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Steel castings for pressure purposes

承压钢铸件

(ISO 4991:2015, MOD)

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Steel castings for pressure purposes

1 Scope

This document specifies the technical requirements, test methods, inspection rules, marks, quality specifications, packaging, transportation and storage, supplementary requirements for steel castings for pressure purposes.

This Standard applies to steel castings for pressure purposes that are made of carbon steel and alloy steel.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 223.3, *Methods for chemical analysis of iron, steel and alloy - The dianthipyryl methane phosphomolybdate gravimetric method for the determination of phosphorus content*

GB/T 223.5, *Steel and iron - Determination of acid-soluble silicon and total silicon content - Reduced molybdosilicate spectrophotometric method* (GB/T 223.5-2008, ISO 4829-1:1986, ISO 4829-2:1988, MOD)

GB/T 223.9, *Iron, steel and alloy - Determination of aluminium content - Chrome azurol S photometric method*

GB/T 223.11, *Iron, steel and alloy - Determination of chromium content - Visual titration or potentiometric titration method* (GB/T 223.11-2008, ISO 4937:1986, MOD)

GB/T 223.14, *Methods for chemical analysis of iron, steel and alloy - The N-benzoyl-N-phenylhydroxylamine extraction photometric method for the determination of vanadium content*

GB/T 223.18, *Methods for chemical analysis of iron steel and alloy - The sodium thiosulfate separation iodometric method for the determination of copper content*

GB/T 223.22, *Methods for chemical analysis of iron, steel and alloy - The nitroso-R-salt spectrophotometric method for the determination of cobalt content*

GB/T 223.23, *Iron, steel and alloy - Determination of nickel content - The dimethylglyoxime spectrophotometric method*

GB/T 223.25, *Methods for chemical analysis of iron, steel and alloy - The dimethylglyoxime gravimetric method for the determination of nickel content*

GB/T 223.26, *Iron, steel and alloy - Determination of molybdenum content - The thiocyanate spectrophotometric method*

GB/T 223.28, *Methods for chemical analysis of iron, steel and alloy - The α -benzoin oxime gravimetric method for the determination of molybdenum content*

GB/T 223.30, *Methods for chemical analysis of iron, steel and alloy - The arsenazo III spectrophotometric method for the determination of zirconium content after separation by p-bromomandelic acid*

GB/T 223.36, *Methods for chemical analysis of iron, steel and alloy - The neutral titration method for the determination of nitrogen content after distillation separation*

GB/T 223.58, *Methods for chemical analysis of iron, steel and alloy - The sodium arsenite-sodium nitrite titrimetric method for the determination of manganese content*

GB/T 223.60, *Methods for chemical analysis of iron, steel and alloy - The perchloric acid dehydration gravimetric method for the determination of silicon content*

GB/T 223.63, *Iron, steel and alloy - Determination of manganese content - Sodium (potassium) periodate spectrophotometric method*

GB/T 223.65, *Steel, iron and alloy - Determination of cobalt content - Flame atomic absorption spectrometric method (GB/T 223.65-2012, ISO 11652:1997, MOD)*

GB/T 223.75, *Iron, steel and alloy - Determination of boron content - Methanol distillation-curcumin photometric method*

GB/T 223.78, *Methods for chemical analysis of iron, steel and alloy. Curcumin spectrophotometric method for the determination of boron content (GB/T 223.78-2000, idt ISO 10153:1997)*

GB/T 223.81, *Iron, steel and alloy - Determination of total aluminum and total boron contents - Microwave digestion-inductively coupled plasma mass spectrometric method*

GB/T 223.84, *Steel and iron - Determination of titanium content - Diantipyrylmethane spectrophotometric method (GB/T 223.84-2009, ISO 10280:1991, IDT)*

GB/T 223.85, *Steel and iron - Determination of sulfur content - Infrared absorption method after combustion in an induction furnace (GB/T 223.85-2009, ISO 4935:1989, IDT)*

GB/T 223.86, *Steel and iron - Determination of total carbon content - Infrared*

steel in the same furnace and heat treated in the same furnace are one batch;

b) Batch by piece: Each piece is a batch. Only applicable to the products specified in the technical conditions;

c) Other batching rules agreed upon by both parties.

5.3 Sampling rules

5.3.1 Sampling for chemical analysis

5.3.1.1 According to the provisions of GB/T 5678 or GB/T 20066, take samples from each molten steel for chemical composition analysis. When there is a dispute between the supplier and the purchaser on the analysis results, samples can be taken from the furnace sample, the test block or the specimen representing the casting. According to GB/T 223.3, GB/T 223.5, GB/T 223.9, GB/T 223.11, GB/T 223.14, GB/T 223.18, GB/T 223.22, GB/T 223.23, GB/T 223.25, GB/T 223.26, GB/T 223.28, GB/T 223.30, GB/T 223.36, GB/T 223.58, GB/T 223.60, GB/T 223.63, GB/T 223.65, GB/T 223.75, GB/T 223.78, GB/T 223.81, GB/T 223.84, GB/T 223.85, GB/T 223.86, check and analyze the corresponding elements. It may refer to Annex E for the allowable deviation between the check analysis result and the smelting analysis result or it is negotiated between the supplier and the purchaser.

5.3.1.2 When the wall thickness is greater than 15mm, samples shall be taken at least 6mm below the casting surface.

5.3.2 Sampling for mechanical properties

5.3.2.1 Room temperature tensile specimen

A tensile test specimen shall be taken from a test block representative of the batch of castings. The size of the specimen shall comply with the provisions of GB/T 228.1.

5.3.2.2 High temperature tensile specimen

When the high temperature tensile test is specified, the tensile specimen shall be prepared from the test block according to the quantity specified in the contract. The size of the specimen shall comply with the provisions of GB/T 228.2.

5.3.2.3 Impact test specimen

When the impact test is specified, a set (three pieces) of Charpy V-notch standard impact test specimens shall be prepared from the test block representing the batch of castings. The size of the specimen shall meet the requirements of GB/T 229.

5.3.2.4 Sampling location

Unless otherwise agreed by the supplier and the purchaser, when sampling type A test

5.5.2 If the tensile test results are unqualified, double reinspection is allowed on the original test block (or another test block cast in the same furnace and heat-treated in the same furnace). The reinspection result shall meet the supplementary requirements specified in 3.5.1 and the contract, otherwise it shall be rejected.

5.5.3 If the average value of the three impact test results does not meet the requirements of 3.5.2 and (or) 3.5.3, or the impact test value of one specimen is lower than 70% of the index requirements, three additional specimens are allowed to be reinspected on the original test block or another test block cast in the same furnace and heat-treated in the same furnace. The average value of the six impact specimens before and after the reinspection shall comply with 3.5.2 and (or) 3.5.3 and the supplementary requirements specified in the contract. The reinspection specimen is not allowed to have a single value lower than 70% of the index requirements, otherwise it will be rejected.

5.6 Re-heat treatment

When the mechanical property inspection or re-inspection fails, re-heat treatment of the casting and its test block is allowed. The reheat-treated castings and their test blocks shall be subjected to all mechanical property tests as a new batch. Without the consent of the purchaser, the re-heat treatment of the casting and its test block shall not exceed two times (if there is no special provision, the number of tempering times is not limited).

6 Marks, quality certificate, packaging, transportation and storage

6.1 Marks

6.1.1 In principle, each casting shall be clearly marked. The mark shall include the material designation, inspection batch number, melting furnace number or identification number traceable to the melting furnace number, and other contents required by the purchaser to be marked.

6.1.2 Small castings can be marked in batches. Hang a marked sign on each batch of castings.

6.1.3 Unless otherwise agreed by the supplier and the purchaser, the casting shall have the name or code of the supplier and other signs.

6.1.4 When a variety of heat treatment methods can be selected for the casting, the selected heat treatment method code shall be added after the material designation in the mark.

6.1.5 Unless specified by the purchaser, the location of the mark shall be determined by the supplier.

6.2 Quality certificate

Castings delivered shall be accompanied by quality certificate. The content of the quality certificate shall include:

- a) Supplier's name;
- b) Casting number or lot number;
- c) Casting drawing number or order contract number;
- d) Cast steel designation, melting furnace number;
- e) Heat treatment furnace number and heat treatment state;
- f) Various inspection results (including supplementary requirements) or reinspection results;
- g) Other content agreed by both parties;
- h) Signature and seal of the quality inspection department and its representative;
- i) Other documents.

6.3 Packaging, transportation and storage

6.3.1 The castings shall be protected or packaged after passing the inspection.

6.3.2 The surface protection, transportation and storage of castings shall comply with the provisions of the contract.

6.3.3 The castings shall be protected from corrosion during storage.

7 Supplementary requirements

For additional requirements for additional inspection or inspection items, see Annex B.

Annex B

(normative)

Supplementary requirements for additional inspection items

B.1 Manufacturing process

B.1.1 Both the supplier and the purchaser shall confirm the manufacturing process of the casting and indicate it in the contract.

B.1.2 Both the supplier and the purchaser shall confirm the residual element content that is not included in the chemical composition of the casting and indicate it in the contract.

B.1.3 A smelting method report shall be provided to the purchaser.

B.1.4 When specified in the contract, the detailed heat treatment process (heat treatment time-temperature curve) of the casting shall be provided to the purchaser.

B.2 Casting weight and weight tolerance

Both the supplier and the purchaser shall determine the casting weight, weight tolerance and weighing method in the contract. The weight tolerance of castings shall comply with the contract or the provisions of GB/T 11351.

B.3 Surface quality inspection and internal quality inspection

B.3.1 Both the supplier and the purchaser shall specify in the contract the non-destructive testing method used for casting inspection, the parts to be inspected and the acceptance requirements.

B.3.2 The surface quality inspection of castings shall be carried out in accordance with the provisions of GB/T 15056.

B.3.3 The magnetic particle inspection of the casting surface is carried out according to the provisions of GB/T 9444.

B.3.4 The penetration testing of castings is carried out in accordance with the provisions of GB/T 9443.

B.3.5 The ultrasonic testing of castings shall be carried out in accordance with the provisions of GB/T 7233.1 and GB/T 7233.2.

B.3.6 The radiographic inspection of castings shall be carried out in accordance with the provisions of GB/T 5677.

B.4 Weld inspection during casting manufacturing

B.4.1 The welding area of the casting shall be inspected before and after welding according to the non-destructive testing method specified in the contract. Magnetic particle testing or penetrant testing shall be selected for surface inspection of castings before welding.

B.4.2 Both the supplier and the purchaser shall specify the acceptance criteria for pre-welding inspection and post-weld inspection in the contract. If there are no other requirements, the acceptance criteria shall be consistent with the cast steel matrix at the same location. See B.3 for the method of non-destructive testing.

B.5 Weight and uniformity inspection of a single batch of castings

B.5.1 Single batch casting weight

The maximum weight of each batch of castings can be 500kg, 1000kg or 5000kg. The supplier and the purchaser can also stipulate other batching methods based on statistical control methods in the contract.

B.5.2 Uniformity inspection of single batch castings

Take 5% of castings from each batch. Each batch shall not be less than 5 pieces (or sample according to the quantity specified in the contract). The hardness test shall be carried out according to the provisions of GB/T 231.1. The location for hardness measurement shall be the same for each casting. The deviation value shall be negotiated by both parties.

B.6 Prior agreement on major welding repairs

B.6.1 Before major welding repairs, the purchaser's consent shall be obtained and indicated in the contract.

B.6.2 When the depth of the pit prepared by welding repair exceeds 20% of the wall thickness of the casting or 25mm (whichever is the smaller), or the area exceeds 65cm², or the casting pressure test leaks, it is considered as a major welding repair.

B.7 Welding repair drawing

The location and scope of each welding repair shall be marked on the drawings or photos. Submit the relevant information to the purchaser.

B.8 Test block

B.8.1 Test blocks that represent castings

B.8.1.1 The maximum thickness of the main section of the casting shall be specified by the purchaser in the contract. The mechanical properties listed in Table 3 to Table 6 are

B.8.2 Selection of type B test block and type C test block

Both the supplier and the purchaser shall confirm to select type B test block or type C test block.

B.8.3 Selection of single cast test block and additional cast test block

Both the supplier and the purchaser shall confirm to select single cast test block or additional cast test block.

B.9 Surface treatment

Surfaces of machined or unmachined castings shall be protected.

B.10 Hot isostatic pressing (HIP)

Both the supplier and the purchaser shall confirm the hot isostatic pressing process of the castings and the methods of examination and inspection.

B.11 Performance inspection**B.11.1 Determination of ferrite content in austenitic steel castings or austenitic-ferritic steel castings**

The determination of ferrite content in austenitic steel castings or austenitic-ferritic steel castings shall be carried out according to the inspection method agreed upon by the supplier and purchaser.

B.11.2 Hardness inspection

Brinell hardness determination of castings or test blocks shall be carried out in accordance with the provisions of GB/T 231.1. If the purchaser does not specify the location for determination, the supplier shall decide. If the Rockwell hardness or Vickers hardness of the casting or test block is determined according to GB/T 230.1 or GB/T 4340.1, it shall be converted into Brinell hardness according to GB/T 33362.

B.11.3 Specified non-proportional elongation strength test at high temperature

The specified non-proportional elongation strength at high temperature shall meet the index or contract.

B.11.4 Impact performance inspection

The impact performance shall meet the specifications or contract requirements. The supplier and the purchaser can agree to add the determination for lateral expansion value and shear section ratio. The determination process shall comply with the provisions of GB/T 12778.

B.11.5 Intergranular corrosion test

Annex C

(informative)

Information that the purchaser needs to provide when ordering casting products

C.1 Information to provide when ordering

C.1.1 The pattern number and/or drawing of the casting shall be provided. If a pattern is provided, a description of the parts in the pattern shall be included. When no drawing is provided, the casting shall be made according to the pattern. The foundry is not responsible for the dimensions of the casting in this case. The modifications to the drawings or appearances due to the manufacturer's process requirements shall be approved by the purchaser.

C.1.2 Casting material standard number, delivery condition and designation.

C.2 Supplementary information to be provided when ordering

Depending on the situation, the following supplementary information shall also be provided when ordering:

- a) The supplementary requirements in Annex B;
- b) The non-destructive testing method used, the location, scope and acceptance conditions of non-destructive testing;
- c) The inspection documents to be provided upon delivery;
- d) The batch size of the test batch;
- e) The marks, machining, guarding, packaging, boxing, shipment, mode of transport and destination;
- f) The provision of casting samples for approval before mass production;
- g) The statistical controls used in sampling;
- h) Other supporting documents.

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