Guideline No.: W-11(201610)

W-11 MOORING CHAINS AND ACCESSORIES FOR POSITIONING OF OFFSHORE INSTALLATIONS

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Foreword:

This Guide is a part of CCS Rules, which contains technical requirements, inspection and testing criteria related to classification and statutory survey of marine products.

This Guide is published and updated by CCS and can be found through http://www.ccs.org.cn . Comments or suggestions can be sent by email to ps@ccs.org.cn .

Historical versions and release date :

W11(201510) release date 20th oct.2015；

Main changes and effective date:

1. In accordance Rules for material and welding 2015 the mooring chain grades are modified to the R3, R3S, R4, R4S and R5.

2. In accordance with the IACS UR W22, the documents and drawing submitted for approval, the R4S and R5 is added.

3. In accordance with the IACS UR W22, the documents requirement of the heat treatment calibration and detection are added.
4. In accordance with the IACS UR W22, the documents requirements of the surface quality requirement and removing and replacing defective links are added.
5. In accordance with the IACS UR W22, the range of the steel for mooring chain cables within different grades.
6. In accordance with the IACS UR W22 and CTOD test is modified.
7. In accordance with < The instruction for the publish of the guideline of the marine productions>, the original guideline is modified.

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MOORING CHAINS AND ACCESSORIES FOR POSITIONING OF OFFSHORE INSTALLATIONS

1 Application

1.1 This Guideline is applicable to the products of mooring chains and accessories for the positioning of mobile offshore units, mooring of floating production units, mooring of offshore loading systems and mooring of gravity based structures, including common links, connecting common links, enlarged links, end links, Kenter shackles, swivels, swivel shackles, excluding studless mooring chains. Depending on the raw material nominal tensile strength, chains are to be divided into five grades, i.e., R3, R3S, R4, R4S and R5.

1.2 This Guideline is applicable to works approval and inspection of the above products.

2 Normative references

2.1 The requirements in Chapter 10, PART ONE of CCS Rules for Materials and Welding.

3 Terms and definitions

3.1 For the purpose of this Guideline, the terms and definitions given in CCS Rules for Materials and Welding apply.

3.2 The term “mooring chains and accessories for positioning of offshore installations” are hereinafter referred to as “mooring chains and accessories”.

4 Plans and documents

4.1 A manufacturer intending for works approval of mooring chains and accessories is to submit the following documents to CCS.

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

(1) Particulars of the manufacturer, including the name, address, history, production capacity, technical and inspection personnel, main products, subordinate relationship, trademark, etc.; (2)Details of the products for approval; Quality management documents; Document of entering to the register of enterprise; Qualification certificate and/or production license; Specimen of products quality certificate; Quality control scheme (where applicable).

(3) Source of raw materials: information on the manufacturer and its approval.

(4) For R4S and R5 chain and accessories, prior to approval, the manufacturer is to have undertaken experimental tests or have relevant supporting data to develop the chain and accessory material. The tests and data may include: fatigue tests, hot ductility tests (no internal flaws are to develop whilst bending in the link forming temperature range), welding parameter research, heat treatment study, strain age resistance, temper embrittlement study, stress corrosion cracking (SCC) data and hydrogen embrittlement (HE) study, using slow strain test pieces in hydrated environments. Reports indicating the results of experimental tests are to be submitted.

(5) Production, inspection and test equipment: name/purpose, specification and capacity of chains manufacturing equipment, proof-load testing machines, forging equipment, mechanical properties and NDT equipment, together with copies of calibration certificates of the equipment.

(6) Manufacturing process: flow chart of manufacturing from the materials to the final products of mooring chains and accessories (including connecting common links), with main process and corresponding inspection points indicated.

(7) Quality management documents;

(8) Document of entering to the register of enterprise;

(9) Qualification certificate and/or production license;

(10) Specimen of products quality certificate;

(11) Quality control scheme(where applicable);

(12) Qualified supplier list(where applicable);

And the following details are to be provided:

①Bar heating and bending including method, temperatures, temperature control and recording;

②Flash butt welding, including current, force, time and dimensional variables as well as control and recording of parameters, the maintenance procedure and programme for welding machine;

③Burr removal, including method and inspection;

④Stud insertion, including method and impression, plastic yielding after heating,

measurements and recording of impression;

⑤Heat treatment, including furnace types, means of specifying, controlling and recording of temperature, and chain speed and allowable limits, quenching bath and agitation; Furnaces are to be checked by conveying a monitoring link instrumented with two thermocouples through the furnaces at representative travel speed. One thermocouple shall be attached to the surface of the straight part and one thermocouple shall be imbedded in a drilled hole located at the mid thickness position of the straight part of the calibration block. The time-temperature curves shall show that the temperatures throughout the cross section and the soaking times are within specified limits as given in the heat treatment procedure.⑥Proof and break 1oading tests, including method and equipment, means of horizontal support (if applicable), method of measurement, recording;

⑦NDT procedure, including method, equipment, standard, and qualification of operators.

⑧The manufacturer's surface quality requirement of mooring components.

⑨The manufacturer's procedure for removing and replacing defective links without heat treatment of the entire chain.

4.3 The following documents are to be submitted to CCS for approval:

(1) Drawings giving detailed design of chains and accessories, including drawings showing the detailed design of the stud;

(2) Design drawings of connecting common links;

(3) The type test program.

5 Design and technical requirements

The requirements are given in the following Table5.

Table of Mooring Chains and Accessories Technical Requirements Table 5

Number	Content	Requirements in CCS Rules for Materials and Welding	Remark
1	Steel for welded mooring chain	10.3.3	
2	Forged steel for mooring chain	10.3.3	
3	Materials for studs	10.3.3	
4	Shape and dimension of chains	10.3.4 10.3.8	
5	Manufacture of mooring chains	10.3.5	
6	Mechanical properties	10.3.8	
7	Proof and break tests	10.3.8	
8	Welding of studs	10.3.6 10.3.4	
9	Connecting common links	10.3.5.3 10.3.7	
10	Non-destructive examination	10.3.8.10 10.3.8.11	
11	Testing and inspection of chains	10.3.8 10.3.9 10.3.11	
12	Testing and inspection of accessories	10.3.11	
13	Marking	10.3.10	

6 Material and parts

An approval of chain manufacturer is only restricted to a single manufacturer and to one type and grade of chains made of materials from a designated or approved steelmaker. Where the materials are supplied by more than one steelmaker and used to make different types and grades of chains, the approval tests are to be carried out respectively.

7 Type test

Each Grade is to be individually approved. Approval for a higher grade does not constitute approval of a lower grade. If it is demonstrated to the satisfaction of the CCS that the higher and lower grades are produced to the same manufacturing procedure using the same chemistry and heat treatment, consideration will be given to qualification of a lower grade by a higher. The parameters applied during qualification are not to be modified during production.

7.1 The largest product with maximum diameter is to be selected for each grade of chain cables or accessories for approval. The approval of enlarged links and end links are to be in accordance with the test items and requirements for links. The chain cables tested are to have adequate number of links for the items in the table.

7.2 In an initial approval, the capacity of different units to manufacture chains of maximum diameter is to be verified.

7.3 The added items, change and renewal of the works approval certificate are in principle to be in

accordance with the requirements for the initial approval. 7.4 The test items and requirements are given in Table 7.4.

Table of Test Items **Table 7.4**

No.	Test items	Test requirements (corresponding paragraphs from CCS Rules for Materials and Welding)	Links	Accessories	Remark
1	Chemical composition	10.3.3	√	√	Materials for links and accessories
2	Tensile test	10.3.8.8	√	—	
		10.3.11 Specimens of swivels to be taken on the body and pin respectively.	—	√	
3	Impact test	10.3.8.8 Test temperatures to be -40℃, -20℃ and 0℃ respectively	√	—	The value at -40℃ for reference only
		10.3.11 Specimens of swivels to be taken on the body and pin respectively	—	√	
4	Break load test	10.3.8.5 (links)，10.3.11 (accessories)	√	√	
5	Proof load test	10.3.8.5 (links)，10.3.111 (accessories)	√	√	
6	Magnetic particles test	10.3.8.10 (links) 10.3.11.11 (accessories)	√	√	
7	Ultrasonic test	10.3.8.11	√	—	
8	Stud weld examination	10.3.6	√	—	
9	Dimensions	10.3.4 10.3.8 (links) 10.3.11.6 (accessories)	√	√	
10	Visual examination	10.3.8.3 (links)，10.3.11.2 (accessories)	√	√	
11	Stud impression examination	Specimen to be the section at the centerline of links, the depth of impression and radius of corner are to be measured, recorded and photographed	√	—	Applicable to stud chain cables
12	Micro-examination	Three micro-specimens to be taken to show flash weld, the impression corner and parent materials respectively. Corrosion of micro-specimens to be photographed (×100 magnification and ×500 magnification)	√	—	
		Three micro-specimens to be taken on the surface, at the center and 1/3r to the surface of the accessories. Specimens of swivels to be taken on the body and pin respectively. Corrosion of micro-specimens is to be photographed (×100 magnification and ×500 magnification)	—	√	
13	Macro-examination	Two macro-specimens, one of which is longitudinal section of links to show flash weld side stud impression area and two crown cross sections, the other is section at the centerline of links to show flash weld, stud impression depth and corner radius and stud weld (if applicable). Corrosion of macro section to be photographed (×1magnification). Impression area (×10 magnification) to be examined and free from cracks, laps or other defects	√	—	Macro-examination may be exempted where the compression ratio is not less than 7:1
		The macro-specimens to be cross sections of accessories. Corrosion of macro section to be photographed (×1magnification) and free from cracks, laps or other defects	—	√	
14	Hardness test	Vickers or Rockwell hardness tester to be adopted to measure hardness distribution through diameter. The maximum space between two measuring points to be 2.5mm. The distribution diagram to be submitted	√	√	

Continued Table7.4

No.	Test items	Test requirements (corresponding paragraphs from CCS Rules for Materials and Welding)	Links	Accessories	Remark
15	Crack tip opening displacement (CTOD)	CTOD tests are to be tested in accordance with a recognized standard such as BS 7448 Part 1 & BS EN ISO 15653:2010The CTOD specimen to be standard 2×1 specimen ,with one open side., The notch of the CTOD specimen is to be located as close to the surface as practicable. Where the diameter of chain cable is less than 120mm, the minimum cross section of the test piece of specimen is 50×25mm. Where the diameter of chain cable is over 120mm, the minimum cross section of the test piece of specimen is 80×40mm. CTOD specimens are to be taken from both the side of the link containing the weld and from the opposite side. Three links are to be selected for testing, a total of six CTOD specimens. The value of CTOD not to be less than that specified in 3 of this Chapter. The test temperature to be -20℃	√	—	
16	Assessment of welding procedure	The welding procedure of studs to be assessed	√	—	At discretion of CCS

Note: "√" indicates "applicable"; "—" indicates "not applicable".

7.5Specified value of CTOD and the sample location.

Grade / Place	R3		R3S		R4		R4S&R5	
	link back	weld	link back	weld	link back	weld	link back	weld
With stud link	0.20mm	0.10mm	0.22mm	0.11mm	0.24mm	0.12mm	0.26mm	0.13mm
Without stud link	0.20mm	0.14mm	0.22mm	0.15mm	0.24mm	0.16mm	0.26mm	0.17mm

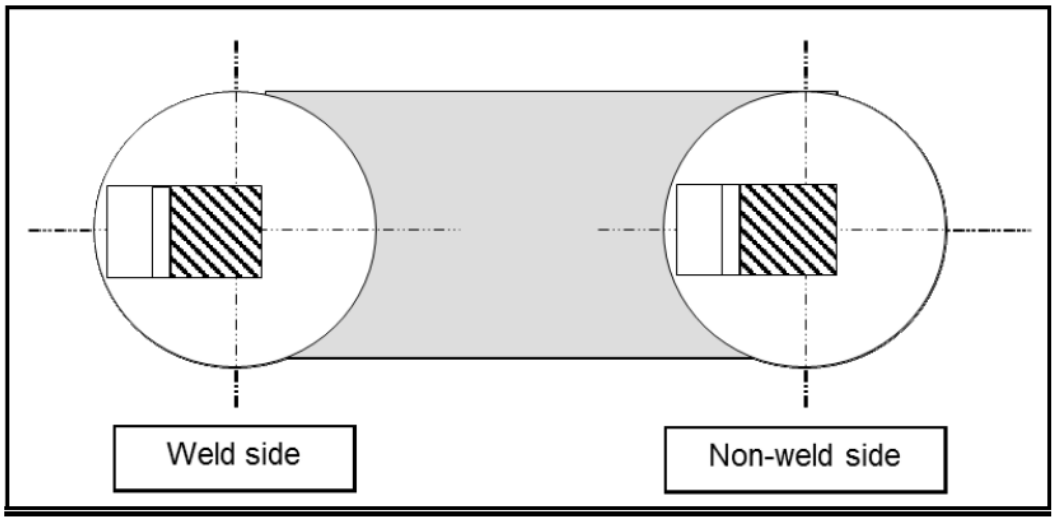

Figure 1 Location of CTOD test specimens for chain

8 Unit/batch inspection

8.1 The test items and requirements are given in Table 8.1.

Table of Test Items **Table 8.1**

No.	Test items	Test requirements (corresponding paragraphs from CCS Rules for Materials and Welding)		Remark
		links	accessories	
1	Mechanical properties test (tensile and impact tests)	10.3.8.8	10.3.11	
2	Break load test	10.3.8.5	10.3.11	
3	Proof load test	10.3.8.5	10.3.11	
4	Magnetic particles test	10.3.8.10	10.3.11.11	
5	Ultrasonic test	10.3.8.11	———	
6	Stud weld examination	10.3.6	———	
7	Dimensions	10.3.4 10.3.8	10.3.11.6	
8	Visual examination	10.3.8.3	10.3.11.2	

8.2 The relevant records or reports submitted by the manufacturer is to contain the materials certificate, mechanical property test, breaking test, proof-load test, non-destructive test, stud weld examination, dimensions, external quality, heat treatment, photograph, non-conforming links, repairs, number and location of connecting common links.