NATIONAL STANDARD OF
THE PEOPLE'S REPUBLIC OF CHINA

中华人民共和国国家标准

GB/T 27684—2011

(replacing "")

Seamless and welded fittings for titanium and titanium alloy

钛及钛合金无缝和焊接管件

Issued: 2011-12-30 Implemented: 2012-10-01

Issued jointly by the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China and the Standardization Administration of the People's Republic of China

Foreword

This standard was drafted in accordance with the rules given in GB/T 1.1—2009.

This standard is under the jurisdiction of the National Nonferrous Metals Standardization Technical Committee (SAC/TC 243).

The drafting organizations of this standard are: Western Metal Materials Co., Ltd., Baoji Titanium Group Co., Ltd., and Northwest Institute for Nonferrous Metal Research.

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1 Scope

This standard specifies the symbols and definitions, requirements, test methods, inspection rules, marking, packaging, transport, storage, quality certificate and contract (or purchase order) contents for seamless and welded titanium and titanium alloy pipe fittings (including elbows, reducers, tees and lap-joint stub ends).

This standard applies to seamless and welded pipe fittings manufactured from titanium and titanium alloys.

2 Normative References

The following documents contain provisions which, through normative reference in this standard, constitute indispensable provisions of this standard. For dated references, only the edition cited applies. For undated references, the latest edition (including all amendments) applies.

Standard No.	Title
GB/T 2965	Titanium and titanium alloy bars
GB/T 3620.1	Designation and composition of titanium and titanium alloys
GB/T 3621	Titanium and titanium alloy plates and sheets
GB/T 3623	Titanium and titanium alloy wires
GB/T 3624	Titanium and titanium alloy tubes
GB/T 3625	Titanium and titanium alloy tubes for heat exchangers and condensers
GB/T 8180	Packaging, marking, transport and storage of wrought titanium and titanium alloy products
GB/T 9118.1	Loose hubbed steel pipe flanges with welding neck for raised face
GB/T 9118.2	Loose hubbed steel pipe flanges with welding neck for ring joint face
JB/T 4730	Non-destructive testing of pressure equipment
JB/T 4745	Titanium welded pressure vessels
ASME B16.5—2003	Pipe Flanges and Flanged Fittings
ASME B16.9—2007	Factory-Made Wrought Buttwelding Fittings

Standard No.	Title
ASME B36.10M—2004	Welded and Seamless Wrought Steel Pipe
ASME B36.19M—2004	Stainless Steel Pipe

3 Symbols and Definitions

The following symbols and definitions apply to this document.

DN — nominal size of pipe fittings in metric units; a size designation consisting of letters and numbers used for components of a piping system. It consists of the letters DN followed by a dimensionless integer number. This number is directly related to the characteristic dimension such as the bore or the outside diameter (expressed in mm) of the end connection.

PN — a designation consisting of letters and numbers used for reference, related to the mechanical properties and dimensional characteristics of the components of a piping system. It consists of the letters PN and a dimensionless number.

NPS — nominal size of pipe fittings in inch units.

a — distance from the centre of one end face to the centre of the other end face of a 90° elbow; distance from the centre to the end face centre of a 180° elbow.

b — distance from the centre to the end face of a 45° elbow.

c — distance from the axis of the branch outlet to the end face of the centre body of a tee or cross.

d — outside diameter at the bevel of an elbow, equal-diameter tee and cross, and pipe cap; outside diameter at the bevel of the large end of a reducer.

d1 — outside diameter at the bevel of the small end of a reducer.

d2 — inside diameter of the end of a pipe fitting.

e — length of a pipe cap (pipe end cap).

f — length of a lap-joint stub end.

g — outside diameter of the lap of a lap-joint stub end.

h — length of a reducer.

i — misalignment of the butt weld.

k — distance from the end face to the top of a 180° elbow.

m — distance from the centre line of the body of a tee or cross to the section of the branch pipe.

n — datum plane of tolerances.

o — distance from the centre of one end face to the centre of the other end face of a 180° elbow.

p — form and position tolerance of 90° and 45° elbows.

q — form and position tolerance of elbows, tees and reducers.

r — radius of the fillet.

s — nominal wall thickness of a pipe fitting.

t — thickness of the lap of a lap-joint stub end.

u — form and position tolerance of 180° elbows.

4 Requirements

4.1 Product Classification

4.1.1 Categories and Codes

The categories and codes of the pipe fittings are given in Table 1.

Table 1 — Categories and codes of pipe fittings

Product variety	Category	Code of seamless fitting	Code of welded fitting
45° elbow	Long radius	45E(L)	W45E(L)
90° elbow	Long radius	90E(L)	W90E(L)
	Short radius	90E(S)	W90E(S)
	Long radius, reducing	90E(LR)	W90E(LR)
180° elbow	Long radius	180E(L)	W180E(L)
	Short radius	180E(S)	W180E(S)
Tee	Equal diameter	T(ST)	WT(ST)
	Reducing	T(RE)	WT(RE)
Lap-joint stub end	Long type	SE(L)	WSE(L)
	Short type	SE(S)	WSE(S)
Pipe cap	—	C	WC
Reducer (concentric or eccentric)	Concentric	R(CO)	WR(CO)
	Eccentric	R(EC)	WR(EC)
Cross	Equal diameter	CR(ST)	WCR(ST)
	Reducing	CR(RE)	WCR(RE)

4.1.2 Designation Examples

Example 1: A 90° short-radius seamless elbow with a nominal size of DN80, an outside diameter of the I-series, a wall thickness schedule of Sch80 and a material designation of TA2 is designated as:

DN80 Ⅰ-Sch80-TA2 90E(S) GB/T 27684—2011

Example 2: A concentric welded reducer with a nominal size of DN300×200, an outside diameter of the Ⅱ-series, a wall thickness of 3.0 mm and a material designation of TA1 is designated as:

DN300×200 Ⅱ-3.0-TA1 WR(CO) GB/T 27684—2011

Example 3: A 90° long-radius welded elbow with a nominal size of DN150, an outside diameter of the I-series, a wall thickness schedule of Sch80 and a material designation of TA9 is designated as:

DN150 Ⅰ-Sch80-TA9 W90E(L) GB/T 27684—2011

4.2 Materials

4.2.1

The material designations used for manufacturing titanium pipe fittings shall conform to the provisions of GB/T 3620.1; the plates and sheets shall conform to GB/T 3621, the tubes shall conform to GB/T 3624 or GB/T 3625, the bars shall conform to GB/T 2965, and the titanium welding wires shall conform to GB/T 3623.

4.2.2

Other titanium materials may be used, provided that they conform to the provisions of the corresponding standards.

4.3 Dimensions and Tolerances

4.3.1 Dimensions

4.3.1.1

The dimensions of the pipe fittings shall conform to the provisions of Figure 1 to Figure 8 and Table 2 to Table 9; the outside diameters at the ends of the pipe fittings are divided into two series, the I-series being the inch pipe dimensions and the Ⅱ-series being the metric pipe dimensions. The wall thickness schedules of the I-series pipe fittings and the connected titanium tubes are given in Annex A.

4.3.1.2

The inch dimension tables of the I-series pipe fittings refer to ASME B16.9—2007.

4.3.1.3

Since metric units and inch units cannot be converted exactly, the user must adopt the two systems of units separately. For pipe fittings with dimensions in metric units, the nominal size is expressed by DN; for pipe fittings with dimensions in inch units, the nominal size is expressed by NPS; the correspondence between the two is given in Annex A.

4.3.2 Special Dimensions

4.3.2.1

For applications involving fatigue loading, the purchaser shall provide the required minimum dimensions.

4.3.2.2

The service conditions and the connection structure usually determine the length requirements of the lap-joint stub ends. Therefore, when ordering, the purchaser must specify the category of the lap-joint stub ends (see note 2 of Table 7).

4.3.3 Tolerances

The dimensional tolerances and form and position tolerances of the pipe fittings are shown in Figure 9 and Table 10. The main contents include: tolerances of the outside diameter at the bevel, tolerances of the wall thickness, tolerances of the centre-to-end distances (dimensions a, b, c, m and o), form and position tolerances of the elbows (p, q and u), the end-face squareness and the misalignment of the butt weld (i), etc. The end-face misalignment x shall not exceed 10 % of the wall thickness and shall not be greater than 2 mm, see Figure 11.

4.4 Welds

4.4.1

The positions of the welds on the pipe fittings shall conform to the following requirements:

a) For elbows, reducers and tees with DN≤450, one longitudinal weld is recommended on the body; for DN500, two or more longitudinal welds are permitted;

b) The positions of the welds of the pipe fittings are shown in Figure 10. Where more than two welds are adopted, the positions of the welds shall conform to the relevant requirements of JB/T 4745;

c) For spliced pipe caps, the distance from the butt weld to the centre line of the pipe cap shall not be greater than one quarter of the outside diameter of the pipe cap.

4.4.2

The quality of the welds of the pipe fittings shall conform to the following requirements:

a) The welds on the body of the pipe fittings shall be butt welds with full penetration structure;

b) The surfaces of the welding bevels shall be free from cracks, delamination, slag inclusions and other defects;

c) The misalignment of the butt weld i shall be not greater than 10 % of the wall thickness and not greater than 2 mm, see Figure 11;

d) The reinforcement of the welds shall conform to the provisions for the reinforcement of the welds of Class A and B joints in JB/T 4745;

e) The surfaces of the welds shall be free from undercut;

f) The colour of the welds shall conform to the provisions of JB/T 4745;

g) All the welds on the pipe fittings shall be subjected to penetrant inspection in accordance with the provisions of JB/T 4730.5, and Grade I is qualified.

4.5 End Bevels of Pipe Fittings

The dimensions and shapes of the end bevels of the pipe fittings shall conform to the requirements of Figure 12 and Table 11.

The simple bevel and the compound bevel are shown in Figure 12. The bevel angle of the simple bevel is 37.5° ±2.5°, and the compound bevel consists of a bevel of 10°±1° plus a bevel of 37.5°±2.5°, with a root face (land) of the dimensions given in Table 11.

4.6 Visual Quality

4.6.1

The appearance of the pipe fittings shall be smooth and free from oxidation.

4.6.2

The pipe fittings shall be free from scars, folds, rolled folds, delamination and other defects with a depth greater than 5 % of the nominal wall thickness and a maximum depth exceeding 0.8 mm; the arc transition parts shall have smooth contours.

4.6.3

Slight scratches and mechanical damage are permitted on the surfaces, but there shall be no cracks. Defective areas shall be ground, and the slope of the ground area shall be at least 1:3. The depth of grinding shall not exceed 5 % of the nominal wall thickness or be greater than 1.6 mm; otherwise, repair welding shall be carried out.

4.7 Non-Destructive Testing

4.7.1

The surfaces of tee fittings and cross fittings shall be subjected to penetrant inspection piece by piece in accordance with the provisions of JB/T 4730.5, and Grade I is qualified.

4.7.2

When required by the purchaser and specified in the contract (or purchase order), other tests may be carried out, and the acceptance level shall be agreed between the supplier and the purchaser.

4.8 Pressure Test

4.8.1

The supplier does not carry out the pressure test, but shall ensure that the pressure resistance performance of the pipe fittings satisfies the requirements of the titanium tubes of the same material, nominal size and wall thickness.

4.8.2

When required by the purchaser and specified in the contract (or purchase order), the supplier may carry out the pressure test on the pipe fittings.

5 Test Methods

5.1 Test Method for Dimensions and Tolerances

The dimensions and tolerances of the pipe fittings shall be inspected with measuring tools of appropriate accuracy.

5.2 Test Method for Welds

The positions and surface quality of the welds of the pipe fittings shall be inspected by visual inspection and measuring tools of appropriate accuracy.

5.3 Test Method for End Bevels of Pipe Fittings

The dimensions of the end bevels of the pipe fittings shall be inspected with measuring tools of appropriate accuracy.

5.4 Test Method for Visual Quality

The visual quality of the pipe fittings shall be inspected by visual inspection and measuring tools of appropriate accuracy.

5.5 Non-Destructive Testing Method

The non-destructive testing of the pipe fittings shall be carried out in accordance with the provisions of JB/T 4730.

5.6 Pressure Test Method

The pressure test of the pipe fittings shall be carried out by the method agreed in the contract.

6 Inspection Rules

6.1 Inspection and Acceptance

6.1.1

The pipe fittings shall be inspected by the supplier to ensure that the product quality conforms to the requirements of this standard and the contract (or purchase order), and a quality certificate shall be filled in.

6.1.2

The purchaser may re-verify the received products in accordance with the provisions of this standard. When the re-verification results do not conform to the provisions of this standard and the contract (or purchase order), a written claim shall be submitted to the supplier within one month from the date of receipt of the products, and the matter shall be settled through consultation between the supplier and the purchaser.

6.2 Batching

The products shall be submitted for acceptance in batches. Each batch shall consist of products of the same designation category, specification, series and wall thickness.

6.3 Inspection Items and Sampling

The inspection items and sampling of the products shall conform to the provisions of Table 12.

Table 12 — Inspection items and sampling

Inspection item	Sampling provisions
Dimensions and tolerances	Per batch, 3 pieces
Welds (positions and surface quality of the welds of welded fittings)	Per batch, 3 pieces
End bevels	Per batch, 3 pieces
Visual quality	Per batch, 3 pieces
Non-destructive testing	The surfaces of tee fittings and cross fittings shall be subjected to penetrant inspection piece by piece

6.4 Judgment of Inspection Results

6.4.1

When the dimensions and tolerances of the products fail, that piece of product shall be judged as nonconforming.

6.4.2

When the weld positions and surface quality of the welds of the welded pipe fittings fail, that piece of product shall be judged as nonconforming.

6.4.3

When the end bevel dimensions of the pipe fittings fail, that piece of product shall be judged as nonconforming.

6.4.4

When the visual quality of the pipe fittings fails, that piece of product shall be judged as nonconforming.

6.4.5

When the penetrant inspection fails, that piece of product shall be judged as nonconforming. The judgment of the other non-destructive testing shall be in accordance with the contract.

6.4.6

For pipe fittings subjected to the pressure test as agreed in the contract, where the inspection result fails, double the number of specimens shall be taken from that batch for repeated testing; where one result still fails in the repeated test, that batch of products shall be judged as nonconforming.

7 Marking, Packaging, Transport, Storage and Quality Certificate

7.1 Marking

7.1.1 Product Marking

The qualified pipe fittings shall be marked with the following contents:

a) name of the supplier;

b) nominal size (including the outside diameter series; when the outside diameter is the I-series, it need not be marked separately; when the outside diameter is the Ⅱ-series, it shall be marked);

c) wall thickness schedule (or wall thickness value);

d) designation;

e) product code;

f) number of this standard.

7.1.2 Packaging Marking

The packaging cases of the products shall bear the words or marks such as "moisture-proof" and "handle with care".

7.2 Packaging, Transport and Storage

The packaging, transport and storage of the pipe fittings shall conform to the provisions of GB/T 8180.

7.3 Quality Certificate

Each batch of products shall be accompanied by a quality certificate stating the following contents:

a) name, address, telephone and fax of the supplier;

b) product code, specification and designation;

c) batch number and number of pieces;

d) results of all analyses and inspections, and the seal of the quality inspection department of the supplier;

e) number of this standard;

f) date of issue (or date of packaging);

g) others.

8 Contents of the Contract (or Purchase Order)

The contract (or purchase order) for the materials specified in this standard shall include the following contents:

a) product name and code;

b) designation, specification and dimensions;

c) number of pieces of the products;

d) other special requirements;

e) number of this standard.

Annex A (Informative) — Wall thickness schedules of seamless titanium tubes connected to pipe fittings

A.1 This annex lists the wall thickness schedule table of the titanium tubes connected to the pipe fittings (see Table A.1) for the reference of the users.

A.2 The wall thickness values in the tables of this annex are extracted from ASME B36.10M—2004 and ASME B36.19M—2004.

Table A.1 — Wall thickness schedules of titanium tubes connected to pipe fittings — Unit: millimetre

NPS	DN	Outside diameter	Sch5	Sch10	Sch20	Sch30	Sch40	Sch60	Sch80	Sch100	Sch120	Sch140	Sch160
1/8	6	10.3	1.24	1.65	—	—	1.73	—	2.41	—	—	—	—
1/4	8	13.7	1.65	1.65	—	—	2.24	—	3.02	—	—	—	—
3/8	10	17.1	1.65	1.65	—	—	2.31	—	3.20	—	—	—	—
1/2	15	21.3	1.65	2.11	—	—	2.77	—	3.73	—	—	—	—
3/4	20	26.7	1.65	2.11	—	—	2.87	—	4.01	—	—	—	—
1	25	33.4	1.65	2.77	—	—	3.38	—	4.55	—	—	—	—
1¼	32	42.2	1.65	2.77	—	—	3.56	—	4.85	—	—	—	—
1½	40	48.3	1.65	2.77	—	—	3.68	—	5.08	—	—	—	—
2	50	60.3	1.65	2.77	—	—	3.91	—	5.54	—	—	—	—
2½	65	73.0	2.11	3.05	—	—	5.16	—	7.01	—	—	—	—
3	80	88.9	2.11	3.05	—	—	5.49	—	7.62	—	—	—	—
3½	90	101.6	2.11	3.05	—	—	5.74	—	8.08	—	—	—	—
4	100	114.3	2.11	3.05	—	—	6.02	—	8.56	—	—	—	—
5	125	141.3	2.77	3.40	—	—	6.55	—	9.53	—	—	—	—
6	150	168.3	2.77	3.40	—	—	7.11	—	10.97	—	—	—	—
8	200	219.1	2.77	3.76	—	—	8.18	—	12.70	—	—	—	—
10	250	273.0	3.40	4.19	—	—	9.27	—	12.70	—	—	—	—
12	300	323.8	3.96	4.57	—	—	9.53	—	12.70	—	—	—	—
16	400	406.4	4.19	4.78	—	—	9.53	—	12.70	—	—	—	—
20	500	508.0	4.78	5.54	—	—	9.53	—	12.70	—	—	—	—
24	600	609.6	5.54	6.35	—	—	9.53	—	12.70	—	—	—	—

Note: The complete wall thickness schedule table (including Sch20, Sch30, Sch60, Sch80, Sch100, Sch120, Sch140 and Sch160 schedules for DN250 and above) is given in the original standard; the values are extracted from ASME B36.10M—2004 and ASME B36.19M—2004. For the I-series pipe fittings, the inch dimension tables refer to ASME B16.9—2007.