CONSTRUCTION CODES AND REGULATIONS

AUTOMATION SYSTEMS

SNiP 3.05.07-85

OFFICIAL EDITION

THE USSR STATE COMMITTEE FOR CONSTRUCTION
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CONTENTS

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DEVELOPED by *GPI Projectmontazhavtomatika* under the USSR Ministry of Installation and Special Construction Works [*M. L. Vitebski,* Project Head; *V. F. Valetov, R. S. Vinogradova, Y. V. Grigoriev, A. Y. Minder, N. N. Pronin*].

SUBMITTED by the USSR Ministry of Installation and Special Construction Works.

PREPARED FOR APPROVAL by *Glavtekhnormirovanie* Under the USSR Ministry of Construction [*B. A. Sokolov*].

Upon the introduction of SNiP 3.05.07-85 "Automation Systems," SNiP III-34-74 "Automation Systems" shall become null and void.

AGREED with the USSR Ministry of Health (Letter of December 24, 1984, No. 122-12/1684-4), and with Gosgortekhnadzor (USSR State Mining Safety Inspectorate) (Letter of February 8, 1985, No. 14-16/88).

With an Amendment developed by GPKI Proektmontazhavtomatika Under the USSR Ministry of Installation and Special Construction Works and approved by Decree No. 93, dated October 25, 1990, of USSR Gosstroy. Amended clauses are marked with asterisk (*).

This Regulations shall be applied with taking into account approved amendments to construction codes and regulations and State Standards, as published in the Newspaper… *[the editor's not:the rest is missing in the document submitted for translation]*

USSR State Committee for Construction (USSR Gosstroi)	Construction Codes and Regulations	SNiP 3.05.07-85
	Automation Systems	In place of SNiP III-34-74

These Regulations apply to the execution and acceptance of the installation and start-up of automated process and equipment control systems, carried out during construction, expansion, reconstruction or re-equipment of enterprises, buildings and structures of national economy.

These Regulations do not apply to the following equipment installation: the automation systems of special facilities (nuclear plants, mines, enterprises manufacturing or storing explosives or isotopes), central signaling and interlocking systems of railroad transport, communication and signaling systems, fire-fighting and smoke-removal automation systems, instruments using isotope-tracer techniques, instrumentation and automation built into machines and other equipment supplied by manufacturers.

The Regulations establish requirements to an organization, execution and acceptance of the installation of devices, automation hardware, control panels and boards, the computing and controlling equipment of automated process control systems, associated wiring and piping, etc. and to the installed automation system start-up.

The Regulations shall be observed by all agencies and enterprises involved in automation system design, installation or start-up.

1. GENERAL PROVISIONS

1.1. Automation system installation and start-up shall be carried out in accordance with the requirements of these Regulations, SNiP 3.01.01-85, SNiP III-3-81 SNiP III-4-80 and branch regulatory documentation approved in accordance with the procedure established by SNiP 1.01.01-82.*

1.2. Automation system installation of shall be carried out in accordance with the approved project, cost estimates, work execution plan and manufacturers' technical documentation.

1.3. When the work utilizes large-unit methods for construction and modular methods for process equipment and pipeline installation in accordance with SNiP 3.05.05-84, automation devices and hardware shall be installed during site assembly of process lines, units and modules.

1.4. The general contractor shall involve an agency responsible for automation system installation (hereinafter referred to as an installation subcontractor) in the consideration of the construction management plan as far as the following is concerned: installation operations utilizing the large-unit or modular techniques, the arrangement of rooms and premises specifically designed for the automation systems (control and operator rooms, equipment halls, spaces for sensors, etc.), their construction and turnover for installation operations ahead of time.

1.5.* Automation system installation and start-up shall be accompanied by the execution of a set of documents in accordance with obligatory Appendix 1 to these Regulations.

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1.6.* Completion of individual testing carried out in accordance with Section 4 of these Regulations and signing the installed equipment acceptance documents, as contained in the technical documentation, shall be considered as the completion of the automation system installation.

2. PREPARATION FOR THE INSTALLATION ACTIVITIES

GENERAL PROVISIONS

2.1. Automation system installation shall be preceded by the preparation phase in accordance with SNiP 3.01.01-85 and these Regulations.

2.2. As part of general logistics and technical preparation, the following shall be defined by the customer and agreed upon with the general contractor and the installation subcontractor:

(a) the terms of equipping the facility with devices, automation hardware, articles and materials supplied by the customer for use in process units (modules), assemblies or lines;

(b) the list of devices, automation hardware, the computing and controlling equipment of automated process control systems to be installed under the supervision of the manufacturer's installation personnel;

(c) the transportation conditions of control panels and board modules, device assemblies and pipe blocks to the place of installation.

2.3. Subcontractor pre-installation activities shall include the following:

(a) obtaining the technical documentation;

(b) development and approval of a work execution project;

(c) accepting construction and process readiness of the site for the automation system installation;

(d) accepting equipment (devices, automation hardware, control boards and panels, the equipment and computing sets of computerized production process control systems), articles and materials from the customer and the general contractor;

(e) site assembly of units and modules;

(f) implementation of occupational- and fire-safety measures in accordance with the applicable standards and regulations.

2.4. Prior to commencing the installation activities, the installation subcontractor, the general contractor and the customer shall resolve the following issues:

(a) advanced construction progress of special premises for automation systems, so that the individual testing of process lines, units and modules, being commissioned, will be accomplished in time;

(b) definition of process lines, units and modules and their turnover dates for individual testing upon completion of automation system installation;

(c) provision of necessary workshops, utility and office spaces with heating, lighting and telephone communication;

(d) use of the general contractor's major construction machinery (vehicles, handling machinery, etc.) for transportation of oversized units and modules (control board and panel modules, pipe blocks, etc.) from installation subcontractor workshops to the construction site and their positioning in accordance with the project;

(e) development of guidelines and procedures for lifting oversized units to the assigned positions and moving them through the installation openings;

(f) availability of either temporary or permanent systems for power, water and compressed air supply along with outlets for equipment connection;

(g) in accordance with the project (detailed design), provisions to protect automation devices and hardware, boards, panels, piping and wiring against precipitation, groundwater, low temperatures, pollution and damage, and additionally protect computer hardware against static electricity are to be made .

2.5.* The installation subcontractor shall verify the following in the automation system technical documentation accepted for the execution of the work:

(a) mutual conformity with the process, power, electrical, plumbing and other technical documentation;

(b) tie-ins in the shop drawings of the automation devices and hardware supplied by their manufacturers in a complete set with the process equipment;

(c) high factory and installation readiness of equipment, advanced installation techniques implementation, execution of labor-intensive work in shops;

(d) specification of the piping categories in accordance with recommended Appendix 2;

(e) availability of areas with explosion or fire hazards and their boundaries; supplying the categories, groups and descriptions of explosive mixtures; location and types of separation seals.

(f) availability of documentation for piping installation and testing activities at pressure above 10 MPa (100 kgf/cm^2).

2.6. The construction and process readiness for automation system installation shall be accepted in stages with individual acceptance of separate completed parts of the facility (control and operator rooms, process units, assemblies, lines, etc.).

2.7. Installation subcontractor shall normally deliver articles and materials to the construction site in containers.

SITE ACCEPTANCE FOR INSTALLATION

2.8. Prior to the automation system installation on the construction site and also in the premises designed for that system installation, the construction work stipulated by technical documentation and the Work Execution Plan shall be completed.

The following shall be made in building structures (floors, ceilings, walls, equipment foundations) in accordance with the architectural and construction drawings:

- reference axis and elevation marks;
- mounting of embed pieces (see recommended Appendix 3) for control boards and panels, automation devices and hardware, etc.;
- channels, tunnels, niches, grooves, embedded pipes for concealed wiring, openings for pipes and wiring with ducts, sleeves, frames and other embedded structures;
- platforms for servicing the automation devices and hardware;
- installation openings for oversized units and modules.

2.9. Construction and finishing work shall be completed, formwork, construction scaffolding and platforms that are not required for automation system installation shall be dismantled, debris are to be removed in the special premises and rooms designed for automation systems (see clause 1.4) and in the parts of production premises and rooms designed for the automation devices and hardware installation.

2.10. Special premises and rooms designed for automation systems (see clause 1.4) shall have permanent heating, ventilation, lighting and, if necessary, air-conditioning as well as glazing and door locks. The temperature in these rooms and premises shall be maintained no lower than 5°C.

No construction work or plumbing is allowed in these rooms and premises after they have been turned over for the automation system installation.

2.11. In addition to the requirements of clauses 2.9 and 2.10 above, air-conditioning systems shall be installed in and all dust shall be thoroughly removed from rooms and premises designed for the installation of the computing and controlling equipment of automated process control systems. Painting these kind of rooms and premises with lime whitewash is not allowed. The windows shall be equipped with means of protection against direct sunlight (louvers or blinds).

2.12. Prior to commencing the automation system installation on the process, plumbing and other kinds of equipment the following shall be mounted on pipelines:

- embedded and protective structures for the primary instrument installation. Embedded structures designed for the installation of pressure, flow-rate and level gage intakes shall terminate with stop valves;
- automation devices and hardware built into piping, air ducts and process vessels (constrictions, volume and rate meters, rotameters, flow-type transducers of flow meters and concentration meters, level gages of all types, control members. etc.).

2.13. The following operations shall be carried out on the site in accordance with the process, electrical, plumbing and other working drawings:

- laying trunk pipelines and distribution networks with heat-carrier takeoffs to the heated devices of automation systems and lines for the heat carrier;
- installing equipment and laying main and distribution networks to supply the automation devices and hardware with electric power and energy carriers (compressed air or gas, oil, steam, water, etc.) and lines for the energy carrier removal;
- laying a sewerage network for receiving fluids from the venting piping of automation systems;
- making a grounding network;
- installation of automatic fire extinguishing systems.

2.14. The grounding network of the computing and controlling equipment of automated process control systems shall conform to the equipment manufacturer requirements.

2.15. The acceptance of the facility shall be documented with a report on readiness for the automation system installation the in accordance with obligatory Appendix 1.

TURNOVER OF EQUIPMENT, ARTICLES, MATERIALS AND TECHNICAL DOCUMENTATION FOR INSTALLATION ACTIVIITIES

2.16. Equipment, materials and technical documentation shall be turned over for installation work in accordance with the “Rules on Capital Construction Contracts” requirements as approved by the USSR Council of Ministers and the “Regulations on Relations Between General Contractors and Subcontractors” as approved by the USSR Gosstroi and Gosplan (the USSR Planning Committee under the USSR Council of Ministers).

2.17.* Equipment, materials and articles presented for acceptance shall conform to the technical documentation, State Standards and specifications and be accompanied with the appropriate certificates, characteristics sheets or other quality documentation. Tubes, fittings and joints for oxygen piping shall be degreased, which shall be noted in documentation confirming the execution of this operation.

During the acceptance process, equipment, materials and articles shall be checked for completeness of delivery, the absence of damage or flaws, the integrity of their finish and special coating, the security seals intactness, availability of special tools and accessories supplied by manufacturers.

Piping parts rated for pressures above 10 MPa (100 kgf/cm^2) shall be turned over for installation as installable articles (pipes, fittings, connections, metalware, etc.) or as complete assembly units in accordance with the specifications of detail drawings. Pipe openings shall be closed with stoppers. Articles and assembly units with weld seams shall be accompanied by documents confirming the seam quality in accordance with SNiP 3.05.05-84.

Any equipment flaws or defects discovered in the course of acceptance shall be corrected in accordance with the “Rules on Capital Construction Contracts.”

Equipment, articles and materials shall be turned over for installation as complete sets in a process line, unit or module or in rooms and premises specifically designed for automation systems (see clause 1.4), in accordance with the technical documentation.

Any equipment with the expired shelf-life stipulated by the applicable State Standard (GOST) or specifications may be accepted for installation only after its pre-installation examination, fault correction and testing. The results of this work shall be entered in appropriate logs, characteristics sheets or other accompanying documentation specified in clause 2.17 of these Regulations, or a report shall be drawn to document the performance of this work.

The equipment, articles and materials accepted for installation shall be stored in accordance with the applicable requirements of GOSTs or specifications.

3. INSTALLATION ACTIVITIES EXECUTION

GENERAL PROVISIONS

3.1. Automation systems shall be installed in accordance with the technical documentation, taking into account manufacturers' requirements to the devices, automation hardware, computing and controlling equipment, established by specifications or operating manuals of this equipment.

The installation work shall be performed by industrialized methods, using small-scale mechanization, power tools and accessories to reduce manual labor.

3.2. Automation system installation of shall be carried out in two stages:

The First Stage shall include the following: preparation of assembly structures, units and modules and wiring components and their assembly outside the installation area; checking the presence of embedded structures, openings and holes in building structures and parts, the presence of embedded structures and intakes in the process equipment and pipelines and the presence of a grounding network; embedding tubes and blind ducts for concealed wiring into the foundations, walls, floors and ceilings that are constructed; demarcation of the routes and the installation of supporting and bearing structures for wiring and piping, actuators and instruments.

The Second Stage shall include the following: laying the piping and wiring on the installed structures; installation of control boards, panels and cabinets, automation devices and hardware; connecting the wiring and piping to them; and individual testing.

3.3. Once installed, the automation devices and hardware of the electric branch of the State System of Instrumentation (SSI), boards, panels, structures, wiring and piping that are to be grounded in accordance with the technical documentation shall be connected to the grounding circuit. The components of equipment and computing sets shall be connected to a special grounding circuit when the manufacturers request this.

STRUCTURE INSTALLATION

3.4. The areas for the installation of the automation devices and hardware structures shall be marked out in accordance with the technical documentation, taking into account the following requirements:

- during the installation process should not be damaged concealed wiring and piping or reduced the strength or fire resistance of the building structures (bases);
- any potential mechanical damage to the installed automation devices and hardware shall be prevented.

3.5. The supporting structure spacing at the vertical and horizontal parts of wiring, piping and pneumatic cables shall be established by the technical documentation.

3.6. The supporting structures shall be parallel to each other and either parallel with or perpendicular (depending on the structure type) to the building structures (bases).

3.7. The supporting structures of wall-mounted devices shall be perpendicular to the walls. Floor-mounted racks shall be checked with a level or a plumb line. When two or more racks are mounted close together, they shall be fixed to each other by detachable joints.

3.8. Ducts and troughs shall be installed as large units preassembled in shops.

3.9. Ducts and troughs shall be fastened to their supporting structures and to one another by welding or by bolted joints.

In case of bolted joints, the joints shall ensure tight connection of the ducts and troughs to one another and to their supporting structures and reliable electric contact.

In case of welded joints, burning through the ducts and troughs is not allowed.

3.10. The positioning of the ducts after their installation shall preclude accumulation of moisture inside the ducts.

3.11. The ducts and troughs shall have compensating devices at the points where they cross the settlement, expansion or contraction joints of buildings, and in case of their outdoor installation.

3.12. All structures shall be painted in accordance with the instructions given in the technical documentation.

3.13. Channels for the passage of piping and wiring through walls (external and internal) and floors shall be made in accordance with the technical documentation.

PIPING

3.14. These Regulations apply to the installation and testing of automation system piping (impulse, control, supply, heating, cooling, ancillary and venting piping, in accordance with recommended Appendix 3) designed for operation at an absolute pressure from 0.001 MPa (0.01 kgf/cm^2) to 100 MPa (1000 kgf/cm^2).

The Regulations do not apply to the installation of piping inside control boards and panels.

3.15. Automation system piping shall be installed and tested in accordance with the requirements of SNiP 3.05.05-84 and this SNiP.

3.16. Equipment, accessories and techniques used in the installation of piping shall provide for the installation of the following piping and pneumatic cables:

- steel water- and gas-supply pipes in accordance with GOST 3262-75, normal and lightweight, with nominal bores of 8, 15, 20, 25, 40 and 50 mm;
- seamless steel cold-formed pipes in accordance with GOST 8734-75, with outside diameters of 8, 10, 14, 16 and 22 mm and a wall thickness of no less than 1 mm;
- seamless cold- and hot-formed pipes made of corrosion-resistant steel in accordance with GOST 9941-81, with outside diameters of 6, 8, 10, 14, 16 and 22 mm and a wall thickness of no less than 1 mm. Using pipes with outside diameters of 15, 25 and 35 mm for piping rated for pressures above 10 MPa (100 kgf/cm^2) is allowed;
- copper pipes in accordance with GOST 617-72, with outside diameters of 6 and 8 mm and a wall thickness of no less than 1 mm;
- pipes made of aluminum and aluminum alloys in accordance with GOST 18475-82, with outside diameters of 6 and 8 mm and a wall thickness of no less than 1 mm;
- pipes made of low density (high pressure) polyethylene in accordance with the manufacturers' specifications, with an outside diameter of 6 mm and a wall thickness of 1 mm or with an outside diameter of 8 mm and a wall thickness of 1 mm or 1.6 mm;
- heavy pressure pipes made of polyethylene in accordance with GOST 18599-83, with outside diameters of 12, 20 and 25 mm;
- flexible PVC pipes in accordance with the manufacturers' specifications, with inside diameters of 4 and 6 mm and a wall thickness of no less than 1 mm;
- rubber pipes in accordance with GOST 5496-78, with an inside diameter of 8 mm and a wall thickness of 1.25 mm;
- pneumatic and pneumo-electric pipes (pneumatic conduits) with polyethylene tubes in accordance with the manufacturers' specifications (the polyethylene tubes shall have the following dimensions: 6x1; 8x1 or 8x1.6).

The type of piping, depending on the particular properties of conveyed medium, range of the measured parameters, kinds of transmitted signals and distances between connected devices, shall be selected in accordance with the technical documentation.

3.17. Piping shall be laid along the shortest routes between the connected devices, parallel to walls, floors or columns, as far as possible from process and electrical equipment, with a minimum number of turns or intersections, in places accessible for installation and maintenance and without sharp variations in the ambient air temperature, not exposed to heavy heating or cooling, shocks or vibration.

3.18. Pipes used for any purpose shall be laid at a distance from each other that provides for convenience in their installation and use.

In dust-laden areas, piping shall be laid in one tier with a distance from walls and floors sufficient for the mechanical removal of dust.

3.19. The total width of a group of horizontal and vertical pipes fastened to one supporting structure shall not exceed 600 mm, in case of piping accessible for maintenance from one side, or 1200 mm, in case of piping accessible for maintenance from two sides.

3.20. Any piping that contains a medium at a temperature above 60°C and is laid at a height of less than 2.5 m from the floor shall be fenced.

3.21. Any piping, except for piping conveying dry gas or air, shall be laid with a slope providing for the drainage of condensate and the removal of gas (air) and be equipped with devices for their discharge.

The direction of slope and gradient shall conform to the requirements of the technical documentation; should the gradient be not specified in the technical documentation, piping shall be laid with the following minimum gradients: 1:50, in case of impulse lines (see recommended Appendix 3) leading to pressure gages for any static pressure, to diaphragm-type or tube-type draft or pressure gages and to gas analyzers; 1:10, in case of impulse lines leading to steam, liquid, air or gas flow meters and to level regulators, gravity discharge oil lines of hydraulic jet regulators and drainage lines (see recommended Appendix 3).

The gradients of heating pipes (see recommended Appendix 3) shall comply with the heating system requirements. When pipes requiring different gradients are fastened to common structures, they shall be laid with the greatest gradient.

3.22. The technical documentation shall specify measures to compensate for the thermal expansion of the piping. If the technical documentation stipulates the self-compensation of thermal expansion at the piping turns and bends, the documentation shall specify the distances from the turns (bends) at which piping can be fastened.

3.23. Metal piping shall be equipped with U-shaped expansion bends at the points of their passage through the expansion joints of the buildings. The location of the U-bends and their number shall be specified in the technical documentation.

3.24. When piping is laid with a gradient, U-shaped expansion bends, swan-necks and similar devices shall be placed at the highest or the lowest point of the pipe in a position, which prevents the accumulation of air (gas) or condensate in them.

3.25. The minimum headway of outdoor piping shall be no less than 2.2 m in the site areas with foot-traffic only or 5 m at intersections with roads.

3.26. Piping shall be installed so as to ensure the strength and tightness of the piping and of the joints connecting the pipes to each other and to fittings, devices and automation hardware, and to securely fix the piping to the supporting structures.

3.27. Piping shall be fastened to supporting structures with standard fasteners; fastening piping by welding is not allowed. Fastening shall not damage the piping.

3.28. Attaching the piping to the control board external sides or to the automation devices and hardware housings is not allowed.

Fastening the piping to dismountable process equipment at intakes is allowed, but at no more than two places.

Fastening the piping to non-dismountable process is allowed when agreed upon with the customer. In this case, the piping shall have detachable joints at the immediate proximity to the equipment.

3.29. The piping shall be fastened:

- at distances of no more than 200 mm from branch-off points (on both sides);
- on both sides of pipe turns (bends) at distances ensuring the self-compensation of the pipe thermal expansion;

- on both sides of the fittings of settling and other vessels if the fittings and the vessels themselves are not secured; if the connection line length at either side of the vessel is shorter than 250 mm, the pipe shall not be fastened to the supporting structure;
- on both sides of U-shaped expansion bends at a distance of 250 mm from their curves if the U-bends are installed at the points where the piping passes through the expansion joints of the walls.

3.30. The direction of a pipe route shall be normally changed by bending the pipe. Using standard bent components for this purpose is allowed.

3.31. The installation subcontractor shall select the techniques of pipe bending.

Bent pipes shall conform to the following key requirements:

(a) the pipe bent part shall not have wrinkles, cracks, dents, etc.;

(b) the pipe out-of-roundness at the bends shall not exceed 10%.

3.32. The minimum inner curvature radius of the pipe bends shall be:

- for polyethylene pipes bent in a cold state:

  no less than 6 OD for low-density polyethylene, or no less than 10 OD for high-density polyethylene, where OD is the outside diameter;
- no less than 3 OD for polyethylene pipes bent in a hot state;
- no less than 3 OD for plasticized (flexible) PVC pipes bent in a cold state;
- no less than 10 OD for pneumatic cables;
- no less than 4 OD for steel pipes bent in a cold state or no less than 3 OD when bent in a hot state;
- no less than 2 OD for annealed copper pipes bent in a cold state;
- no less than 3 OD for annealed pipes made of aluminum or aluminum alloys, bent in a cold state.

3.33. The pipe connection made during their installation may be either detachable or non-detachable. The elimination of gaps or misalignment between the pipes to be connected, by heating, stressing or bending the pipe is not allowed.

3.34. Piping shall be connected to the embedded pieces (see recommended Appendix 3) of process equipment and pipelines, to any automation devices or hardware and to control boards and panels by detachable joints.

3.35. The detachable connections of piping shall be made with standard threaded joints. In this case, where the piping is made out of stainless steel, aluminum or aluminum alloys, the connection parts shall be specifically designed for these pipes.

3.36. Making pipe joints of any type at U-shaped expansion bends, at the bends or turns of piping, at the points of attachment to supporting or bearing structures, in passages through walls or floors of buildings and in areas not accessible for maintenance in operation is not allowed.

3.37. Pipes shall be joined at a distance of no less than 200 mm from the points of attachment.

3.38. When pipes are joined in piping groups, the joints shall be spaced so as to give room for the use of tools in mounting or dismounting the pipes.

If piping groups are laid in blocks, spacing between detachable joints shall be established in the technical documentation, taking into account the techniques of large-unit installation.

3.39. Where tubes made of rubber or other elastic materials are used to join the piping to automation devices and hardware, the tubes shall cover the full length of the connection adapters and be laid without strains or excessive bending.

3.40. Fittings (valves, cocks, pressure reducers, etc.) installed on piping made of copper, aluminum and plastic pipes shall be rigidly fixed to the supporting structures.

3.41. All piping shall be marked. Marking symbols on the tags shall match the marking of piping given in the technical documentation.

3.42. Protective coatings shall be applied to thoroughly cleaned and degreased surface of piping. The colors of the pipe finishing shall be specified in the technical documentation.

Steel pipes designed for the protection of piping shall be painted on the outside. Plastic tubes or pipes shall not be painted. Pipes made of non-ferrous metals shall be painted only when this is specifically stipulated in the technical documentation.

3.43. When plastic tubing or pneumatic cables are installed, the number of joints shall be minimized by the maximum use of the factory length of the tubing or cable.

3.44. Plastic tubing and pneumatic cables shall be laid on noncombustible structures, without tension, taking into account thermal variations in their length.

Unarmored cables and plastic tubing, in the places of their contact with the sharp edges of metal structures and fasteners, shall be protected with spacers (made of rubber or PVC) extending, on both sides, to a length of 5 mm beyond the edges of the supports or fastening brackets.

Fastening parts shall be positioned so as not to deform the section of the plastic tubing and pneumatic cables.

3.45. Thermal expansion and contraction of plastic tubing shall be compensated by the rational arrangement of movable (free) and fixed (rigid) fasteners and by using bent sections of the piping itself (bends, swan-necks, S-turns, etc.).

3.46. Fixed fasteners that do not permit axial displacement of the piping shall be arranged so as to divide the piping into sections whose thermal expansion and contraction would be independent from that of adjoining sections and self-compensating.

Fasteners at junction boxes, cabinets, boards, etc., and at the middle of sections between two bends shall be rigid.

Movable fasteners shall be used in all other places where axial displacement of pipes, tubes or pneumatic cables is allowed.

3.47. Plastic tubing and pneumatic cables may not be secured at their turns.

In case of horizontal laying, the apex of a turn shall be on a solid flat support. Plastic tubes and pneumatic cables shall be secured by movable fasteners at a distance of 0.5 to 0.7 m from the turn apex.

3.48. Plastic tubing shall be mounted so as to avoid its damage (nicks, deep scratches, dents, fused or burnt-through areas, etc.). Damaged portions of the tubing shall be replaced.

3.49. Plastic tubing and pneumatic cables laid in areas where they are exposed to mechanical effects, at a height less than 2.5 m from the floor shall be protected against damage by metal casing, pipes or other devices. The design of these protecting devices shall provide for their easy removal and pipe maintenance.

Protection is not required for pipe or tube sections with a length less than 1 m, connected to devices, actuators or hardware of automation that are mounted on process vessels or pipelines.

3.50. Outdoor piping made of plastic tubes shall be protected against direct sunlight.

3.51. Plastic tubing and pneumatic cables laid in horizontal ducts or troughs shall lie loosely, without fasteners. Plastic tubing and pneumatic cables laid in vertical ducts or troughs shall be fastened at intervals of no more than 1 m.

At the turns or branches, pneumatic cables shall be secured in accordance with clause 3.47 of these Regulations, for any arrangement of the supporting troughs.

When plastic tubing or pneumatic cables are laid in a duct, noncombustible partitions with a fire resistance of no less than 0.75 hr shall be mounted in the duct at a distance of 50 m from each other along the duct length.

Armored pneumatic cables may not be laid in ducts.

Tubes or cables shall exit the duct through openings in its walls or bottom. The openings shall be fitted with plastic sleeves.

3.52. The distance between the fasteners of plastic tubes or tube bundles shall not exceed the values specified in Table 1.

3.53. The horizontal sections of piping made of plastic tubes used to convey liquids or moist gases or plastic tubes used at an ambient temperature or internal medium temperature of 40°C or higher shall be laid on continuous supporting structures, and the distance between the fasteners of their vertical sections shall be two times shorter than that specified in Table 1.

Table 1.

Outside Diameter (OD) of Tube or Tube Bundle, mm	Distance between fasteners, m, for	
	horizontal arrangement	vertical arrangement
Up to 10	0.3	0.5
From 10 to 25	0.5	0.8

3.54. Plastic tubing shall have a reserve length of no less than 50 mm left at the connections to devices, equipment or partition joints (taking into account permissible bend radii) to allow for possible damage in repeated connection and disconnection.

3.55. Pneumatic cables shall be mounted on cable-supporting structures in accordance with the following requirements:

- the pneumatic cables shall be laid in one tier;
- the sag shall be formed only by the own weight of the pneumatic cable and shall not exceed 1% of the span.

In case of horizontal laying, the cables shall be fastened to every second support.

3.56. Any welding process that ensures the quality of joints may be used in the mounting of metal piping, unless a specific kind or technique of welding is stipulated in the technical documentation.

3.57. The welding of steel piping and the quality control of welded joints shall be carried out in accordance with SNiP 3.05.05-84.

3.58. Welding process, conditions and materials and the procedures of welding quality control shall be selected in accordance with the standard welding technique as laid out in Industry Standards OST 36-57-81 and OST 36-39-80 approved by the USSR Ministry of Installation and Special Construction Works (USSR Minmontazhspetsstroi). The types and structural components of welds shall conform to GOST 16037-80.

3.59. Non-detachable joints of copper tubes shall be made by soldering in accordance with GOST 19249-73.

The quality of soldered joints shall be monitored by visual examination and by hydraulic or pneumatic testing.

The surface of soldered joints shall look smooth. Rolls, overlaps, pin holes, blisters, foreign inclusions and poor solder penetration are not allowed.

3.60. Single metal piping shall be fastened to every support.

ADDITIONAL REQUIREMENTS TO THE OXYGEN PIPING MOUNTING

3.61. Oxygen piping shall be mounted by the personnel who was taught the special requirements to this work.

3.62. The contamination of the piping internal surfaces with oils or fats during its mounting and welding shall be prevented.

3.63. Any necessary degreasing of pipes, fittings and joints shall be carried out in accordance with the technology given in Industry Standard OST 26-04-312-83, as approved by the Ministry of Chemical Engineering (Minhimmash), with fire-safe solvents and aqueous solutions of detergents.

Tubes, fittings and joints for oxygen piping shall be accompanied with a document confirming their degreasing and readiness for mounting.

3.64. In case of threaded joints, wrapping with flax or hemp or sealing the joints with minium or other materials that may contain fats or oils is not allowed.

ADDITIONAL REQUIREMENTS TO THE MOUNTING OF PIPING RATED FOR PRESSURES ABOVE 10 MPa (100 kgf/cm^2)

3.65. Prior to commencing the installation of piping rated for pressures above 10 MPa (100 kgf/cm^2), the technical staff representatives shall be charged with responsibility for supervising the piping mounting, quality control thereof and documentation preparation.

These technicians shall be certified after special training.

3.66. All components of piping rated for pressures above 10 MPa (100 kgf/cm^2) and the welding materials delivered to the warehouses of the installation subcontractor shall be checked by visual examination. Checking shall also include verifying the presence and quality of the accompanying documentation, and shall terminate in drawing a Report on the acceptance of the pipes, fittings, pipeline components, etc.

3.67. The ends of pipes designed for lens seals shall be machined in accordance with GOST 9400-81.

The edges of pipes designed for joining by welding shall be prepared by mechanical means only.

3.68. Threads on piping designed for operating pressures $P_{oper} \geq 10$ MPa (100 kgf/cm^2) shall be cut to the second accuracy class in accordance with GOST 16093-81.

3.69. Every pipes designed for $P_{oper} \geq 10$ MPa (100 kgf/cm^2) with its complementing components, prior to its delivery for mounting, shall pass hydraulic testing with a test pressure selected in accordance with GOST 356-80.

Hydraulic testing of pipes and components designed for $P_{oper} \geq 10$ MPa (100 kgf/cm^2) shall be performed in manufacturing shops at specially equipped workplaces, away from areas of possible accumulation of personnel and from passages or halls.

Industrial oil in accordance with GOST 20799-75 shall be normally used as the test fluid.

Pipes and piping components designed to convey oxygen shall be tested only with water.

The pipes and components shall be held under the test pressure for 5 minutes. If the pressure gage shows no pressure drop, the pressure shall be reduced to the operating value, and the pipes and components being tested shall be examined to detect possible faults (bulging, sweating, etc.).

3.70. The internal surface of every pipe designed for $P_{oper} \geq 10$ MPa (100 kgf/cm^2) shall be thoroughly cleaned of lubricants, shavings, any foreign matter, etc.

A flanged pipe shall be closed on both ends with wooden plugs, and all machined surfaces shall be coated with grease (except for the piping designed to convey oxygen). The pipes shall be delivered to the installation area with their flanges in place.

3.71. Flanged joints shall comply with the following requirements:

(a) the gasket dimensions shall match the sealing surfaces of the flanges;

(b) the thread of the bolts (threaded studs) of piping designed for operation at temperatures above 300°C shall be coated with graphite prior to their installation;

(c) the nuts of all bolts shall be on the same side of a flanged joint;

(d) the flanges shall be uniformly tightened to ensure the parallelism of the sealing surfaces.

3.72. During the assembling of a flanged joint, the distance from the end face of a pipe (or the fitting of a valve or another component of the piping) to the plane of the flange shall be strictly controlled. The distance, depending on the pipe diameter, shall be:

1.5 mm, for a diameter of 6 mm;

2 mm, for a diameter of 10, 15, 25 or 32 mm;

3 mm, for a diameter of 40 mm.

3.73. Valves and fittings rated for nominal (conditional) pressure $P_{nom} \geq 10$ MPa (100 kgf/cm^2), irrespective of the availability of the manufacturers' certificates, shall be depreserved and examined; the presence of marking, the condition of threads and the cleanliness of the sockets for the seal lenses shall be checked; and the valves and fittings shall be subjected to hydraulic testing for strength and tightness, with the execution of an appropriate report.

3.74. Piping designed for operating pressures $P_{oper} \geq 10$ MPa (100 kgf/cm^2) shall be secured only with clamps. Securing these pipes without metal fasteners or securing several pipes with one clamp is not allowed.

3.75. The piping of automation systems designed to convey combustible or toxic liquids or gases and piping rated for $P_C \geq 10$ MPa (100 kgf/cm^2) shall be mounted and adjusted in accordance with the requirements of the specifications and technical documentation listed in recommended Appendix 4.

PIPING TESTING

3.76. When the mounting of piping is fully finished it shall be tested for strength and tightness in accordance with SNiP 3.05.05-84.

The type (for strength or for tightness), technique (hydraulic, pneumatic) and duration of the testing shall be selected and the testing results shall be evaluated in accordance with the technical documentation.

3.77. Should the value of pressure required for testing (hydraulic and pneumatic) the piping (impulse, venting, supply, heating, cooling, ancillary and command piping of hydraulic automation systems) for strength and tightness be not specified in the technical documentation, the test pressure shall be established in accordance with SNiP 3.05.05-84.

3.78. Command piping designed to convey air at an operating pressure of $P_{oper} \leq 0.14$ MPa (1.4 kgf/cm^2) shall be tested for strength and tightness by a pneumatic method, under a test pressure of $P_{test} = 0.3$ MPa (3 kgf/cm^2).

3.79. Pressure gages used in the testing shall have the following characteristics:

- accuracy class of no less than 1.5;
- body diameter of no less than 160 mm;
- measurement limit equal to 4/3 of the pressure to be measured.

3.80. Plastic piping and pneumatic cables shall be tested with a test medium temperature no higher than 30°C.

3.81. Plastic piping shall be tested at least 2 hours past the time of the last pipe welding.

3.82. Prior to testing for strength and tightness, all piping, irrespective of its purpose, shall be subjected to:

(a) visual examination to detect any installation flaws and to ensure its conformity to the technical documentation and its readiness for testing;

(b) purging and, if stipulated in the technical documentation, flushing.

3.83. Piping shall be purged with compressed air or an inert gas cleaned of oil and dust.

Purging or flushing steam and water piping with their working medium is allowed.

3.84. Piping shall be purged with pressure equal to their operating pressure, but no more than 0.6 MPa (6 kgf/cm^2).

Should it be necessary to purge piping with a pressure exceeding 0.6 MPa (6 kgf/cm^2), purging shall be carried out in accordance with instructions contained in special plans for purging process pipelines, agreed upon with the customer.

Piping shall be purged for 10 minutes until clean air starts coming out of the piping.

Piping rated for operation at a gage pressure up to 0.1 MPa (1 kgf/cm^2) or an absolute pressure from 0.001 to 0.095 MPa (0.01 to 0.95 kgf/cm^2) shall be purged with air under pressure no higher than 0.1 MPa (1 kgf/cm^2).

3.85. Piping shall be flushed until there is a steady flow of clear water from the piping outlet or discharge device.

Upon the completion of the flushing, the piping shall be completely emptied of water and, if necessary, purged with compressed air.

3.86. After purging and flushing, the piping shall be plugged.

The design of the plugs shall preclude them from being torn off by the test pressure.

Plugs or blind lenses with tails shall be set on pipes rated for operation at $P_{oper} \geq 10$ MPa (100 kgf/cm^2).

3.87. Pipelines that conduct test fluids, air or inert gases for testing purposes from pumps, compressors, cylinders, etc. to the piping shall be tested in advance by hydraulic pressure in a fully assembled state with their stop valves and pressure gages.

3.88. In case of hydraulic testing, water shall be used as a test fluid. The temperature of water used in testing shall be no less than 5°C.

3.89. In case of pneumatic testing, either air or an inert gas shall be shall be used as a test medium. Air or inert gases used for testing shall be cleaned of moisture, oil and dust.

3.90. The following stages of pressure buildup are recommended for hydraulic and pneumatic testing:

Stage 1, to 0.3 P_{test};

Stage 2, to 0.6 P_{test};

Stage 3, to P_{test};

Stage 4, reduction to P_{oper} [for pipes with P_{oper} up to 0.2 MPa (2 kgf/cm^2) only Stage 2 is recommended].

Stage 1 and 2 pressure shall be maintained for 1–3 minutes, and during this time, the absence of pressure drop in the pipe shall be established with the pressure gage.

The full test pressure (Stage 3) shall be maintained for 5 minutes.

In case of pipelines rated for pressures $P_{oper} \geq 10$ MPa (100 kgf/cm^2), the test pressure shall be maintained for 10–12 minutes.

The buildup of pressure at Stage 3 is the testing for strength.

The operating pressure (Stage 4) shall be maintained for a time period required for final examination and flaw detection. Stage 4 is testing for tightness.

3.91. Any flaws may be corrected only when the pressure in the pipe is reduced to the atmospheric value.

When the flaws are corrected, the testing shall be repeated.

3.92. Piping shall be deemed fit for service if no pressure drop is indicated by the pressure gage during the testing for strength and no leaks are detected in the welds and joints during the subsequent testing for tightness.

A report shall be drawn upon the testing completion.

3.93. Piping for combustible, toxic or liquefied gases (except for gas-supply lines for pressures up to 0.1 MPa [1 kgf/cm^2]), piping for oxygen and piping for pressures above of 10 MPa (100 kgf/cm^2) or for an absolute pressure from 0.001 to 0.095 MPa (0.01 to 0.95 kgf/cm^2) shall pass additional testing for tightness with the determination of pressure drop.

3.94. Prior to testing the piping for tightness with the determination of pressure drop, the piping shall be flushed or purged.

3.95. Prior to testing the piping rated for pressures 10–100 MPa (100–1000 kgf/cm^2), for tightness with the determination of pressure drop, safety valves shall be mounted on the pipe lines and adjusted for opening at a pressure exceeding the operating pressure by 8%. These safety valves shall be provided for in the technical documentation.

3.96. Testing for tightness with the determination of pressure drop shall be accomplished by air or an inert gas under a test pressure equal to the operating pressure ($P_{test} = P_{oper}$), except for pipelines rated for an absolute pressure from 0.001 to 0.095 MPa (0.01 to 0.95 kgf/cm^2) that shall be tested a pressure of:

(a) 0.1 MPa (1 kgf/cm^2), in case of pipelines used to convey combustible, toxic or liquefied gases;

(b) 0.2 MPa (2 kgf/cm^2), in case of pipelines used to convey usual media.

3.97. The duration of additional testing for tightness and the time of maintaining the test pressure shall be specified in the technical documentation, but may not be less than:

- 24 hrs, for pipelines rated for pressures from 10 to 100 MPa (100 to 1000 kgf/cm^2);
- 24 hrs, for pipelines used to convey combustible, toxic or liquefied gases;
- 12 hrs, for pipelines used to convey oxygen;
- 12 hrs, for pipelines rated for an absolute pressure from 0.001 to 0.095 MPa (0.01 to 0.95 kgf/cm^2).

3.98. The pipes shall be deemed to have passed the testing if the pressure drop does not exceed the values given in Table 2.

Table 2.

Piping	**Permissible Pressure Drop, % per hour**		
	for toxic combustible gases	**for other combustible gases**	**for air and inert gases**
For pressures 10–100 MPa (100–1000 kgf/cm^2)	0.05	0.1	0.2
For combustible, toxic and liquefied gases	0.05	0.1	—

These requirements are applicable to piping with a nominal bore of 50 mm. When piping with other nominal bores is tested, the permissible pressure drop shall be calculated as a product of the pressure drop values specified in the above table and a factor determined from the following formula:

$$K = 50/D,$$

where D is the nominal bore of the piping being tested, mm.

3.99. Upon the completion of testing the piping for tightness with the determination of pressure drop over the testing time, a report shall be drawn.

3.100. The pneumatic testing shall be carried out in accordance with the safety rules laid down in SNiP III-4-80 and in “Rules for the Construction and Safe Operation of Pipelines for Combustible, Toxic and Liquefied Gases (PUG-69).”

WIRING

3.101. Wiring of automation systems (measuring, control, power supply, alarm, signaling, etc. circuits) by laying wires and control cables in ducts and troughs, in protective tubing made of plastic or steel, on cable-supporting structures, in cable conduits and on the ground; wiring in explosion- and fire-hazardous zones and grounding (neutral earthing) shall be made in accordance with SNiP 3.05.06-85, taking into account the peculiarities of automation system installation, as given in the reference documentation of the above SNiP.

3.102. Single-wire copper cores of wires and cables with a section of 0.5 or 0.75 mm^2 and multiple-wire (stranded) copper cores with a section of 0.35, 0.5 or 0.75 mm^2 shall be normally connected to the terminals of devices and units and to terminal blocks by soldering, if this is permitted by the terminal design (non-detachable contact connection).

When it is necessary to connect single- or multiple-wire cores of wires and cables with the above sections to devices, units or terminal blocks with screw contact terminals (detachable contact connection), the cores of these cables shall terminate with lugs.

Single-wire copper cores of wires and cables with a section of 1, 1.5, 2.5 or 4 mm^2 shall be normally connected by immediate screw contact, and stranded wires with the same sections, either with lugs or by immediate screw contact. In this case, the cores of single-wire and stranded wires and cables, depending on the design of the terminals of devices, units and terminal banks, may terminate with a ring or a pin; the termination (rings or pins) of stranded cores shall be soldered through, compressing terminal pins with contact rods is allowed.

If the design of the terminals of devices, units or terminal banks requires or provides for other ways of connecting single-wire or stranded copper cores of wires and cables, the method of connection stipulated by the appropriate product standards or specifications shall be used.

Aluminum cores of wires and cables with a section of 2.0 mm^2 or more shall be connected to devices, units or terminal banks only by terminals designed for immediate connection of aluminum conductors with corresponding sections.

Single-wire cores of wires and cables shall be connected (by screw terminal or by soldering) only to stationary components of devices or units.

If the devices, units or automation hardware have connection points in the form of plug-and-socket connectors, then the connections shall be made by stranded (flexible) copper wires or cables routed from the terminal blocks or junction boxes to these devices and automation hardware.

The detachable and non-detachable connections of the copper, aluminum and copper-aluminum cores of wires and cables to the terminals of devices, units or terminal blocks shall conform to the requirements of GOST 10434-82, GOST 25154-82, GOST 25705-83, GOST 19104-79 and GOST 23517-79.

3.103. Protective steel pipes shall be joined to one another, to conduit boxes (ducts), etc. in rooms and premises of all classes by standard threaded joints.

Joining thin-wall protective steel pipes by sleeves made of steel plate or by steel pipes of a greater diameter, followed by welding around the entire perimeter of the connection place, is allowed in rooms and premises of all classes, except explosion- or fire-hazardous zones. In this case, burning through the pipes is not allowed.

3.104. When installed, the automation system wiring shall be visually examined to verify its conformity to the technical documentation and these Regulations requirements. Wiring, which conforms to these requirements, shall be tested for the insulation resistance.

3.105. The insulation resistance of automation system wiring (measuring, control, power supply, alarm, signaling, etc. circuits) shall be measured with a megohmmeter for voltage range 500–1000 V. The insulation resistance shall be no less than 0.5 MΩ.

The insulation resistance shall be measured with the wires and cables connected to the terminal blocks of the boards, cabinets, panels and junction boxes.

Devices, units and wiring that cannot be tested with a megohmmeter at a voltage of 500–1000 V shall be disconnected for the testing period.

A report shall be drawn on the results of the insulation resistance measurement.

BOARDS, CABINETS AND PANELS

3.106. Boards, cabinets and panels supplied by the customer shall be ready for installation, complete with their devices, valves, fittings and mounting components, with their internal wiring and piping ready for connection to external wiring, piping and devices and with the fasteners for the assembly and installation of these boards, cabinets and panels on the site.

3.107. Individual boards, cabinets and panels shall be designed for assembling by detachable joints into composite boards (control or operator boards) of any configuration.

Threaded connections shall be uniformly and tightly screwed down and protected against self-unscrewing.

3.108. Boards, cabinets and panels shall be mounted on embedded structures, exception for small boards mounted on walls or columns and flat cabinets that do not require embedded pieces for their installation.

The main method of fastening the supporting frames of boards to embedded structures shall be permanent fastening by welding.

Installed boards, cabinets and panels shall be checked with a plumb line and then secured.

The ancillary components installation (decorative panels, mnemonic diagrams, etc.) shall not affect the axial lines or verticality of the entire face plane of the board. If the value of a mnemonic diagrams inclination is specified in the technical documentation, the established tolerances shall be maintained.

3.109. Board, cabinet and panel lead-ins for wiring and piping shall be made in accordance with Industry Standard OST 36.13-76 as approved by USSR Minmontazhspetsstroi.

3.110. Industrial automation rooms, including complete operator rooms and complete sensor stations, shall be normally used in order to increase the installation work industrialization level. Industrial automation rooms shall be delivered to the site with already installed boards, cabinets, panels, wiring and piping. Activities on the site shall be limited to connection of the external piping and wiring.

3.111. The wiring and piping terminations and connections that enter boards, cabinets, panels, complete operator rooms and complete sensor stations shall be made in accordance with the SNiP 3.05.06-85 and these Regulations requirements.

AUTOMATION DEVICES AND HARDWARE

3.112. Only those automation devices and hardware that have been checked with the execution of appropriate reports shall be accepted for installation.

To protect the devices and equipment against damage, cannibalization and theft, their installation shall be commenced upon receiving a written permission from the general contractor (or the customer).

3.113. Automation devices and hardware shall be checked by the customer or by specialized agencies, engaged by the customer for the automation devices and hardware start-up, in accordance with procedures accepted by these agencies, taking into account the requirements of the instructions issued by the USSR State Committee for Standards (Gosstandart) and by manufacturers.

3.114. Automation devices and hardware accepted for installation after checking shall be prepared for delivery to the installation site. Movable systems shall be arrested, and connecting devices shall be protected against moisture, dirt and dust.

Along with the automation devices and hardware, the installation subcontractor shall receive the special tools, accessories and fasteners that are part of their complete set and are required for installation.

3.115. Automation devices and hardware shall be positioned in accordance with the technical documentation. They shall be installed so as to ensure the accuracy of measurement and unobstructed access to the devices and their locking and tuning means (cocks, valves, switches, adjustment knobs, etc.).

3.116. Where automation devices and hardware are installed in limited access points the construction of ladders, pits and platforms as specified in the technical documentation shall be completed before the installation work commencement.

3.117. Automation devices and hardware shall be installed at the ambient temperature and relative humidity environment specified in the manufacturer installation and service manuals.

3.118. The connection of external piping to the devices shall comply with the GOST 25164-82 and GOST 25165-82 requirements, and external wiring, with the GOST 10434-82, GOST 25154-82, GOST 25705-83, GOST 19104-79 and GOST 23517-79 requirements.

3.119. The methods of fastening automation devices and hardware to metal structures (boards, cabinets, racks, etc.) shall be determined by the design of the automation devices and hardware and the components included in their complete set.

If the complete set of some automation devices and hardware does not include fasteners, these devices and hardware shall be fastened with standardized fasteners.

In the presence of vibration in the areas of installation of the devices, their threaded fasteners shall be equipped with means to prevent their self-unscrewing (lock washers, lock nuts, split pins, etc.).

3.120. Openings in the automation devices and hardware designed for the piping and wiring connection shall remain closed until the moment of the piping or wiring connection.

3.121. The automation device and hardware housings shall be grounded in accordance with the manufacturers' manuals and SNiP 3.05.06-85 requirements.

3.122. The sensors of fluid thermometers, thermal alarms, filled-system thermometers, thermoelectric transducers (thermocouples), thermal resistance transducers (resistance thermometers) shall be normally positioned in the center of the flow of the medium being measured. If pressure exceeds 6 MPa (60 kgf/cm^2) and steam flow speed reaches 40 m/sec or water flow speed reaches 5 m/sec, the depth of the sensor submersion into the measured medium (from the inside wall of the pipeline) shall not exceed 135 mm.

3.123. The sensing parts of surface-type thermoelectric transducers (thermocouples) and resistance thermometers shall be snug against with the monitored surface.

Prior to the installation of these devices, the area of their contact with the monitored pipelines or equipment shall be cleaned of scale and scraped bright.

3.124. Inserting thermoelectric transducers (thermocouples) in porcelain holders into a high-temperature zone to the protective porcelain tube length is allowed.

3.125. Thermometers whose protective cases are made of different metals shall be submersed into the measured medium no deeper than specified in the manufacturer's certificate.

3.126. Laying the capillary tubes of filled-system thermometers on surfaces whose temperature is either above or below the ambient temperature is not allowed.

Where it is necessary to lay the capillary tubes in areas with either hot or cold surfaces, the capillary tube shall be separated from the surfaces by an air gap sufficient to protect the tube against heating or cooling or by appropriate thermal insulation.

The capillary tubes of filled-system thermometers shall be protected against mechanical damage over the entire length of laying.

In case of an excess length of the capillary tube, it shall be wound into a coil with a diameter of no less than 300 mm, and the coil shall be bound at three points with nonmetallic ties and securely fastened to the device.

3.127. Vapor/liquid pressure meters, if possible, shall be mounted at the same level with the pressure takeoff point; if this requirement cannot be met, the technical documentation shall set a permanent offset to the instrument readings.

3.128. Liquid U-tube manometers shall be mounted exactly upright. The liquid filling manometers shall be free from contaminants and air bubbles.

Spring-type pressure gages (vacuum meters) shall be mounted upright.

3.129. Separation vessels shall be positioned in accordance with the applicable standards or the project technical documentation; normally they shall be close to the impulse intake points.

The separation vessels shall be positioned so that their checkpoint openings are at the same level and can be easily accessed by the operating personnel.

3.130. In case of piezometric level metering, the metering tube open end shall be positioned below the minimum measured level. Gas or air pressure in the metering tube shall be sufficient for the passage of gas (air) through the tube at the maximum metering level. The gas or air flow rate in piezometric level indicators shall be adjusted to a value sufficient to cover any loss or leakage and provide for the required response speed of the metering system.

3.131. Devices for physicochemical analysis and their intakes shall be installed in strict compliance with the manufacturers' manual requirements.

3.132. When indicating and registering devices are mounted on the walls or racks attached to the floor, the dial, diagram, stop valves and the adjusters and controls of pneumatic and other sensors shall be positioned at a height of 1.0 to 1.7 m from the floor, and valve control shall be on the same plane with the device dial.

1.333. The computing and controlling equipment of automated process control systems shall be installed in accordance with the manufacturers' technical documentation.

3.134. All automation devices and hardware that are mounted on or built into process vessels or pipelines (constrictions, takeoffs, meters, rotameters, floats of level gages, direct-action controllers, etc.) shall be installed in accordance with the technical documentation and the requirements of obligatory Appendix 5.

OPTICAL CABLES

3.135.* Prior to routing optical cable, its integrity and attenuation factor shall be checked.

3.136.* Optical cables shall be laid in accordance with the technical documentation using methods similar to those used in routing wiring, piping and communication cables.

Routing optical cables in the same duct, trough or pipe with other types of automation system channels is not allowed.

Routing single- or double-fiber cables on cable racks is not allowed.

Routing optical cables in ventilation ducts and shafts and in escape routes is not allowed.

3.137.* Optical cables laid in areas where they are exposed to mechanical effects, at a height less than 2.5 m from the floor of the room or service platform shall be protected against damage by casing, pipes or other devices in accordance with the technical documentation.

3.138.* When an optical cable is pulled, the pulling means shall be attached to the load-bearing element, with tension limiters and twisting preventers. The pull shall not exceed the values specified in the cable specifications.

3.139.* Optical cable shall be laid in climatic conditions set in the cable specifications. Laying cable at an air temperature below minus 15°C or a relative humidity above 80% is not allowed.

3.140.* Optical cable shall have a reserve length left at the connections to transmitting/receiving devices and at cable connectors. The reserve length shall be no less than 2 m at each cable joint or transmitter/receiver.

3.141.* Optical cable shall be secured along the entire length every 1 m, in case of vertical laying or direct laying on the wall surface, or at the turns, in case of horizontal laying (except for laying in ducts).

At the turns, the cable shall be secured on both sides of the corner at a distance equal to the permissible bending radius, but no less than 100 mm, from the angle vertex. The turning radius of the optical cable shall conform to the cable specifications requirements.

When the cable is laid on separate supports, the distance between the supports shall be no more than 1 m, and the cable shall be fastened to each support.

3.142.* Mounted optical cable shall be checked by measuring signal attenuation is separate fibers and by verifying its integrity. A report on the results of measuring the optical parameters of the mounted optical cable shall be documented (see obligatory Appendix 1).

4. INDIVIDUAL TESTING

4.1. Automation systems shall be presented for acceptance by a working committee as a complete set, as specified in the technical documentation, after individual testing.

4.2.* The individual testing shall include:

(a) checking the conformity of the installed automation systems to the technical documentation and the these Regulations requirements ;

(b) checking the piping strength and tightness;

(c) measuring the wiring insulation resistance.

(d) measuring signal attenuation is separate fibers in accordance with a special instruction.

4.3. Checking the installed systems for conformity to the technical documentation shall include checking the conformity of the automation device and hardware positioning, their types and technical characteristics to the equipment specifications and checking the conformity of the installation methods of devices, automation hardware, control boards and panels and other hardware of local automated process control systems, piping and wiring to this SNiP and operating manuals requirements.

4.4. Testing the piping for strength and tightness and checking the wiring insulation resistance shall be carried out in accordance with Section 3.

4.5.* Upon individual testing completion, a Report on the equipment acceptance shall be generated; of the documentation per Appendix 1 items 4 to 12, 16 and 21 shall be attached to the report.

4.6.* Turning over the installed equipment for start-up by individual systems or by individual parts of the entire complex (e.g. control or operator rooms) is allowed. The act of the automation system handover shall be documented in form of a report (see obligatory Appendix 1).

5. START-UP ACTIVITIES

5.1. Start-up activities shall be executed in accordance with obligatory Appendix 1 to SNiP 3.05.05-84 and these Regulations.

5.2. Start-up activities shall be carried out in conformity to the requirements of the project and production schedules of the facility being commissioned, the "Electrical Equipment Construction Rules" (PUE), "User Rules for Operating Electrical Equipment" (PTE) and "User Safety Rules for Operating Electrical Equipment" (PTB) as approved by the USSR Ministry for the Power Generating Industry (USSR Minenergo).

5.3. During the individual testing and integrated trial runs of the process equipment, the customer or a startup-and-adjustment agency, engaged by the customer, shall put into operation the automation systems required for testing the process equipment in accordance with the project and the manufacturers' specifications.

5.4. Before the automation systems start-up is commenced, the customer shall ensure the operable condition of all control and stop valves that have of the automation system actuators and put into operation automatic fire-fighting and alarm systems.

5.5. The automation system start-up shall be carried out in three stages.

5.6. **The First Stage** shall include preparation work and studying the technical documentation of the automation systems and the key characteristics of the automation devices and hardware. The automation devices and hardware shall be checked with any necessary tune-up of their individual components.

5.7. To have the automation devices and hardware test, the customer shall:

- deliver the automation devices and hardware to the facility testing place;
- hand over to the start-up company, for the period of checking of the automation devices and hardware, the spare parts and special tools supplied by the manufacturers of the automation devices and hardware and the comparison equipment and special tools included in the complete set.

5.8. Automation device and hardware testing shall include verification the conformity of their main technical characteristics to the requirements set by the manufacturers' characteristics sheets and manuals. Testing and tune-up results shall be documented in a report or in the equipment passport. Defective automation devices and hardware shall be returned to the customer for repair or replacement.

Automation devices and hardware that have been cannibalized, without an appropriate technical documentation (characteristics sheets, certificates, etc.) or with modifications not reflected in the specifications shall not be accepted for testing. When the testing is completed, the automation devices and hardware shall be turned over for installation with a report.

5.9. **The Second Stage** shall comprise off-line automation system start-up upon their installation completion.

This stage shall include:

- checking the automation devices and hardware mounting for conformity to the manufacturers' manuals and the technical documentation requirements. Any defects found in the automation devices and hardware installation shall be corrected by the installation subcontractor;
- replacement of individual defective components (tubes, diodes, resistors, fuses, modules, etc.) with good ones supplied by the customer;
- checking the correctness of wiring marking, connection and phases;
- phasing and monitoring the actuators characteristics;
- adjusting the logical and timing relationships of signaling, alarm, safety, interlocking and control systems; verifying proper signal transmission;
- preliminary evaluation of the facility characteristics; analysis and setting of the system and hardware parameters;
- automation systems preparation and initiation for individual testing of the process equipment and control system setting adjustments during operation;
- process and technical documentation development.

5.10. Any piping and wiring disconnection or reconnection required for individual automation device and hardware checking or tune-up shall be made by the start-up company.

5.11. Automation system initiation shall be carried out only:

- when all requirements to the operating conditions of the automation devices and hardware and the communication channels (temperature, humidity and corrosiveness of the environment) and occupational safety are complied with;
- in the presence of the minimum process load on the automated facility, required for automation device and hardware parameters determination and setting and for the automation system testing and commissioning;
- when threshold setpoints for automation devices and hardware correspond to those specified in the technical documentation or established by the customer;
- when the customer has documents confirming the completion of installation, as listed in obligatory Appendix 1.

5.12. **The Third Stage** shall comprise the integrated start-up of the automation systems and bringing the setting parameters of the automation devices and hardware and the communication channels to their operating values. The following should be accomplished as an entire package of activities:

- verification of the operation sequence conformity for the signaling, alarm, safety and control system devices and components to the algorithms given in technical documentation, and isolating the causes of their failures or false operation; setting the required values for the positioning devices triggerring;
- verification of the stop/control valves through put conformity to the requirements of the work process and the correctness of switch responses;
- determination of the control element flow-rate characteristics and bringing them to nominal values with the available controls provided by the design;
- automation system preparation and activation for the process equipment testing support as a whole unit;
- refining the facility static and dynamic characteristics, and the system setting parameters values tune-with consideration for their interference in operation;
- testing and establishing the suitability of the automation systems for supporting the equipment operation with the production output established for the initial period of service;
- automation system performance analysis during operation;

- process documentation development.

5.13. The third stage activities shall be carried out after the full completion of construction and assembly work and its acceptance by the working committee in accordance with SNiP III-3-81 and these Regulations, when the equipment has been put into operation and a stable performance of the work process has been achieved.

5.14. The flow-rate characteristics and flow capacities of control elements shall be determined only when the parameters of the medium in the pipeline conform to the norms set by the standard, technical documentation or control elements data sheets.

5.15. Triggering setpoints for alarming and protection system components / devices specified in the process or other technical documentation shall be changed only upon customer approval for these new values.

5.16. To facilitate preparation the automation systems for operation during process equipment integrated trial runs the customer shall supply the startup services company with a list of systems to be put into operation and the schedule for their commissioning.

5.17. The personnel of the startup services company assigned to maintain operating automation systems shall be briefed by the customer on safety and operating procedures in the functioning enterprise. The scope of the briefing shall be established by the appropriate branch ministries; and the fact of briefing shall be noted in the work safety log.

5.18. Where no specific requirements to the automation systems performance parameters are set in the technical documentation, such requirements shall be established by the customer in coordination with the startup services company.

In this case, the requirements to the automation system performance parameters shall primarily address the systems quality and reliability factors.

5.19. When the actual characteristic of automated objects are being determined, the customer shall accomplish any changes in process equipment operating mode. Automation system activation and deactivation shall be recorded in the operation log.

5.20. Automation systems startup shall be carried out in accordance with the requirements established in the technical documentation, automation device/hardware manufacturer manuals or in the industry branch guidelines concerning commissioning of completed construction projects as approved by the appropriate the USSR ministries and authorities in coordination with USSR Gosstroi.

5.21. The scope and content of startup activities for individual automation systems shall be established in a plan developed by the startup services company and approved by the customer; that plan shall assure compliance with the requirements of clauses 5.5 to 5.12 of these Regulations.

5.22. The results of the startup activities shall be documented in a report, which shall contain an evaluation of the system performance, conclusions and recommendations. The customer shall implement recommendations on automation system performance improvement.

5.23. Automation systems handover to operations is to be achieved for individually prepared systems or for integrated automated complexes, process units and workshops, as agreed with the customer.

When automation systems are commissioned as individually prepared systems, a report on the acceptance of automation systems for operation shall be drawn in accordance with obligatory Appendix 1.

The report shall be accompanied with the following documentation:

- list of settings for devices, instruments and automation hardware and values of automatic control systems setpoints;
- automation systems testing procedures and reports;
- a chart reflecting the structure of technical documentation related to automation, which shall show all modifications introduced and coordinated with the customer in the course of the startup activities (one copy);

- data sheets and manuals supplied by the automation devices/hardware manufacturer; any additional technical documentation received from the customer during the startup activities.

5.24. Completion of the startup operations shall be documented in an acceptance report for automation systems commissioning in the scope specified in the project.

APPENDIX 1
Mandatory

PROCESS DOCUMENTATION DRAWN DURING AUTOMATION SYSTEMS INSTALLATION AND START-UP

Title	Contents of Document	Notes
1. Statement of Technical Documentation Handover for Work Execution	Completeness of the documentation package in accordance with SN 202-81, VSN 281-75 and with design documentation system standards; suitability for installation works utilizing pre-assembled units and modular construction practices; availability of permission to commence the work; date of the documentation acceptance and signatures of representatives of the customer, Prime contractor and installation subcontractor	
2. Statement of Site Readiness for the Installation of Automation Systems	Contents shall be specified in VSN in accordance with SNiP 3.01.01-85	The Report shall specifically note the readiness of embedded structures and primary instruments mounted on the process equipment, vessels and pipelines in accordance with clause 2.12
3. Installation Works Suspension Report	In any format	
4. Concealed Work Verification Report	In the format of the Concealed Works Verification Report as specified in SNiP 3.01.01-85	
5. Report on Piping Testing for Strength and Tightness	Contents shall be specified in VSN	
6. Report on Pneumatic Piping Testing for Tightness with Pressure Drop Determination	As above	The report shall be drawn for piping conveying combustible, toxic or liquefied gases (except for piping rated for pressures up to 0.1 MPa), for piping conveying oxygen and for piping rated for pressures above 10 MPa and for absolute pressures from 0.001 to 0.095 MPa
7. Report on the Degreasing of Valves, Fittings, Joints and Pipes	Contents shall be specified in the VSN	The report shall be drawn for piping conveying oxygen
8. Documentation for piping rated for pressures above 10 MPa	As above	The documentation shall be drawn for piping rated for pressures above 10 MPa
9. Welding Log	As above	The log shall be kept for piping of categories I and II and for piping rated for pressures above 10 MPa
10. Insulation Resistance Measurement Protocol	As above	
11. Drummed Cables Warm-up Protocol	As above	The report shall be drawn only when the cables are laid at low temperatures

Title	Contents of Document	Notes
12. Documentation on Wiring in Explosion Hazardous Zones	Types of documents shall be specified in VSN	The documentation shall be drawn only for explosion hazardous zones
13. Documentation on Wiring in Fire Hazardous Zones	As above	The documentation shall be drawn only for fire hazardous zones
14. Automation Hardware Verification Statement	In any format	
15. Permission for Installation of Automation Hardware	Contents shall be specified in VSN	
16. List of Installed Automation Hardware	In any format	
17. Report on the Acceptance of Equipment After Individual testing	In any format	
18. Authorization for Introducing Modifications Into Technical Documentation	Form in accordance with GOST 21201-78	
19. Acceptance Report for Automation Systems Handover to Operations	In accordance with the attached form	The report shall be drawn during acceptance of individually prepared systems for operation
20. Acceptance Report for Automation Systems Handover to Operations	In a report form gspecified in Appendix 2 to SNiP III-3-81	In the scope established by the project
21. Protocol on Measurements of Optical Characteristics of Routed Fiber-optic Cable	In any format	

APPROVED

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(Customer)

REPORT
_________ No. _____________
City: ______________________
Acceptance Report for Automation Systems Handover to Operations

Grounds: Presentation of automation systems for commissioning by:

____
(Name of Startup-and-adjustment Agency)

Filled out by Committee:

____
(Representative of Customer, name, position)

____
(Representatives of Startup Service Company; names, positions)

The Committee has verified the suitability of the following automation systems for operation:

____
(Titles of automation systems)

It has been found that the automation systems listed above:

1. Have supported continuous operation of process equipment in the established mode during an integrated trial run period of ______________ with a positive result.
   (time)
2. Conform to the specifications and the requirements of:

____
(Title of standard, regulatory document or project)

Based on the data thus obtained, the Committee resolves:

1. To accept for operation the automation systems presented for commissioning.
2. To give a grade of ___________________ to the start-up job performed.

Attachments to the Report:
1. _________________
2. _________________
3. _________________

Signed by:

For Customer	**For Startup-and-adjustment Agency**
____________________________	______________________________________
(signature}	*(signature)*

APPENDIX 2
Recommended

AUTOMATION SYSTEMS PIPELINES GROUPS AND CATEGORIES BY CONVEYED MEDIUM AND OPERATING PRESSURE

Piping Function	Conveyed Medium and Its Parameters	Piping Group	Piping Category
Pneumatic and hydraulic automation command and feeding systems; heating and cooling piping	Water or air	V	U
Hydraulic automation command systems	Oil at $P_{oper} \le 1.6$ MPa ($16\ kgf/cm^2$)	A_b	II
	Oil at $P_{oper} > 1.6$ MPa ($16\ kgf/cm^2$)		I
Impulse, drainage and auxiliary piping	Air, water, steam, inert gases, non-hazardous and noncombustible gases and liquids at P_{oper} up to 10 MPa ($100\ kgf/cm^2$)	V	In accordance with SN 527-80
	Other gases and liquids within the scope of SN 527-80	In accordance with SN 527-80	

APPENDIX 3
Recommended

INSTALLATION OF AUTOMATION SYSTEMS: TERMS AND DEFINITIONS

1. Embedded structure (embedded piece): a part or an assembly unit permanently embedded into the building structures (channel or angle bar, sleeve, pipe, slab with sleeves, ducts with sand closures, ceiling-suspended structures, etc.) or into the process vessels or piping (bosses, fittings, pockets or sleeves for devices, etc.).

2. Piping: all pipes and pipe cables (pneumatic houses) with their joints, attachments, protective devices and fittings.

3. Impulse communication line: piping that connects an sampling point with an instrument, sensor or controller. Its purpose is to transmit the impact of monitored or controlled process fluid on sensitive components of instruments, sensors or controllers, either directly or via a separating media.

Impulse communication lines also include capillary tubes of filled-system thermometers and temperature controllers that connect thermally responsive elements (thermal bulbs) to filled measuring devices of the instruments or controllers.

4. Command communication line: piping that connects individual functional units of automatic control systems (sensors, switches, secondary instruments, transducers, computing, regulating and controlling devices, actuators). Its purpose is to transmit command signals (air, water or oil pressure) from transmitters to receivers.

5. Supply line: piping that connects instruments and automation hardware to the sources of fluid (pumps, compressors and other sources). Its purpose is to supply automation devices and hardware (sensors, transducers, computing, regulating and controlling devices, amplifiers, positioning devices) with liquid (water, oil) or gas (air) under an excess pressure varying within a predetermined range, used as a carrier of auxiliary energy for the handling and transmission of command signals.

6. Heating line: piping used to supply (and remove) heat carriers (air, water, steam, etc.) to (from) the heating of intakes, instruments, automation devices and hardware, control boards and flows in pulse, control and other piping.

7. Cooling line: piping used to supply (and remove) coolants (air, water, brine, etc.) to (from) cooling devices of sampling points, sensors, actuators and other automation hardware.

8. Auxiliary line: piping used to:

(a) transfer protective fluids to impulse communication lines in order to create counter-current flows therein for protection against corrosion, congestion, clogging and other phenomena damaging sampling points, instruments, automation hardware or the impulse lines themselves or upsetting their normal operation;

(b) transfer fluids to devices, controllers and impulse communication lines for their periodic flushing or purging during their operation;

(c) establish a parallel flow of a product part taken off a process vessel or piping for analysis so as to accelerate the sample delivery to a remote instrument (e.g. an analyzer of liquid petroleum products, etc.).

9. Drainage line: piping used to discharge the products of flushing or purging (gases and liquids) from instruments, controllers, impulse and command communication lines to designated receivers (special receptacles, atmosphere, sewers, etc.).

10. Pipe block: a number of pipes with required length and configuration, secured in a certain position, fully prepared for connection with adjoining units of piping.

APPENDIX 4
Recommended

LIST OF PROCESS PIPELINES PRINCIPAL SPECIFICATIONS AND TECHNICAL DOCUMENTATION

Code	Document	Additional Data
PUG-69	Rules for the Construction and Safe Operation of Pipelines for Combustible, Toxic and Liquefied Gases	Approved by the USSR State Mining Safety Inspectorate (USSR Gosgortekhnadzor) and coordinated with the USSR State Committee for Construction (USSR Gosstroi) in 1969
—	Safety Rules for Production Processes in the Basic Chemical Industry	Approved by USSR Gosgortekhnadzor, the Ministry of Chemical Industry (Minkhimprom) and the Central Committee of the Trade Union of the Oil, Chemical and Gas Industry and coordinated with USSR Gosstroi in 1979
PBVKhP-74	Safety Rules for Chemical and Petro-chemical Production Processes with Explosion or Explosion & Fire Hazards	Approved by USSR Gosgortekhnadzor and coordinated with USSR Gosstroi in 1974
—	Safety Rules for the Acetylene Manu-facturing	Approved by USSR Gosgortekhnadzor and Minkhim-prom and coordinated with USSR Gosstroi in 1977
PBKh-83	Safety Rules for Chlorine Manufactur-ing, Storage and Transportation of	Approved by USSR Gosgortekhnadzor and Minkhim-prom and coordinated with USSR Gosstroi in 1973; amended in 1983
—	Safety Rules for the Inorganic Produc-tion Processes in Nitrogen Industry	Approved by USSR Gosgortekhnadzor and Minkhim-prom and coordinated with USSR Gosstroi in 1976
—	Safety Rules for Synthetic Ethyl Alcohol Manufacturing	Approved by USSR Gosgortekhnadzor and the USSR Ministry of Petrochemical Industry (USSR Minneftek-himprom) and coordinated with USSR Gosstroi in 1981
—	Safety Rules for Gas Equipment at Fer-rous Metallurgy Plants	Approved by USSR Gosgortekhnadzor and the USSR Ministry for Ferrous Metallurgy (USSR Minchermet) and coordinated with USSR Gosstroi in 1969
—	Safety Rules for the By-product-coke Industry	Approved by USSR Gosgortekhnadzor and USSR Minchermet and coordinated with Gosstroi USSR in 1981.
VSN 10-83 Minkhimprom	Instructions for Design of Gaseous-oxygen Pipelines	Approved by Minkhimprom and coordinated with USSR Gosstroi, USSR Gosgortekhnadzor and The Chief Ad-ministration of Fire Safety of the USSR Ministry of Home Affairs (GUPO of USSR MVD) in 1983
—	Safety Rules for Gas Equipment	Approved by USSR Gosgortekhnadzor and coordinated with USSR Gosstroi and the All-Union Central Council of Trade Unions in 1979
GOST 12.2-060-81 (CMEA Stan-dard 2083-80)	Occupational Safety Standards System Acetylene Pipelines. Safety Requirements	Approved by the USSR State Committee for Standards — —

APPENDIX 5
Obligatory

REQUIREMENTS TO THE INSTALLATION OF DEVICES ON PROCESS VESSELS AND PIPELINES

1. Constriction devices shall be installed in pipelines in accordance with the design drawings, standards and the “Rules for Measuring Flow Rates of Gases and Liquids with Standard Constriction Devices” as approved by Gosstandart.

2. Prior to the installation of a constriction device, the following shall be verified against the project data and delivery list:

(a) pipeline diameter and the place of installation;

(b) grade of the constriction device material;

(c) flow direction and correctness of "plus" and "minus" designations marked on the body of the constriction device.

3. The constriction device shall be mounted so that in the operating condition the designations on its body are open to view.

Should the compliance with this requirement be not feasible, a tag with the data shown on the constriction device body shall be attached to the constriction device.

4. The following key technical requirements shall be complied with in the installation of constriction devices on pipelines:

(a) the lengths of the straight sections of the pipeline upstream and downstream of the constriction device shall match the values specified in the technical documentation;

(b) flanges shall be mounted so that the flange faces are parallel to each other and perpendicular to the axis of the pipeline.

The distance between the flange planes shall be equal to the embedding length of the constriction device, taking into account the space for gaskets on both sides;

(c) upstream the constriction device, the pipeline shall be cleaned of dirt, traces of welding and internal projections that could distort the shape of the stream; the internal surface of the pipeline on a length equal to two external pipeline diameters, upstream and downstream of the constriction device, shall have no projections or irregularities visible to the naked eye (dents, welding flashes, etc.);

(d) strict axial alignment of the pipeline and the constriction device and the perpendicularity of the end face of the constriction device to the pipeline axis shall be ensured;

(e) the direction of the arrow on the constriction device shall match the flow direction of the medium in the pipeline; the sharp edge of the diaphragm and the rounded part of the nozzle or Venturi tube shall be turned against the flow direction of the fluid being measured;

(f) sealing gaskets shall not extend into the internal space of process pipelines.

5. Embedded structures for the installation of pressure takeoffs and the takeoffs from constriction devices on horizontal and inclined pipelines shall be mounted in the following positions:

(a) on the top of gas and air lines;

(b) on the side of liquid and steam lines.

6. Flowmeters (rate meters, rotameters, etc.) built into process pipelines shall be installed in accordance with the following key technical requirements:

(a) meters shall be installed when the pipeline is fully mounted and thoroughly cleaned; the pipeline and the meter shall be tested at the same time;

(b) rate meters shall be installed in the straight sections of pipelines, at points specified in the project;

(c) the flange faces shall be parallel to each other and perpendicular to the axis of the pipeline.

7. Bypass lines with appropriate stop valves shall be provided at the places of installation of rotameters, volume and rate meters on process pipelines.

8. When a meter caliber is less than the pipeline diameter, the meter shall be installed between two tapering adapter sleeves, with stop valves in the main pipeline upstream and downstream of the tapering sleeves. Using adapter flanges is not allowed.

9. The floats of level gages of all types shall be set so as to provide for the free movement of the float and its cable without jamming. The float travel shall be either equal to or slightly exceed the maximum measured level.

10. Direct-action temperature and pressure controls shall be installed on process pipelines so that the direction of the arrow marked on their bodies match the flow direction of the measured medium.

11. The length of the straight sections of a pipeline downstream and upstream of control valves shall be equal to the value specified in the project.

12. When the nominal bore of a control valve does not match the pipeline diameter, the valve shall be installed by means of two tapering adapter sleeves.

Using adapter flanges is not allowed.

13. All automation devices and hardware mounted on or built into process vessels and pipelines (direct-action controls, constriction devices, control valves, meters, etc.) shall be installed after the pipelines and vessels are cleaned and flushed and before their hydraulic testing for strength and tightness, and, in case of oxygen lines, after their degreasing.