

Translated English of Chinese Standard: NB/T47016-2011

www.ChineseStandard.net

Sales@ChineseStandard.net

ICS 19.160

H 22

NB

INDUSTRY STANDARD

OF THE PEOPLE'S REPUBLIC OF CHINA

NB/T 47016-2011 (JB/T 4744)

Replacing JB 4744-2000

Mechanical Property Tests of Product Welded Test

Coupons for Pressure Equipment

承压设备产品焊接试件的力学性能检验

NB/T 47016-2011 How to BUY & immediately GET a full-copy of this standard?

1. www.ChineseStandard.net;
2. Search --> Add to Cart --> Checkout (3-steps);
3. No action is required - Full-copy of this standard will be automatically & immediately delivered to your EMAIL address in 0~25 minutes.
4. Support: Sales@ChineseStandard.net. Wayne, Sales manager

Issued on: July 01, 2011

Implemented on: October 01, 2011

Issued by: National Energy Administration

Table of Contents

Foreword.....	3
1 Scope	5
2 Normative Reference	5
3 General Provisions	5
4 Coupon Preparation	7
6 Inspection Method and Qualified Indexes	10
7 Reinspection.....	22
Announcement (Corrigendum).....	24

Foreword

The main changes of this standard over JB 4744-2000 "Mechanical property tests of product welded test coupons for steel pressure vessels" and JB/T 1614-1994 "Methods of mechanical property test for boiler pressure parts welded joints" are as follows:

- The product welded test panel is modified into product welded test coupons;
- The application scope is enlarged from pressure vessels to boiler, pressure vessels and pressure piping;
- Aluminum, titanium, copper and nickel product welded coupons are added and tubulous coupons are added;
- "Symbol" of Chapter 3 in JB 4744-2000 is deleted and "General Provisions" is increased;
- Preparation of coupons is modified in Chapter 5;
- The Category, sampling quantity and position of coupon mechanical property inspection are modified in Chapter 6;
- Methods of tensile test and qualified indexes are modified in Chapter 7; dimensions and test methods of bending samples are modified; sampling point, quantity, inspection item and qualified indexes of impact test are modified;
- The requirements of reinspection in Chapter 8 are modified.

This standard shall replace the relevant contents in JB 4744-2000 and JB/T 1614, from the implementation date.

This standard was proposed by and shall be under the jurisdiction of the National Technical Committee on Boilers and Pressure Vessels of Standardization Administration of China (SAC/TC 262).

Drafting organizations and staffs of this standard:

Hefei General Machinery Research Institute, Ge Zhaowen, Dou Wanbo, Fang Wunong;

China Special Equipment Inspection and Research Institute, Shou Binan, Xie Tiejun, Yang Guoyi.

Participating drafting organizations and staffs of this standard:

Mechanical Property Tests of Product Welded Test Coupons for Pressure Equipment

1 Scope

This standard specifies the preparation, sample preparation, inspection method and qualified indexes for pressure equipment's (boiler, pressure vessels and pressure piping) product welded coupons.

This standard is applicable to the inspection of mechanical property and bending property for steel, aluminum, titanium, copper and nickel pressure equipment's product welded coupons.

The product welded coupons include product weld test plate, product inspection coupons, simulating loop and certification loop.

This standard is not applicable to gas cylinders.

2 Normative Reference

The following referenced documents are indispensable references, only the edition cited applies. For dated references, only the dated edition of the normative reference referred to applies. For the undated normative references, the latest editions (including all amendments) apply.

GB/T 228 Metallic Materials - Tensile Testing

GB/T 229 Metallic Materials - Charpy Pendulum Impact Test Method

GB/T 2653 Bend Test Methods on Welded Joints

NB/T 47014 Welding Procedure Qualification for Pressure Equipment

3 General Provisions

3.1 In addition to the requirements of this standard, the inspection of mechanical property for product welded coupons shall also be in accordance with the relevant requirements of safety technical codes, standards and design documents.

3.2 Materials used for coupons shall be of the same standard, code (mark and steel

grade), specification (only for thickness and outside diameter) and heat treatment state with materials used for components of pressure equipment. Where 06Cr13Al steel is adopted to weld pressure equipment and post-weld heat treatment is not carried out, the base metal of coupons shall include steel plate of each furnace number.

3.3 The pressure equipment product welded coupons are classified into plate coupons and tubulous coupons. Tubulous refers to pipeline and loop.

3.4 The arrangement of product welded coupons:

- a) The plate coupon of shell ring longitudinal joints shall be arranged at the prolongation of its welding line; it shall be welded simultaneously with the shell ring that it represents.
- b) The tubulous coupons or plate coupons used for circumferential joints shall be welded in the welding process of components of pressure equipment which it represents.

3.5 Welding procedure of coupons

3.5.1 Where the inspected welded joints are subjected to different welding procedures, the welding procedure and condition of the coupons shall be the same with those of the welded joints that coupons represent; coupons shall be prepared with practical welding procedure (includes post-weld heat treatment) which can bring lower mechanical property.

3.5.2 Welders for welding the coupon shall be the one participates in welding the pressure equipment components.

3.5.3 Coupons shall be prepared according to the special welding process documents. Coupon code, work order number or pressure equipment number and material code shall be indicated clear in the welding process documents.

3.5.4 Coupons shall be equipped with welding records.

3.6 Repair coupon welding line is permissible and the repair process shall be the same with the repair process of pressure equipment components.

3.7 After being carried out appearance inspection and nondestructive testing, coupons shall be sampled at the position where free from defect and imperfection.

3.8 The sample shall be allowed for cool leveling before removing welded joint reinforcement.

3.9 Where two or more than two kinds of welding methods are adopted or welding procedure with different key factors and supplemental factors are adopted, all weld

different; three impact samples shall be taken at each side of heat affected zone.

5.4.3 Except for requirements of design documents, the composite metal shall be prepared of impact sample only at the basement layer.

5.4.4 Impact test at heat affected zone of low carbon steel, Q345R and austenitic chromium-nickel steel coupons is permissible to be omitted.

5.4.5 Aluminum magnesium alloy whose magnesium content exceeds 3% shall be prepared of impact samples only at the weld zone.

5.5 Sample position

5.5.1 The sampling position of plate sample is detailed in Figure 1; the impact sample position used for reinspection remains unchanged.

5.5.2 The sampling position of tubulous coupons is detailed in Figure 2.

5.6 The length of rejection part at both ends of coupons shall be subject to welding method and plate thickness, it shall not be less than 30mm for manual welding, and not be less than 40mm for motorized welding and automatic welding. If there are arc starting plate and run off plate, the parts at the both ends of coupon may be rejected or not.

5.7 Sample blank shall be made with cold process and hot working method but the heat affected zone shall be neglected.

5.8 After the sample inspection is qualified and marked with lines, steel seal or permanent marking shall be printed.

6 Inspection Method and Qualified Indexes

6.1 Tensile test

6.1.1 Tensile samples for joints

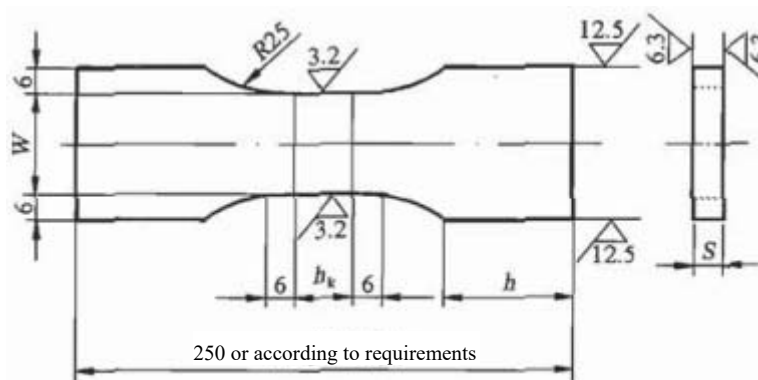
6.1.1.1 Sampling and processing requirements:

- a) Tensile samples shall be taken from the heat affected zone and each kind of weld metal of each welding method (or welding process);
- b) As for composite metal, where the coating thickness is involved in calculating the composite board strength, the tensile sample shall include the coating and basement layer; where the coating thickness is not involved in calculating the composite board strength, the tensile sample shall omit the coating and its weld metal;

- c) The weld reinforcement of samples shall be removed with cold process to make it be flush with base metal;
- d) Coupons whose thickness less than or equal to 30mm, samples of through thickness shall be adopted to conduct an experiment; the sample thickness shall be equal to or close to the base material thickness of coupons T;
- e) When the testing machine is unable to carry out the tensile test of full thickness due to capacity restriction, the coupon may be uniformly sampled in layer at thickness direction, and the sample preparation thickness after equation shall be close to the maximum thickness of testing machine bearing test. Two or multiple sample test after equation may replace the test of one full thickness sample.

6.1.1.2 Sample form:

- a) Tensile sample of compact type plate joint with shoulder plate (see Figure 3) is applicable to the plate coupon of all thickness;
- b) Tensile sample of compact type pipe joint with shoulder plate, type I (see Figure 4) is applicable to all tubulous coupons whose outer diameter is greater than 76mm;
- c) Tensile sample of compact type pipe joint with shoulder plate, type II (see Figure 5) is applicable to all tubulous coupons whose outer diameter is less than or equal to 76mm;
- d) Pipe joint total cross-section tensile sample (see Figure 6) is applicable to all tubulous coupons whose outside diameter is less than or equal to 76mm.



Note: S - the sample thickness, its unit is mm;

W - the parallel side width of sample tension, larger than or equal to 20mm;

h_k - the maximum width of welding seam at both sides of S, the unit is mm;

h - the clamping length determined by the clamp of testing machine, its unit is mm.

Figure 3 Tensile Sample of Compact Type Plate Joint with Shoulder Plate

- 3) The specified minimum tensile strength value of titanium base metal equals to the tensile strength lower limiting value specified in the annealed state standard;
- 4) The specified minimum tensile strength value of copper base metal equals to the smaller value of tensile strength lower limiting values specified in the annealed and other state standard;

Where the tensile strength lower limiting value for extruding copper product specified in annealed state is not given out in standards, it can be determined according to 90% of tensile strength lower limiting value specified in original state or according to the results of experimental investigation;

- 5) The specified minimum tensile strength value of nickel base metal equals to the specified tensile strength lower limiting value of base metal in annealed state (only for Ni-1 and Ni -2) or solid solution condition (only for Ni -3, Ni -4 and Ni -5);
- b) Where the sample base metals are of two kinds of metal material codes, the tensile strength of each sample shall not be less than the smaller value of the specified minimum tensile strength values of these two base metals in this standard:
- c) Samples which the coating thickness is involved in calculating the design strength of composite metallic material, the tensile strength R_m of each sample shall meet:

$$R_m \geq \frac{R_{m1}t_1 + R_{m2}t_2}{t_1 + t_2}$$

Where,

R_{m1} - The specified minimum tensile strength value of coating, the unit is MPa;

R_{m2} - The specified minimum tensile strength value of base metal, the unit is MPa;

t_1 - The coating thickness;

T_2 - The basement layer thickness

- d) Where weld metal is required whose room-temperature tensile strength is lower than the base metal, the tensile strength of each sample shall not be less than the specified minimum value of weld metal tensile strength.

Where T is less than or equal to 10mm, S shall be close to T as much as possible;

- 3) Where the clintheriform and outside diameter ϕ are greater than 100mm tubulous coupons, the sample width $B=38\text{mm}$; where the outside diameter

of tubulous coupons ϕ is 50mm~100mm, then $B = \left(S + \frac{\phi}{20} \right)$ mm; where

B is greater than or equal to 8mm but less than or equal to 38mm, ϕ is

greater than or equal to 10mm but less than 50mm, then $B = \left(S + \frac{\phi}{10} \right)$

mm and the minimum value is 8mm; where ϕ is less than or equal to 25mm, the coupon shall be divided into four equal parts in the circumference direction to sample.

- c) See Figure 10 for transverse side bending sample.

- 1) Where the coupon thickness T is greater than or equal to 10mm but less than 38mm, the sample width B shall be close to or equal to the coupon thickness. The thickness of the sample respectively is 3mm (base metal category whose number is 1 in Table 3) or 10mm (base metal category whose number is exclusive of 1 in Table 3);
- 2) Where the coupon thickness T is greater than or equal to 38mm, test for samples which is cut into two or more pieces of 20mm ~ 38mm along the coupon thickness direction by layers may be adopted to replace a test for side bending samples of through thickness or to replace sample bending in full width.

Table 3 Bending Test Condition and Parameter

No.	Base metal category at both sides of the welding seam	Sample thickness S mm	Bend center diameter D mm	Distance between backup rolls mm	Bending angle (°)
1	(1). Weld A1-3 with A1-1, A1-2, A1-3 and A1-5;	3	50	58	180
	(2). Weld A1-1, A1-2, A1-3 and A1-5 (separately welding or mutually welding) with A1S-3 welding stick; (3) Cu-5; (4) Various copper base metals are welded with welding rod (CuT-3, CuT-6 and CuT-7) and welding stick (CuS-3, CuS-6 and CuS-7).	<3	16.5S	18.5S+1.5	

diameter equals $\frac{S(200 - A)}{2A}$ (A refers to the specified lower limiting value of percentage elongation after fracture multiplied by 100); the spacing of supports equal to the bend center diameter plus $2S+3\text{mm}$;

- e) When carrying out horizontal sample bending test, the weld metal and heat affected zone shall be entirely located in the bending parts of the sample.

6.2.4 Qualified indexes

When the sample is bent to a specified angle, the welding seam and heat affected zone on stretching plane along any direction shall be free from crack opening defect with single length larger than 3mm, and the edge angle crack of sample shall generally not be counted, but the edge angle crack length caused by incomplete fusion, slag inclusion or other internal defects shall be counted.

If adopting two or more samples, each sample shall meet above requirements.

As for the composite metallic material produced by rolling method, exploded rolling method and explosion method, where there are layering and crack caused by non-combined defect of side bending sample composite interface, it is permissible to sample again for testing.

6.3 Impact test

6.3.1 As for the weld zone and heat affected zone which adopt various welding methods (or welding procedures), Charpy V test shall be carried out.

6.3.2 Sample:

- a) Sampling orientation: the longitudinal axis shall be vertical to the weld axis, and the Charpy V-notch axis shall be vertical to the base metal surface;
- b) Sampling position: the sampling position on the coupon thickness is detailed in Figure 11;
- c) The notch position: the notch axis of the weld zone sample shall be located on the weld center line.

For the distance from the notch axis of the heat affected zone sample to the longitudinal axis and fusion line, the K is greater than zero and the crossing point shall pass through the heat affected zone as much as possible, see Figure 12.

zone impact test;

- b) The coupon amount of tensile test and bending test for reinspection is 2 times of the former amount;
- c) The coupon amount of impact test for reinspection shall be 3 in each group.

7.2 Sample, test methods and qualified indexes

7.2.1 The chopping position, preparation, test methods of reinspected samples shall meet the requirements of this standard.

7.2.2 The qualified indexes of tensile test and bending test shall meet the requirements of 6.1 and 6.2; only when all reinspected samples are qualified the reinspection can be regarded as qualified.

7.2.3 The qualified indexes of impact sample: the average value of impact power of successive two groups (6 samples) shall not be less than the specified value; the average value of two samples may be less than the specified value, but only one may be less than 70% of the specified value.

14	NB/T 47018 (P.8)	Table 2, Line 2	Aluminum aluminum alloy	Aluminum and aluminum alloy
----	------------------	-----------------	-------------------------	-----------------------------

National Boilers and Pressure Vessels Standardization Technical Committee, Secretariat

April 5, 2011

_____ **END** _____

This is an excerpt of the PDF (Some pages are marked off intentionally)

Full-copy PDF can be purchased from 1 of 2 websites:

1. <https://www.ChineseStandard.us>

- SEARCH the standard ID, such as GB 4943.1-2022.
- Select your country (currency), for example: USA (USD); Germany (Euro).
- Full-copy of PDF (text-editable, true-PDF) can be downloaded in 9 seconds.
- Tax invoice can be downloaded in 9 seconds.
- Receiving emails in 9 seconds (with download links).

2. <https://www.ChineseStandard.net>

- SEARCH the standard ID, such as GB 4943.1-2022.
- Add to cart. Only accept USD (other currencies - <https://www.ChineseStandard.us>).
- Full-copy of PDF (text-editable, true-PDF) can be downloaded in 9 seconds.
- Receiving emails in 9 seconds (with PDFs attached, invoice and download links).

Translated by: Field Test Asia Pte. Ltd. (Incorporated & taxed in Singapore. Tax ID: 201302277C)

About Us (Goodwill, Policies, Fair Trading...): <https://www.chinesestandard.net/AboutUs.aspx>

Contact: Wayne Zheng, Sales@ChineseStandard.net

Linkin: <https://www.linkedin.com/in/waynezhengwenrui/>

----- The End -----