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**Code for Construction and Quality Acceptance of
Automation Instrumentation Engineering
自动化仪表工程施工及质量验收规范**

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Code for Construction and Quality Acceptance of Automation Instrumentation Engineering

1 General Provisions

1.0.1 This Code is formulated with a view to improving the construction technique and management level of automation instrumentation engineering, unifying the construction quality acceptance method of automation instrumentation engineering and guaranteeing the engineering quality.

1.0.2 This Code is applicable to the construction and quality acceptance of automation instrumentation engineering.

1.0.3 This Code is not applicable to the automation instrumentation installation engineering at places where explosive substances are manufactured, stored or used as well as the transportation tools or in mines.

1.0.4 Construction of automation instrumentation engineering shall be in accordance with those specified in the design document and this Code.

1.0.5 Where it is necessary to revise the design document or use other material as substitute, it shall be agreed by the original design organization and also be issued with relevant documents.

1.0.6 The instrumentation and instrumentation tap directly installed on equipment or piping shall be constructed in accordance with the requirements on specialization and division of work given in the design document.

1.0.7 Equipment and materials adopted in automation instrumentation engineering shall comply with relevant current standards of the Nation and shall be with the product quality evidentiary documents.

1.0.8 The welding construction in automation instrumentation engineering shall be in accordance with those specified in the current national standards "Code for Construction of Field Equipment, Industrial Pipe Welding Engineering" (GB 50236), "Code for Acceptance of Field Equipment, Industrial Pipe Welding Construction Quality" (GB 50683) and "Code for Acceptance of Construction Quality of Steel Structures" (GB 50205).

1.0.9 Construction and quality acceptance of automation instrumentation engineering not only shall comply with this Code, but also shall comply with those in the current relevant standards of the nation.

2 Terms

2.0.1 Automation instrumentation

A general term of instrumentation units and instrumentation systems which are used to measure and control the measured and manipulated variables.

2.0.2 Measurement

A group of operations with purpose to determine the values.

2.0.3 Control

Purposed activities on system or in system to achieve the specified objective.

2.0.4 Field instrument

The instrument installed outside the field control room and generally nearby the measured object and controlled object.

2.0.5 Detecting and measuring instrument

The instrument used to determine the quantity value or the characteristics and state of the measured variable.

2.0.6 Transducer

The unit receiving the information of input variable and converting them to output variable of the same type or other type in accordance with certain law.

2.0.7 Converter

The unit receiving signals of one type and converts them to signals of other type for output in accordance with certain law.

2.0.8 Transmitter

The transducer of which the output is normalized signal.

2.0.9 Display instrument

The instrument displaying the values of quantity measured.

2.0.10 Control instrument

The instrument used to control the manipulated variables.

2.0.11 Actuator

The unit in the control system, which directly changes the manipulated variable via the action of its mechanism.

2.0.12 Sensor

The primary element in the measuring chain, which converts the input variables to the signals suitable for measurement.

2.0.13 Tap

The elements such as dedicated pipe fittings, outlet and junction valve set on the measured object for purpose of installing and connecting the sensor.

2.0.14 Measuring point

The specific positions where the measured variable is detected and measured, i.e., the field installation positions of sensor and tap.

2.0.15 Control system

The system reaching the established status via precision guidance or via manipulation of several variables. The instrument control system consists of such hardware as instrumentation apparatus, instrument piping, instrument power and auxiliary facilities as well as the relevant

3 Basic Requirements

3.1 Technical Preparation of Construction

3.1.1 The construction organization design and construction scheme of automation instrumentation engineering shall have already been approved. As for the complicated and critical installation and test work, construction technical scheme shall be prepared.

3.1.2 Prior to the construction of automation instrumentation engineering, the construction organization shall participate in the joint review on construction drawing design document.

3.1.3 The technical safety measures during the construction of automation instrumentation engineering shall be in accordance with those specified in this Code and in the current relevant standards of the Nation.

3.1.4 Prior to the construction of automation instrumentation engineering, technical disclosure shall be carried out to the construction personnel.

3.1.5 The monitoring and measuring equipment shall be calibrated and (or) verified at a specified time interval or before use.

3.2 Quality Control

3.2.1 At the construction site, sound quality management system, quality management system and corresponding construction technical standards shall be available.

3.2.2 As for automation instrumentation engineering, the construction process shall be carried out with quality control, and inspection shall be carried out according to procedures and quality control points.

3.2.3 Handing-over inspection on construction procedures shall be carried out between the automation instrumentation profession and relevant professions.

3.2.4 As for the automation instrumentation engineering, the engineering division, determination of quality control points, quality inspection and acceptance record form all shall be defined in the construction scheme or quality plan.

3.2.5 Quality acceptance of automation instrumentation engineering shall be carried out on basis of qualified self-inspection of construction organization.

3.2.6 The quality of inspection items shall be inspected and accepted according to dominant items and general items.

3.3 Division for Acceptance of Construction Quality

3.3.1 Construction quality acceptance of instrumentation engineering shall be divided according to unit project, subsection project and subitem project.

3.3.2 Unit project shall be composed of subsection projects. Where a unit project only consists of instrumentation subsection project, this subsection project shall be one unit project.

3.3.3 Subsection project shall be composed of subitem projects. The instrumentation projects in one unit project shall be one subsection project.

3.3.4 Division of subitem project shall meet the following requirements:

1 Where the instrumentation engineering is the subsection project of unit projects such as plant area, workshop, station area and unit, it shall be divided into installation of instrument panels, cabinets and cases, instrument installation, instrumentation test, installation of instrumentation line, installation of instrumentation piping, degreasing, grounding, protection and the like according to the instrument category and installation work contents.

2 Instrumentation subsection project of the main control room shall divided into installation of panels and cabinets, installation of power supply device, installation of instrumentation line, grounding, and system hardware and software experiment, etc.

3 Instrument loop test and system test shall be included in the instrumentation subsection project of the main control room.

4 In large- and medium-scale civil building engineering, subitem projects shall be divided according to storeys, bays or intervals, and the line installation and instrumentation test may be separately deemed as subitem projects.

5 The small-scale engineering may be divided into such subitem projects as installation of field instrument and line piping, control room instrument installation and instrumentation test, etc..

6 Where the large- and medium-sized unit or equipment is supplied in full sets by the manufacturer and also is deemed as one subsection project, the installation and test of its mating instrument and control system may be deemed as one subitem project.

3.4 Inspection Quantity

3.4.1 As for the inspection quantity and random inspection proportion specified in this Section, the inspection quantity may be increased under special circumstances.

3.4.2 The installation of taps used for high-temperature, low-temperature, high-pressure, combustible, explosive, toxic and harmful materials as well as the installation of taps of the metering, safety monitoring alarm and interlock systems shall be inspected by 100%. Other taps shall be randomly inspected by 30% and no less than one piece respectively according to purpose classification such as temperature, pressure, flow, level and analysis.

3.4.3 The installation of instruments used for high-temperature, low-temperature, high-pressure, combustible, explosive, toxic and harmful materials as well as the installation of instruments of the metering, safety monitoring alarm and interlock systems shall be inspected by 100%. Other instruments shall be randomly inspected by 30% and no less than one set (piece) respectively according to their types.

3.4.4 The installation of the separately set instrument panels, cabinets and cases shall be randomly inspected by 20% and no less than one set. The installation of the instrument panels, cabinets and cases that are set in rows shall be randomly inspected by 30% and no less than one row.

3.4.5 Installation of the power supply devices of instruments shall be inspected by 100%.

3.4.6 The installation of instrumentation line outside the explosive and fire hazardous areas shall be randomly inspected by 30% according to system.

3.4.7 The installation of instrumentation piping used for high-temperature, low-temperature, high-pressure, combustible, explosive, toxic and harmful materials as well as the installation

4 Inspection and Preservation of Instruments and Materials

4.1 Inspection and Preservation of Instruments and Materials

4.1.1 The instruments and materials, after arriving at the site, shall be inspected or verified.

4.1.2 The unpacking visual inspection of instruments and materials shall meet the following requirements:

- 1** The package and sealing shall be in good condition.
- 2** Type, specification, material and quantity shall be consistent with those specified in the design document, and the instruments and materials shall be free from damage and shortage.
- 3** Nameplate, accessories and spare parts shall be complete.
- 4** Technical document and quality certificate of the product shall be complete.

4.1.3 In addition to complying with those specified in Article 4.1.2 of this Code, the unpacking inspection of instrument panels, cabinets and cases also shall meet the following requirements:

- 1** The surface shall be flat and smooth, and the coating on internal and external surfaces shall be in good condition.
- 2** The external dimensions, the size of installation hole, as well as the type and specification of all instruments, power supply devices and their components in panels, cabinets and cases shall meet the requirements of design document.

4.1.4 In addition to complying with those specified in Article 4.1.2 in this Code, the unpacking inspection of radioactive instrumentation also shall meet the following requirements:

- 1** The mark for radioactive source shall be intact, firm and distinct.
 - 2** The radioactive source shall be at the lock state.
- 4.1.5** In addition to complying with those specified in Article 4.1.2 in this Code, the unpacking inspection of analyzing instrument also shall meet the following requirements:
- 1** The name, quantity and sample concentration of the mating standard test samples for analyzing instrument shall meet the requirements of design document.
 - 2** The test sample shall be well packed without leakage.

4.1.6 Performance test of instruments shall be in accordance with those specified in Chapter 12 of this Code.

4.1.7 The instruments and materials disqualified upon inspection shall not be used and shall be well marked and isolated.

4.1.8 After being qualified upon inspection, the instruments and materials shall be preserved according to the required preservation conditions, and their marks shall be obvious and distinct.

4.1.9 During construction, the installed instruments and materials shall be protected.

4.2 Quality Acceptance

4.2.1 Quality inspection for acceptance of instruments and materials shall be in accordance

5 Tap Installation

5.1 General Requirements

5.1.1 The structural dimension, material and installation position of tap shall meet the requirements of design document.

5.1.2 The tap on equipment shall be installed at the same time as the equipment manufacturing, the tap on piping shall be installed at the same as the piping fabrication and installation.

5.1.3 The hole opening and welding work on tap installed on equipment or piping must be carried out before the anti-corrosive, lining and pressure test of equipment or piping.

5.1.4 When opening hole on high-pressure, alloy steel or nonferrous metal equipment and piping, the mechanical processing method shall be adopted.

5.1.5 As for tap prone to damage, protective measures shall be taken during installation.

5.1.6 The tap installed on masonry and concrete deposit shall be buried at the same time as building or pouring, the buried depth and exposed length shall meet the design and technological requirements. Where the tap cannot be installed at the same time as building or pouring, installation hole shall be left. The surrounding space of installation hole shall be filled and plugged compactly and tightly with the material specified in design document.

5.1.7 When installing tap, neither hole opening nor welding is allowed at weld or its edge.

5.1.8 Where the equipment and piping are with heat insulating layer, the installed tap shall be exposed out of the heat insulating layer.

5.1.9 Connection of tap valve with equipment or piping should not be adopted with ferrule-type connector.

5.1.10 After the tap installation is completed, the tap shall be carried out with pressure test simultaneously with equipment and piping.

5.2 Temperature Tap

5.2.1 Temperature tap installed on piping shall meet the following requirements:

1 Where the tap is installed perpendicular to the piping, its axis shall perpendicularly intersect with the piping axis.

2 Where the tap is installed with an inclination angle with the piping, it should be opposite to the material flow direction, and its axis shall intersect with the piping axis.

3 Where the tap is installed at a turn of piping, it should be opposite to the material flow direction, and its axis shall coincide with the axis of process piping.

5.2.2 Where the tap is installed on an expansion pipe, thus the installation mode of the expansion pipe shall meet the requirements of design document.

5.3 Pressure Tap

5.3.1 Installation position of pressure tap shall be selected at the position where the measured material stream is steady.

5.3.2 Where the pressure tap and temperature tap are installed on one same pipe section, the pressure tap shall be installed at the upstream side of temperature tap.

5.3.3 The end of pressure tap shall not be beyond the inner wall of equipment or piping.

5.3.4 When detecting and measuring the pressure of such turbid material containing dust, solid particle or deposit, the tap shall be installed slantly upward if it is installed on the vertical or slant equipment and piping, and the tap shall be installed with a sharp angle along the material stream if it is installed on horizontal piping.

5.3.5 When installing pressure tap on horizontal or slant piping, the direction of pressure measuring point shall meet the following requirements:

1 When measuring the gas pressure, the measurement shall be conducted at the upper half of the piping.

2 When measuring the liquid pressure, the measurement shall be conducted within scope of $0^{\circ}\sim 45^{\circ}$ included angle between the lower half part and the horizontal center line of piping.

3 When measuring the steam pressure, the measurement shall be conducted at the upper half of piping as well as within scope of $0^{\circ}\sim 45^{\circ}$ included angle between the lower half part and the horizontal center line of piping.

5.4 Flow Tap

5.4.1 The minimum length of the straight pipe sections at the upstream or downstream of flow tap shall meet the requirements of design document.

5.4.2 If there is no relevant requirement given in the design document, the minimum length of straight pipe sections at the upstream or downstream of orifice plate, nozzle and venturi tube shall meet those specified in Appendix B of this Code.

5.4.3 No other tap or sensor shall be set within the range of the specified minimum length of straight pipe section, and the internal surface of the pipe at the straight pipe section shall be clean without pit or protrusion.

5.4.4 Where thermometer is installed at the upstream of throttling element, the distance of straight pipe section between thermometer and throttling element shall meet the following requirements:

1 It shall not be less than $5D$ if the diameter of the plug bush or bushing of thermometer is less than or equal to $0.03D$ (D is the inside diameter of piping).

2 It shall not be less than $20D$ if the diameter of the plug bush or bushing of thermometer is between $0.03D$ and $0.13D$ (D is the inside diameter of piping).

5.4.5 Where thermometer is installed at the downstream of throttling element, the distance of straight pipe section between thermometer and throttling element shall not be less than five times of the inside diameter of piping.

5.4.6 Where the throttling set is installed on the horizontal or slant piping, the direction of pressure tapping shall meet the following requirements:

1 When measuring the gas flow, the measurement shall be conducted at the upper half of the piping.

2 When measuring the liquid flow, the measurement shall be conducted within scope of $0^{\circ}\sim 45^{\circ}$ included angle between the lower half part and the horizontal center line of piping.

1 Before installation, the manufacturing dimension shall be rechecked.

2 It shall be vertically installed, and the center point shall coincide with the normal liquid level.

5.5.4 The single-chamber balancing vessel should be vertically installed and the installation elevation shall meet the requirements of design document.

5.5.5 When installing and fixing compensatory balancing vessel, measures avoiding the damages due to thermal expansion of the measured vessel shall be taken.

5.5.6 The flange stub pipe installed with float ball liquid gauge shall allow the float ball move freely within the range of full range.

5.5.7 The measuring tube of electrical contact water level meter shall be vertically installed, and the central axis of zero level electrode in the measuring tube shall be at the same height as the zero level line of the measured vessel at the normal working condition.

5.5.8 The installation position of the tap of static level gauge shall be far away from the liquid inlet and outlet.

5.5.9 The tap of heavy hammer level meter shall be vertically installed between the center and side wall of vessel.

5.5.10 The positions of taps of radar, ultrasonic and radio frequency admittance level meters shall meet that no shelter exists in the area of sensor and the measured object and also shall be far away from material inlet and outlet.

5.6 Analysis Tap

5.6.1 The analysis tap shall installed at the position where the pressure is stable, is able to sensitively reflect the actual compositional variation and obtain typical analytical samples. Around the sampling point, there shall be no laminar flow, vortex flow, air infiltration, dead corner, material blocking, or chemical reaction during production process.

5.6.2 When installing analysis tap on horizontal or slant piping, the installation direction shall meet those specified in Article 5.3.5 of this Code.

5.6.3 Where the analyzed gas contains solid or liquid impurities, the elevation angle between the axis of tap and the horizontal line shall be larger than 15°.

5.7 Quality Acceptance

5.7.1 The generally required quality acceptance for tap installation shall be in accordance with those specified in Table 5.7.1.

6 Instrument Installation

6.1 General Requirements

6.1.1 The Installation position of field instrument shall meet the requirements of the design document; in case it is not specified in the design document, it shall meet the following requirements:

- 1** At the places of sufficient sun light and easy for operation and maintenance.
- 2** The height between the centerline of the instrument and the operational ground should be 1.20 m~1.50 m.
- 3** The display instrument shall be installed at the places where are easy for observing display value.
- 4** The instrument shall not be installed at the places where there is vibration, damp, strong electromagnetic field interference, high temperature, intense temperature change and corrosive gas and is liable to mechanical damage.

5 The sensor shall be installed at the places where real input variables can be shown.

6.1.2 The instrument installed on equipment and piping shall be installed at the position specified by the design document.

6.1.3 Before instrument installation, the item number, model, specification, material and accessories shall be checked according to the design document.

6.1.4 Instrument shall not be knocked or vibrated during the installation process. After installation, the instrument shall be firm and right. The connection and fixing position of the instrument and the equipment, piping and member shall be stressed uniformly without any abnormal external force.

6.1.5 For instrument specified by the design document for degreasing shall not be installed until they are degreased and qualified.

6.1.6 The instrument directly installed on piping should be installed after purging of piping. Where instrument is installed simultaneously with piping, the instrument shall be removed before the piping purging.

6.1.7 For the instrument directly installed on equipment or piping, after finishing the installation, the pressure test shall be carried out.

6.1.8 For the instrument junction case (box), the cover and intake shall be sealed timely during the construction.

6.1.9 Sealing measure shall be taken for instrument junction case (box) and the intake should not be upward.

6.1.10 When insulation measurement is carried out on the instrument and the power supply device of instrument, measures shall be taken to avoid any damage to weak current apparatus and electronic elements.

6.1.11 The nameplate of instrument and the mark of instrument item number shall be complete, firm and clear.

6.1.12 For the capillary pipe of instrument, protective measure shall be taken for laying, its bending radius shall not be less than 50 mm; in case the intense ambient temperature changes, heat insulation measure shall be taken.

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