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# S33 Requirements for Use of Extremely Thick Steel Plates in Container Ships

(Jan  
2013)  
(Rev.1  
Sept  
2015)

## 1. Application

### 1.1 General

1.1.1 This UR is to be complied with for container ships incorporating extremely thick steel plates having steel grade and thickness in accordance with 1.2 and 1.3 respectively.

1.1.2 This UR identifies when measures for the prevention of brittle fracture of extremely thick steel plates are required for longitudinal structural members.

1.1.3 This UR gives the basic concepts for application of extremely thick steel plates to longitudinal structural members in the upper deck and hatch coaming structural region (i.e. upper deck plating, hatch side coaming and hatch coaming top).

1.1.4 The application of the measures specified in 2, 3 and 4 is to be in accordance with Annex 1.

### 1.2 Steel Grade

1.2.1 This UR is to be applied when any of YP36, YP40 and YP47 steel plates are used for the longitudinal structural members.

*Note: YP36 YP40 and YP47 refers to the minimum specified yield strength of steel defined in UR W11 and W31; 355, 390 and 460 N/mm<sup>2</sup>, respectively.*

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#### Notes:

1. This UR is to be applied by IACS Societies to ships contracted for construction on or after 1 January 2014.
2. Revision 1 of this UR is to be applied by IACS Societies to ships contracted for construction on or after 1 January 2017.
3. 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.

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1.2.2 In the case that YP47 steel plates are used for longitudinal structural members in the upper deck region such as upper deck plating, hatch side coaming and hatch coaming top and their attached longitudinals, the grade of YP47 steel plates is to be EH47 specified in UR W31.

**1.3 Thickness**

1.3.1 For steel plates with thickness of over 50mm and not greater than 100mm, the measures for prevention of brittle crack initiation and propagation specified in 2, 3 and 4 are to be taken.

1.3.2 For steel plates with thickness exceeding 100mm, appropriate measures for prevention of brittle crack initiation and propagation are to be taken in accordance with each Classification Society's procedures.

**1.4 Hull structures (for the purpose of design)****1.4.1 HT(K) factors (Material factor for YP36, YP40 and YP47 steel)**

The HT factor (Material factor of high tensile steel, K) of YP47 steel for the assessment of hull girder strength is to be taken as 0.62.  
For HT factors of YP36 and YP40 refer to UR S4.

**1.4.2 Fatigue assessment**

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

**1.4.3 Details of construction design**

Special consideration is to be paid to the construction details where extremely thick steel plates are applied as structural members such as connections between outfitting and hull structures. Connections details are to be in accordance with each Classification Society's requirements.

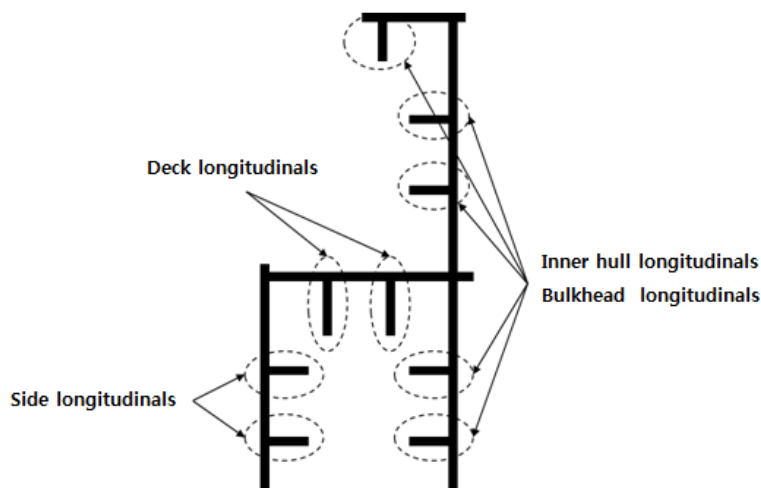
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### 2. Non-Destructive Testing (NDT) during construction (Measure No.1 of Annex 1)

Where NDT during construction is required in Annex 1, the NDT is to be in accordance with 2.1 and 2.2. Enhanced NDT as specified in 4.3.1(e) is to be carried out in accordance with an appropriate standard.

#### 2.1 General

2.1.1 Ultrasonic testing (UT) in accordance with IACS Rec.20 or each society's requirement is to be carried out on all block-to-block butt joints of all upper flange longitudinal structural members in the cargo hold region. Upper flange longitudinal structural members include the topmost strakes of the inner hull/bulkhead, the sheer strake, main deck, coaming plate, coaming top plate, and all attached longitudinal stiffeners. These members are defined in Fig.1.



**Fig.1 Upper Flange Longitudinal Structural Members**

#### 2.2 Acceptance criteria of UT

2.2.1 Acceptance criteria of UT are to be in accordance with IACS Rec.20 or each Classification Society's practice.

2.2.2 The acceptance criteria may be adjusted under consideration of the appertaining brittle crack initiation prevention procedure and where this is more severe than that found in IACS Rec.20, the UT procedure is to be amended accordingly to a more severe sensitivity.

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(cont)**3. Periodic NDT after delivery (Measure No.2 of Annex 1)**

Where periodic NDT after delivery is required, the NDT is to be in accordance with 3.1, 3.2 and 3.3.

**3.1 General**

3.1.1 The procedure of the NDT is to be in accordance with IACS Rec.20 or each Society's requirements.

**3.2 Timing of UT**

3.2.1 Where UT is carried out, the frequency of survey is to be in accordance with individual Society requirements.

**3.3 Acceptance criteria of UT**

3.3.1 Where UT is carried out, acceptance criteria of UT are to be in accordance with IACS Rec.20 or each Classification Society's practice.

**4. Brittle crack arrest design (Measure No.3, 4 and 5 of Annex 1)****4.1 General**

4.1.1 Measures for prevention of brittle crack propagation, which is the same meaning as Brittle crack arrest design, are to be taken within the cargo hold region.

4.1.2 The approach given in this section generally applies to the block-to-block joints but it should be noted that cracks can initiate and propagate away from such joints. Therefore, appropriate measures should be considered in accordance with 4.2.1 (b) (ii).

4.1.3 Brittle crack arrest steel is defined in 2.1.2 of UR W31. Only for the scope of this UR, the definition in UR W31 2.1.2 also applies to YP36 and YP40 steels.

**4.2 Functional requirements of brittle crack arrest design**

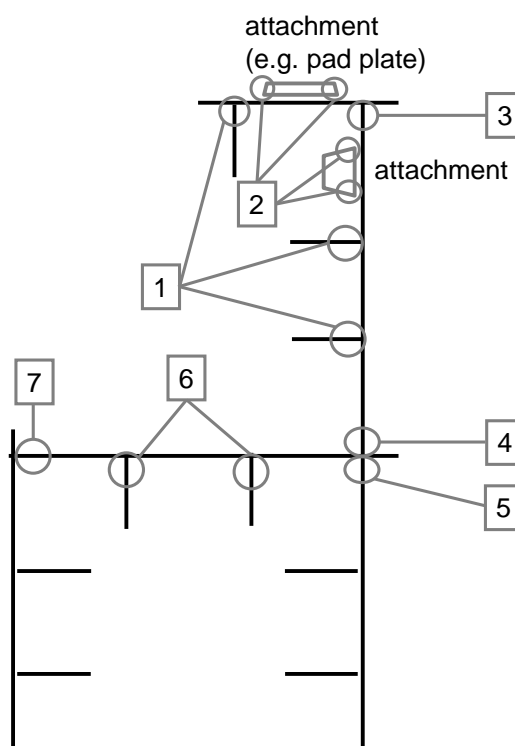
4.2.1 The purpose of the brittle crack arrest design is aimed at arresting propagation of a crack at a proper position and to prevent large scale fracture of the hull girder.

- (a) The point of a brittle crack initiation is to be considered in the block-to-block butt joints both of hatch side coaming and upper deck.
- (b) Both of the following cases are to be considered:
  - (i) where the brittle crack runs straight along the butt joint, and
  - (ii) where the brittle crack initiates in the butt joint but deviates away from the weld and into the plate, or where the brittle crack initiates from any other weld (see the figure below for definition of other welds) and propagates into the plate.

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\*\*\*: "Other weld areas" includes the following (refer to Fig.2):

1. Fillet welds where hatch side coaming plating, including top plating, meet longitudinals;
2. Fillet welds where hatch side coaming plating, including top plating and longitudinals, meet attachments. (e.g., Fillet welds where hatch side top plating meet hatch cover pad plating.);
3. Fillet welds where hatch side coaming top plating meet hatch side coaming plating;
4. Fillet welds where hatch side coaming plating meet upper deck plating;
5. Fillet welds where upper deck plating meet inner hull/bulkheads;
6. Fillet welds where upper deck plating meet longitudinal; and
7. Fillet welds where sheer strakes meet upper deck plating.



**Fig.2 Other Weld Areas**

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(cont)**4.3 Concept examples of brittle crack arrest design**

4.3.1 The following are considered to be acceptable examples of brittle crack arrest-design. The detail design arrangements are to be submitted for approval by each Classification Society. Other concept designs may be considered and accepted for review by each Classification Society.

Brittle crack arrest design for 4.2.1(b)(ii):

- (a) Brittle crack arresting steel is to be used for the upper deck plating along the cargo hold region in a way suitable to arrest a brittle crack initiating from the coaming and propagating into the structure below.

Brittle crack arrest design for 4.2.1(b)(i):

- (b) Where the block to block butt welds of the hatch side coaming and those of the upper deck are shifted, this shift is to be greater than or equal to 300mm. Brittle crack arrest steel is to be provided for the hatch side coaming plating.
- (c) Where crack arrest holes are provided in way of the block-to-block butt welds at the region where hatch side coaming weld meets the deck weld, the fatigue strength of the lower end of the butt weld is to be assessed. Additional countermeasures are to be taken for the possibility that a running brittle crack may deviate from the weld line into upper deck or hatch side coaming. These countermeasures are to include the application of brittle crack arrest steel in hatch side coaming plating.
- (d) Where Arrest Insert Plates of brittle crack arrest steel or Weld Metal Inserts with high crack arrest toughness properties are provided in way of the block-to-block butt welds at the region where hatch side coaming weld meets the deck weld, additional countermeasures are to be taken for the possibility that a running brittle crack may deviate from the weld line into upper deck or hatch side coaming. These countermeasures are to include the application of brittle crack arrest steel in hatch side coamings plating.
- (e) The application of enhanced NDT particularly time of flight diffraction (TOFD) technique using stricter defect acceptance in lieu of standard UT technique specified in 2 can be an alternative to (b), (c) and (d).

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## Annex 1 Measures for Extremely Thick Steel Plates

The thickness and the yield strength shown in the following table apply to the hatch coaming top plating and side plating, and are the controlling parameters for the application of countermeasures.

If the as built thickness of the hatch coaming top plating and side plating is below the values contained in the table, countermeasures are not necessary regardless of the thickness and yield strength of the upper deck plating.

Yield Strength (kgf/mm <sup>2</sup> )	Thickness (mm)	Option	Measures			
			1	2	3+4	5
36	50 < t ≤ 85	-	N.A.	N.A.	N.A.	N.A.
	85 < t ≤ 100	-	X	N.A.	N.A.	N.A.
40	50 < t ≤ 85	-	X	N.A.	N.A.	N.A.
	85 < t ≤ 100	A	X	N.A.	X	X
		B	X*	N.A.**	N.A.	X
47 (FCAW)	50 < t ≤ 100	A	X	N.A.	X	X
		B	X*	N.A.**	N.A.	X
47 (EGW)	50 < t ≤ 100	-	X	N.A.	X	X

### Measures:

- 1 NDT other than visual inspection on all target block joints (during construction) See 2 of UR S33.
- 2 Periodic NDT other than visual inspection on all target block joints (after delivery) See 3 of UR S33.
- 3 Brittle crack arrest design against straight propagation of brittle crack along weldline to be taken (during construction) See 4.3.1 (b), (c) or (d) of UR S33.
- 4 Brittle crack arrest design against deviation of brittle crack from weldline (during construction) See 4.3.1 (a) of UR S33.
- 5 Brittle crack arrest design against propagation of cracks from other weld areas\*\*\* such as fillets and attachment welds. (during construction) See 4.3.1 (a) of UR S33.

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(cont)**Symbols:**

- (a) "X" means "To be applied".
- (b) "N.A." means "Need not to be applied".
- (c) Selectable from option "A" and "B".

**Notes:**

\*: See 4.3 (e) of UR S33.

\*\* : may be required at the discretion of each Society.

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