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1 Purpose and scope

This specification describes the basic requirements for pneumatic systems to be proven by the supplier.

2 Application in NIDEC plant

This specification is part of the requirement system of production equipment for all relevant plants of Nidec Motors & Actuators (NMA). It has to be implicated for purchasing equipment in the same way as for maintenance and repair inside of plants.
This subsection, "Pneumatics," to the “Production Equipment - General Delivery Requirements” defines the basic requirements on operating equipment in the area of pneumatics.

The requirement specification handed over at the time of the request for quotation/order applies to the supplier in its entirety.
The requirements in the version in effect on the date of ordering must be implemented for the order as a mandatory requirement. This documented is updated at irregular intervals to reflect the state of the art.

Note for informational purposes:
In the main document, the relevant DIN EN ISO 4414 is referred to as the applicable document in the list of standards.

3 Level of confidentiality

This NIDEC standard specification is assessed as “public”.

4 Requirements

4.1 Safety requirements

- The machine must not damage itself in any operating state or in emergency situations (emergency-stop, loss of power or pressure).
- If there are disruptions during the normal production sequence, it must be possible for a controlled home position movement to move the pneumatic systems into a defined position and in this way to easily bring them back into operation.
- Elements raised by pneumatics with a possible risk of uncontrolled falling must be provided with an additional safety device (mechanical block, appropriate valve protective element, etc.) that takes over the holding function if the pressure is lost.
- During a home position movement guided by the PLC also out from faulty operating situations, collision-free movement must be guaranteed by suitable measures.
- If there is a drop in pressure, parts that are located in a gripper hand must not be lost.

4.2 Component selection

- All components of a system must be selected or designed such that they ensure safety during operation; they must operate within the limits specified in their design when the system is operated in the intended manner. Components must be selected or designed such that they can operate reliably in all intended applications of the system, and in all cases of foreseeable misuse of the system. Special attention must be paid to the reliability of the components that can cause dangers in case of failure or malfunction.

- The loads on the pneumatic axes must be designed to be at least 15% below the max. permissible loads.
- The preferred components list specifies the permitted suppliers and components that are to be used. Components that are not listed must be agreed upon with the purchaser.

4.3 Application requirements

- All parts of the system must be designed for, or otherwise protected against, pressures that exceed the maximum operating pressure of the system or any part of the system, or the rated pressure of a specific component.
- The preferred protection devices against impermissibly high pressure are one or multiple pressure limiting valves that limit the pressure in all parts of the system. Alternative equipment, for example, pressure regulators, may be used as long as they meet the application requirements.
- Systems must be designed, built, and set up to minimize pressure shock and pressure amplification. Pressure shock and pressure amplification must not cause any danger.
- Pressure loss or critical dropping of the pressure must not cause any danger to persons.
- Blowing air always requires corresponding suctioning.
- See DIN EN ISO 11688-1 for the design of low-noise machines and systems. Limit values are to be adhered to.
- Leaks are not permissible.
- The exact pressure and vacuum operations are to be adjusted by means of a separate, lockable pressure reducer and safeguarded by means of a pressure switch with window monitoring and displacement monitoring; direct display of the value on the sensor.
- To ensure sufficient volume flow, the air consumption quantities must be computed in the system concept and delivered to Nidec in order to be able to correctly dimension the supply lines.
- Pneumatic components are to be used with the manufacturer's coloring; an additional coating is not permissible. For the selection of the hoses, the color is to be selected corresponding to their function (see chapter 8.5)

5 System concept

5.1 Circuit diagrams

The contractor must deliver a circuit diagram as per DIN ISO 1219-2 that reflects the system design, marks the components, and ensures that the requirements defined in section 4 are complied with. The necessary release of the processing status (concept, preliminary acceptance, final acceptance, etc.) is realized using the circuit diagram

The following information must be provided on the circuit diagram or together with the circuit diagram:

- marking of all equipment parts with designation, catalog number, serial or drawing number and name of manufacturer;
- the outer diameter, wall thickness, and material of the pipes and the nominal diameter and designation of the hoses;
- the diameter of the piston and rod of each cylinder, the stroke length, the maximum force and required speed computed for the intended use;
- the pressure setting values;
- the type of screens, filters and filter elements;

- the sequencing diagram, e.g., a figure showing the cycle period and data, or text, or both, describing the work actions performed, including the function of the electrical and mechanical control elements and drives involved;
- unambiguous representation of each circuit contained in a control block; if border lines are used, they may only enclose symbols of components that are installed in or on the control block;
- unambiguous statement of the function of each drive in each orientation
- the size, type and location of pressure measuring, sample taking, and ventilation points in the circuit;
- marking of all component or control block connections (as marked on the component or control block);
- the expected volumetric flow and the highest and lowest pressure of the cooling medium, and the highest feed temperature of the cooling medium;
- marking of all electrical signal transducers with the same designation.

5.2 Energy efficiency

- Energy efficiency must be taken into account in the overall design:
- The air consumption of actuators must be kept as small as possible (smaller diameter)
- The distance between valves and actuators, as well as also the hose diameter, should be as small as possible
- The air consumption must be determined and indicated
- For large cylinder strokes, the more sensible system (in comparison with possible electrical cylinders) must be selected
- For more than 2 positions of the actuators, the optimum must be selected also in a comparison with electrical cylinders

5.3 Marking

5.3.1 Components

The following details must be attached and displayed in a permanent, cleaning agent-resistant and easily readable manner:

- Name and short address of the manufacturer,
- Manufacturer's product marking,
- Rated pressure,
- Pictograms as per DIN ISO 1219-1 with correct marking of all connections.

If this is not possible for space reasons, an appropriate sign must be attached next to the component.

Cylinders that **cannot be depressurized** in the event of servicing must be marked with the label "CAUTION pressurized air". The connecting hoses of corresponding cylinders must be **red**.

5.3.2 Components in a system

A unique item number and/or item letter must be allocated to each component. This unique item number must be used for identifying the component in all circuit diagrams, bills of materials, and storage plans.

Connections:

All connections, load connections, test points, bleeding points, and drain points (e.g., container drain) must be marked clearly and unmistakably. The marking must match the details in the circuit diagram.

If components have a connection marking assigned by the manufacturer, a supplementary marking that matches the circuit diagram must be attached when the components are installed in the machine or system.

All connections must adhere to DIN EN ISO 6149 for threaded connections and screwed sockets or ISO 6162 or ISO 6164 for four hole flange connections.

5.3.3 Valve actuators

- Non-electrical actuators and their functions must be clearly and permanently marked with the same marking that is used in the circuit diagram.
- Electrical actuators (magnets and their connectors or cables) must be marked with the same marking in the circuit diagram and in the pneumatic circuit diagram.

5.3.4 Installed parts

Built-in valves and other functional parts (nozzles, covers, shuttle valves, non-return valves, etc.) that lie within a control block, a connection plate, a damper or a threaded connection must all be marked next to the corresponding installation opening. If installation spaces lie below components, the marking must be provided, if possible, next to this component and tagged with the word "HIDDEN."

5.4 Installation, use, and maintenance

5.4.1 Exchanging components

To facilitate maintenance work, steps must be provided or the components must be installed such that their removal from the system for maintenance purposes does not require, if possible, extensive disassembly of adjacent components.

5.4.2 Maintenance requirements

The system must be designed and built such that the components are accessible and can be safely set up, maintained, and repaired. Pneumatic components, including the pipe system, must be accessible and attached such that they do not interfere with setup and maintenance work. Special attention must be paid to the layout of the system/components that require regular maintenance. These devices must not be covered. They must also not be installed or arranged in secured areas.

5.4.3 Lifting equipment

Devices for lifting with lifting equipment are to be provided for components and assemblies with a mass greater than 15 kg. Appropriate clearances must be provided for the lifting devices.

5.4.4 Installation of components

Components must be installed such that they are accessible without risk from a safe working position (e.g., from the floor or from a work platform).

Fitted height of the lower edge at least 0.6 m. Fitted height of the upper edge max. 1.8 m over the base.

5.5 Use of standard parts

The contractor must use commercially available parts (splined keys, bearings, packing materials, seals, washers, plugs, fasteners, etc.) and part configurations (dimensions of the shaft and keyway, connection sizes, fasteners, connection patterns, etc.) that have been manufactured in line with existing national and higher-ranking standards and that ensure a uniform designation.

5.6 Seals

The sealing materials must be compatible with the pressure media, the materials of neighboring components, their operating conditions, and the environmental conditions.

The component design must support the maintenance and replacement of the seals.

5.7 Specifications for maintenance and for operation

The contractor must provide the necessary specifications for maintenance and for operation that

- clearly describe the startup and shutdown procedures, contain all necessary instructions to depressurize the system and designate any parts of the system that are not depressurized by the normal pressure release device
- describe adjustment procedures
- indicate the external lubricating points and the type of required lubricant and the inspection intervals
- describe the maintenance method for special assemblies
- designate all pneumatic components. These parts must be marked with the part number of the component manufacturer and the designation provided in the standard
- list the recommended spare parts and wear parts.

6 Compressed air preparation

6.1 System interfaces and supply

- The pneumatic system must have a maintenance unit at an easily accessible station position assembled on a mounting plate and must contain the following components/assemblies:
  - Manual stop valve (or stop-cock) with bleeding
  - Automatic stop valve that closes the compressed air supply in the home position when the system is switched off at the control system
  - Filter with automatic condensate trap
  - Pressure regulator with manometer
  - Starting valve (preventing uncontrolled movement and to protect persons/MCK)
  - Oiler (if required)
  - For connecting the supply unit to the on-site supply, a ½" quick-connect coupling is usually provided; for larger systems, a fixed installation is realized according to project-specific specifications (3/4", 1", etc.)
  - T-piece connectors are provided at the factory for closing off compressed air
  - The supply unit must be designed for a prepared compressed-air quality according to ISO 8573-1.
  - Dust content 0.1 mg/m3
  - Water content pressure dew point 3°C
  - Residual oil content 0.01 mg/m³

6.2 System monitoring

- The pneumatic system must be designed and monitored during operation in such a way that its proper function is ensured at the installation location at 5 bars (network supply pressure) with sufficient volume flow.
- Starting at a pressure > 8 bar downstream of the supply unit of the production equipment, a warning message must be output to the operator.

6.3 Filtering

6.3.1 Filters and traps

Filtering must be performed to remove harmful substances from the system. The filter elements must be either easily replaceable without allowing contaminating particles to enter into the system or must be easy to clean.

6.3.2 Degree of filtering

The degree of filtering must match the requirements for components and the environmental conditions. Here, the most sensitive requirements within the system must be taken into account for the entire system.

6.4 Filter pressures

6.4.1 Pressure drop

If a degraded filter performance could cause a dangerous situation, this must be clearly displayed.

6.4.2 Pulsation

Filters should not be arranged in lines in which they are exposed to pressure pulses, because this could negatively affect the efficiency of the filtering.

6.4.3 Provisions for maintenance

Filters and traps must be arranged as close as possible to the device being protected. They must be easy to access and must have sufficient space for replacing the elements.

6.4.4 Water trap

Automatic water traps are preferably used to drain water from air filters and traps. If necessary, the water traps must be protected from frost damage by suitable measures.

6.5 Pressure control

- All working pressures must be adjustable using pressure reducers, and secured mechanically against improper adjustment.
- A directly allocated plain text label with target, minimum, and maximum values is to be attached permanently to each manometer.
- Each adjustable pressure must be able to be read easily using a manometer.
- Pressure-regulating valves must be lockable if not defined otherwise.

6.6 Lubrication

6.6.1 Lubricants

Compatibility
If required, suitable lubricants should be recommended for use in the components.

The lubricants must be compatible with all components, elastomers, plastic pipes, and hoses in the system.

Lubricants must not enter into components that do not require lubrication, unless specified by the contractor.

Handling precautions
Detailed information on dangers that could be produced by the specified lubricants must be submitted by the contractor to the purchaser. The information must contain:

- hygiene requirements
- toxicity
- risk of suffocation in the event of a fire
- biological resistance
- method for disposal

6.6.2 Compressed-air oiler

Use of compressed-air oilers
Compressed-air oilers are to be used only with agreement of the specialist department.

Arrangement of the compressed-air oilers
Compressed-air oilers must be installed in the vicinity of the device to be lubricated and must be accessible for maintenance.

Filling the compressed-air oiler
Compressed-air oilers must be constructed so that the oiler can be refilled without dismantling the pipe system.

It must be possible to fill the oilers from the working plane.

6.7 Burst protection

6.7.1 Non-metallic containers for compressed-air maintenance units

Persons must not be put in danger by damage to non-metallic containers for filters, traps, filter regulators, and oilers, whose product from the rated pressure in Pa (bar) and volume of the empty container in liters is not greater than 100kPa x l (1 bar x l). The container must be provided for use as burst protection.

6.7.2 Metallic containers for compressed-air maintenance units

To prevent possible damage to plastic containers under certain environmental conditions or if burst protection cannot be attached, metal containers must be used.

6.8 Vacuum generation

If decentralized vacuum generation is required, the supply must be formed as a function of the vacuum volume and pressure.

- Use of an oil-free vacuum pump with suitable liquid trap for larger and cyclically frequent consumption volumes. A filter is to be installed upstream of the vacuum source (pump or on-site supply).
- Use of controlled and monitored injector system, if necessary, of high vacuum and lower volumes. For a sufficient vacuum, the compressed air is to be switched off.

7 Valve systems

- Pressure control valves: The pressure control valves must be equipped with a secondary bleeding port and a manometer for displaying the secondary pressure. The target pressure is to be indicated in the circuit diagram.
- Flow control and shut-off valves: Only flow regulators are permitted for flow control and shut-off valves.
- Pneumatic valves in the production cell are assembled on a valve carrier system and are controlled by means of the bus line to the device.
- Pneumatic valves are to be assembled into valve clusters.
- If different, variant-specific pressures are required in the process modules, a servo regulating valve loaded by means of the control system must be provided.

7.1 Selection

The valve type must be selected taking the intended function, leak tightness, and resilience to foreseeable mechanical and environmental influences into consideration. Machine suppliers must not make any modifications to valves.

7.2 Installation

7.2.1 General information

The following must be taken into consideration when installing valves:

- easy ability to disconnect the valve from the lines or connections to which it is connected,
- ease of access for replacement, repair, or adjustment,
- the influence of gravity, impact, or vibrations on the valve,
- sufficient space for tightening and loosening screws, bolts, and electrical connections,
- precautions to prevent incorrect installation of valves,
- position as close as possible to the matching drives without negatively affecting accessibility,
- directional control valves with pistons must be installed horizontally with respect to the piston position.

7.2.2 Valves for pipe installation

Valves for pipe installation must be connected with connecting apertures in line with DIN EN ISO 6149-1.

7.2.3 Valves for plate connections

Valves for plate connections must have protections

- to prevent undesirable effects caused by back pressure,
- to be able to use control blocks or connection plates with mounting surfaces. Chain and us connection plates are to be mounted securely and without stress.

7.2.4 Built-in valves

Installation spaces must be kept clear accordingly for built-in valves in control blocks.

7.2.5 Pressure-limiting valves

Pressure-limiting valves must be installed such that they cannot become ineffective. The pressure range of the valves must be matched to the specified system pressure.

7.3 Multiple connection plates

- If three or more valves with common compressed air supply are used close to each other, one multiple connection plate should be used.
- The evenness and roughness of the attachment surface must match the valve manufacturer's recommendations.
- Multiple connection plates must not deform at the operating pressure and temperature causing components to malfunction.
- Multiple connection plates must be mounted rigidly and securely.

7.3.1 Flow channels

The flow diameters of flow channels must at least match the cross section of the matching components.

Flow channels in control blocks, including cast and drilled holes, must be free from harmful foreign bodies such as scale, burrs, chips, etc. capable of obstructing the volumetric flow and provoking malfunctions and/or damage to components, including seals. Before maintenance, the flow channels must be flushed in order to remove foreign bodies.

7.4 Electrical actuation

- Solenoid valves must also be able to be operated manually (manual override in case of an emergency), whereby the possibility of accidental operation must be eliminated.
- Pneumatic valves must be combined if possible in valve blocks and connected by means of a bus system.

7.5 Type plates with symbols

Type plates must be fastened on the valves such that the switching positions shown match the actuation direction of the switching device.

7.6 Pressure limitation

If there is the possibility that pressures could be produced that exceed the rated pressures of the components or the pipe system, pressure-limiting valves must be arranged in an area within reach of the component or the pipe.

7.7 Rapid ventilation

All pneumatic system air outlets must be equipped with noise reduction systems (only low-noise nozzles and covers). They cannot be mounted at head height. Plate dampers are to be used for valve terminals.

8 Pipe systems

8.1 General information

Pneumatic hoses and connections from the same manufacturer are to be used.

- Pneumatic hoses are preferably housed in pipe ducts.
- If bundling equipment is used (drag chains, pipe ducts, hoses), a reserve of 20% must be maintained.
- Lines must not be pinched by cable ties; a better design would be to use appropriate rubber grommets.
- Keep the number of pneumatic lines on the robot axes (pipe ducts) and movement axes as small as possible. Minimum 15% reserve for feedthroughs in the center sleeve.
- The routing of pipes and hoses on the machine plate (without pipe ducts) is impermissible.
- For long feed lines, a plug connection must be provided in the transition between moving and fixed pipes.
- The entire range of motion must be taken into account for the routing from fixed system parts to moving system parts, so that kinks are not produced in the hoses and other elements are not damaged.
- The dimensioning of hose cross sections is realized with reference to the conditions of required working air volume, pipe length, transition cross sections to connecting points and permissible movement period for optimizing the cycle period and energy consumption.

8.2 Requirements on pipes

Materials, bending radii, bending properties, etc., must be compliant with relevant national and international standards.

In areas at risk of corrosion (emulsions, condensation, chemicals), seamless pipes made from stainless steel must be used.

If plastic pipes are used, these must not be negatively affected by the media used in the system. If the use of plastic pipes is not suitable or is impermissible, this must be specified by the purchaser. Plastic pipes must not be used for pressures above the rated pressure stated by the manufacturer. They must not be exposed to any loads that exceed the manufacturer's recommendations.

Flexible plastic pipes calibrated on the outside must be installed such that

- the required minimum length to avoid kinks and tensile stress on the pipe is present during operation. The bending radius of the pipe must not be below the recommended minimum bending radius;
- rotation of the pipe during installation and during operation, e.g., due to a blocked rotational movement, must be reduced to a minimum;
- they are arranged or protected so as to avoid abrasion of the pipe surface;
- they are protected against thermal radiation,
- they are not routed in bundles, but in parallel and separately (e.g., in cable drag chains)

8.3 Holder and pipe systems

- Pipes must be securely fastened at both ends, and at intervals along their length, by suitably designed holders (see DIN EN ISO 4414).
- The holders must not damage the pipes or reduce the flow rate.

- If the equipment is made from individual assemblies, the end pieces must be constructed as bulkhead pipe fittings or distributors.

8.4 Foreign bodies

The entire pipe system must be free from foreign bodies (e.g., splinters, burrs, grinding dust, weld beads, rust and scales, etc.). Before bringing into operation, the pipe system must be cleaned.

8.5 Hose colors

- Lines that are pressurized even after the station has been switched off by means of the main valve: **red**
- Actuator feed-in: **blue**
- Actuator return line: **black**
- Test lines: **yellow**
- Vacuum lines: **silver**
- Control lines: **natural (transparent)**

8.6 Quick-release coupling

To avoid danger, quick-release couplings must be selected such that they automatically seal off the pressure media on the supply side in the uncoupled state.

9 Actuators

- If the supply pressure is switched off, pressurized actuators must be either equipped with forced bleeding or marked accordingly with notices.
- Pneumatic drives must be equipped with position monitoring. This includes the working position and the home position if it cannot be reliably guaranteed that the production processes will continue without these positions are reached.

9.1 Pneumatic motors and rotary drives

9.1.1 Protection

Pneumatic motors and rotary drives must be mounted such that they are protected against foreseeable damage, or they must be fitted with appropriate protection devices.

Rotating shafts and couplings must be provided with protections to rule out injury to persons.

9.1.2 Mounting

The mounting of the pneumatic motors and rotary drives on or with respect to their driven units must be sufficiently stiff to be able to permanently maintain an appropriate alignment and transfer the torque. Protection from unintentional end and lateral forces must be provided. The mounting must be designed so that:

- they are easily accessible for maintenance;
- operating cycles, temperature fluctuations, or pressure loads do not impair the shaft alignment;
- occurring axial and radial loads lie within the limit values specified by the manufacturer of the pneumatic motors;
- drive couplings and fastening parts can permanently transfer the maximum torque occurring on the pneumatic motors and rotary drives in all intended operating conditions.

- the transfer or amplification of torsional vibration is limited by sufficiently damped couplings.
- The startup and braking torques, the effect of load changes, and the kinetic energy of the moved load must be taken into account for the use of pneumatic motors and rotary drives.

9.1.3 Speed

The speed/rotational angle speed must not exceed the maximum value stated in the manufacturer documentation.

9.2 Pneumatic cylinder

9.2.1 Suitability for use

Pneumatic cylinders must be designed and selected for the following properties:

- The stroke length, load and cylinder mounting must be considered to avoid bending and kinking of the piston rod in any stroke position.
- In applications in which there can be changes in the load direction or other external loads can occur, the maximum foreseeable load or pressure peak must be taken into consideration when designing the cylinder and its mounting.
- The mounting type must take all loads into consideration. NOTE: Pressure specifications for cylinders might only relate to the load-carrying capacity of the pressurized housing and not to the mounting type. Please consult with the cylinder manufacturer or supplier for details.
- The cylinder must not be used as an end stop. The stroke must be limited by a damping stop; the end positions must be effectively damped.
- All components added to a pneumatic cylinder, or connected to it, must be fastened so as to resist working loose due to impact, vibrations, or similar. It must be ensured that foreign media cannot penetrate into the components.
- Suitable steps must be taken to prevent the rated pressures being exceeded due to pressure ratios (e.g., due to differences in the piston surface). A design like this must always be agreed upon with the specialist department of Nidec in the concept release phase.
- Each pneumatic cylinder must be designed in such a way that the occurring counterforce is no greater than 70% of the actual cylinder piston force. Cylinders that are pressurized or under external loading after an energy failure must be secured against uncontrolled movements, e.g., with clamping cartridges. The risks produced from this situation must be listed separately in the risk assessment.

9.2.2 Mounting and alignment

Pneumatic cylinders must be mounted so that the load acts axially on the center line of the cylinder.

Lateral forces must be absorbed by appropriate guides.

The mounting must keep the following as small as possible:

- Impermissible deformation of the pneumatic cylinders due to compressive or tensile loading;
- Introduction of lateral or bending loads
- Swiveling speeds in spigot assembly that necessitate external lubrication

The mounting of the cylinder must not be statically overdetermined.

Pneumatic cylinders must not be deformed by mounting surfaces and expansion due to temperature changes must be possible. The mounting of pneumatic cylinders must allow simple access for maintenance, adjusting of the dampers, and the complete replacement of the pneumatic cylinders.

Fastening bolts for pneumatic cylinders and add-on parts must be designed and fitted such that they absorb all foreseeable forces. Bolts must be free from shearing forces.

Pneumatic cylinders with a base mount must have other options for absorbing shear forces than via the fastening bolts. The fastening bolts must be able to absorb tilting moments.

9.2.3 End position damping

Overloading of the internal end position damping as a consequence of excessive mass deceleration must be avoided, e.g., through the use of additional external shock absorbers.

9.2.4 Stroke end stops

Adjustable external stroke end stops must be secured against displacement by suitable means.

9.2.5 Piston stroke

The piston stroke must be designed to be greater than the required stroke.

9.2.6 Piston rods

The material and surface treatment of piston rods must be selected such that wear, corrosion, and foreseeable damage are avoided.

Piston rods must be protected against foreseeable damage such as notching, scratching, corrosion, material deposits, etc. Covers can also be used.

For assembly purposes, the flats for piston rod ends with internal or external thread must be chosen such that standard wrenches can be used.

9.2.7 Maintenance

Piston rod seals, sealing assemblies, and other wear parts must be easily replaceable in the installed state of the cylinder.

9.2.8 Single-action cylinders

The air outlet aperture of single-action cylinders must be designed and/or arranged such that the displaced leakages can be emitted without endangering persons. Intake of soiling must be prevented.

9.2.9 Air connection

Where possible, pneumatic cylinders must be installed such that the connections are at the top. The connections must be easily accessible.

9.3 Pneumatic/hydraulic cylinders (power packs from TOX)

- For the hydraulic part of the cylinders, the annexes in the TLV hydraulics document apply.
- The mounting for these cylinders must be designed for the max. operating force of the system being used.
- The system is to be used only as an actuator WITHOUT control properties. Accordingly, a connection to a work tool with a separate control must be built.

10 Accumulator tank

All compressed air accumulators are subject to EC directive 97/23/EC (pressure equipment directive) or comparable requirements of the guidelines in the country where the purchasing production site is located.

The corresponding test documentation (e.g., test certificate for the accumulator and the safety valves) must be supplied with the accumulator. Compressed-air tanks and other auxiliary air tanks within a system must also take into account the following aspects:

- Sufficient capacity to ensure the required pressure stability;
- Layout, production, and marking according to the applicable rules;
- Possibility for correct pressure measurement, if necessary;
- Possibility for water drainage and protection from freezing, if the installation position allows condensed water to collect;
- Bleeding or pneumatic cutoff, if the air supply is switched off. If the tank can be cut off, a manual breather valve must be provided and an appropriate service warning sign must be permanently mounted on the tank.

10.1 Marking

The following markings are to be attached permanently to the compressed air accumulator:

- Year of manufacture,
- Capacity in liters,
- Manufacturer's serial number,
- Permissible temperature range in degrees Celsius.

The following information must be provided on a sign next to the compressed air accumulator:

"CAUTION – system contains compressed air accumulator. The system must be depressurized before starting maintenance work."

11 References / related documents

DIN EN ISO 4414

12 Specific remarks

None

13 Changes made since the previous edition

First edition with new number