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**TRADE STANDARDS OF  
THE PEOPLE'S REPUBLIC OF CHINA  
中华人民共和国行业标准**

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NB/T 47009-2010 (JB/T 4727)

Replace JB 4727-2000

**低温承压设备用低合金钢锻件  
Low-Alloy Steel Forgings for Low Temperature  
Pressure Equipments  
(英文版)**

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## Foreword

Compared with JB 4727- 2000, this standard has the following main changes:

—Design pressure in application scope has been improved to less than 100MPa from not greater than 35MPa;

—100℃ grade low temperature steel 08Ni 3D was added;

—Sulfur content of each steel grade was reduced;

—The chromium and molybdenum contents of 08MnNiCrMoVD steel forging were adjusted, and the steel grade is reduced to 08MnNiMoVD;

—As for 16MnD steel forging, tensile property index of nominal thickness less than or equal to 100mm is added, and the impact test temperature is reduced from -40℃ to -45℃;

—Low temperature impact power index of all of the steel forgings were improved.

Appendix A of this standard is normative.

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

Drafting organizations: Hefei General Machinery Research Institute, China National General Machinery Engineering Corporation, China Special Equipment Inspection and Research Institute, Anhui Bureau of Quality and Technical Supervision, Wuxi Falan Forging Co., Ltd., Nanjing Develop Industry Co., Ltd., Changzhou Sunshine General Petrochemical Fittings Co., Ltd., Jiangyin Fangyuan Ringlike Forging&Flange Co., Ltd.

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National Technical Committee on Boilers and Pressure Vessels of Standardization Administration of China (SAC/TC 262) is in the charge of the explanation of this standard.

The previous editions replaced by this standard are as:

—JB 4727—1994;

—JB 4727—2000.

## Low-Alloy Steel Forgings for Low Temperature Pressure Equipments

### 1 Scope

This standard specifies the technical requirements, test methods and inspection rules, etc. for low-alloy steel forgings for low temperature pressure equipments.

This standard is applicable to low-alloy steel forgings for low temperature pressure equipments with a design temperature lower than 0°C and design pressure below 100Mpa.

### 2 Normative References

The following documents contain provisions which, through reference in this text, constitute provisions of this standard. For dated references, only the dated versions apply to this standard. For undated references, the latest edition of the normative document (include all the amendments) is applicable to this standard.

GB/T 222-2006	Permissible Tolerances for Chemical Composition of Steel Products
GB/T 223	Methods for Chemical Analysis of Iron, Steel and Alloy
GB/T 228 (ISO 6892:1998(E))	Metallic Materials - Tensile Testing at Ambient Temperature
GB/T 229—2007 148-1:2006)	Metallic Materials-Charpy Pendulum Impact Test Method (ISO
GB/T 4336	Standard Test Method for Spark Discharge Atomic Emission Spectrometric Analysis of Carbon and Low-alloy Steel (Routine Method)
GB/T 6394	Metal-methods for Estimating the Average Grain Size (ASTM E112:1996)
GB/T 10561	Steel Determination of Content of Nonmetallic Inclusions-Micrographic Method Using Standards Diagrams (ISO 4967:1998)
GB/T 20066	Steel and Iron-Sampling and Preparation of Samples for the Determination of Chemical Composition (ISO 14284:1996)
JB/T 4730.3	Nondestructive Testing of Pressure Equipments-Part 3: Ultrasonic Testing

### 3 Terms and Definitions

This standard applies the following terms and definitions.

#### 3.1

##### Hollow forging

It refers to axisymmetrical hollow forging whose axial length  $L$  is greater than its outer diameter  $D$ , as shown in Figure 1a).  $t$  shall be the nominal thickness.

#### 3.2

##### Ring forging

It refers to axisymmetrical hollow forging whose axial length  $L$  is less than or equal to its outer diameter  $D$ , as shown in Figure 1b). The smaller one of  $L$  and  $t$  shall be the nominal thickness.

#### 3.3

##### Disk forging

It refers to the axisymmetrical solid forging whose axial length  $L$  is less than or equal to its outer diameter  $D$ , as shown in Figure 1c).  $L$  shall be the nominal thickness.

#### 3.4

##### Bowl forging

It refers to the axisymmetrical forging with concave section, whose height  $H$  is less than or equal to its outer diameter  $D$ , as shown in Figure 1d). The greater one of  $t_1$  and  $t_2$  shall be the nominal thickness.

#### 3.5

##### Neck flange forging

It refers to the axisymmetrical hollow forging with two axial outside diameters, as shown in Figure 1e). The greater one of  $t_1$  and  $t_2$  shall be the nominal thickness.

#### 3.6

##### Bar forging

It refers to the solid forging with circular section, whose axial length  $L$  is greater than its outer diameter  $D$ , as shown in Figure 1f).  $D$  shall be the nominal thickness.

It refers to the forging with rectangular section, whose length  $L$  is greater than its both side length  $a$  and  $b$ , as shown in Figure 1g). The smaller one of  $a$  and  $b$  shall be the nominal thickness.

## 7 Inspection Rules

7.1 Forgings shall be inspected by the Supplier's inspection department according to the order contract.

7.2 Specimen for chemical analysis shall be prepared according to requirements of GB/T 20066. One specimen shall be taken from each smelting furnace number.

### 7.3 Sampling rules of tension and impact test

#### 7.3.1 Sampling quantity

7.3.1.1 One group of specimens (one for tension, three for impact) shall be taken for forgings with single weight less than or equal to 3500 kg in heat treatment.

7.3.1.2 Two groups of specimens in 180° interval shall be taken from the heat-treated forgings whose weight of single piece is greater than 3500kg. If the length of the forging is greater than 1.5 times of its diameter, a group of specimens shall be taken from the both ends of forging respectively.

#### 7.3.2 Sampling direction

Tangential specimens should be taken from the forgings (excluding strip type); if unavailable, the longitudinal or radial specimens shall be taken. Bar forging should be taken longitudinal specimen.

#### 7.3.3 Sampling position

7.3.3.1 Specimens of hollow forgings and ring forgings shall be taken from the ends of the forgings from the positions of 1/2 of the wall thickness, as shown in Figure 2a) and Figure 2b).

7.3.3.2 Specimens of disk forgings shall be taken from the ends of the forgings; where the diameter of disk forging is less than or equal to 350mm, specimens shall be taken from the outer edge; where the diameter is greater than 350mm, specimens shall be taken from the position greater than or equal to 20mm away from the edge inwardly, as shown in Figure 2c).

7.3.3.3 Specimens of bowl forgings shall be taken from the open ends of the forgings from the positions of 1/2 of the wall thickness, as shown in Figure 2d).

7.3.3.4 Specimens of neck flange forgings shall be taken from the nominal thickness positions greater than or equal to 20mm away from the outer edge inwardly (or outwardly from the internal surface of the excess metal), as shown in Figure 2e).

7.3.3.5 Specimens of bar forgings shall be taken from the ends of the forgings from the positions of 1/4 of the nominal thickness away from the surface.

7.3.3.6 Except Class IV forgings, the mechanical property specimens of forgings may also be prepared and taken from the independently-forged inspection forging stocks of the same batch number. Inspection forging stock shall have the same forging process and forging ratio as the forging; its nominal thickness shall be greater than or equal to that of the forging, and it shall be heat treated in the same furnace with the forging.

#### 7.3.4 Specimen

7.3.4.1 Tensile specimens shall adopt No. R4 specimens ( $d=10\text{mm}$ ,  $L_0=50\text{mm}$ ) in GB/T 228. Due to the sampling dimensional restrictions, No. R7 specimens ( $d=5\text{mm}$ ,  $L_0=25\text{mm}$ ) in GB / T 228 may also be adopted according to the agreement between the Buyer and the Supplier.

7.3.4.2 Impact specimen shall use the standard Charpy V-shape notch specimen in GB/T

## **8 Marking and Quality Certificate**

**8.1** Mark shall be stamped at apparent position of forging or at the position designated by the Buyer. The position of the printed marks and the way to stamp shall not affect the final use of the forgings. For small sized forgings, marks may be stuck on the packing box.

**8.2** The delivered forgings, qualified in the inspection according to this standard, shall include the following marks:

- a) Manufacturer's name (or code);
- b) Standard number;
- c) Steel grade;
- d) Forging class;
- e) Batch number.

**8.3** Forgings shall be accompanied with quality certificate when delivering, including:

- a) Manufacturer's name;
- b) Order contract number;
- c) Standard number, steel grade, forging class, batch number, forging quantity;
- d) Each inspection result, inspection organization and inspectors' seals;
- e) Heat treatment curve diagram (hard copy);
- f) Inspection results of special requirements specified in the contract.

## Appendix A (Normative)

### Additional Requirements

This requirement will only be implemented when specified in order contract by the Buyer. One or some of the items may be adopted, and the details of additional requirements shall be determined through negotiation between the Buyer and the Supplier.

#### A.1 Simulated post-weld heat treatment of mechanical property specimen blank

One or several heat treatments shall be carried out for all the specimen blanks below the critical temperature before the test, for the purpose of simulating the post-weld heat treatment or other heat treatment that the forgings will experience in the subsequent vessel manufacture process. The Buyer shall provide the Supplier detailed heat treatment specifications and requirements, including temperature, holding time and cooling speed etc.

#### A.2 Heat treatment by adopting heat buffering ring or ring section

Before the heat treatment of forgings, edge of heat buffering ring at least  $t \times t$  ( $t$  is the nominal thickness of forging) in section or ring section at least  $t \times t$  in section and at least  $3t$  in arc length shall be welded to the sampling end of the forging; heat buffering ring or ring section shall adopt the carbon steel or low alloy steel with favorable weldability. Heat buffering ring or ring section shall be cut off from the forging after heat treatment; specimens shall be taken from the heat buffering areas on the forgings by heat buffering ring or ring section. Where the heat buffering ring section is adopted, specimen shall be taken from the corresponding position which is  $1/3$  of arc length in the middle of the heat buffering ring section on forging. The specimen position shall be at least 13mm away from the heat buffering surface of the forging and at least  $t/4$  away from the heat treatment surface of the forging.

#### A.3 Series impact test

Series impact test may be added for Class III or Class II forgings in each steel grade and Charpy (V-notch) series impact transition temperature curve shall be provided by the Supplier. Test methods shall meet the requirements specified in GB/T 229.

#### A.4 Determination of grain size

Grain size qualification class of forging shall be determined through negotiation between the Buyer and the Supplier. Determination method of grain size shall be in accordance with the requirements of GB/T 6394.

#### A.5 Inspection of non-metallic inclusion

Qualification class of nonmetallic inclusion of forging shall be determined through negotiation between the Buyer and the Supplier. Determination method of inspection of non-metallic inclusion shall be in accordance with the requirements of GB/T 10561.