

**GD18-2013**



**China Classification Society**

**Guidelines for Survey of Marine Higher**

**Tensile and Thick Steel Plates**

**2013**

**Beijing**

**October 2013**

## CONTENTS

1. Application.....	3
1.1 General .....	3
1.2 Thickness.....	3
1.3 Use of steel grade .....	3
2. General.....	3
2.1 Hull structures (design) .....	4
2.2 Material specifications .....	4
2.3 Manufacturing approval test.....	5
2.4 Welding works .....	7
2.5 Welding Procedure Qualification Test.....	9

# **1. Application**

## **1.1 General**

1.1.1 This guidelines is to be applied to ships contracted for construction<sup>1</sup> on or after 1 January 2014.

1.1.2 This guidelines is to be complied with for container carriers incorporating extremely thick steel plates in accordance with 1.2.1.

1.1.3 This guidelines gives the basic concepts for application of YP47 steel plates to longitudinal structural members in the upper deck region of container carriers (such as hatch side coaming, hatch coaming top and the attached longitudinals). Special consideration is to be given to the application of YP47 steel plate for other hull structures.

1.1.4 Unless otherwise specified in this guidelines, IACS UR W11 is to be followed.

1.1.5 YP47 steel plates mean the steel plates of specified minimum yield point of 460 N/mm<sup>2</sup>. The scope of application is defined under 1.2 and 1.3.

## **1.2 Thickness**

1.2.1 This guidelines gives the requirements for steel plates with thickness of over 50mm and not greater than 100mm.

1.2.2 For steel plates outside of this thickness range, special consideration is to be given by CCS.

## **1.3 Use of steel grade**

1.3.1 In the case that YP47 steel plates are used for longitudinal structural members in the upper deck region such as hatch side coaming and hatch coaming top and their attached longitudinals, the grade of YP47 steel plates is to be EH47 specified hereinafter.

# **2. General**

---

<sup>1</sup> The “contracted for construction” date means the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. For further details regarding the date of “contract for construction”, refer to IACS Procedural Requirement (PR) No. 29.

## 2.1 Hull structures (design)

### 2.1.1 HT factor (Material factor of high tensile steel, K)

HT factor for the assessment of hull girder strength is to be taken as 0.62.

### 2.1.2 Fatigue assessment

Fatigue assessment on the longitudinal structural members is to be performed in accordance with CCS's procedures.

### 2.1.3 Details of construction design

Special consideration is to be paid to the details of constructions of structural members where YP47 steel plates are applied such as connections between outfitting and hull structures. Connections are to be in accordance with CCS's procedures.

## 2.2 Material specifications

2.2.1 Material specifications for YP47 steel plates are defined in Table 1 and Table 2.

**Table 1 Conditions of supply, grade and mechanical properties for YP47 steel plates**

Supply condition	Grade	Mechanical Properties			Impact test			
		Yield Strength (N/mm <sup>2</sup> ) min.	Tensile Strength (N/mm <sup>2</sup> )	Elongation (%) min	Test Temp. (°C)	Average Impact Energy (J) min.		
						50 < t ≤ 70	70 < t ≤ 85	85 < t ≤ 100
TMCP*	EH47	460	570/720	17	-40°C	53	64	75

Note

t: thickness (mm)

\* Other conditions of supply are to be in accordance with CCS's procedures.

**Table 2 Chemical compositions for YP47 steel plates**

Chemical composition	C <sub>eq</sub> *1	P <sub>cm</sub> *2
As approved by CCS	≤ 0.49%	≤ 0.22%

Note

- \*1 The carbon equivalent  $C_{eq}$  value is to be calculated from the ladle analysis using the following formula.

$$C_{eq} = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} (\%)$$

- \*2 Cold cracking susceptibility is to be calculated using the following formula.

$$P_{cm} = C + \frac{Si}{30} + \frac{Mn}{20} + \frac{Cu}{20} + \frac{Ni}{60} + \frac{Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + 5B(\%)$$

The extent of testing is to be one set of three specimens taken from each piece defined in UR W11 11.1.

## 2.3 Manufacturing approval test

### 2.3.1 General

Approval test items, test methods and acceptance criteria not specified in this guidelines are to be in accordance with CCS's procedures.

### 2.3.2 Approval range

One test product with the maximum thickness to be approved is to be selected provided the approved target chemical composition range remains unchanged.

### 2.3.3 Base Metal test

#### (a) Charpy V-notch Impact Tests

Generally Charpy V-notch impact testing is to be carried out in accordance with IACS UR W11.

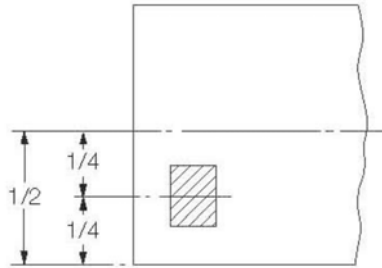
Test samples are to be taken from the plate corresponding to the top of the ingot, unless otherwise agreed.

In the case of continuous castings, test samples are to be taken from a randomly selected plate.

The location of the test sample is to be at the square cut end of the plate, approximately one-quarter width from an edge, as shown Fig.1.

Samples are to be taken with respect to the principal rolling direction of the plate at locations representing the top and bottom of the plate as follows:

Longitudinal Charpy V-notch impact tests - Top and bottom,  
Transverse Charpy V-notch impact tests - Top only,  
Strain aged longitudinal Charpy V-notch impact test - Top only.



**Fig.1 Plates and flats**

Charpy V-notch impact tests are required from both the quarter and mid thickness locations of the test samples.

One set of 3 Charpy V-notch impact specimens is required for each impact test.

The Charpy V-notch impact test temperature is to be  $-40^{\circ}\text{C}$ .

In addition to the determination of the energy value, the lateral expansion and the percentage crystallinity are also to be reported.

The strain aged samples are to be strained to 5% followed by heating to  $250^{\circ}\text{C}$  for 1 hour prior to testing.

Additionally at each location, Charpy V-notch impact tests are to be carried out with appropriate temperature intervals to properly define the full transition range.

(b) Brittle fracture initiation test

Deep notch test or Crack Tip Opening Displacement (CTOD) test is to be carried out and the result is to be reported.

Test method is to be in accordance with CCS's practice.

(c) Naval Research Laboratory (NRL) drop weight test

The test method is to comply with ASTM E208 or equivalent method.

Nil Ductility Test Temperature (NDTT) is to be reported for reference.

(d) Brittle crack arrest test

Standard ESSO test described in Annex 2 of IACS UR S33 (Safety Measures of Extremely Thick Steel Plates) or other alternative test (e.g. double tension test etc.) is to be carried out in order to obtain the brittle crack arrest toughness for reference.

#### 2.3.4 Weldability test

(a) Charpy V-notch Impact Test

Charpy V-notch impact tests are to be taken at a position of 1/4 thickness from the plate surface on the face side of the weld with the notch perpendicular to the plate surface.

One set of the specimens transverse to the weld is to be taken with the notch located at the fusion line and at a distance 2, 5 and minimum 20 mm from the fusion line.

The fusion boundary is to be identified by etching the specimens with a suitable reagent.

One additional set of the specimens is to be taken from the root side of the weld with the notch located at the same position and at the same depth as for the face side.

The impact test temperature is -40°C.

Additionally at each location, impact tests are to be carried out with appropriate temperature intervals to properly define the full transition range.

(b) Y- shape weld crack test (Hydrogen crack test)

The test method is to be in accordance with recognized national standards such as KS B 0870, JIS Z 3158 or GB 4675.1.

Acceptance criteria are to be in accordance with CCS's practice.

(c) Brittle fracture initiation test

Deep notch test or CTOD test is to be carried out.

Test method and results are to be considered appropriate by CCS.

## 2.4 Welding works

#### 2.4.1 Welder

Welders engaged in YP47 welding work are to possess welder's qualifications specified in CCS's procedures.

#### 2.4.2 Short bead

Short bead length for tack and repairs of welds by welding are not to be less than 50mm.

In the case where  $P_{cm}$  is less than or equal to 0.19, 25mm of short bead length may be adopted with approval of CCS.

#### 2.4.3 Preheating

Preheating is to be 50°C or over when air temperature is 5°C or below.

In the case where  $P_{cm}$  is less than or equal to 0.19, air temperature of 0°C or below may be adopted with approval of CCS.

#### 2.4.4 Welding consumable

Specifications of welding consumables for YP47 steel plates are to be in accordance with Table 3.

**Table 3 Mechanical properties for deposited metal tests for welding consumables**

Mechanical Properties			Impact test	
Yield Strength (N/mm <sup>2</sup> ) min.	Tensile Strength (N/mm <sup>2</sup> )	Elongation (%) min	Test Temp. (°C)	Average Impact Energy (J) min.
460	570/720	19	-20	53

Consumable tests for butt weld assemblies are to be in accordance with Table 4.

**Table 4 Mechanical properties for butt weld tests for welding consumables**

Tensile strength (N/mm <sup>2</sup> )	Bend test ratio: $\frac{D}{t}$	Charpy V-notch impact tests		
		Test temperature (°C)	Average energy (J) min.	
			Downhand, horizontal-vertical, overhead	Vertical (upward and downward)
570 - 720	4	- 20	53	53

#### 2.4.5 Others

Special care is to be paid to the final welding so that harmful defects do not remain.

Jig mountings are to be completely removed with no defects in general, otherwise the treatment of the mounting is to be accepted by CCS.

### 2.5 Welding Procedure Qualification Test

#### 2.5.1 General

Approval test items, test methods and acceptance criteria not specified in this guidelines are to be in accordance with CCS's procedures.

#### 2.5.2 Approval range

IACS UR W28 is to be followed for approval range.

#### 2.5.3 Impact test

IACS UR W28 is to be followed for impact test. 64J at -20°C is to be satisfied.

#### 2.5.4 Hardness

HV10, as defined in IACS UR W28, is to be not more than 380. Measurement points are to include mid-thickness position in addition to the points required by IACS UR W28.

#### 2.5.5 Tensile test

Tensile strength in transverse tensile test is to be not less than 570N/mm<sup>2</sup>.

#### 2.5.6 Brittle fracture initiation test

Deep notch test or CTOD test may be required.

Test method and acceptance criteria are to be considered appropriate by CCS.