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Code for Construction Quality Inspection & Acceptance Specification of Petrochemical Static Equipment Installation

石油化工静设备安装工程施工质量验收规范

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1 General Provision

1.0.1 This code is formulated with a view to strengthen the quality control of petrochemical construction work, unify the requirements of installation work construction acceptance for petrochemical static equipment (hereinafter referred to as “equipment”) and guarantee the quality for equipment installation.

1.0.2 This code is applicable to the construction quality inspection & acceptance for equipment installation of petrochemical construction work integral installation equipment and on-site welding equipment and their special internal components, safety accessories, adjunctive ladder and platform of equipment.

This code is not applicable to the construction quality inspection & acceptance for vertical type cylindrical tank, gas tank and nonmetal equipment.

1.0.3 Overall inspection is required for all articles except the ones which are indicated with the inspection quantity in this code.

1.0.4 Not only the requirements stipulated in this standard, but also those in the current relevant ones of the nation shall be complied with for the construction quality inspection and acceptance for the equipment installation.

3 Basic Requirements

3.1 Qualification Requirements

3.1.1 The construction organizations that are employed in equipment installation, on-site welding and nondestructive testing works shall be staffed with the corresponding professionals who are competent for the works they are in charge with.

Check method: Check the enterprise qualification certificate.

3.1.2 The staff who is employed in equipment welding and nondestructive inspection work shall take the examination according to the current national standard and provision requirements and obtain the relevant certificates, and the competent staff can be employed in the works which are corresponding to their qualifications.

Check method: Check the staff's qualification certificate.

3.2 Counting Devices

3.2.1 The counting device shall be calibrated, adjusted or verified, and in the qualified state, the device also shall be used in the effective and determining period.

Check method: Check the test marks of the counting device.

3.2.2 When the cycle certified counting device is transferred, the calibrating/adjusting certificate shall be required.

Check method: Check the verification certificate of the counting device.

3.3 Supervision and Inspection for Pressure Vessel Installation Work

3.3.1 As for the pressure vessel on-site welding and installation work, the employed construction organization shall notify the local special equipment safety supervisory department for inspection in writing before commencement.

Check method: Check "the Special Equipment On-site Welding and Installation Notice".

3.3.2 As for the pressure vessel on-site welding and installation work, the employed construction organization shall accept the supervision and inspection from the inspection and detection organization which takes the qualification on the work place.

Check method: Check "The Installation Quality Certificate of Boiler Pressure Vessel", and "Safety Performance Supervision Testing Certificate for Boiler Pressure Vessel Products".

3.4 Technical Documents of Equipment Installation

3.4.1 The equipment installation shall be equipped with the following technical documents:

1 After pickling and passivating and it is washed, the 0.01% methyl orange extract solution shall be dropped on the equipment surface which is pickled and passivated, it is eligible that no redness appears.

2 The inspection of passivating film shall be carried out on the test panel which is carried out the surface-treatment under the same conditions, dissolve 10g red prussiate of potash into 500mL water, add 10mL concentrated sulfuric acid and 20mL concentrated hydrochloric acid, dilute it to 1000mL and make it act as test solution, then drop it on the washed surface, it is eligible that no deep-blue appears in 0.5 ~ 1min.

Check method: Visual check.

4.9.2 As for the austenitic stainless steel equipment, the chloride ion content in flashing water shall not be more than 25mg/L.

Check method: Check the report of chloride ion content in water.

4.9.3 The equipment degreasing quality check method and approval standard shall meet the following requirements:

1 Direct method:

1) Wipe the in-wall and internal components for the equipment in clean and dry white-filter paper, the Lipin shall not be on the paper.

2) In the UV-lamp whose wavelength is 320~380nm, the hyacinthine fluorescence shall not be on the degreasing surface.

2 Indirect method:

1) When steam is used to blow and clean the degreasing, a little steam condensate shall be filled in the vessel, and some pure camphor whose granularity is less than 1mm shall be pulled into the vessel, it is eligible that camphor keep gyrating.

2) When the organic solvent or aqua fortis is used for degreasing, the solution or acid which has been degreased shall be took away for analyzing the oleaginous or organic matter contents, their contents shall not be more than 0.03%.

4.9.4 The ware trace or alkali trace must not be on the aluminium equipment after the chemical cleaning.

Check method: Visual check.

4.9.5 After the chemical cleaning is adopted for the titanium equipment, the red prussiate of potash or ($C_{12}H_3N_2$) solution shall be spread (or sprayed) or the filter papers which contain aforesaid solutions shall be attached on the equipment surface, the solution or filter paper shall not be discolored.

4.9.6 The interior shall be unscrambled before the equipment is seal, the adhesive materials and sundries shall not be on it.

5 On-site Welding for Equipment

5.1 General Requirements

5.1.1 Not only the requirements stipulated in Article 3.5 of this code, but also the following materials shall be equipped with:

1 Report of welding procedure qualification and guidebook of welding work.

2 Quality supporting documents of welding material.

3 Arrangement drawing of equipment.

Check method: Check the related materials.

5.1.2 The welding procedure qualification of the pressure vessel shall be implemented according to the current relevant standard "Welding Procedure Qualification for Steel Pressure Vessels" JB 4708, the welding procedure qualification of non-pressure vessel may comply with the current relevant standard of the national "Code for Construction and Acceptance of Field Equipment, Industrial Pipe Welding Engineering" GB 50236. The welding procedure qualification of low temperature pressure vessel shall comply with the current national standard "Steel Pressure Vessels" GB 150 and the low temperature Charpy Impact Test (V-notch) shall be added for the welding seam and heat-affected zone.

Check method: Check the report of welding procedure qualification.

5.1.3 The designations like material code, assembling (arranging) serial number on the assembling component shall be in accordance with the arranging drawing.

Check method: Inspect on-site according to the arranging drawing.

5.1.4 If the equipment is assembled on the foundation, the concrete foundation shall meet the requirements of Article 4.1.1 and 4.1.6 in this code.

5.1.5 The welding rods shall be baked according to the requirements of the specifications or welding technology documents before they are used.

Check method: Check the record of welding rods baking.

5.1.6 The spherical tank welding rods and flux-cored wires shall be re-inspected for the diffusible hydrogen content of deposited metal according to the batch number; the diffusible hydrogen content shall meet those specified in Table 5.1.6 after baked. The diffusible hydrogen content test shall meet the relevant requirements of current national standard "Methods for Determination of Diffusible Hydrogen in Deposited Metal of Covered Electrodes" GB/T 3965.

Check method: Check the re-inspection "report of diffusible hydrogen content of welding rods".

Check method: Visual check.

5.3.12 The assembly of support and skirt support shall meet the following requirements:

1 The permissible variation of planeness of the pedestal which arrived in section is 3mm after welded; the permissible variation of center distance of anchor bolt holes at the interface is ±2mm; the permissible variation of center circle diameter of anchor bolt hole is ±2mm.

2 The permissible variation of pedestal loop, skirt support and equipment noumenon axial line is 5mm.

3 At the connection section of support, skirt support and equipment noumenon, the opening shall be set on the support and skirt support if there is any splicing weld.

Check method: Inspect on-site with steel rule according to the arranging drawing.

5.3.13 The difference between the maximal shell internal diameter and minimal shell internal diameter shall be less than 3% of the design internal diameter of spherical tank and not larger than 50mm after the spherical tank is assembled. The difference between the maximal shell internal diameter and minimal shell internal diameter shall be in accordance with the following requirements after other equipment are assembled:

1 The difference of the maximal shell internal diameter and the minimal shell internal diameter on a same cross section shall not be larger than 1% of the internal diameter of this cross section and not larger than 25mm.

2 When the checked cross section is located at the one time open pore internal diameter scale of the open pore centre, the difference of the maximal internal diameter and the minimal internal diameter on the cross section shall not be larger than the sum of 1% of the cross section internal diameter and 2% of the open pore internal diameter, and not larger than 25mm.

Check method: Measure with pull-wire or check the inspection report.

5.4 Welding

5.4.1 When one of the following situations appears in the welding environment, the welding work must not be carried out if no effective protection measure is adopted:

1 In the situation of welding rod arc welding, the wind speed is larger than 8m/s.

2 In the situation of shielded arc welding, the wind speed is larger than 2m/s.

3 The relative humidity is larger than 90%.

4 Raining and snowing environment

5 The welding temperature is lower than −20℃.

Check method: Measure on-site with anemoscope, electron temperature meter, hygrometer

Check method: Visual check.

5.4.7 The workpieces like lifting eye, fixture that welded with equipment shell shall meet the following requirements:

1 The material shall be same to the equipment shell or in the same classification.

2 Adopt regular welding technology or qualified welding technology.

3 When the fillet weld of the junction panel and equipment shell is continuous weld, the ventholes shall be put apart at the position where rainwater is difficult to flow in.

4 When the equipment shell weld requires preheat, the preheat shall be carried out for the workpiece weld, the upper value shall be adopted for the preheating temperature, and the preheat range should not be less than 150mm of workpiece periphery.

5 After the heat treatment and withstand voltage test is carried out, the workpiece shall not be welded on the equipment noumenon.

6 The base material shall not be damaged when dismantling, the residual traces shall be burnished and trimmed after dismantling, the depth of trimming shall not be larger than 5% of the steel thickness of the section, and not larger than 2mm, or it shall be welded up.

Check method: Check the related data.

5.4.8 The welding repair shall meet the following requirements:

1 The welding repair shall be carried out according to the qualified welding technology.

2 The trimmed depth of flaw on the weld surface shall not be larger than 5% of steel thickness of this section and not larger than 2mm, and it shall be burnished smoothly or trimmed into 1: 3 or lower flat gradient.

3 If the preheat is required in welding repair, the upper limit shall be adopted for the preheating temperature.

4 The weld quality requirement of repair is the same to the original weld.

Check method: Check the related data.

5.5 Heat Treatment

5.5.1 When the heat-treatment is carried out in furnace internal heating method for the whole or subsection of on-site welding equipment, it shall meet the requirements of current national standard “Steel Pressure Vessels” GB 150.

Check method: Inspect on-site as required in GB 150.

5.5.2 The weld of on-site welding equipment may be carried out in differential heat treatment method. The weld centre shall be taken as base for heat treated heated perimeter, each side of the butt joint weld shall not be less than 2 times of steels thickness; each side of corner joint weld shall not be less than 6 times of steels thickness. The range of 100mm out of

documents.

Check method: Check the report of nondestructive testing.

5.7.3 Except the pressure vessels stated in Article 5.7.2 of this code, the partial radiographic or ultrasonic testing shall be carried out for the soldered joint of Grade A and B. The check method shall be carried out as required in design documents. The inspected length must not be less than 20% of each length of soldered joint, and not less than 250mm; the proportion of the partial nondestructive testing of cryogenic vessel which is manufactured in ferrite steel shall be larger than or equal to 50%. The soldered joint of the following sections shall be inspected totally; the inspected length may be counted into the partial inspected length:

1 Cross section of weld.

2 The soldered joint which is covered by the reinforcement pad, support, dunnage, internal component and others.

3 The soldered joints which are included in the circle whose semi-diameter is 1.5 times of the initial hole diameter and center of circle id open pore centre.

4 The soldered joint-flush bonding connection tube connects with the cylinder or shell cover.

Check method: Check the report of nondestructive testing.

5.7.4 As for the soldered joint of Class 2, the connection tube whose pressure vessel nominal diameter is larger than or equal to 250mm or wall thickness is larger than 28mm connects with long neck flange, and the connection tube connects with connection tube, its nondestructive testing proportion and qualified grade shall be in accordance with the main body weld requirements of pressure vessel shell; as for the soldered joint of Class 2, the connection tube whose nominal diameter is less than 250mm and wall thickness is less than or equal to 28mm connects with long-neck flange, connection tube connects with connection tube, the magnetic particle testing or infiltration testing may be carried out.

Check method: Check the report of nondestructive testing.

5.7.5 As for the section which meets one of the following conditions, the 100% magnetic particle testing or infiltration testing shall be carried out for its surface:

1 Built-up welding on the surface

2 The soldered joint surface of Class C and D of pressure vessels in Clause 3, 4, 5, 6 and 7 in Article 5.7.2 of this code.

3 The surface of flaw thinning or repairing welding section of the equipment which are manufactured in chrome molybdenum steel or steel whose lower limit value of standard tensile strength is larger than or equal to 540MPa and low temperature pressure vessel steel, and the surface of the welding trace on the dismantling section of fixture and pulling side.

Check method: Check the report of nondestructive testing.

5.7.6 The 100% magnetic particle testing or infiltration testing shall be carried out on the surface of on-site welding joint before the pressure test is carried out for the spherical tank, then carry out the 20% or infiltration testing reinspection after the pressure test is finished.

Check method: Check the report of nondestructive testing.

5.7.7 The testing for internal quality of soldered joint of unpressurized vessel shall meet the requirements in design documents.

Check method: Check the report of nondestructive testing.

5.7.8 The grade estimation shall be carried out for the nondestructive testing according to the requirements of current national standard "Nondestructive Testing of Pressure Equipment" JB/T 4730.1~JB/T 4730.5, and the following requirements shall be met:

1 As for the pressure vessel which is carried out the nondestructive testing according to the requirements of Article 5.7.2 (except Clause 8 and 9) in this code, when the radiographic testing is adopted, the qualified level is Grade II; when the ultrasonic testing is adopted, the qualified level is Grade I.

2 As for other pressure vessel, when the radiographic testing is adopted, the qualified level is Grade III; when the ultrasonic testing is adopted, the qualified level is Grade II.

3 Grade I of magnetic particle testing and infiltration testing is qualified.

4 The qualified level of the titanium and titanium alloy equipment, zirconium and zirconium alloy equipment, aluminium and aluminium alloy equipment shall be in accordance with the requirements in design documents.

Check method: Check the report of nondestructive testing.

5.7.9 The disallow flaw which is found when the nondestructive testing is carried out for the weld joint shall be cleaned inside out and it the repairing welding shall be carried out later, then inspected the repairing welding section in the original stated method till it is qualified. As for the soldered joint of pressure vessel whish is required for partial nondestructive testing, when the unallowed flaw is found, the inspecting length shall be added on the extended section of two ends of the flaw, the added length is 10% of the soldered joint length, and not less than 250mm. If the unallowed flaw still exists, the 100% testing shall be carried out for the soldered joint.

Check method: Check the record of weld repairing and report of nondestructive testing.

5.8 The Overall Shape and Dimensional Inspection of Equipment

5.8.1 The following inspection shall be carried out for the overall shape and dimension of the equipment after the on-site assembly welding for the equipment is finished:

1 The roundness of equipment cylinder shall meet those specified in Table 5.2.9-1 in this code.

6 Test

6.1 General Requirements

6.1.1 The following conditions shall be validated before the pressure test is carried out for the on-site welding equipment:

1 The weld and inspection work of equipment noumenon and the welding with the noumenon is finished whole.

2 The heat treatment is finished for the equipment which is required for post-weld heat treatment.

3 As for the reinforcement pad weld of equipment open pore, 0.4~0.5MPa compressed air is used to check the quality for soldered joint.

4 The alignment and align primarily work is finished for the installed equipment.

5 The secondary grouting of foundation meets the design strength requirement.

6 The workmanship material is integrity.

7 The pressure test scheme is approvable.

Check method: Check the related data.

6.1.2 The pressure test may be not carried out for the following equipment after the field installation is finished.

1 The integral arrived equipment meets the following conditions at the same time:

1) The quality certificate documents prove that the pressure test is carried out.

2) There is not damage and deform in transportation process.

3) The equipment required for gas protection exists in effective protection state.

2 The heat exchange equipment which meets the requirements of this Clause 1 and the regular fastener and gasket are used for it.

3 Nonmetal backing strip equipment

Check method: Check the related data, visual check.

6.1.3 The hydraulic test shall be adopted for the pressure test, if the hydraulic test is superseded by the gas pressure test, the following requirements must be met:

1 The 100% radiographic or ultrasonic testing is carried out for the soldered joint of pressure vessel, the voluntary standards and qualified level in the original design documents shall be implemented.

2 The 25% radiographic or ultrasonic testing is carried out for the soldered joint of

3 The numerical value 1.25*p* in the parentheses is only applicable to vacuum column type steel vessel.

6.1.7 When the vertical type equipment is in the horizontal position and the hydraulic test is carried out for it, the test pressure shall be the charging column static pressure of test pressure at the vertical position state, and stress check is required for the equipment top.

6.2 Hydraulic Test

6.2.1 The uncontaminated water should be adopted as the test medium. When water is used as media for the austenitic stainless steel equipment, the chloride ion content of the water quality must not exceed 25mg/L. Other liquids which will not cause the hazard also may be used as test media.

Check method: Check the water quality probation report or other liquid chemical composition analyzing and physical property report.

6.2.2 The temperature of the test medium shall be in accordance with the following requirements:

1 When hydraulic test is carried out for the carbon steel, Q345R, Q370R steel equipment, the liquid temperature must not be less than 5℃; when hydraulic test is carried out for other low alloy steel equipment, the liquid temperature must not be less than 15℃.

2 When hydraulic test is carried out for the equipment with nil-ductility transition temperature of material caused by the plating thickness and manufactured with other materials, the liquid temperature shall be in accordance with the requirements stated in the design documents.

Check method: Measure with thermoscope.

6.2.3 When the hydraulic test is carried out, the external surface of the equipment shall be kept dry, when the wall temperature of the equipment is approximate to the liquid temperature, the pressure shall be risen slowly to the design pressure; after confirming for no leakage, the pressure shall be risen to stated test pressure, the dwell time shall not be less than 30min;then the pressure shall be dropped to 80% of the specified testing pressure, the check over all soldered joint and connection sections, it is regarded as qualified is the following conditions are meet:

1 No leakage.

2 Without visible deform.

3 Without exceptional noise in the testing course.

Check method: Visual check or check the test report.

6.2.4 As for the equipment which is carried out the hydraulic test on the foundation and its cubage is larger than 100m^3, at the same time of carrying out the hydraulic test, the foundation settlement observation is required before charging, charging in 1/3, charging in 2/3, 24h after charging and after discharging. The foundation settlement shall be even, the

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