

Guideline No.G-02 (201510)



# **G-02**

# **SHACKLE**

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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](mailto:mp@ccs.org.cn).

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## SHACKLE

### 1 Application

The Guideline applies to the works approval and product inspection on the shackle made with carbon/carbon manganese steel or alloy steel that is used on the lifting appliances as well as mooring and towing apparatuses on ships and offshore installations. It does not apply to shackles used for anchor chain accessories.

### 2 Basis for approval and inspection

2.1 *CCS Rules for Material and Welding*

2.2 *CCS Rules for Lifting Appliances of Ships and Offshore Installations*

2.3 *Technical Regulation on Legal Inspection of Offshore Towing of the PRC*

### 3 Terms and definitions

3.1 Shackle: The assembly of shackle body and pin.

3.2 Shackle body: The body made with a bar with certain section via bending and forging, with coaxial eyes at both ends.

3.3 Shackle top: The top of the shackle.

3.4 Eyes: A pair of coaxial holes **coordinating with the pin on** the end of the shackle body.

3.5 Pin: The circular-section pin coordinating with the shackle body to pass through the eyes.

3.6 Safe working load (SWL): The max. load **of the shackle, which has been designed and verified by tests;**

### 4 Plans and documents

4.1 The following documents should be submitted to CCS for approval:

4.1.1 The type test program should be submitted to CCS for approval, which should specify the product name, sample model and specification, test item, method and technical requirement, formulation basis and reference standard, test site, and criterion rule on disqualification during the test.

4.2 The following documents should be submitted to CCS for information:

4.2.1 Such documents as the factory (enterprise) profile and factory business license.

4.2.2 Product details: Including the specification, structure, material and **heat treatment** of the

shackle.

4.2.3 Raw material **origin**: Including the manufacturer, variety and specification of the raw material.

4.2.4 Main production equipment overview: List such contents as the equipment name, model, capacity, status, and main instrument calibration status of the equipment.

4.2.5 Quality management and control document: Including the organizational structure, relevant quality control point, procedure documents related to quality management, as well as responsibilities of each management department and interrelationship.

4.2.6 Process engineering document: Including such contents as the production process flow chart, internal control standard executed by the enterprise, process operation regulations, relevant process record document, operation instructions, as well as the process card for each phase of the typical product manufacturing process.

4.2.7 Format of product quality certificate.

4.2.8 Testing equipment and personnel qualification.

## **5 Materials and components**

Shackle is the assembly of shackle body and pin. The shackle body and pin are two main parts of the shackle, both of which should be subject to material test and verification test.

## **6 Welding procedures qualification**

It is not applicable because welding is not allowed on the shackle.

## **7 Design and technical requirements on products**

Design plan and document of the shackle: Including the shackle material, safe working load, proof load and the applied standard, which should be submitted to CCS for information. Necessary strength calculation and description should be provided for non-standard shackle produced as per the plan, and the plan and technical document should be submitted to CCS for information.

## **8 Selection of typical samples**

During approval, the product with max. specification submitted for approval with respect to the shackle of each structure type made with same process should be selected for type test.

## **9 Type test**

The sample should be selected and tested after final heat treatment and surface cleaning. All the samples used for type approval should be taken from the product itself.

### **9.1 Raw material**

The raw material should be the non-aging steel **which is killed and fine grain treated** and manufactured as per the standard recognized by CCS, and the factory should conduct physicochemical property re-test on each batch of raw materials. The re-test should involve at least the chemical composition and mechanical properties (tension and impact). During works approval, the list of qualified raw material suppliers should be submitted to CCS for information.

#### 9.2 Material mechanical properties of the finished shackle

The mechanical properties of the finished shackle (including shackle body and pin) should meet relevant requirement of 6.3 in Chapter 6 of CCS Rules for Lifting Appliances of Ships and Offshore Installations. The impact test temperature should be selected properly according to the design temperature of the shackle, which should meet the requirement of Table 6.3.4.4 in Chapter 6 of the CCS Rules for Lifting Appliances of Ships and Offshore Installations. The shackle should be subject to material test as per Sections 1 and 2 in Chapter 5 of Part One of CCS Rules for Material and Welding. Shackles produced in batch, during the delivery inspection, can be subject to lot grouping as per 5.1.5.2 in Chapter 5 of Part One of CCS Rules for Material and Welding in order to perform the material test.

#### 9.3 Chemical composition

The chemical compositions of carbon steel and carbon manganese steel should comply with the requirement of Section 2 in Chapter 5 of Part One of CCS Rules for Material and Welding; the chemical compositions of low alloy steel should meet the requirement of the standard accepted by CCS.

#### 9.4 Metallographic inspection (structure, grain size and inclusion)

During approval, the factory should conduct metallographic inspection as per the standard accepted by CCS. The metallographic inspection should involve such contents as the metallographic structure, ferrite grain size and inclusion. For evaluation method, refer to the requirement of the standard accepted by CCS.

#### 9.5 Heat treatment and hardness

The shackle should be subject to relevant heat treatment to guarantee the mechanical properties of the material, and the treatment should meet relevant requirement in Sections 1 and 2 of Chapter 5 in Part One of CCS Rules for Material and Welding. Hardness test should be carried out usually after heat treatment, so as to determine the effect of the heating treatment. For hardness value, refer to the requirement of the standard accepted by CCS. The hardness test should be carried out during works approval. **It also should be carried out if the technical conditions are available**, or it is required by CCS or the Purchaser.

#### 9.6 Load test of the finished product

9.6.1 The verification test should meet relevant requirement of Sections 1 and 2 in Chapter 7 of CCS Rules for Lifting appliances of Ships and Offshore Installations.

9.6.2 Breaking test (only for the type test, so as to verify the designed safety factor), and the

product should bear the min. breaking load specified in the standard or design plan **in principle**. After test, the shackle should be free of crack or deformation that makes the shackle lose the bearing capacity.

#### 9.7 Basic model and size

9.7.1 The basic structure and size of the shackle must comply with the national, international or other standard accepted by CCS; for non-standard shackles produced as per the plan, the plan and technical document should be submitted to CCS for information.

9.7.2 Threads should be provided at the ends of the lateral pin of the shackle, and the lateral pin should be provided with locking device generally. The shackle used to connect the sling system components (such as the lifting hook, weight and short hoisting chain) should be provided with half-countersunk lateral pin. The thread and **mate precision** should meet the requirement of the standard accepted by CCS.

#### 9.8 Surface inspection requirements

The finished shackle should feature smooth and clean surface, and be free of such partial defects affecting the strength as burr, crack, folding or overburning. No repair welding is allowed for the defect on the shackle. The two pin holes on the shackle body should be coaxial and concentric with the external diameters at both sides of the eyes.

#### 9.9 Nondestructive test

The shackle should be subject to nondestructive test, and the nondestructive test process should meet the requirement of the standard accepted by CCS. The nondestructive test process rules of the product should be determined during approval. The type, sampling proportion, testing method, qualification level and **result of the nondestructive test** should meet the requirements specified during approval.

#### 9.10 Test and determination

The items of type test and delivery inspection are shown in Table 9.10. If the verification test fails to meet relevant requirement, the cause should be found out. If the failure is caused by such factors rather than the product performance as the testing equipment or test method, retest can be conducted, and the **result of the test** can only be determined to be qualified after all requirements are met. Otherwise, the **result** is not qualified.

**Test item and requirement**

**Table 9.10**

Test items	Type test	Delivery inspection
Material test <sup>‡</sup>		
Chemical composition analysis	☒ <sup>②</sup>	☒
Tensile test	☒	☒

Table 9.10 (continued)

Test items	Type test	Delivery inspection
Impact test	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Hardness test (if any)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Metallographic inspection	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Verification test	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Breaking test	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Appearance and size inspection	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Nondestructive test	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Others (if required especially by users)	<input type="checkbox"/>	<input type="checkbox"/>

Note: ① During delivery test, the factory should provide raw material quality certificate and report on raw material re-test when entering the factory. The shackle should be subject to material test as per batch (If the chemical composition analysis has been carried out on all items required by CCS during raw material re-test, such analysis is not required on the finished product; the chemical composition analysis on finished products is required during works approval.) “If any” means that if the technical conditions are available, or it is required by CCS or the Purchaser.

② -----Not available -----Available;

### 10 Unit/batch inspection

10.1 After obtaining CCS works approval, the factory should manufacture the product as per the approved condition. Shackles that are used on the lifting appliances as well as mooring and towing apparatuses on ships and offshore installations should be applied for inspection from CCS.

10.2 The shackle unit/batch inspection should be carried out as per the approved inspection plan. The factory will be informed in written of the shackle inspection plan when CCS issues the works approval certificate. The inspection items are shown in Table 9.10.

10.3 The factory quality certificate format should be submitted to CCS for approval, including at least the following contents:

- (1) Purchaser name;
- (2) Specification and material type of the shackle;

- (3) Manufacturing standard and inspection basis of the shackle;
- (4) Serial number (or batch number if the size is small and inspection is to be conducted as per batch) and quantity;
- (5) Safety working load, proof load, and holding time of proof load;
- (6) Heat treatment method, chemical composition and mechanical properties test result;
- (7) Theoretical breaking load and usage of the product (when used for mooring and towing apparatuses on ships and offshore installations);
- (8) Type, sampling proportion, inspection method, qualification level and result of the nondestructive test;
- (9) Test date, inspection status, and signature of relevant personnel from the factory;

10.4 Mark

- (1) It should be made on the side arm near the pin hole;
- (2) Safety working load, kN (or T);
- (3) Test date (which is not required if it is not practical at the marking position);
- (4) Serial number;
- (5) Manufacturer mark;
- (6) CCS stamp.