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GB 50236-2011

**Code for Construction of Field Equipment,
Industrial Pipe Welding Engineering**

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Forward

According to the requirements of Document Jian Biao [2007] NO.126 issued by the former Ministry of Construction (MOC) - "Notice on Printing and Publishing the Development and Revision Plan of National Engineering Construction Standards and Codes in 2007 (2nd Batch)", this code is revised on the base of "Code for Construction and Acceptance of Field Equipment, Industrial Pipe Welding Engineering" (GB 50236-98) by the chief development organizations the China Petroleum & Chemical Engineering Survey and Design Association and the China Petroleum Jilin Chemical Engineering & Construction Co., Ltd. jointly with the organizations concerned, and the standard name was changed to "Code for Construction of Field Equipment, Industrial Pipe Welding Engineering" after revision.

During the revision process of this code, the code drafting group revised, examined and finalized this standard upon carrying out extensive investigation and study, earnestly summarizing practical experiences, referring to related international standards and advanced foreign standards, and soliciting opinions widely.

This code comprises 13 chapters and four appendixes. Its main technical contents include: general provisions, terms, basic requirements, materials, welding procedure qualification, welding skill qualification, welding of carbon steel and alloy steel, welding of aluminium and aluminium alloy, welding of copper and copper alloy, welding of titanium and titanium alloy, welding of nickel and nickel alloy, welding of zirconium and zirconium alloy as well as welding inspection and hand over of welding engineering, etc.

There have been some significant changes in this code in the following technical aspects:

1 The application scope was modified, the metallic materials such as titanium alloy (low alloy titanium), zirconium and zirconium alloy as well as welding methods such as electroslag welding and stud welding were added.

2 The inapplicable scope was deleted.

3 Chapter "Terms" was added.

4 The relevant requirements for inspection, preservation and application of welding materials were supplemented.

5 The contents of welding procedure qualification and welding skill qualification were modified and adjusted according to current relevant standard.

6 The new welding technologies, new procedures and quality requirements such as electroslag welding, stud welding and dual phase steel welding of carbon steel and alloy steel were supplemented. The requirements of the conditions for preheating before welding and heat treatment after welding were modified.

7 The procedure requirements of brass tungsten inert gas arc welding were supplemented.

8 The welding procedures and quality requirements for titanium and titanium alloy equipment were added.

9 The welding procedures and quality requirements for metal inert gas arc welding and submerged arc welding of nickel and nickel alloy as well as the nickel and nickel alloy equipment were added.

10 The welding procedures and quality requirements for the tungsten inert gas arc

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1 General Provisions

1.0.1 This Code was formulated with a view to improving the construction level of welding engineering for equipment in construction site of engineering construction and the industrial metallic pipeline, strengthening the quality control in construction process of welding engineering, and guaranteeing the engineering quality and engineering safety.

1.0.2 This Code is applicable to the welding engineering construction of the materials made of carbon steel, aluminium and aluminium alloy, copper and copper alloy, titanium and titanium alloy (low alloy titanium), nickel and nickel alloy as well as zirconium and zirconium alloy.

1.0.3 The welding methods applicable to this Code include gas welding, shielded metal arc welding, submerged arc welding, tungsten inert gas arc welding, metal inert gas arc welding, self-shielded flux cored arc welding, electroslag welding and stud welding.

1.0.4 The welding engineering construction shall be carried out according to the requirements of the design document and this Code.

1.0.5 Where the design document needs be modified or the material needs be substituted, it shall be approved by the original design organization and issued with written document.

1.0.6 This Code shall apply in conjunction with the current national standard "Code for Construction and Acceptance of Field Equipment, Industrial Pipe Welding Engineering" (GB 50683).

1.0.7 The welding engineering construction shall meet the relevant requirements of the relevant current national standards on energy conservation and emission reduction, environmental protection, safety technology as well as labour protection, etc.

1.0.8 The construction of field equipment, industrial pipe welding engineering shall not only in accordance with this Code, but also comply with the requirements specified in the current relevant standards of the nation.

2 Terms

2.0.1 Field equipment

It refers to the equipment manufactured or installed in construction site of engineering construction.

2.0.2 Welding responsible personnel

The personnel obtaining the required professional knowledge of welding by training, education or practice, being qualified with his capacity and designated to take responsibility of welding and relevant manufacture activities.

2.0.3 Welding procedure specification

It refers to the document of technical formulated, according to welding procedure qualification report, in combination with practical experience for directly instructing the welding engineering, it specifies in detail of the contents such as welded joint, base metal, welding material, welding position, preheating, electrical characteristic and operating technique, so as to guarantee the reproducibility of welding quality.

2.0.4 Welding procedure pre-specification

The welding procedure specification in need of qualification.

2.0.5 Welding procedure qualification

The process of preparing test piece and test specimen, conducting the test and assessing the result according to welding procedure pre-specification.

2.0.6 Welding procedure qualification report

The document recording the relevant test data and test result during the process of welding procedure qualification.

2.0.7 Welding skill qualification

The process to assess and examine the operating skill of welding operation personnel.

2.0.8 Interpass temperature

The transient temperature of multi-pass weld and adjacent base metal before welding the next weld pass.

3 Basic Requirements

3.0.1 The requirements of welding technical specification shall be specified in design document.

3.0.2 The qualifications and responsibilities of welding responsible personnel and welding operation personnel shall meet the following requirements:

1 Welding technical personnel shall have a professional educational background of technical secondary school or above, with more than one year's welding operation practice. Welding technical personnel shall be responsible for the welding procedure qualification, develop welding procedure specification and welding technical measures, carry out welding technology and safety disclosure, instruct on the welding operation, participate in the welding quality management, handle welding technical problems and arrange welding technical data.

2 Welding inspection personnel shall have an theoretical knowledge level equivalent to that for technical secondary school or above, with certain welding experience. Welding inspection personnel shall conduct overall inspection on field welding operation and control it, be responsible for determining the weld locations for inspection, qualify the welding quality, issue inspection documents and participate in the examination and approval of welding technical measures.

3 The management personnel for welding materials shall have elementary knowledge of relevant welding materials and shall be responsible of the welding materials for warehouse entry acceptance, preservation, stoving, distributing and recycling, etc.

4 Non-destructive testing personnel shall be those who have been tested and qualified by professional testing institutions with the state's authorization, and shall take the responsibility of inspection, examination and verification according to the qualified examination item and authority item. Non-destructive testing personnel shall carry out the inspection according to the locations to be inspected determined by welding quality inspection personnel, qualify the weld quality, sign and issue inspection reports, and refuse to inspect the weld which visually do not conform to the inspection requirements.

5 The welder shall have the quality certificate of welding skill qualification in accordance with the requirements specified in Chapter 6 of this Code and corresponding capability. The welder shall conduct the welding according to the specified welding procedure specification and welding technical measures, where the operation condition do not conform to the requirements of welding procedure specification and welding technical measures, the welder shall refuse to carry out welding.

6 The welding heat treatment personnel shall be subject to a professional training and shall conduct the heat treatment on welds in accordance with standard specifications, operation instructions for heat treatment and design documents.

3.0.3 The supervision organization and general contracting organization shall be equipped with welding responsible personnel.

3.0.4 The construction organization shall meet the following conditions:

1 The construction organization shall establish the management system for welding quality and control the welding activities. The relevant personnel specified in Article 3.0.2 in this Code shall be equipped in construction organization.

4 Materials

4.0.1 The base metal adopted in welding engineering shall be provided with quality proof documents of manufactory and shall meet the requirements of the current national standard and design document.

4.0.2 Prior to use the base metal, it shall be subject to inspection and acceptance in accordance with the requirements of the current relevant standard of the nation and design document, its mark shall be clear and complete and shall be able to trace back to the product quality proof document.

4.0.3 The welding materials shall meet the requirements of design document and those specified as follows:

1 The welding materials shall be provided with quality proof document issued by manufactory.

2 The carbon steel and alloy steel electrode, welding wire as well as welding flux shall respectively meet the requirements of the current standards of the Nation "Carbon Steel Covered Electrodes" (GB/T 5117), "Low Alloy Steel Covered Electrodes" (GB/T 5118), "Stainless Steel Covered Electrodes" (GB/T 983), "Wire Rod for Electrode" (GB/T 3429), "Stainless Steel Wire Rods for Welding" (GB/T 4241), "Steel Wires for Melt Welding" (GB/T 14957), "Welding Electrodes and Rods for Gas Shielding Arc Welding of Carbon and Low Alloy Steel" (GB/T 8110), "Stainless Steel Rods and Wires for Inert-Gas Shield Welding" (YB/T 5091), "Carbon Steel Electrodes and Fluxes for Submerged Arc Welding" (GB/T 5293), "Low Alloy Steel Electrodes and Fluxes for Submerged Arc Welding" (GB/T 12470), "Stainless Steel Electrodes and Fluxes for Submerged Arc Welding" (GB/T 17854), "Carbon Steel Flux Cored Electrodes for Arc Welding" (GB/T 10045), "Low Alloy Steel Flux Cored Electrodes for Arc Welding" (GB/T 17493) and "Stainless Steel Flux Cored Wires" (GB/T 17853).

3 The aluminum and aluminium alloy welding wires shall meet the requirements of the current national standard "Aluminum and Aluminium Alloy Welding Rods and Wires" (GB/T 10858).

4 The copper and copper alloy welding wires shall meet the requirements of the current national standard "Copper and Copper Alloy Wires and Rods" (GB/T 9460).

5 The titanium and titanium alloy welding wire shall meet the requirements of the current standards of the nation "Titanium and Titanium Alloy Wire" (GB/T 3623) and "Technical Permission of Welding Materials for Pressure Equipment Section 7: Titanium and Titanium-Alloy Welding Electrodes and Rods" (NB/T 47018.7).

6 The nickel and nickel alloy welding rods and wires shall respectively meet the requirements of the current national standards "Nickel and Nickel Alloy Covered Welding Electrodes" (GB/T 13814) and "Nickel and Nickel Alloy Wires and Rods" (GB/T 15620).

7 The male pin and ceramic ring shall meet the requirements of the current national standard "Cheese Head Studs for Arc Stud Welding" (GB/T 10433).

8 The application of gas for welding shall meet the following requirements:

- 1)** Argon gas for welding shall meet the requirements of the current national standard "Argon" (GB/T 4842), the purity of argon gas for zirconium welding

5 Welding Procedure Qualification

5.0.1 After mastering the welding performance, the welding procedure qualification must be carried out before engineering welding.

5.0.2 The welding procedure qualification shall be carried out according to the requirements of the current professional standard "Welding procedure qualification for pressure equipment" (NB/T 47014).

5.0.3 Before welding procedure qualification, the welding procedure pre-specification shall be drawn out based on the welding performance of metallic material according to design documents and procedures of manufacture and installation.

5.0.4 Materials for welding procedure qualification shall meet the requirements of Chapter 4 in this Code.

5.0.5 The procedure measures for welding procedure qualification of test piece on groove processing, fitting up and cleaning shall meet the requirements of relevant chapters in this Code.

5.0.6 The performance of equipment and instruments for welding procedure qualification shall be in normal operating condition and shall meet the requirements of Article 3.0.7 in this Code.

5.0.7 The welding procedure qualification shall be carried out in the company of itself. The test pieces for welding procedure qualification shall be welded by skilled welders in the company. Inspection and test may be entrusted to the organization engaged in inspection and test with corresponding qualification.

5.0.8 Records shall be made in good condition during the welding procedure qualification. After the qualification is finished, a welding procedure qualification report shall be prepared, which shall be examined and verified by the welding technical director.

5.0.9 Welding procedure pre-specification, welding procedure qualification report, inspection and test report, qualification test specimen and other documents shall be filed for preservation.

5.0.10 Prior to welding the products for the engineering, a welding procedure specification shall be prepared based on the welding procedure qualification report to guide the welder for welding and post-weld heat treatment. One welding procedure specification may be prepared based on one or more welding procedure qualification reports, while one welding procedure qualification report may be used to prepare more than one welding procedure specification. The format of the welding procedure specification should be in compliance with the one specified in Table A of Appendix A of this Code.

6 Welding Skill Qualification

6.0.1 The welding skill qualification shall be organized and implemented by the welding skill qualification committee of the company. In case that the company fails to establish the welding skill qualification committee, qualified company shall be entrusted to organize the examination.

6.0.2 The welding skill qualification committee of the company shall meet the following conditions:

1 Members in the welding skill qualification committee shall include welding engineer, radiographic testing personnel and welding technician.

2 The company shall be able to manage 50 welders at least.

3 Corresponding welding equipment, welding site, processing equipment for test piece and test specimen, as well as measures for test and inspection shall be provided.

4 The question bank applicable to the examination of theoretical knowledge for various welding methods and material types shall be provided, and the welding procedure qualification in accordance with the welding skill qualification shall be also provided.

5 Various rules and regulations such as sound examination site discipline, rules for invigilation and assessment personnel, confidentiality system and examination management, file management, and emergency response plan shall be provided.

6.0.3 The welding skill qualification committee of the company shall be responsible to examine the skill qualification eligibility of welder, prepare the skill qualification plan for welder, provide the welding procedure specification, supervise the skill qualification, qualify the examination result, sign and issue the quality certificate, establish the welder archives as well as to examine and approve the eligibility of welder to be exempted from examination.

6.0.4 The welder applying to participate in the welding skill qualification shall have education background of middle school or above, the welder's body is in condition that is able to meet the requirement of the operation items included in the applied examination, and the welder shall be competent in welding work independently after safety education and professional training and shall take the examination after being approved by the welding skill qualification committee.

6.0.5 The welding skill qualification shall cover two parts which are elementary knowledge examination and operating skill qualification, the examination contents shall be in accordance with the range of the welding work taken by the welder. After being qualified to the elementary knowledge examination, the welder is able to participate in operating skill qualification.

6.0.6 Elementary knowledge examination shall include the following contents:

1 Application and maintenance of welding equipment and tools.

2 General knowledge and service regulations of metallic materials and welding materials.

3 Knowledge of welding operation procedures, including the welding method and its characteristics, procedure parameter, weld heat input, slag fluidity, shielding gas effect, operating method, welding sequence, preheating and post-heating, etc.

4 General knowledge of welding defect type, avoidance and elimination of welding

- 2) Subject to radiographic examination, the platy butt weld with a length no less than 300mm conducted by field welding on corresponding items, or tubular butt welds with number no less than 1 and accumulated perimeter no less than 360mm conducted on corresponding items, shall be all qualified.

3 During the validity period of qualified items, the first pass yield (the quantity of accumulative negative films) for radiographic testing on weld shall be above 90%; or the first pass yield for ultrasonic testing (accumulative extended meters of weld) shall be above 99%, so that the quality inspection department of the company shall provide the welding achievement proof data of the welder and the validity period of the qualified item shall be extended for 3 years by the welding skill qualification committee.

4 For welders with poor field welding quality as proposed by the company's quality inspection department and approved by the company's welding skill qualification committee, their qualification certificates may be canceled. And another examination may be taken by the welder after training.

6.0.12 Welders who have been qualified by welding skill qualification according to other relevant standards shall not perform the welding work in the applicable scope of this Code until they are approved by the responsible engineer on welding of the construction organization, and the approved items shall conform to the requirements of this chapter.

6.0.13 The welding skill qualification record, the registration form for welding skill qualification result and the quality certificate should take the format as stated in Appendix B of this Code. The items in the welding operating skill qualification shall be expressed in codes which shall meet the requirements of the special equipment safety technical regulation "Examination Rules for Welding Operators of Special Equipment" (TSG Z6002) specified by AQSIQ.

7 Welding of Carbon Steel and Alloy Steel

7.1 General Requirements

7.1.1 This chapter is applicable to the welding construction for the field equipment and pipeline made of carbon steel and alloy steel with a carbon content less than or equal to 0.30%.

7.1.2 This chapter is applicable to the welding method including shielded metal arc welding, tungsten inert gas arc welding, metal inert gas arc welding, self-shielded flux cored arc welding, submerged arc welding, electroslag welding, stud welding and gas welding.

7.2 Preparation before Welding

7.2.1 The cutting and groove processing of weldment shall meet the following requirements:

1 The mechanical method or flame cutting method may be adopted for groove processing of carbon steel and carbon manganese steel.

2 The machining method should be adopted for the groove processing of nickel steel and alloy steel in low temperature.

3 The machining method or plasma cutting method shall be adopted for the groove processing of stainless steel.

4 After processing the groove by hot-work such as plasma arc and oxyacetylene flame. The groove surface shall be removed of oxygenized scale, molten slag and surface layer that will affect the quality of the joint, and shall be polished and smoothened.

5 The cutting and groove processing of composite steel of stainless steels should be adopted with machining method. In case of thermal processing, the plasma cutting method should be adopted. In case of thermal processing for cutting and groove processing, the generated molten slag shall not be sprayed down the composite layer surface.

7.2.2 Before the fitting up and welding of the weldment, the groove and its internal and external and lateral surface within the range of no less than 20mm shall be cleaned up of impurities, dirt, burrs and zinc coatings without such defects as cracks and interlayers.

7.2.3 Except of the pipelines subject to cold drawing or cold reducing as specified by the design, the weldment shall not be forced to fit up.

7.2.4 When the butt welds of pipe or pipe fittings are fit up, the misalignment at the internal wall shall not be greater than 10% of the base metal thickness, and it shall not be greater than 2mm.

7.2.5 When the butt welds of the equipment are fit up, rolling pipe shall be in accordance with those specified in Table 7.2.5 and the following requirements:

1 The fitting up shall be only carried out on the longitudinal and circumferential weld by single side welding, its internal wall misalignment shall not be greater than 25% of wall thickness and shall not exceed 2mm.

2 Where adopting electroslag welding, the misalignment shall not be greater than 10% of base metal thickness and shall not be greater than 3mm.

3 Composite steel plate shall be fit up by taking the composite layer surface as a benchmark, with the misalignment no greater than 50% of the composite layer thickness and no greater than 1mm.

Table 7.2.5 Misalignment When Fitting Up the Butt Weld of Equipment and Rolling Pipe (mm)

Base metal thickness of weldment joint T	Misalignment	
	Longitudinal weld	Circumferential weld
$T \leq 12$	$\leq T/4$	$\leq T/4$
$12 < T \leq 20$	≤ 3	$\leq T/4$
$20 < T \leq 40$	≤ 3	≤ 5
$\leq T/8$, and ≤ 20	≤ 3	$\leq T/8$
$T > 50$	$\leq T/16$, and ≤ 10	$\leq T/8$, and ≤ 20

7.2.6 The weld shall not be located in the area of stress concentration, it shall be accessible for welding and heat treatment and shall conform to the following requirements:

1 When the cylinder joints or the cylinder joints and the heads of the steel plate rolling pipe or equipment are fit up, the distance between the two adjacent longitudinal welds shall be greater than 3 times of the wall thickness and shall not be less than 100mm, and the distance shall not be less than 200mm when the two adjacent longitudinal welds are located on the same cylinder joint.

2 The distance between the centers of two butt welds on the same straight pipe section of the pipeline shall meet the following requirements:

- 1) Where the nominal dimension is larger than or equal to 150mm, the distance shall not be less than 150mm;
- 2) Where the nominal dimension is less than 150mm, the distance shall not be less than the external diameter of pipe and shall not be less than 100mm.

3 The longitudinal weld of rolling pipe shall be arranged on the position that is easy to overhaul, and it should not be arranged at the bottom.

4 As for the rolling pipe with reinforcement ring/plate, the butt weld of reinforcement ring/plate shall be staggered from the longitudinal weld of the pipe, and the spacing hereof shall not be less than 100mm. The distance between reinforcement ring/plate and circumferential joint of rolling pipe shall not be less than 50mm.

5 The distance between the weld on the heating side pipe of heating furnace and the bending position of the pipe, the external wall of the header as well as the edge of the bracket and the cradle shall not be less than 70mm. The distance between the centers of two butt joints on the same straight section shall not be less than 150mm.

6 Except that the formed elbow is adopted, the distance between the center between circumferential weld of pipeline butting and the bending position of the bent pipe shall not be less than the external diameter of the pipe and shall not be less than 100mm, the distance between the circumferential weld of pipeline butting and the edge of the bracket and the cradle shall not be less than 50mm; the distance between the weld in need of heat treatment and the edge of the bracket and the cradle shall not be less than 5 times of the weld width and shall not be less than 100mm.

7 Hole opening should not be carried out on the welds and its edges, and when it is unavoidable, it shall meet the requirements of Article 13.3.6 in this Code.

7.2.7 The type and dimension of groove should meet the requirements of Table C.0.1-1 and Table C.0.1-2 in Appendix C of this Code as well as the current national standard "Recommended joint preparation for gas welding manual metal arc welding gas-shield arc

materials of type 25Cr-13Ni or with higher nickel content shall be selected. Where the design temperature is higher than 425°C, the nickel based welding materials should be selected.

5 When the composite steels are welded, the welding materials of base layer and the composite layer shall be selected respectively according to the base metal of the base layer and composite layer, the welding materials of the transition layer shall be selected as type 25Cr-13Ni or those with higher nickel content.

6 The common welding material for carbon steel and alloy steel as well as the welding materials for dissimilar steels may be selected in accordance with Table D.0.1-1 and Table D.0.1-2 in Appendix D of this Code.

7 In case of the submerged arc welding, the selected welding flux shall match with the base metal and welding wire.

7.3.2 The tack weld shall meet the following requirements:

1 The tack weld shall be conducted by the welder holding corresponding qualified items.

2 When the tack weld is welded, the welding procedure shall be adopted as the same welding with the formal one in engineering.

3 The length, thickness and spacing of tack weld shall be able to guarantee no fissuring in formal welding process.

4 Tack weld shall be inspected before root pass welding. In case of defect, the welding shall be applied after the defects are treated.

5 The material of the clamping apparatus used in welding with base metal should be the same with that of base metal or in same type. Its welding materials should be adopted as the same with the base metal or having the same type number with the base metal. The removal of the clamping apparatus shall not damage the base metal. It shall be confirmed that there is no crack and the residual welding-scars shall be polished and repaired to be level with the base metal surface after removal.

6 In case of the tacking of composite steel, the tack weld should be welded in the base metal groove of the base layer, and the welding materials of it shall be the same with those for welding base metal.

7.3.3 The arc starting and current test shall not be conducted on the base metal surface out of the groove, and the base metal shall be avoided of electric arc scratch.

7.3.4 As for the weldment with chrome content larger than or equal to 3% or with total alloying element content greater than 5% applied with root welding by adopting tungsten inert gas arc welding or metal inert gas arc welding, the argon gas or other shielding gas shall be filled in the weld back, or measures shall be taken to prevent the back weld from being oxidized.

7.3.5 Reasonable welding method and welding sequence shall be adopted for welding.

7.3.6 The quality at the points of arc starting and arc ending shall be guaranteed during welding. The arc crater shall be completely filled at the time of arc ending. The joints of multi-layer and multi-pass welding shall be staggered.

7.3.7 During welding the pipe, the draught shall be avoided inside the pipe.

7.3.8 Unless the procedure or inspection requires the welding to be conducted in several times, all welds should be completed at once continuously. In case the welding is interrupted

restrained within the range of specified preheating temperature. The maximum preheating temperature of carbon steel and low alloy steel as well as the interpass temperature should not be greater than 250°C, and the interpass temperature of austenitic stainless steel should not be greater than 150°C.

7.4.6 The post-weld heat treatment shall meet the requirements of design document. Where there is no requirement in design, the post-weld heat treatment of pipeline shall meet the relevant requirements of the current national standard "Code for Construction of Industrial Metallic Piping Engineering" (GB 50235); the post-weld heat treatment of equipment shall meet the relevant requirements of the current professional standard "Welding Specification for Pressure Vessels" (NB/T 47015).

7.4.7 The requiring stress corrosion resistance shall be carried out with post-weld heat treatment.

7.4.8 When non-austenitic dissimilar steel is welded, the temperature for prior weld preheating and post-weld heat treatment shall be selected based on the steel at one side with poorer weldability, but the temperature for post-weld heat treatment shall not exceed the lower critical point of the steel at the other side. The weld of hardened and tempered steel shall have a post-weld heat treatment temperature lower than its tempering temperature.

7.4.9 The method for post-weld heat treatment shall meet the following requirements:

1 The post-weld integral heat treatment of field equipment should be adopted with such methods as integral heating in the furnace, heating by sections in the furnace, integral heating outside the furnace and heating by sections outside the furnace; the circumferential weld, pipeline weld and heat treatment after welding repair of the assembly and welding in sections for field equipment should be adopted with local heating method.

2 In case of the heating by sections in the furnace, the overlapped part at each section for heating shall not be less than 1500mm. The part of the equipment outside the furnace shall be taken with insulation measures to avoid harmful temperature gradient.

3 Where adopting the heat treatment by local heating, the heating area shall include weld, heat affected area and its adjacent base metals. The heating range at each side of the weld shall not be less than three times of weld width, and the thermal insulation shall be carried out within the range of 100mm away from the heating area.

7.4.10 The insulation material and insulating layer thickness for integral heat treatment and local heat treatment outside the furnace shall meet the requirements of design documents, relevant standards and heat treatment procedures. The insulating layer shall be adhered to the weldment surface firmly and the seam shall be tight. When multi-layer thermal insulation is adopted, the seam at each layer shall be staggered. During heat treatment process, the insulating layer shall not be loose or fall off.

7.4.11 During the weld preheating and post-weld heat treatment, the internal and external wall temperature of weldment shall be uniform. The post-heating and post-weld heat treatment of pipeline should be adopted with electrical heating method.

7.4.12 In case of weld preheating and post-weld heat treatment, the temperature shall be measured and recorded, the positions and quantity of temperature measurement points shall be reasonable, and the thermometric instrument shall be qualified by verification.

7.4.13 The heat treatment temperature throughout the heat treatment process shall be recorded continuously and automatically, the value at each temperature measurement point

8 Welding of Aluminium and Aluminium Alloy

8.1 General Requirements

8.1.1 This chapter is applicable to the welding construction of field equipment and pipeline made of commercial purity aluminium and aluminum alloy.

8.1.2 This chapter is applicable to tungsten inert gas arc welding and metal inert gas arc welding.

8.2 Preparation before Welding

8.2.1 The welding wire shall be selected by taking comprehensive consideration of base metal chemical components, mechanical properties and service conditions, etc., and the following requirements shall be met:

- 1** The welding procedure performance shall be in good condition.
- 2** The mechanical property of the weld metal shall not be lower than the lower limit value specified in corresponding standards of base metal. The service performance of the weld shall be in accordance with those specified in the current relevant standards of the nation and design documents.
- 3** When the pure aluminium is welded, the welding wire with purity no less than that of base metal shall be selected.
- 4** When the aluminum magnesium alloy are welded, the welding wire with magnesium content no less than that of base metal shall be selected.
- 5** When the aluminum manganese alloy are welded, the welding wire with similar compositions to base metal or welding wire made of aluminum silicon alloy shall be selected.
- 6** When the dissimilar aluminum alloy are welded, the welding wire shall be selected according to the base metal with higher corrosion resistance and higher strength.
- 7** The common welding wire made of aluminium and aluminium alloy may be selected according to Table D.0.2-1 and Table D.0.2-2 in Appendix D of this Code.
- 8** The shielding gas shall be selected as argon gas, helium gas or the mixed gas of argon and helium.

8.2.2 The preparation of the weldment groove shall meet the following requirements:

- 1** The type and dimension of the groove should be in accordance with the requirements of Table C.0.2 in Appendix C of this Code or the current national standard "Recommended Joint Preparation for Gas-shield Arc Welding on Aluminium and Its Alloys" (GB/T 985.3).
- 2** The mechanical method or plasma arc cutting shall be adopted for groove processing. The groove surface shall be cleaned after cutting, the surface shall be flat and smooth without burrs and flash.

8.2.3 The cleaning before welding shall meet the following requirements:

- 1** The weldment groove, backing plate and welding wire shall be cleaned before fitting up and welding. The cleaning range at both sides of the groove shall not be less than 50mm. The oil stain shall be removed first from the surface by adopting organic solvent such as acetone, and then the oxide films shall be cleared by using mechanical method or chemical method.

- 1)** Cleaning by mechanical method: the surface of both sides of the groove shall be cleaned by scraping, filing or milling, and cleaning by brush (wheel) made of

design, the material of the backing plate shall be the same as base metal, the backing plate shall be arranged with trench for weld root. Where the weld shall be added with temporary backing plate at its back, the material of the backing plate shall be adopted as the one without bad effect to the weld quality.

8.2.6 When the butt welds of pipelines are fit up, the misalignment of internal wall shall meet the following requirements:

1 Where the base metal thickness is less than or equal to 5mm, the internal wall misalignment shall not be greater than 0.5mm.

2 Where the base metal thickness is greater than 5mm, the internal wall misalignment shall not be greater than 10% of base metal thickness and shall not be greater than 2mm.

8.2.7 The butt weld misalignment of equipment shall meet the following requirements:

1 Where the base metal thickness is less than or equal to 12mm, the misalignment of both longitudinal weld and circumferential weld shall not be greater than 1/5 of base metal thickness.

2 Where the base metal thickness is greater than 12mm, the misalignment of longitudinal weld shall not be greater than 2.5mm, and the misalignment of circumferential weld shall not be greater than 1/5 of base metal thickness and shall not be greater than 5mm.

8.2.8 When the butt weldments with unequal thicknesses are fit up, the end face of the thinner weldment shall be located within that of the thicker one. Where the external wall misalignment is greater than 3mm or the internal wall misalignment is greater than those specified in Article 8.2.6 and Article 8.2.7 of this Code, the weldment shall be processed according to the requirements of Article 7.2.8 in this Code.

8.3 Requirements of Welding Procedure

8.3.1 The AC power supply shall be adopted for tungsten inert gas arc welding, and the DC power supply shall be adopted for metal inert gas arc welding, the welding wire shall be connected to the positive pole.

8.3.2 A trial welding shall be conducted on the test plate before welding, and the formal welding shall not be carried out until the procedure parameter is adjusted in good condition and the weld is confirmed without air hole.

8.3.3 When the weldment with thickness greater than 10mm is welded by adopting tungsten inert gas arc welding and the weldment with thickness greater than 15mm by adopting metal inert gas arc welding, the weldment should be carried out with preheating before welding, the preheating temperature should be 100℃~150℃.

8.3.4 Where the temperature of the weldment is lower than 5℃, the area shall be preheated to 15℃ within the range of 100 mm from the welding point.

8.3.5 The oxide inclusions and other defects between the weld layers and weld passes shall be removed during the welding process. The weld root shall be cleared for both side welding, and the weld metal under laid at the front face shall be exposed.

8.3.6 The rapid welding with high current should be adopted, the transverse oscillation of welding wire should not exceed 3times of its diameter. The arc crater shall be filled up, and the arc connecting point shall be carried out with penetrated fusion.

8.3.7 The material of run on plate and arc quenching plate shall be the same as base metal.

8.3.8 The end of welding wire for tungsten inert gas arc welding shall not be out of the protection area of argon gas, the included angle between the welding wire and weld surface

9 Welding of Copper and Copper Alloy

9.1 General Requirements

9.1.1 This chapter is applicable to the welding construction of equipment and pipelines made of pure copper and brass.

9.1.2 This chapter is applicable to the tungsten inert gas arc welding for pure copper and brass and the oxyacetylene welding for brass.

9.2 Preparation before Welding

9.2.1 The selection of welding materials shall meet the following requirements:

1 The mechanical property of the weld metal shall not be lower than the lower limit value specified in corresponding standards of base metal in annealed condition. the welding procedure performance shall be in good condition, and the service performance of the weld shall be in accordance with those specified in the current relevant standards of the nation and design documents.

2 The welding wire containing de-oxidation elements with good cracking resistance shall be selected for pure copper.

3 The welding wire with less zinc content and good cracking resistance shall be selected for brass welding.

4 The copper and copper alloy welding wire as well as welding flux may be selected according to Table D.0.3 in Appendix D of this Code.

5 The shielding gas for tungsten inert gas arc welding shall be selected as argon gas, helium gas or mixed gas of argon and helium.

9.2.2 The preparation of the weldment groove shall meet the following requirements:

1 The type and dimension of the groove may be determined according to different welding methods and welding procedure parameter, the type with larger groove angle and wider clearance at the root shall be adopted.

2 The type and dimension of the groove on the weldment should be in accordance with the requirements of Table C.0.3-1 and Table C.0.3-2 in Appendix C of this Code.

3 The cutting and groove processing of pure copper and brass shall be adopted with mechanical method or plasma arc cutting.

9.2.3 Before fitting up and welding the weldment, the groove, the surface at both sides within the range of no less than 20mm and the welding wire shall be removed of oil stain with organic solvent as acetone, the oxide film and other dirt shall be cleared off by adopting mechanical method or chemical method to make the weldment have metallic luster; when chemical method is adopted, the nitric acid solution may be used for erosion for 2~3min, and the weldment shall be washed by water and dried.

9.2.4 When the butt welds of pipelines are fit up, the internal wall misalignment shall not exceed 10% of base metal thickness and shall not be greater than 1mm. Opening should be conducted at the edge of the weld, if the opening is necessary, it shall meet the requirements of Article 13.3.6 in this Code.

9.2.5 The butt weld misalignment of equipment shall meet the requirements of Article 8.2.7 in this Code.

9.2.6 As for the fitting up of butt weldment with unequal thickness, if the internal wall

10 Welding of Titanium and Titanium Alloy

10.1 General Requirements

10.1.1 This chapter is applicable to the welding construction of equipment and pipelines made of titanium and titanium alloy (low alloy titanium, hereinafter inclusive).

10.1.2 This chapter is applicable to tungsten inert gas arc welding.

10.2 Preparation before Welding

10.2.1 The selection of welding materials shall meet the following requirements:

1 The mechanical property of the weld metal shall not be lower than the lower limit value specified in corresponding standards of base metal in annealed condition. The welding procedure performance shall be in good condition, and the service performance of the weld shall be in accordance with those specified in the current relevant standards of the nation and design documents.

2 The chemical composition of welding wire shall be equivalent to base metal.

3 Where the weld requires higher plasticity, the welding wire with purity higher than base metal shall be adopted.

4 When the titanium materials with different designations are welded, the welding wire shall be selected according to the base metal with higher corrosion resistance and lower strength level.

5 The base metal for welding shall not be cut into strips to be treated as welding wires.

6 The shielding gas shall be selected as argon gas, helium gas or the mixed gas of argon and helium.

10.2.2 In case of DC tungsten argon arc welding, the tungsten electrode diameter shall be selected according to the applied welding current, its end shall be grinded into conical shape (Figure 10.2.2). During the welding process, the end of tungsten electrode shall be always in conic shape.

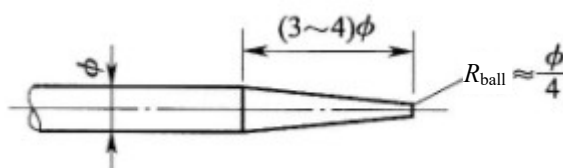


Figure 10.2.2 Shape and Dimension of Tungsten Electrode End

10.2.3 The type and dimension of the groove should be in accordance with the requirements of Table C.0.4 in Appendix C of this Code.

10.2.4 The machining method shall be adopted for groove processing, the groove surface shall be flat and smooth without cracks, sub-layers, impurities, burrs, flashes and oxidation tint after processing. The groove surface shall have silver white metal luster.

10.2.5 Before fitting up and welding the weldments, the cleaning of groove and welding wire shall meet the following requirements:

1 Degreasing, mechanical cleaning or chemical cleaning may be selected according to surface contamination degree.

2 In case of mechanical cleaning, the oil stain on the groove as well as the internal and external surface within the range of 20mm at both sides of it and the oil stain on the welding

10.3.3 The welding of titanium and titanium alloy should not be carried out with weld preheating. The interpass temperature of multi-layer weld shall be less than 100°C. Cooling by copper backing plate may be adopted if necessary.

10.3.4 With the guaranteed fusion penetration and favorable forming, small heat input welding shall be selected.

10.3.5 As for the welding area at internal and external surface of welding molten pool and welding joint, the following protective measures shall be taken:

1 The molten pool shall be protected by adopting torch tip, the extrusive argon gas shall be in stable laminar conditions.

2 The dragging cover or full cover by welding torch shall be adopted on the weld in hot state and the heat affected area of the weld, the dragging cover type of the welding torch shall be determined according to the shape and dimension of the weldment. The pipeline with nominal dimension less than or equal to 50mm should be adopted with full cover protection.

3 The shielding gas or copper backing plate shall be adopted to protect the weld and the back of the area near to the weld. When protected by gas, the protected area shall be filled with gas in advance, fully discharged with air, being kept under weak positive pressure and in flow condition.

10.3.6 The high frequency arc starting shall be adopted for welding, the welding torch shall supply air in advance; the current attenuation device and time delay gas shielding device shall be adopted for quenching the arc. The arc crater shall be filled up and prevented from air conservation.

10.3.7 During the welding process, the heating end of welding wire shall be protected by shielding gas, after the quenching of the arc, the welding wire shall not be exposed to atmosphere immediately, instead, it shall be taken out while the weld is no longer in protection; where the welding wire is contaminated or oxidized and have its colour changed, the contaminated part and the colour-changed part, which is caused by oxidation, shall be cut off.

10.3.8 One weld shall be completed at once, where it is interrupted, it shall be overlapped by 10~20mm when it is continued. The arc crater shall be filled up, the arc connecting position shall be fused and welded completely.

10.3.9 During the welding process, the electric arc shall remain stable. Where such defects as tungsten inclusion or over-oxidation as well as crack are generated during the multi-layer welding process, the welding shall not be continued before the defects are cleaned up according to the requirements of Article 10.2.5 in this Code.

10.3.10 When welding, the oxidation tint shall not be removed by re-melting and re-welding the contaminated weld to ameliorate the weld appearance.

10.3.11 Post-weld heat treatment should not be carried out to titanium and titanium alloy. Where the post-weld heat treatment is required in the requirements of the design document, it shall be carried out after it passes the weld inspection.

10.3.12 During welding process, reasonable welding sequence, welding method or rigid fixing shall be adopted to reduce welding deformations and stress.

11 Welding of Nickel and Nickel Alloy

11.1 General Requirements
11.1.1 This chapter is suitable for the welding construction of field equipment of nickel and nickel alloy and pipe.

11.1.2 This chapter is suitable for such methods as shielded metal arc welding, gas tungsten arc welding, consumable electrode inert gas arc welding and submerged arc welding.

11.2 Preparation before Welding

11.2.1 The selection of nickel and nickel alloy welding materials shall meet the following requirements:

1 The mechanical property of the weld metal shall not be lower than the standard lower limit value of corresponding base metal at annealed condition or solid solution condition. Welding shall have a good process performance, and the service performance of the weld shall be in accordance with those specified in the relevant current national standards and design documents.

2 The welding materials which are the same as the base metal alloy series shall be selected for the welding of the similar nickel material.

3 The base metal with a good corrosion resisting property and the material with a linear expansion coefficient close to the base metal shall be selected for the welding of dissimilar nickel materials and welding of nickel material and austenitic steel.

4 The welding materials for nickel and nickel alloy should be selected in accordance with Table D.0.4-1 and Table D.0.4-2 in Appendix D of this code.

5 As for the inert gas shielded arc welding, the mixed gas of argon gas and helium gas or argon and helium shall be selected as the shielding gas.

11.2.2 The groove preparation shall meet the following requirements:

1 The groove in large angle or small root face type shall be selected, and the type and dimension of groove should be in accordance with those specified in Table C.0.5 of this code.

2 Mechanical methods should be adopted for weldment cutting and groove preparation. When plasma cutting is adopted, the finished surface shall be cleaned.

11.2.3 The oil stain may be degreased with vapor; as for the paint and other foreign substances that are insolvable to degreasing agent, such cleaning agents as chloromethane and alkali may be adopted; the marking ink may be removed by adopting methanol; as for the foreign substances that are pressed into the weldment surface, they may be removed through grinding, shot blasting or being cleaned with 10% hydrochloric acid solution. After the cleaning is finished, it shall be rinsed with water, and welding shall be conducted when it is dried.

11.2.4 When the butt welds of the pipe are fitted up, the misalignment of the inner wall shall not be larger than 0.5mm.

11.2.5 The misalignment of the butt welds of equipment shall meet those specified in Article 8.2.7 of this code.

11.2.6 When butt weldments of different thickness are fitted up, the end face of the thin weldment shall be located within that of the thick one. When the unfitness of butt joint of the inner wall is larger than those specified in Article 11.2.4 and Article 11.2.5 of this code or where the misalignment of the outer wall is larger than 3mm, the weldment shall be processed

12 Welding of Zirconium and Zirconium Alloy

12.1 General Requirements

12.1.1 This chapter is suitable for the pipe welding construction of zirconium and zirconium alloy.

12.1.2 This chapter is suitable for the gas tungsten arc welding method.

12.2 Preparation before Welding

12.2.1 The welding materials shall be selected in accordance with the following requirements:

1 The mechanical property of the weld metal shall not be lower than the lower limit value specified in corresponding standards of base metal annealed condition. Welding shall have a good procedure performance, and the service performance of the weld shall be in accordance with those specified in the current relevant standards and design documents of the nation.

2 The chemical compositions of the selected welding wires shall be the same. The commonly used zirconium and zirconium alloy welding wires may be selected in accordance with Table D.0.5 in Appendix D of this code.

3 The gas mixture of argon gas and helium gas or argon and helium shall be adopted as the shielding gas.

12.2.2 The preparation of the weldment groove shall meet the following provisions:

1 The groove types and dimensions of the pipes and pipe castings should be in accordance with those specified in Table C.0.6 of Appendix C.

2 Mechanical methods shall be adopted in weldment cutting and groove preparation, and the processing rate shall be proper. Besides, the overheated oxidization shall be prevented. When the plasma cutting is adopted to cut the pipe, measures to prevent the internal and external surface of the pipe from being contaminated and mechanical methods shall be adopted to remove the contamination layer.

3 Mechanical cleaning shall be conducted to the groove and the metal surface within 20mm of the groove edge until the metal shows its metallic luster.

4 Such foreign substances as the grease, moisture, dust, etc. on the external surface and surface of the welding wire within 20mm range of the groove surface and its both sides shall be eliminated by adopting absolute alcohol or acetone solvents, and the chloric solvent shall not be adopted to clean the weldment.

5 The weldment shall be welded as soon as it's well cleaned. When it has not been welded four hours after it is cleaned and no effective protection measures are adopted during this period, it shall be cleaned again before being welded.

12.2.3 When the butt welds of the pipe are fitted up, the misalignment of the inner wall shall not be larger than 10% of the base metal thickness, and it shall not be larger than 1mm, either.

12.2.4 When butt weldments of different thickness are fitted up, the end face of the thin weldment shall be located within that of the thick one. When the misalignment of the inner wall is larger than those specified in Article 11.2.3 or when the misalignment of the outer wall is larger than 3mm, processing shall be carried out in accordance with those

specified in Article 7.2.8 of this code.

12.2.5 The tack weld shall meet the following requirements:

1 The welding procedure of the tack weld shall be the same as the formal welding and shall be welded by qualified welders.

2 The tack welds shall be distributed evenly, and the weld bead height shall not exceed 2/3 of the pipe wall thickness.

3 The tack weld shall be free from any crack and gas pore or it is not allowable to have such defects as color change caused by oxidation.

12.3 Requirements of Welding Procedure

12.3.1 The direct current power supply and straight polarity method shall be adopted for the welding of zirconium and zirconium alloy. As for the welding position, the rotated flat welding shall be adopted.

12.3.2 A larger welding current or a relatively quick welding rate should be selected for the welding of zirconium and zirconium alloy. During the welding procedure, cooling measures shall be adopted and the interpass temperature shall not be less than 100°C.

12.3.3 Effective gas shielding measures shall be taken for the internal and external surface of zirconium and zirconium alloy in the welding area, and the following requirements shall be met:

1 The larger-diameter torch-tip shall be adopted to protect the molten pool, and the diameter of the torch-tip should be 12mm~20mm, and the dense gases blown out shall remain at a stable laminar condition.

2 The welding torch dragging cover and full cover shall be adopted to protect the thermal weld and the external surface of the of the heat affected zone. The shape and dimension of the welding torch dragging cover shall be determined according to the weldment size and the joint type, and the welding torch dragging cover shall be fabricated with materials of a better heat conductivity.

3 The weld and the internal surface of the heat affected zone shall be protected by filling argon or other shielding gases into the pipe, and it shall remain a slight positive pressure and a flow condition.

4 Separate gas circuits shall be adopted to provide shielding gas for each area and the gas shall be transmitted uniformly without disturbing each other. The gas circuit shall be free from residual moisture or any leakage, and plastic hose, instead of the rubber pipe or other moisture absorption materials, shall be adopted for the gas circuit.

5 The gas shielding device at front and back shall supply gas in advance, so that the air and adsorbed moisture may be evacuated. After the welding is quenched, the gas shall be supplied continuously until the weld and heat affected area are cooling to 300°C.

12.3.4 During the welding procedure, the welding wire shall always stay within the protection area of the shielding gas. When it contacts the air, welding shall be terminated immediately, and 25mm from the welding wire end shall be cut off, then welding may be continued.

12.3.5 During the welding procedure, if the tungsten electrode touches the welding wire or molten pool, welding shall be terminated, and the contaminated weld shall be removed and then the electrode shall be ground or replaced.

12.3.6 When the surface of the weld pass changes color, welding shall be terminated

13 Welding Inspection and Hand Over of Welding Engineering

13.1 Inspection before Welding

13.1.1 Before putting into use, the metal and welding materials used in engineering shall be inspected and accepted in accordance with those specified in Chapter 4 of this code.

13.1.2 Before welding, the equipment for welding, heat treatment and tooling shall be inspected and calibrated. Besides, those specified in Article 3.0.7 of this code shall be met.

13.1.3 Before welding, the welding procedure document shall be inspected, and the relevant requirements stated in Chapter 5 of this code shall be met.

13.1.4 Before welding, the welder qualification shall be inspected, and the relevant requirements stated in Chapter 6 of this code shall be met.

13.1.5 Before welding, the welding environment shall be monitored, and the relevant requirements stated in Article 3.0.5 and Article 3.0.8 of this code shall be met.

13.1.6 Before fitting up, the main structure size and shape, groove type and size as well as the groove surface shall be inspected, which shall meet the relevant requirements of the design document, welding procedure document and this code. Where nondestructive test for the groove surface is required in the design document and relevant requirements, the test and defect treatment must be completed before welding.

13.1.7 After fitting up, the shape, position, misalignment, angular deformation, fitting-up gap, amount of lap of lap joint and faying, faying of butt joint with backing, etc. of fitted up component parts shall be inspected. The quality shall meet those specified in the design document, welding procedure document and the relevant requirements of this code.

13.1.8 Before welding, the cleaning quality of the groove and its both sides. The cleaning width and the surface quality after cleaning shall meet those specified in this code and the welding procedure document.

13.1.9 Before welding, the drying and cleaning quality of the welding materials shall be inspected and the quality shall meet those specified in Chapter 4 of this code and the welding procedure document.

13.1.10 As for weldment that requires weld preheating, the preheating temperature shall be inspected and rescored before welding. The preheating temperature and the width of the preheating zone shall meet the design document, welding procedure document and the relevant requirements specified in this code.

13.1.11 When the inspection result specified in Article 13.1 does not meet the requirements, welding shall not be conducted.

13.2 Inspection in the Mid of Welding

13.2.1 When the tack weld is welded, it shall be inspected and the slag crust shall be eliminated. The quality of the tack weld shall meet those specified in this code and the welding procedure document. Welding shall continue when all the discovered defects are eliminated.

13.2.2 As for the weld which requires impact toughness, the weld heat input shall be measured and recorded before welding, and the weld heat input shall meet those specified in the design document and welding procedure document.

13.2.3 As for the multilayer welding, when each layer is finished welding, the

document, heat treatment technology document and this code.

3 As for the weld on which local heating is conducted, such parameters as the rate of temperature rise, cooling rate, constant temperature, duration of constant temperature, temperature difference between any two temperature measurement points and the hot zone width shall be inspected and recorded. The heat treatment parameter and the hot zone width shall meet the relevant requirements stated in the design document, heat treatment technology document and this code.

4 The effects of heat treatment on the weld shall be inspected according to the specified methods in the design document or the current relevant standards of the nation. As for welds on which the in-furnace overall heat treatment, in-furnace local treatment by segments and out-furnace overall heat treatment are conducted, the welding test pieces of the product which are heated in the same condition shall be adopted for inspection. After local heating, the weld hardness shall be inspected.

5 When the effect of heat treatment is not qualified or there is abnormality in the heat treatment curve, other inspection methods should be adopted to re-inspect and evaluate.

13.3.9 When pickling and passivation treatments are conducted on the weld and its nearby surface, the treatment quality shall meet those specified in the design document and the current relevant standards of the nation.

13.3.10 When such inspections as the chemical composition analysis of the weld, ferrite content determination of the weld, metallographic inspection on welded joints, inspection on the mechanical property of the product specimen are conducted, the inspection results shall meet those specified in the design document and the current relevant standards of the nation.

13.3.11 The strength test and tightness test for the weld shall be conducted after the radiographic testing or ultrasonic testing and the weld heat treatment. The test methods and requirements for the strength test and tightness test for the weld shall meet those specified in the design document and the current relevant standards of the nation.

13.3.12 When the weld is finished welding, the welder's mark or other specified marks shall be left near the weld. The marking methods shall do no harm or pollution to the material surface. Embossed stamp mark shall not be adopted for cryogenic steel, stainless steel and non-ferrous metal. Where the stainless steels and nonferrous materials are marked with color codes, the ink shall be free from any substance that may damage the material.

13.4 Hand over of Welding Engineering

13.4.1 After the construction organization completes all the engineering projects of welding according to those specified in the contract, it shall hand over the projects to the development organization or the general contracting in time.

13.4.2 Before handing over, the development organization or general contracting unit shall inspect and accept the welding engineering, and the following content shall be confirmed:

1 The range and content of construction is consistent with those specified in the contract.

2 The engineering quality is in accordance with those specified in the design document and this code.

13.4.3 When handing over the welding engineering, the construction organization shall

submit the following documents to the development organization or general contracting unit.

1 Quality proof document or re-inspection or test report of the base metal and welding material.

2 The following contents shall be included in the inspection record and test report on the welding construction, and the requirements of the current relevant standards of the nation shall be met:

- 1) Welder qualification approval record;
- 2) Welding inspection record;
- 3) Repair inspection records of the weld;
- 4) Report on weld heat treatment (including the heat treatment record curve);
- 5) Nondestructive testing report (radiographic testing, ultrasonic testing, magnetic particle testing and penetrant testing, etc.)
- 6) Reports on hardness testing, spectrum analysis or other test reports.

3 Equipment composing graph or pipe axonometric drawing, design change and material substitution list.

13.4.4 As for the weld that is required to go through nondestructive testing and post-weld heat treatment, the weld position, weld No., welder code number, nondestructive testing method, weld position checked through nondestructive testing, positions of weld repairing, heat treatment and hardness inspection shall be marked clearly on the equipment composing graph or pipe axonometric drawing. As for the weld without requirements for nondestructive testing, the weld identification drawing shall be adopted to mark the weld.

Technical measures: weaving or non-weaving welding pass _____ Weaving parameter _____ Pre-weld cleaning or interlayer cleaning _____ Back cleaning _____ Distance from electrode nozzle to workpiece _____ Extended length of tungsten electrode _____ Welding torch, electrode(welding wire, welding rod) angle _____ Nozzle size _____ Single pass welding or multi-pass welding (on each side) _____ Single-wire welding or multi-wire welding _____ Peening _____ Other _____					
Prepared by		Reviewed by		Approved by	
Date		Date		Date	

Appendix B

Welding Performance Qualification Record, Welding Performance Qualification Result Form and Welding Performance Certification Form

B.0.1 The welding performance qualification record form should be in accordance with those specified in Table B.0.1.

Table B.0.1 Welding Performance Qualification Record

Test piece No.		Name		Position of test piece			
Base material designation			Designation and diameter of welding rod				
Plate thickness			Designation and diameter of welding wire				
External diameter and wall thickness of pipe			Designation of welding wire				
Welding method			Designation and diameter of tungsten electrode				
Test piece type			Shielding gas				
Visual inspection	Inspection result						
	Quality evaluation of visual inspection						
	Examiner		Inspection date				
Radiographic testing	Photo quality level	Weld quality level		Inspection report No.	Inspection date		
Fracture testing	Inspection result			Inspection report No.	Inspection date		
Bending property testing	Face bending	Root bending	Side bending	Inspection report No.	Inspection date		
Macroscopic metallographic testing	Inspection result			Inspection report No.	Inspection date		
	Inspection result			Inspection report number	Inspection date		
	Inspection result			Inspection report number	Inspection date		
Reviewed by: Recorded by: Date:							

B.0.2 The format of the welding performance qualification result registration form should be in accordance with those specified in Table B.0.2.

Table B.0.2 Registration Form of Welding Performance Qualification Result

Examination No.:

Name			Gender		Welder steel seal		
Birth date			Education level		Welding seniority		
Basic knowledge examination		Examination date	Test paper No.	Test scores	Signature of examinant		
Welding operation performance qualification	Examination date	Test piece No.	Operation performance qualification item(code)			Examination result	Signature of examinant
Conclusion	Qualified for items: Chairman of welding performance qualification committee Date:						

B.0.3 The format of welding performance qualification certificate should be in accordance with those specified in Table B.0.3.

Table B.0.3 Welding Performance Qualification Certificate

(Plastic Cover)

Field equipment, industrial pipe welding engineering Welding performance qualification certificate _____ Welding performance qualification committee
--

(Inside Cover)

Name _____ Gender _____ Welder's steel seal _____	Photo
(The photo shall be pressed with the official seal of welding performance qualification committee)	
Certificate No. _____	

(page1~page5)

Eligible items of skill evaluation(Code)	Signature of committee chairman	Issue date

(page6~page10)

Item free from examination(Code)	Signature of committee chairman	Issue date

(page11~page12)

Record on welding quality accident			
Date	Content of quality accident	Recorded by	Signature of person in charge of quality inspection

Base material type	Welding rod model	Welding wire model
Nickel 200	ENi 2061(ENi-1)	SNi 2061(ERNi-1)
Monel 400	ENi 4060(ENiCu-7)	SNi 4060(ERNiCu-7)
Inconel 600	ENi 6062(ENiCrFe-1)	SNi 6062(ERNiCrFe-5)
	ENi 6182(ENiCrFe-3)	SNi 6082(ERNiCr-3)
Inconel 625	ENi 6625(ENiCrMo-3)	SNi 6625(ERNiCrMo-3)
Incoloy 800	ENi 6133(ENiCrFe-2)	SNi 6082(ERNiCr-3)
	ENi 6182(ENiCrFe-3)	
Incoloy 825		SNi 8065(ERNiFeCr-1)
Hastelloy B	ENi 1001(ENiMo-1)	SNi 1001(ERNiMo-1)
Hastelloy B2	ENi 1066(ENiMo-7)	SNi 1066(ERNiMo-7)
Hastelloy C276	ENi 6276(ENiCrMo-4)	SNi 6276(ERNiCrMo-4)
Hastelloy C4	ENi 6455(ENiCrMo-7)	SNi 6455(ERNiCrMo-7)

Note: The models in the parentheses are those welding rod models of the replaced standard "Nickel and Nickel Alloy Covered Welding Electrodes" GB/T 13814-1992 and welding wire models of the replaced standard "Nickel and Nickel Alloy Welding Wires" GB/T 15620-1995.

Table D.0.4-2 Selection of Commonly Used Dissimilar Nickel and Nickel Alloy Welding Materials

Base metal type		Welding rod model	Welding wire model
Nickel 200	Monel 400	ENi 2061(ENi-1)	SNi 2061(ERNi-1)
		ENi 4060(ENiCu-7)	SNi 4060(ERNiCu-7)
	Inconel 600 Incoloy 800	ENi 2061(ENi-1)	SNi 2061(ERNi-1)
		ENi 6062(ENiCrFe-3) ENi 6133(ENiCrFe-2)	SNi 6082(ERNiCr-3)
	Hastelloy B Hastelloy B2 Hastelloy C	ENi 6062(ENiCrFe-3)	SNi 6082(ERNiCr-3)
		ENi 6133(ENiCrFe-2)	SNi 7092(ERNiCrFe-6)
Monel 400	Inconel 600 Incoloy 800	ENi 6062(ENiCrFe-3)	SNi 6082(ERNiCr-3)
		ENi 6133(ENiCrFe-2)	SNi 7092(ERNiCrFe-6)
	Hastelloy B Hastelloy B2	ENi 4060(ENiCu-7)	SNi 4060(ERNiCu-7)
		ENi 6133(ENiCrFe-2) ENi 6062(ENiCrFe-3)	SNi 6082(ERNiCr-3) SNi 7092(ERNiCrFe-6)
	Hastelloy C		
Inconel 600 Incoloy 800	Hastelloy B Hastelloy B2 Hastelloy C	ENi 6062(ENiCrFe-3)	SNi 6082(ERNiCr-3)
		ENi 6133(ENiCrFe-2)	SNi 7092(ERNiCrFe-6)
	Hastelloy C276 Hastelloy C4	ENi 1004(ENiMo-3)	SNi 1004(ERNiMo-3)
Hastelloy B		ENi 1004(ENiMo-3)	SNi 1004(ERNiMo-3)

Note: The models in the parentheses are those welding rod models of the replaced standard "Nickel and Nickel Alloy Covered Welding Electrodes" GB/T 13814-1992 and welding wire models of the replaced standard "Nickel and Nickel Alloy Welding Wires" GB/T 15620-1995.

D.0.5 The zirconium and zirconium alloy welding wire should be selected in accordance with those specified in Table D.0.5.

Explanation of Wording in This Code

1. Words used for different degrees of strictness are explained as follows in order to mark the differences in executing the requirements in this code.
 - 1) Words denoting a very strict or mandatory requirement:

“Must” is used for affirmation; “must not” for negation.
 - 2) Words denoting a strict requirement under normal conditions:

“Shall” is used for affirmation; “shall not” for negation.
 - 3) Words denoting a permission of a slight choice or an indication of the most suitable choice when conditions permit:

“Should” is used for affirmation; “should not” for negation.
 - 4) “May” is used to express the option available, sometimes with the conditional permit.
2. “Shall comply with...” or “shall meet the requirements of...” is used in this code to indicate that it is necessary to comply with the requirements stipulated in other relative standards and codes.

List of Quoted Standards

Code for Construction of Industrial Metallic Piping Engineering GB 50235

Code for Construction and Acceptance of Field Equipment, Industrial Pipe Welding Engineering GB 50236

Stainless Steel Covered Electrodes GB/T 983

Recommended Joint Preparation for Gas Welding Manual Metal Arc Welding Gas-shield Arc Welding and Beam Welding GB/T 985.1

Recommended Joint Preparation for Submerged Arc Welding GB/T 985.2

Recommended Joint Preparation for Gas-shield Arc Welding on Aluminium and Its Alloys GB/T 985.3

Recommended Joint Preparation for Welding on Clad Steels GB/T 985.4

Wire Rod for Electrode GB/T 3429

Titanium and Titanium Alloy Wire GB/T 3623

Stainless Steel Wire Rods for Welding GB/T 4241

Argon GB/T 4842

Pure Helium GB 4844.2

Carbon Steel Covered Electrodes GB/T 5117

Low Alloy Steel Covered Electrodes GB/T 5118

Carbon Steel Electrodes and Fluxes for Submerged Arc Welding GB/T 5293

Dissolved Acetylene GB 6819

Welding Electrodes and Rods for Gas Shielding Arc Welding of Carbon and Low Alloy Steel GB/T 8110

Pure Nitrogen and High Purity Nitrogen and Ultra Pure Nitrogen GB/T 8979

Copper and Copper Alloy Wires and Rods GB/T 9460

Carbon Steel Flux Cored Electrodes for Arc Welding GB/T 10045

Cheese Head Studs for Arc Stud Welding GB/T 10433

Aluminium and Aluminium Alloy Wires and Rods GB/T 10858

Low-alloy Steel Electrodes and Fluxes for Submerged Arc Welding GB/T 12470

Nickel and Nickel Alloy Covered Welding Electrodes GB/T 13814

Steel Wires for Melt Welding GB/T 14957

Nickel and Nickel Alloy Wires and Rods GB/T 15620

Low Alloy Steel Flux Cored Electrodes for Arc Welding GB/T 17493

Stainless Steel Flux Cored Wires GB/T 17853

Stainless Steel Electrodes and Fluxes for Submerged Arc Welding GB/T 17854

Examination Rules for Welding Operators of Special Equipment TGS Z6002

Carbon Dioxide for Welding HG/T 2537

Regulations on Quality Management of Welding Materials JB/T 3223

Nondestructive Testing of Pressure Equipment JB/T 4730

Welding Procedure Qualification for Pressure Equipment NB/T 47014

Welding Specification for Steel Pressure Vessels NB/T 47015

Technical Permission of Welding Materials for Pressure Equipment- Part 7: Titanium and Titanium Alloy Welding Wire and Filling Wire NB/T 47018.7

Stainless Steel Rods and Wires for Inert-gas Shield Welding YB/T 5091

_____ **END** _____

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