations for components (especially components subject to corrosion, cracking, creep, abrasion).
- Calculation and selection of insulation.
- Performance characteristics of energy flow devices(efficiency, power ,efficiency , pressure/compression, NPSH).
- Analysis of the impact of new facilities and installations relative to existing facilities.

During the selection and design of surveillance equipment, the possibility of failure must be reasonably anticipated, so calculation methods must take into account a sufficient safety margin, which translates into:

- the permissible stresses must be limited by safety factors that completely eliminate the possibility of danger,
- the design pressure must be higher than the maximum allowable working pressure, taking into account the hydrostatic pressure when the vessel is filled with the working medium,
- if there is more than one working volume, the partition must be designed for the highest pressure,
- the design temperature must be below the lowest permissible operating temperature by at least 5°C, and at least 10°C higher than the maximum permissible operating temperature.

3.13.2. AS-BUILT DOCUMENTATION

The as-built documentation should be prepared taking into account changes and deviations from the design documentation and confirmed by "AS BUILD" (in red with date of change). As-built documentation must be provided in a clear manner, in Polish and in the metric system, and should be provided for each branch separately. As-built documentation shall be provided in 2
copies in paper form and 1 copy in electronic form (on a labelled CD or on a
pendrive and made available on the PCC's internal electronic drive).

3.13.3. DELIVERYAND QUALITY

DOCUMENTATION FOR THE PUMP

The complete documentation (technical, operational and quality) with the delivery of the pump must include at least:

1) Declaration of conformity according to the Machinery Directive 2006/42/EU.
2) Operating instructions in Polish (including: storage, assembly, commissioning, operation and maintenance instructions, troubleshooting procedures).
3) Assembly drawing of the pump including full parts list (A3 drawing format).
4) Full parts specification (part numbers, technical data and other necessary data).
5) Assembly drawing of the entire pump unit (A3 drawing format).
6) Dimensions on the drawings must be given in the metric system.
7) A technical data sheet (data sheet), with details of the specific pump supplied:
    a) type and serial number of the pump,
    b) manufacturer's details and type of other components (motor, coupling, mechanical seal) with the supply of technical documentation (OMM) for these components,

c) for pumps that will have capacity control by means of a frequency converter, the performance characteristics should include several curves - at least for minimum, nominal and maximum frequency,
d) type and quantity of lubricants and frequency of replacement/lubrication,
e) the scope of maintenance and overhaul, together with the specification of parts and duration,
f) the weight of the pump, motor and foundation frame,
g) the position of the centres of gravity of all the units,
h) permissible forces and torques on spigots.

8) Documentation of the manufacturing process and the tests and examinations carried out - inter alia, certificates / approvals (including material approvals for the pressurised components) and performance curves (H [m] / Q [m3/h]; P [kW] / Q [m3/h]; Eta [%] / Q [m3/h]; NPSH[m] / Q [m3/h]) with the operating point for the nominal and minimum efficiency for the impeller diameter used.
9) Test bench vibration measurement certificate (ISO 10816).
10) With the delivery of the pump, 2 (two) copies of the documentation in hard copy and 1 (one) set of documentation in electronic version (on a labelled CD or on a pendrive) must be provided.

CONVEYORS

The complete documentation (technical, operational and quality) with the delivery of the conveyor must include at least:

1) Declaration of conformity according to the Machinery Directive 2006/42/EU.
2) Operating instructions in Polish (including: installation, commissioning, operation and maintenance instructions, troubleshooting procedures).
3) Assembly drawing with complete parts list (A3 drawing format).
4) Detailed drawings of the housing/conveyor frame including minimum wall thicknesses of the components.
5) Manufacturing drawings of drums and rollers (sheaves).
6) Detailed drawings of bunkers/loading/unloading silos.
7) Manufacturing drawings of other components that are not standardised (e.g. guards, ladders and operating platforms, pulley supports).
8) Full parts specification (part manufacturers' part numbers and other necessary data).
9) In the case of conveyor elements which additionally have chemical/abrasive coatings on the wear side, additionally information on the type of coating used together with the dimensions.
10) Technical conditions of execution and acceptance.
11) Dimensions on the drawings must be given in the metric system.
12) Data sheet, including at least:
    a) type and serial number of the conveyor,
    b) capacity, speed, maximum load,
    c) details of the manufacturer and type of the other main components included in the conveyor (working element: belt/chain, geared motors, buckets, drums, safety systems, correcting rollers, scrapers) together with the supply of technical documentation (OMM) for these elements,
    d) scope of maintenance and overhaul with specification of parts and intervals,
    e) permissible forces and moments for bolted connections,
    f) type and quantity of lubricants and frequency of replacement/relubrication,
13) Documentation of manufacture and testing carried out - certificates / approvals (including material approvals and testing of anti-corrosion coatings).
14) With the delivery of the conveyor, 2 (two) hard copies of the documentation shall be provided and 1 (one) set of documentation in electronic version (on a labelled CD or on a pendrive).

FANS

The complete documentation (technical, operational and quality) with the delivery of the fan must include at least:

1) Declaration of conformity according to the Machinery Directive 2006/42/EU.
2) Operating instructions in Polish (including: storage, assembly, commissioning, operation and maintenance instructions, troubleshooting procedures).
3) Assembly drawing of the fan with complete parts list (A3 drawing format).
4) Full parts specification (part numbers, technical data and other necessary data).
5) Assembly drawing of the entire unit (A3 drawing format).
6) Dimensions on the drawings must be given in the metric system.

7) A technical data sheet with data on the specific fan supplied:
    a) type and serial number of the fan,
    b) manufacturer's details and type of other components (motor, clutch), including supply of documentation
    technical data (OMM) for these components,
    c) for fans that will have capacity control by means of a frequency converter, the energy performance curves should include several curves - at least for minimum, nominal and maximum frequency,
    d) type and quantity of lubricants and frequency of replacement/relubrication,
    e) the scope of maintenance and overhaul, together with the specification of parts and duration,
    f) weight of fan, motor and foundation frame,
    g) the position of the centres of gravity of all the units,
    h) permissible forces and torques on spigots.
8) Documentation of the manufacturing process as well as examinations and tests carried out - inter alia, certificates / approvals (including material approvals for the pressurised components) and energy performance curves (P [kW] / Q [m3/h]; Eta [%] / Q [m3/h];) with the operating point for the nominal and minimum capacity in terms of the impeller diameter used.
9) Test bench vibration measurement certificate (ISO 10816).
10) With the delivery of the fan, 2 (two) copies of the documentation in hard copy and 1 (one) set of documentation in electronic version (on a labelled CD or on a pendrive) must be provided.

GEARED MOTORS

The complete documentation (technical, operational and quality) with the delivery of the gearmotor must include at least:

1) Declaration of conformity according to the Machinery Directive 2006/42/EU.
2) Operating instructions in Polish (including: installation, commissioning , operation and maintenance instructions , troubleshooting procedures).
3) Assembly drawing with complete parts list (A3 drawing format).
4) Full parts specification (part manufacturers' part numbers and other necessary data).
5) Dimensions on the drawings must be given in the metric system.
6) Data sheet, including at least:
    a) type and serial number of the gearmotor,
    b) ratio value, maximum and minimum speeds, permissible torque,
    c) scope of maintenance and overhaul with specification of parts and duration,
    d) permissible forces and moments for bolted connections,
    e) type and quantity of lubricants and frequency of replacement/relubrication
7) Documentation of manufacture and testing carried out - certificates / approvals (including material approvals and
testing of anti-corrosion coatings).
8) With the delivery of the gearmotor, 2 (two) copies of the documentation in hard copy and 1 (one) set of documentation in electronic version (on a labelled CD or on a pendrive) must be provided.

AGITATORS

The complete documentation (technical, operational and quality) with the delivery of the agitator must include at least:

1) Declaration of conformity according to the Machinery Directive 2006/42/EU.
2) Operating instructions in Polish (including: installation, commissioning , operation and maintenance instructions , troubleshooting procedures).
3) Assembly drawing with complete parts list (A3 drawing format).
4) Full parts specification (part manufacturers' part numbers and other necessary data).
5) Dimensions on the drawings must be given in the metric system.
6) Data sheet including at least:
    a) type and serial number of the agitator,
    b) scope of maintenance and overhaul with specification of parts and duration,
    c) permissible forces and moments for bolted connections,
    d) type and quantity of lubricants and frequency of replacement/relubrication
7) Documentation of manufacture and testing carried out - certificates / approvals (including material approvals and testing of anti-corrosion coatings).
8) Agitator movement test protocol.

9) With the delivery of the agitator, 2 (two) copies of the documentation in hard copy and 1 (one) set of documentation in electronic version (on a labelled CD or on a pendrive) must be provided.

PRESSURE VESSELS

The complete documentation (technical, operational and quality) with the delivery of the pressure equipment must include at least:

1) Declaration of conformity according to the Machinery Directive 2014/68/EU.
2) Operating instructions in Polish (including: instructions for storage, assembly, commissioning, operation and maintenance, horizontal and vertical transport).
3) Assembly drawing with full component specifications (minimum A3 drawing format) and dimensions.
4) Structural drawing of non-standard components e.g. sieve bottom connections to the roller or tubes, baffles, sight glasses, etc.
5) Full parts specification (part numbers, technical data and other necessary data).
6) Drawings for welded, bolted, threaded, reamed connections.
7) Specification of heat treatment if applicable.
8) Strength calculations with compilation of data for calculations (minimum thickness, nominal, corrosion allowance, stress strength, hardness, etc.), or a list of the minimum design thicknesses and the adopted/applied device and corrosion allowance.
9) Flange connection calculations.
10) Indication of permissible loads on spigots and jacket mounting brackets (if any).
11) Nameplate drawing.
12) Technical conditions of execution and acceptance.
13) Dimensions on the drawings must be given in the metric system.
14) Data sheet containing permissible forces and torques on spigots.
15) If safety devices (safety valves/safety plates or breather valves) are included in the delivery of the vessel, a selection of these devices in accordance with Section **3.7.4 SAFETY VALVES** and a report on settings and acceptance must be provided.
16) If other equipment or accessories are included in the delivery, technical documentation (OMM) for these components must be provided.
17) Documentation of the manufacturing and of the examinations and tests carried out:
    a) records of examinations and tests carried out (non-destructive tests, hydraulic tests, testing of anti-corrosion coatings, spark tests for chemical-resistant linings, etc.),
    b) technology sheets for manufacturing processes (WPS, bending sheets, etc.),
    c) for tanks with chemical-resistant liners, certification that the chemical-resistant lining has been manufactured and tested,
    d) material certificate(s) 3.1 in accordance with EN 10204.
18) With the delivery of the vessel, 2 (two) copies of the documentation in hard copy and 1 (one) set of documentation in electronic version (on a labelled CD or on a pendrive) must be provided.

NON-PRESSURE VESSELS

The complete documentation (technical, operational and quality) with the delivery of the pipeline for the non-pressure or low-pressure vessel must include at least:

1) Certificate of construction test and acceptance pressure test.
2) Operating instructions in Polish (including: instructions for storage, assembly, commissioning, operation and maintenance).
3) Assembly drawing with full component specifications (minimum A3 drawing format) and dimensions.
4) Structural drawing of non-standard components e.g. sieve bottom connections to the roller or tubes, baffles, sight glasses, etc.
5) Full parts specification (part numbers, technical data and other necessary data).
6) Drawings for welded, bolted and threaded connections.
7) Specification of heat treatment if applicable.
8) Strength calculations with compilation of data for calculations (minimum thickness, nominal, corrosion allowance, stress strength, hardness, etc.), or a list of the minimum design thicknesses and the adopted/applied device and corrosion allowance.
9) Flange connection calculations.

10) Indication of permissible loads on spigots and jacket mounting brackets (if any).
11) Nameplate drawing.
12) Technical conditions of execution and acceptance.
13) Dimensions on the drawings must be given in the metric system.
14) Data sheet containing permissible forces and torques on spigots.
15) If safety devices (safety valves/safety plates or breather valves) are included in the delivery of the vessel, a selection of these devices in accordance with Section **3.7.4 SAFETY VALVES** and a report on settings and acceptance must be provided.
16) If other equipment or accessories are included in the delivery , technical documentation (OMM) for these components must be provided.
17) Documentation of the manufacturing and of the examinations and tests carried out:
    a) records of examinations and tests carried out (non-destructive tests, hydraulic tests, examination of anti-corrosion coatings, spark testing for chemical-resistant linings, etc.),
    b) technology sheets for manufacturing processes (WPS, bending sheets, etc.),
    c) for vessels with chemical-resistant liners, certification that the chemical-resistant lining has been manufactured and tested,
    d) material certificate(s) 3.1 in accordance with EN 10204.
18) With the delivery of the vessel, 2 (two) copies of the documentation in hard copy and 1 (one) set of documentation in electronic version (on a labelled CD or on a pendrive) must be provided.

In the case of non-pressure or low-pressure vessels subject to full or limited supervision **by the UDT , the technical documentation must also include the technical requirements specified by the technical supervision for this type of vessel, together with the delivery of a report of the construction test and acceptance pressure test signed by the UDT inspector.**

In the case of plastic vessels, a Statement by the vessel manufacturer on the service life (according to 3.5.1.B) is required.

FILTERS AND FILTRATION EQUIPMENT

The complete documentation (technical, operational and quality) with the delivery of the filter/filter unit must include at least:

1) Declaration of conformity according to the Machinery Directive 2014/68/EU.
2) Operating instructions in Polish (including: instructions for storage, assembly, commissioning, operation and maintenance).
3) Assembly drawing with full component specifications (minimum A3 drawing format) and dimensions.
4) Structural drawing of non-standard components e.g. sieve bottom connections to the roller or tubes, baffles, sight glasses, etc.
5) Data sheet including at least:
    a) type and serial number,
    b) pressure PS, temperature TS,
    c) capacity,
    d) weight of empty and full apparatus,
    e) permissible forces and torques on spigots.
    f) technical specification of the filtering elements - number/type of filtering elements used, as well as their material and degree of filtration,
    g) the type of gaskets used and their dimensions,
6) Full parts specification (part numbers, technical data and other necessary data).
7) Drawings for welded, bolted and threaded connections.
8) Specification of heat treatment if applicable.
9) Strength calculations with compilation of data for calculations (minimum thickness, nominal, corrosion allowance, stress strength, hardness, etc.), or a list of the minimum design thicknesses and the adopted/applied device and corrosion allowance.
10) Indication of permissible loads on spigots and jacket mounting brackets (if any).
11) Flange connection calculations.
12) Nameplate drawing.
13) Technical conditions of execution and acceptance.
14) Dimensions on the drawings must be given in the metric system.

15) If safety devices (safety valves/safety plates) are included in the delivery, a selection of these devices in accordance with Section 3.7.4 SAFETY VALVES and a record of settings and acceptance must be provided.
16) If other equipment or accessories are included in the delivery, technical documentation (OMM) for these components must be provided.
17) Documentation of the manufacturing and of the examinations and tests carried out:
    a) records of examinations and tests carried out (non-destructive tests, hydraulic tests, testing of anti-corrosion coatings, spark tests for chemical-resistant linings, etc.),
    b) technology sheets for manufacturing processes (WPS, bending sheets, etc.),
    c) for filters with chemical-resistant liners, certification that the chemical-resistant lining has been manufactured and tested,
    d) material certificate(s) 3.1 in accordance with EN 10204.
18) With the delivery of the vessel, 2 (two) copies of the documentation in hard copy and 1 (one) set of documentation in electronic version (on a labelled CD or on a pendrive) must be provided.

HEAT EXCHANGERS

The complete documentation (technical, operational and quality) with the delivery of the heat exchanger must include at least:

1) Declaration of conformity according to the Machinery Directive 2014/68/EU.
2) Operating instructions in Polish (including: instructions for storage, assembly, commissioning, operation and maintenance).
3) Assembly drawing with full component specifications (minimum A3 drawing format) and dimensions.
4) Structural drawing of non-standard components e.g. sieve bottom connections to the roller or tubes, baffles, sight glasses, etc.
5) Data sheet including at least:
    a) type of exchanger and serial number,
    b) medium type A / B,
    c) pressure PS and temperature TS for space A / B,
    d) space capacity A / B,
    e) heat exchange surface area [m2],
    f) heat exchanger output [kW],
    g) empty and full weight,
    h) spigot orientation,
    i) permissible forces and torques on spigots.
    j) specification of the 'thermal ' plates - the number of plates used together with the material of the plates, the thickness and the type of seals used,
    k) flow diagram,
    l) heat exchanger selection sheet for heat transfer, taking into account flow, temperature and pressure for operating (nominal) and maximum parameters,
6) Full parts specification (part numbers, technical data and other necessary data).
7) Drawings for welded, bolted and threaded connections.
8) Specification of heat treatment if applicable.
9) Strength calculations with compilation of the data for the calculations (minimum thickness, nominal thickness, corrosion allowance, stress strength, hardness, etc.), or a list of the minimum design thicknesses and the corrosion allowance adopted/applied to the device.
10) A-indication is mandatory for plate heat exchangers.
11) Flange connection calculations.
12) Indication of permissible loads on spigots and jacket mounting brackets (if any).
13) Nameplate drawing.
14) Technical conditions of execution and acceptance.
15) Dimensions on the drawings must be given in the metric system.
16) If safety devices (safety valves/safety plates) are included in the delivery, a selection of these devices in accordance with Section 3.7.4 SAFETY VALVES and a record of settings and acceptance must be provided.
17) If other equipment or accessories are included in the delivery, technical documentation (OMM) for these components must be provided.
18) Documentation of the manufacturing and of the examinations and tests carried out:
    a) records of examinations and tests carried out (non-destructive tests, hydraulic tests, testing of anti-corrosion coatings, spark tests for chemical-resistant linings, etc.),
    b) technology sheets for manufacturing processes (WPS, bending sheets, etc.),

c) in the case of exchangers with chemical-resistant linings, certification of manufacture and testing of the chemical-resistant lining,
d) material certificate(s) 3.1 in accordance with EN 10204.

19) With the delivery of the vessel, 2 (two) hard copies of the documentation shall be provided and 1 (one) set of documentation in electronic version (on a labelled CD or on a pendrive).

PROCESS PIPING

The complete documentation (technical, operational and quality) with the delivery of the process pipeline must include at least:

1) A Declaration of Conformity according to Pressure Directive 2014/68/EU, and for pipelines exempted from the Pressure Directive on the basis of Article 4.3, a Performance Certificate must be provided.
2) Operating instructions in Polish (including: instructions for storage, assembly, commissioning, operation and maintenance).
3) Isometric drawing with component specifications (A3 drawing format) and dimensions.
4) Construction drawing of non-standard piping components (not covered by harmonised standards to the Pressure Directive).
5) Full parts specification (part numbers, technical data and other necessary data).
6) Drawings for welded, bolted, threaded, soldered connections.
7) Drawings of supports and slings.
8) Specification of heat treatment if applicable.
9) Strength calculations with compilation of data for calculations (minimum thickness, nominal, corrosion allowance, stress strength, hardness, etc.), or a list of the minimum design thicknesses and the adopted/applied device and corrosion allowance.
10) Flange connection calculations.
11) Nameplate drawing.
12) Technical conditions of execution and acceptance.
13) Dimensions on the drawings must be given in the metric system.
14) If safety devices (safety valves/safety plates) are included in the pipeline delivery, a selection of these devices in accordance with Section 3.7.4 SAFETY VALVES and a record of settings and acceptance must be provided.
15) If other equipment or accessories are included in the delivery , technical documentation (OMM) for these components must be provided.
16) Documentation of manufacture and testing carried out - certificates / approvals (including material approvals 3.1
according to EN10204:
    a) records of examinations and tests carried out (non-destructive tests, hydraulic tests, testing of anti-corrosion coatings, spark tests for chemical-resistant linings, etc.),
    b) technology sheets for manufacturing processes (WPS, bending sheets, etc.),
    c) for pipelines with chemical-resistant liners, certification that the chemical-resistant lining has been manufactured and tested,
    d) material certificate(s) 3.1 in accordance with EN 10204.
17) With the delivery of the pipeline, 2 (two) hard copies of the documentation shall be provided and 1 (one) set of documentation in electronic version (on a labelled CD or on a pendrive).

SUPPORTS AND SLINGS

The documentation required with the delivery of supports and/or slings is defined in EN 13480-3 Annex N (Documentation of Supports).

BARRIER FITTINGS (CUT-OFF)

The complete documentation (technical, quality) with the delivery of the barrier fittings should include:

1) Declaration of conformity in accordance with 2014/68/EU.
2) Material certificate 3.1 in accordance with EN 10204.
3) Leak test report in accordance with EN 12266.
4) Diagram of the operating temperature-pressure relationship.
5) Manufacturer's warranty and catalogue card.
6) TA-LUFT Certificate.

BACKFLOW FITTINGS

The complete documentation (technical, quality) with the delivery of the backflow fittings should include:

1) Declaration of conformity in accordance with 2014/68/EU.
2) Material certificate (approvals) 3.1 in accordance with EN 10204.
3) Leak test report in accordance with EN 12266.
4) Valve opening pressure.
5) Diagram of the operating temperature-pressure relationship.
6) Manufacturer's warranty and catalogue card.

BREATHER VALVES

The complete documentation (technical, quality) with the delivery of the breather valves should include:

1) Material certificate (approvals) 3.1 in accordance with EN 10204.
2) Diagram of the operating temperature-pressure relationship.
3) Graph of valve opening pressure vs. throughput.
4) Manufacturer's warranty and catalogue card.

SAFETY VALVES

The complete documentation (technical, quality) with the delivery of the safety valves should include:

1) Declaration of conformity in accordance with 2014/68/EU.
2) Certified technical data, necessary for capacity calculations.
3) Material certificate (approvals) 3.1 in accordance with EN 10204.
4) Valve selection sheet.
5) Diagram of the operating temperature-pressure relationship.
6) Manufacturer's warranty and catalogue card.

4. INDEX OFDOCUMENTED INFORMATION

The documentation listed under point 5 "List of forms" shall be forwarded by the contractor/designer to the person responsible for the project, each time the project is designed. The retention and archiving period is indefinite and the documents are kept in the archive by the technical specialist for records.

5. INDEX OF FORMS

No.	Link	Document name
1		PBT.00.04.F01 Air cooler
2		PBT.00.04.F02 Column
3.		PBT.00.04.F03 Agitator
4.		PBT.00.04.F04 Static agitator
5.		PBT.00.04.F05 Dosing pump
6.		PBT.00.04.F06 Centrifugal pump
7.		PBT.00.04.F07 Vertical centrifugal pump
8.		PBT.00.04.F08 Vacuum pump, liquid ring compressor
9.		PBT.00.04.F09 Piston pump
10.		PBT.00.04.F10 Centrifugal pump
11.		PBT.00.04.F11 Reactor
12.		PBT.00.04.F12 Centrifugal compressor
13.		PBT.00.04.F13 Reciprocating compressor
14.		PBT.00.04.F14 Fan
15.		PBT.00.04.F15 Blower
16.		PBT.00.04.F16 Storage tank

17.		PBT.00.04.F17 Tank
18.		PBT.00.04.F18 Ejector
19.		PBT.00.04.F19 Filter
20.		PBT.00.04.F20 Bag filter
21.		PBT.00.04.F21 Silo
22.		PBT.00.04.F22 Bucket conveyor
23.		PBT.00.04.F23 Screw conveyor, feeder
24.		PBT.00.04.F24 Belt conveyor, feeder
25.		PBT.00.04.F25 Dehydrator
26.		PBT.00.04.F26 Safety plate
27.		PBT.00.04.F27 Flame arrester
28.		PBT.00.04.F28 Gearbox
29.		PBT.00.04.F29 Electric motor
30.		PBT.00.04.F30 Shell and tube heat exchanger
31.		PBT.00.04.F31 Heat exchanger
32.		PBT.00.04.F32 Heat exchanger, spiral
33.		PBT.00.04.F33 List of apparatus and equipment
34.		PBT.00.04.F34 Overview of insulation of process equipment and apparatus
35		PBT.00.04.F35 List of fittings and materials
36.		PBT.00.04.F36 List of storage tanks
37.		PBT.00.04.F37 List of conveying machines
38.		PBT.00.04.F38 List of pipelines
39.		PBT.00.04.F39 Pipeline detail statement
40.		PBT.00.04.F40 Overview of pipe insulation
41.		PBT.00.04.F41 Spare parts list
42.		PBT.00.04.F42 List of spigots
43.		PBT.00.04.F43 Non-return valve

6. INDEX OF RELATED DOCUMENTS

No.	Link	Document name
1.		PZB.PR.03.I02 Marking method for pipelines, chemical storage areas, sampling sites, containers and storage tanks for chemicals
2.	NA	DIRECTIVE 2014/68/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 May 2014 on the harmonisation of the laws of the Member States relating to
3.	NA	DIRECTIVE 2014/29/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on the harmonisation of the laws of the Member States relating to
4.	NA	DIRECTIVE 2006/42/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2006 on the approximation of the laws of the Member States relating to
5.	NA	DIRECTIVE 2014/34/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on the harmonisation of the laws of the Member States on protective devices and systems intended for use
6.	NA	DIRECTIVE 2014/35/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on the harmonisation of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits

7.	NA	DIRECTIVE 2014/30/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on the approximation of the laws of the Member States relating to
8.	NA	DIRECTIVE 2014/33/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on the approximation of the laws of the Member States relating to lifts
9.	NA	DIRECTIVE 2005/88/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 14 December 2006 on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use
10.	NA	REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL (EU) 2021/821 of 20 May 2021 setting up a Union regime for the control of exports, brokering, technical assistance, transit and transfer of dual-use items
11.	NA	REGULATION (EU) No. 388/2012 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 April 2012 setting up a Community regime for the control of exports, transfer,
12.	NA	REGULATION OF THE MINISTER OF DEVELOPMENT of 11 July 2016 on requirements for pressure equipment and pressure equipment assemblies
13.	NA	REGULATION OF THE MINISTER OF ECONOMY of 18 September 2001 on on the technical conditions for technical supervision to be met by non-pressurised and low-pressure vessels intended for the storage of flammable liquids
14.	NA	REGULATION OF THE MINISTER OF ECONOMY of 31 March 2008 on the technical requirements of technical supervision that should be met by non-pressure and low-pressure vessels intended for the storage of flammable liquids
15.	NA	REGULATION OF THE MINISTER OF ECONOMY of 16 April 2002 on the technical requirements of technical supervision that should be met by non-pressure and low-pressure tanks intended for the storage of toxic and corrosive materials
16.	NA	REGULATION OF THE MINISTER OF TRANSPORT, CONSTRUCTION AND MARITIME ECONOMY of 24 September 2013 on the technical requirements of technical supervision that should be met by devices for filling and emptying
17.	NA	REGULATION OF THE MINISTER OF TRANSPORT, CONSTRUCTION AND MARITIME ECONOMY of 24 September 2013 on the technical requirements of technical supervision that should be met by devices for filling and emptying
18.	NA	REGULATION OF THE MINISTER OF ECONOMY of 13 June 2011 on essential requirements for machines
19.	NA	REGULATION OF THE MINISTER OF ECONOMY of 20 December 2005 on the essential requirements for machines and safety elements
20.	NA	REGULATION OF THE MINISTER OF ECONOMY of 30 October 2002 on minimum requirements for occupational health and safety in the use of machinery by employees during work
21.	NA	REGULATION OF THE MINISTER OF DEVELOPMENT AND TECHNOLOGY of 17 December 2021 on the technical conditions of technical supervision in the scope of operation of
22.	NA	REGULATION OF THE MINISTER OF DEVELOPMENT of 6 June 2016 on requirements for protective equipment and systems intended for use in potentially explosive atmospheres
23.	NA	REGULATION OF THE MINISTER OF DEVELOPMENT of 3 June 2016 on requirements for lifts and their safety components for lifts
24.	NA	REGULATION OF THE MINISTER OF ENTERPRISE AND TECHNOLOGY of 30 October 2018 on the technical conditions of technical supervision in the scope of operation of certain short-range transport devices

25.	NA	REGULATION OF THE MINISTER OF ECONOMY of 28 December 2001 on the technical requirements of technical supervision that lifting devices should meet
26.	NA	REGULATION OF THE MINISTER OF ECONOMY of 5 August 2005 on occupational health and safety during work involving exposure to noise or mechanical vibrations
27.	NA	REGULATION OF THE MINISTER OF ECONOMY of 28 May 2007 on the essential requirements for devices used outdoors in terms of noise emission into the environment
28.	NA	ACT of 22 January 2021 on technical supervision
29.	NA	ACT of 15 April 2021 on conformity assessment and market surveillance systems
30.	NA	ACT of 22 November 2019 on electromagnetic compatibility
31.	NA	ACT of 31 March 2021 Energy Law
32.	NA	WUDT/UC/2003 PRESSURISE EQUIPMENT Rev. 1 October 2003 voluntary technical specifications for manufacturing and upgrading pressure equipment
33.	NA	WUDT/ZB/2009 SUSTAINABILITY AND LOW PRESSURE VESSELS Rev. 2 November 2009 technical specifications for general requirements for the manufacture and retrofitting of non-pressure and low-pressure vessels

7. REVISION HISTORY

NOTE! Any changes are highlighted in blue in the body of the document.

No.	Revision date	Revision initiated by	Revision applies to	Section
1.	18.04.2025	Technical Specialist Mechanic (Karol Lenczyk) Senior Technical Specialist Mechanic (Krzysztof Janik)	1. Addition of a table of contents. 2. Records update. 3. Addition of provisions for the anchoring of machinery and equipment. 4. Addition of provisions for anchoring of pressure and non-pressure vessels and equipment. 5. Addition of provisions regarding requirements for hydraulic closures. 6. Addition of provisions regarding lubricants.	 3.4; 3.5; 3.6; 3.7; 3.8; 3.9; 3.11; 3.13 3.4.6 3.5.5 3.7.5 3.12
2.	15.05.2023	Mechanical and Technical Specialist (Bartłomiej Orkisz)	1. Removal of PCC PU Sp. z o.o. from the scope of the document (absorption of the company by PCC Rokita). 2. Addition of PC BD Sp. z o.o. to the scope of the document. 3. Records update. 4. Addition of Section 3.7.7 on expansion joints and Section	2 2 3.3 3.7.7; 3.13.2
3.	21.06.2022	Mechanical and Technical Specialist (Bartłomiej Orkisz)	Records update.	26.
4.	21.06.2021	Mechanical and Technical Specialist (Bartłomiej Orkisz)	1) API standards have been added to the pump selection guidelines. 2) The definition of the maximum permissible pressure has been updated and value designations	3.4.1 3.5

			the manufacture of the vessel . 3) Definitions of highest and lowest permissible temperature have been added . 4) A definition of a low pressure vessel has been 5) Added provision for corrosion allowances should be taken into account in the case of steel pipelines.	3.5 3.5.1 3.6.1
5.	19.02.2021	Mechanical and Technical Specialist (Bartłomiej Orkisz)	A provision has been added in the "Technical Equipment Standard - SUT M Mechanical Engineering" (pdf version) on the selection of gaskets in section 1.1.6 (Plate Heat Exchangers) and in section 6.1 the provisions on painting of pipe	3.3
6.	03.04.2020	Technical Specialist (Michal Attinger)	Update of Table 3 under 'A Metal', section 3.3.3.2 Material and construction requirements.	3.3.3.2.
7.	05.08.2019	Technical Specialist	Transfer of General Director's Order No. 05/2016 of 08 February 2016 on the introduction of the Technical Equipment Standard at PCC Rokita SA Mechanical Branch to instruction PBT.I04 Technical Equipment Standard - SUT M.	Entire document