

Guideline No.: W-20(201510)



W-20

IRON CASTINGS

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Foreword

CCS Product Inspection and Testing Guideline (hereinafter referred to as this Guideline) contains the technical requirements, inspection and testing criteria related to classification and statutory survey of marine products to be applied for CCS approval/inspection.

This Guideline frees the users to adopt other test methods and requirements which are equivalent to or are stricter than this Guideline.

This Guideline is published and updated by CCS, and is released at <http://www.ccs.org.cn>. Your comments or suggestions are welcomed and may be sent to our email addressed mp@ccs.org.cn.

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IRON CASTINGS

1 Application

1.1 The Guidelines apply to the initial works approval and inspection of cast iron products manufactured in accordance with the requirements in CCS Rules for Classification of Sea-going Steel Ships and CCS Rules for Materials and Welding.

1.2 The Guidelines also apply to the initial works approval and inspection of air cylinder heads and other graphite cast iron products (e.g. vermicular graphite cast iron).

2. Normative references

Chapter 7, PART ONE of CCS Rules for Materials and Welding.

3. Terms and definitions

3.1 The Guidelines mainly describe grey cast iron, spheroidal graphite cast iron and vermicular graphite cast iron based on the categorization of iron castings and common marine iron castings specified in Chapter 7, PART ONE of CCS Rules for Materials and Welding.

- (1) Grey cast iron (grey iron): cast iron in which the carbon mainly precipitates in the form of flaky graphite and of which the fracture is in grey color.
- (2) Spheroidal graphite cast iron (spheroidal iron): molten iron which is spheroidized instead of being heated after solidification, to make most or all of the graphites become spheres or to make a small quantity of graphites become rounded clumps.
- (3) Vermicular graphite cast iron (vermicular iron): cast iron with microstructures in which the graphite is mainly in vermicular form.

3.2 Mold thickness: the distance from surface of the sand mold cavity to the inner wall, top surface, bottom surface or box stop of the sand box and the thickness of the sand layer between mold cavities.

4. Drawings and documentation to be submitted

4.1 For manufacturers intended to be approved by CCS, an application for works approval is to be submitted to CCS.

4.2 The drawings and documentation listed below are to be submitted to CCS for review:

- (1) Basic information of factory: including the name, address, organization, personnel configuration, production history, production capacity, main products, legal representative, industrial and commercial business license of the factory;
- (2) Details of the products to be approved: product name, material type, weight single of piece, heat treatment condition and other technical characteristics of the product;
- (3) Other valid documents, reports and evidences demonstrating the applicant's production capacity and quality level of the products within the scope of approval;
- (4) Basic information of main production and testing equipment: basic information, such as the name/intended purpose, specifications, calibration status, etc. of the equipment used for sand mixing, molding (core molding), steel making, pouring, cleaning (removal of loose sand and gating riser), sand treatment (if any), heat treatment (may not be provided when the product is delivered in the as-cast state), lifting, chemical components analysis, metallurgical test, mechanical tests, etc.;
- (6) Quality management documents and other documents: procedures and systems (a detailed document list may be provided) developed for the purpose of implementing quality control; quality management system certificates and other qualification certificates issued by qualified organizations;
- (7) Documents related to management and control of main raw materials;
- (8) Templates of quality certificates;
- (9) Product approval test program.

5 Selection of typical samples for approval purpose

Typical samples, within the scope of approval as requested, are to be selected by the following principles and may be selected collectively or individually:

- (1) At least one piece of each type of iron casting is to be selected as the typical sample for approval test. For grey cast iron, products with higher grade designations are to be selected as far as practicable. For spheroidal graphite cast iron of ferrite base and pearlite base, it is recommended that products with higher proportion of ferrite and pearlite, i.e. products with higher elongation rate grade designation and higher strength grade designation be selected

respectively.

- (2) Among the selected cast iron products, at least one piece is to reflect the manufacturer's largest single piece casting capability (over 80% of the maximum weight).
- (3) At least one type of product representing a casting process with greater technical difficulty is to be selected depending on the level of technological complexity of the casting process, for example, a spheroidal graphite iron casting that represents greater technical difficulty than grey cast iron products.
- (4) At least one piece of the product produced in higher quantity by the manufacturer is to be selected depending on the manufacturer's production quantity.

6 Type test

6.1 Determination of type test plan

Prior to the type test for works approval, the type test plan for the products to be approved is to be determined through consultation between CCS and the applicant. The type test plan may be proposed by the applicant and reviewed and approved by CCS, or may be presented by CCS and confirmed by the applicant. The type test plan is to cover the following details:

- (1) Type, specifications, delivery condition (unless specified otherwise, the castings may be delivered in the as-cast or heat treated state), etc. of the products to be approved as requested;
- (2) Test basis (currently effective codes and standards);
- (3) Details of the selected typical samples and theoretical basis for such selection;
- (4) Type test items, methods and requirements;
- (5) Specimen fabrication and requirements
- (6) Test location.

6.2 Type test items and requirements

6.2.1 Type test items and requirements are given in the table 6.2.1.

Items of type test

Table 6.2.1

Type of iron casting		Grey iron casting	Spheroidal graphite iron casting	Crankshaft iron casting
Test item				
Chemical composition		Unless otherwise specified (e.g. alloy cast iron), the chemical composition of iron castings may be determined independently by the manufacturer and the manufacturer is to ensure that the specified mechanical properties for iron castings are properly obtained.		
Mechanical tests	Tensile test	The technical requirements specified in Chapter 7, PART ONE of CCS Rules for Materials and Welding and product drawings are to be complied with.		
	Hardness test			
	Impact test	Not applicable.	The technical requirements specified in Chapter 7, PART ONE of CCS Rules for Materials and Welding and product drawings are to be complied with.	
Metallurgical test		The test may be performed, where required, according to the technical requirements of product drawings.		
NDT		NDT is to be carried out where required or when the iron casting is deemed to have any hazardous defects, and may be carried out according to the technical requirements of product drawings for products such as the body of diesel engine, etc.		Linear defects such as crack are not allowed for MT. Crankshaft of spheroidal graphite cast iron is to be examined through UT in accordance with recognized standards.
Visual inspection		The technical requirements specified in Chapter 7, PART ONE of CCS Rules for Materials and Welding and product drawings are to be complied with.		
Confirmation of defect repair procedure		The technical requirements specified in Chapter 7, PART ONE of CCS Rules for Materials and Welding and product drawings are to be complied with. The repair procedure is to be submitted to CCS for confirmation.		Repair is not allowed.
Weight tolerance		May be in accordance with the recognized standards.		

Continued Table 6.2.1

Type of iron casting Test item	Grey iron casting	Spheroidal graphite iron casting	Crankshaft iron casting
Dissection test	Where necessary, the internal quality test and tests on other required items (e.g. geometric dimensions, etc.) are to be carried out for small iron castings produced in batches which represent more stringent requirements and more complicated casting process and for which the internal test is difficult to be conducted. Visible shrinkage cavity and porosity and other defects affecting the use of the products are not allowed.		
Others	Other tests, such as leak test, are to be carried out when required by the technical requirements described on product drawings.		

6.2.2 The type test items, methods and requirements are to be clearly defined in the test program in accordance with CCS Rules for Materials and Welding, relevant recognized standards and technical requirements for product.

6.2.3 Vermicular graphite iron castings are to be approved and surveyed with reference to the relevant requirements for spheroidal graphite iron castings.

6.3 Fabrication and requirements of test specimen

6.3.1 The type, dimensions and quantity of test specimens are to be in compliance with the requirements of Chapter 7, PART ONE of CCS Rules for Materials and Welding. If test specimen from casting itself is used, its type and dimensions, where not specified in Chapter 7, PART ONE of CCS Rules for Materials and Welding, are to be determined in accordance with the relevant recognized standards.

6.3.2 Where the iron castings are produced by means of manual molding and sand mold casting, the test of the attached test bar and individual casting test bar should be carried out normally at the same time in order to check whether they meet the requirements of relevant specifications/standards. The molding materials of the casting mould for individual casting test bar should be same as the castings'.

6.3.3 Where iron castings are produced by means of centrifugal casting, the test specimens from casting itself are to be taken from the finished products or rough castings.

6.3.4 For small iron castings continuously produced in batches, single pouring test specimens may be used. The single pouring test specimens are to be of the same batch of molten iron as the poured iron castings and to be poured at the late stage of the single pouring. For single pouring

test specimens, the mold thickness is to be no less than 50mm and the demolding temperature no less than 500 °C. The single pouring test specimens are to be heat treated in the same furnace together with the iron castings represented by these specimens.

7 Unit/batch inspection

7.1 After the type test for iron castings has been completed and verified compliant with the requirements, the manufacturer is to finalize the general or special factory test program for marine iron castings in accordance with the relevant requirements of the approved type test plan, to specify at least the following aspects: application, basis for acceptance, test and inspection items and requirements, test methods, grouping and fabrication of test specimens, documents and information to be submitted for obtaining CCS certificates, etc. Such factory test program is to be submitted to CCS for approval.

7.2 The specific unit/batch inspection items for iron castings will be informed in writing to the manufacturer when CCS issues the works approval certificate.

7.3 The unit/batch inspection of iron castings will be carried out according to the approved inspection program. The items for witness, review and random inspection in the inspection program are to be determined based on the operation conditions of the manufacturer's product quality assurance system. The inspection program is to, as a minimum, include the following inspection and test items:

- (1) Fabrication and selection of test specimens (a sufficient number of test specimens, including those for possible re-test, are to be provided for each piece or batch of casting);
- (2) Mechanical tests of materials;
- (3) Metallurgical test (when required);
- (4) Visual inspection;
- (5) Inspection of main dimensions;
- (6) NDT (when required);
- (7) Other test and inspection items, such as leak test, etc.;
- (8) Defects (if any) repair records;

7.4 Products qualified through inspection are to be identified by the manufacturer with CCS steel stamps piece by piece. The information on steel stamps is to comply with the requirements of Chapter 7, PART ONE of CCS Rules for Materials and Welding.

7.5 For products qualified through inspection, the manufacturer is to present the product quality certificates or conformity certificates containing the details specified in 7.1.11, Chapter 7, PART ONE of CCS Rules for Materials and Welding, according to CCS requirements.

7.6 After the CCS surveyor has completed field inspection of the products and considered the documents submitted by the factory satisfactory through review, marine product certificates will be issued for the qualified products.