Guideline No.: W-15(202204)

W-15

STEEL PIPE FITTINGS

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Foreword

China Classification Society (hereinafter referred to as CCS)~~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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Main changes:

~~The "6.2 Requirements for raw materials of pipe fittings" is amended to coordinate with the rules~~1. Revised the scope of application, clarified that "the guideline is not applicable to the approval and inspection of flanges", and delete the description with flange in the "definitions" and "design and technical requirements";

2. Adjust the framework structure of the guide according to the requirements of the instruction for the publish of the guideline of the marine productions;

3. Revised the contents of section 4 "Drawings and documents ";

4. Revised the order of section 5.5 "Identification";

5. Revised the contents of section 7 "Type test";

6. Revised the contents of section 8 "Unit/batch inspection ";

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STEEL PIPE FITTINGS

1 Application

1.1 This Guideline is applicable to the works approval and unit/batch inspection of steel pipe fittings intended for use in the ship's piping system. Reference may also be made to in this Chapter for steel pipe fittings intended for use in the piping system of offshore installations.

1.2 The guideline is not applicable to the approval and inspection of flanges.

2 Normative references

2.1 CCS Rules for Classification of Sea-going Steel Ships;

2.2 CCS Rules for Materials and Welding.

3 Terms and ~~D~~definitions

3.1 Steel pipe fittings mean the fittings made of steel for the use of pipe junction, such as bends, Tee joints, cross, reducing pipes, ~~flanges,~~ caps, laps, branch bedplates. The fittings may be of hot formed or cold formed steel sections or forgings, or welded by one or more casings that are hot formed or cold formed by steel plates.

4 ~~Plans~~ Drawings and documents

~~A manufacturer intending for works approval by CCS is to submit the following documents as required in this Chapter.~~

4.1 The applicant is to submit the following documents to CCS for information:

(1) Particulars of the applicant, qualification documents and details of the products for approval, including the product type, specification and material, etc.;

(2) Particulars of main production equipment, inspection and test equipment and personnel qualification;

(3) Main production technology and quality control documents.~~The following documents as required in 3.2.1, PART ONE of the Guidelines are to be submitted to CCS for information.~~

(4) A welding pipe fittings manufacturer required to obtain approval by CCS is to submit the welding procedure specifications to CCS, which include all the details for approval, such as the

weld characteristic of pipe fittings, welding technical specifications, welding materials, welding procedure, heat treatment and weld inspection methods.

4.2 The documents to be submitted to CCS for approval include:

(1) ~~the~~ The type test program~~;~~, which is to clearly state the products name, specification of specimens, test items, methods and technical requirements, development basis, test place, evaluation standards for non-conforming products.

5 ~~Assessment of welding procedure~~ Technical requirements

5.1 The requirements for approval of pipe fittings are to be determined in accordance with CCS rules or standards acceptable to CCS .

5.2 Assessment of welding procedure is to be carried out for welding pipe fittings manufacturers in accordance with requirements of CCS Rules for Materials and Welding.

5.3 Requirements for heat treatment of pipe fittings

5.3.1 All the materials for fittings are to be subject to heat treatment or hot working in accordance with CCS Rules for Materials and Welding or standards acceptable to CCS or material technical instructions.

5.3.2 For ferritic steels required to be normalized and heat-formed, where heat forming operation can achieve the corresponding grain structure, the subsequent heat treatment may be exempted.

5.3.3 Cold formed fittings are generally to be heat treated. If not, the maker is to demonstrate the required properties of the finished components are satisfied.

5.3.4 For fittings welded by hot formed or cold formed components, the heat treatment methods are to be determined in the test of welding procedure approval.

5.4 Requirements for properties of fittings: all of the finished fittings are to have all the properties of the materials. For example, the permissible pressure of fittings made of seamless pipes is calculated according to the internal pressure of the straight section of the seamless pipes of the same materials.

5.5 Identification

All fittings which have been inspected with satisfactory are to be clearly marked on the surface as

follows:

(1) specifications, including the nominal size and schedule of wall thickness;

(2) manufacturer's name or trade mark;

(3) batch number;

(4) grade of material or designation and/or grade of steel;

(5) product code (according to actual manufacturing standards);

(6) standard number;

(7) CCS inspection marks.

Where the specification of fittings can not be fully marked, marks may be omitted according to the reverse order of the above items, or labels are to be taken for identification.

6 ~~Design and technical requirements~~Materials and components

~~6.1 The requirements for approval of pipe fittings are to be determined in accordance with CCS rules or recognized standards.~~

6.~~2~~ 1 Requirements for raw materials of pipe fittings

~~(1)~~6.1.1 –Materials and components are to comply with relevant requirements of CCS Rules

~~(2)~~ 6.1.2 Where the materials adopted for fittings are not manufactured by steel makers approved by CCS, the Surveyor is, in the approval test, to inspect the materials in accordance with the requirements in Chapters 3, 4 and 5, PART ONE of CCS Rules for Materials and Welding or standards acceptable to CCS.

~~(3) Generally, pipe flanges are to be made of forgings, while steel plates and sections are not recommended. Steel plates are to be only used for blind flange, lining blind flange, plate flanges, loose flanges with welding neck collar and loose flanges with welding on collar. Casting materials only apply to integral flanges.~~

~~6.3 Requirements for heat treatment of pipe fittings~~

~~(1) All the materials for fittings are to be subject to heat treatment or hot working in accordance~~

with CCS Rules for Materials and Welding or other recognized standards or material technical instructions.

(2) For ferritic steels required to be normalized and heat formed, where heat forming operation can achieve the corresponding grain structure, the subsequent heat treatment may be exempted.

(3) Cold formed fittings are generally to be heat treated. If not, the maker is to demonstrate the required properties of the finished components are satisfied.

(4) For fittings welded by hot formed or cold formed components, the heat treatment methods are to be determined in the test of welding procedure approval.

6.4 Requirements for properties of fittings: all of the finished fittings are to have all the properties of the materials. For example, the permissible pressure of fittings made of seamless pipes is calculated according to the internal pressure of the straight section of the seamless pipes of the same materials.

6.5 Identification

All fittings which have been inspected with satisfactory are to be clearly marked on the surface as follows:

(1) manufacturer's name or trade mark;

(2) specifications, including the nominal size and schedule of wall thickness;

(3) batch number;

(4) grade of material or designation and/or grade of steel;

(5) product code (according to actual manufacturing standards);

(6) standard number;

(7) CCS inspection marks.

Where the specification of fittings can not be fully marked, marks may be omitted according to the reverse order of the above items, or labels are to be taken for identification.

7 ~~Selection of typical samples~~Type test

7.1 Selection of typical samples

7.1.1 The selection of typical samples is to be capable of representing and covering the types of product for approval.

~~7.2~~7.1.2 It is not required for any combination of specifications, wall thickness and materials to be tested one by one. A representative fitting verified to be satisfactory is to represent the other fittings in the following range:

(1) Range of specifications: a test pipe fitting may be used to evaluate the qualification of DN 0.5~2 times the fittings with similar proportion. The proof test for non-reducing fittings may be used on the qualification evaluation of reducing fittings of the same type. The proof test for reducing fittings may be used on the qualification evaluation of reducing fittings of smaller specification.

(2) Range of thickness: a test pipe fitting may be used to evaluate the qualification of fitting design 0.5~3 times the ratio of *t*/*D* (*t*—nominal wall thickness of the fitting; *D*—nominal diameter).

(3) Grade of materials: the bearing pressure of the same geometrical dimension fittings made of steels of different grades is proportional to the tensile strength of the grades. Consequently, the test for a sample fitting made of a single grade of material or designation is sufficient to check the design of the fitting.

7.1.3 Seamless pipe fittings and welded pipe fittings shall be tested separately by selecting typical samples according to the coverage principle in article 7.1.2 above.

~~**8 Type test**~~

~~8.1~~7.2 Type test items

~~8.1.1~~7.2.1 The test items for fittings are as follows:

(1) visual examination;

(2) dimensional tolerance;

(3) chemical composition analysis;

(4) hardness test;

(5) tensile test;

(6) V-notch impact test (steels for low temperature service);

(7) metallographic examination(austenitic stainless steel and austenitic-ferritic duplex stainless steel);

(8) intercrystalline corrosion test (austenitic stainless steel and austenitic-ferritic duplex stainless steel);

(9) non-destructive test;

(10) pressure-tight test;

(11) bursting test;

(12) pitting corrosion test (austenitic-ferritic duplex stainless steel);

(13) other test deemed necessary by CCS.

~~8.1.2~~7.2.2 The type test items of fittings are different depending on different materials and uses. The items are to be determined subject to negotiation between CCS and the manufacturer according to specific requirements.

~~8.2~~7.3 Test requirements

~~(1)~~7.3.1 Visual examination

The internal and external surfaces of all finished fittings are to be smooth and free from stains, cracks, over-heating, scabs, laminations, laps, mechanical drawings, dents which can impair strength and appearance.

~~(2)~~7.3.2 Dimensional tolerance

The geometrical and dimensional tolerances are to comply with the relevant requirements of standards acceptable to CCS~~recognized standards~~.

~~(3)~~7.3.3 Chemical composition analysis

The chemical composition of fittings are to be the same as that of the materials and comply with the requirements in Chapters 3, 4 and 5, PART ONE of CCS Rules for Materials and Welding and/or standards acceptable to CCS~~other recognized standards~~.

~~(4)~~7.3.4 Hardness test

The hardness value of fittings is to comply with the relevant requirements in standards acceptable to CCS~~recognized standards~~. In general, the differential of Brinell hardness value is to be within HB25 for the same fitting. For welded pipe fittings, additional hardness test shall be carried out for the weld and heat affected zone, and the result shall not be greater than 120% of the body hardness value.

~~(5)~~ 7.3.5 Tensile test

① To prepare specimen, the pipe fittings manufacturer is to provide additional fittings or fittings with elongation; forged pipe fittings manufacturer may also provide the same batch of parental material with the same final heat treatment. Transverse or longitudinal specimens are to be taken for tensile test according to the geometrical shape of fittings. For welded pipe fittings, additional tensile test shall be carried out on the welded joint.

② The preparation and means of test for the specimen in the tensile test are to be in accordance with the requirements in Chapter 2, PART ONE of CCS Rules for Materials and Welding. The test result is to be in accordance with the requirements in Chapters 3, 4 and 5, PART ONE of CCS Rules for Materials and Welding and/or standards acceptable to CCS~~recognized standards~~.

③ For fittings of DN 100 or smaller, tensile test may be exempted.

~~(6)~~ 7.3.6 V-notch impact test (steels for low temperature service)

① The requirements for sampling are referred to in ~~7.2~~7.1.2 and ~~8.2(5)~~7.3.5. For welded pipe fittings, additional impact test shall be carried out on the welded joint.

② ~~The test is only applicable to fittings with wall thickness ≥6 mm and geometrical shapes permissible for impact tests.~~ When the standard impact specimen with the width of 5mm and above can be taken out from the pipe wall, the impact test shall be carried out.

③ ~~For fittings made of austenitic steel pipes and heat treated, if the design temperature intended is not less than -105℃, the test may be exempted subject to approval by CCS.~~ When austenitic stainless steel pipe fittings are intended to be used at the working

temperature of - 100 ℃ and below, and the standard impact samples with the width of 5mm and above can be taken out of the pipe wall, the Charpy V-notch impact test at the temperature of - 196 ℃ shall be carried out, and indicated in the approval certificate.

④ The test temperature and test results shall meet the relevant requirements of chapters 3, 4 and 5, Part 1 of CCS Rules for Materials and Welding and/or standards acceptable to CCS.

~~(7)~~7.3.7 Metallographic examination(austenitic stainless steels and austenitic-ferritic duplex stainless steel)

The test methods and results are to comply with the requirements in standards acceptable to CCS~~recognized standards~~.

~~(8)~~7.3.8 Intercrystalline corrosion test (austenitic stainless steels and austenitic-ferritic duplex stainless steel)

Fittings made of austenitic stainless steel are to be subject to intercrystalline corrosion test. The test methods and results are to comply with the requirements in Section 7, Chapter 2, PART ONE of CCS Rules for Materials and Welding and/or standards acceptable to CCS~~recognized standards~~.

~~(9)~~7.3.9 Non-destructive test

The finished fittings are to be subject to non-destructive test in accordance with CCS recognized standard. Fittings of magnetic materials are to be subject to magnetic particle examination; fittings of austenitic stainless steel are to be subject to dye penetrant examination. Welds in fittings made of steel plates are to be subject to 100% radiographic examination. The result of non-destructive test is to comply with the relevant requirements of standards acceptable to CCS~~recognized standards~~.

~~(10)~~7.3.10 Pressure-tight test

~~For fittings manufactured and approved in accordance with the Guidelines, an independent pressure-tight test is not required. However all the~~ The fittings are to be capable of withstanding the same pressure for seamless steel tube of the same material, dimension and wall thickness, and free from any leakage or defects that may impair its property. The specific requirements may be referred to in 4.1.8, PART ONE of CCS Rules for Materials and Welding.

~~(11)~~7.3.11 Bursting test

① Bursting test is a destructive test intended for the demonstration of fittings design. Water and other suitable fluids are often used as media in bursting test. Bursting test is to be carried out in a competent test unit acceptable to CCS. The junction of fittings for bursting test and the determination for conformity of the bursting test are to comply with the requirements of manufacturing standard for different fittings.

② The bursting pressure load of fittings are to be calculated as appropriate to different fittings:

(i) for butt-welding seamless steel fittings and butt-welding fittings made of steel plates, the bursting pressure load is not to be less than 105% of the calculated P for welded straight section of the same wall thickness, specification and material:

$$P = 2R_mT/D \text{ MPa}$$

where: P- bursting pressure load calculated for straight section, in MPa;

R_m - the actual tensile strength of straight section material (measured from specimen of test pipe fittings), to meet the requirements of minimum tensile strength in the Rules or standards, in MPa;

T - the nominal wall thickness of steel straight pipe, in mm;

D - the outside diameter of steel straight pipe, in mm;

(ii) in works approval, fittings covering the range for approval (usually 90 ° elbow or Tee joints) are to be selected for bursting test;

(iii) in works approval, where the manufacturer can provide the qualified bursting test report by a competent unit acceptable to CCS (the period of time between the bursting test and approval is not to exceed 2 years), and the specification of the fitting meet the sampling requirements for works approval, the bursting test for the fittings of such materials may be exempted.

7.3.12 Pitting corrosion test (austenitic-ferritic duplex stainless steel);

Fittings made of austenitic-ferritic duplex stainless steel are to be subject to pitting corrosion test. The test methods and results are to comply with the requirements in Section 9, Chapter 2, PART ONE of CCS Rules for Materials and Welding and/or standards acceptable to CCS.

~~9~~ 8 Unit/batch inspection

~~9.1~~8.1 The fittings are to be manufactured in the works as approved by CCS. If the applicant needs to apply for inspection after approval, ~~T~~the unit/batch inspection items are to contain:

(1) ~~visual examination;~~ re-inspection of chemical composition of raw materials;

(2) ~~dimensional tolerance;~~ visual examination

(3) ~~chemical composition analysis;~~ dimensional tolerance;

(4) hardness test;

(5) tensile test;

(6) V-notch impact test (steels for low temperature service);

(7) non-destructive test;

(8) other items as required by the purchaser.

~~9.2 Requirements of materials test for sets and groups~~

~~(1) Fittings are to be divided into several groups as required for their mechanical property tests. The base number of test groups is to be in accordance with Table 9.2.~~

~~**Test Group Table 9.2**~~

~~**DN (mm)**~~	~~**Base number of test group (piece)**~~
~~<100~~	~~≤200~~
~~≥100～<200~~	~~≤100~~
~~≥200～<350~~	~~≤50~~
~~≥350~~	~~≤25~~

~~Notes: ① The test group in the table is applicable to 90° elbow.~~

~~② For the quantity of elbow of each group, if it is 180°, the base number is 1/2 of the tabled value and if 45°, the base number is twice the tabled value.~~

~~③ Reference may be made for other fittings.~~

~~(2) Hardness test is to be carried out with 10% minimum (but not less than 3 pieces); while the test for fittings of DN>200 are to be carried out with 100%.~~

~~(3) At least one specimen is to be subject to tensile test in one test group, unless the requirements~~

~~of 8.2(5) are satisfied.~~

~~(4) V-notch impact test (steels for low temperature service): at least a set of specimen are to be subject to the impact test in one group, unless the requirements of 8.2(6) are satisfied.~~

8.2 Test requirements

(1) The results of the above test items shall meet the requirements of CCS specifications and / or standards acceptable to CCS;

(2) When austenitic stainless steel pipe fittings are intended to be used at the working temperature of - 100 ℃ and below, and the standard impact samples with the width of 5mm and above can be taken out of the pipe wall, the Charpy V-notch impact test at the temperature of - 196 ℃ shall be carried out.