APPENDIX 2 THICKNESS MEASUREMENTS: EXTENT, DETERMINATION OF LOCATIONS AND ACCEPTANCE CRITERIA

1 General

1.1 Aim of the Appendix

1.1.1 Thickness measurements are a major part of surveys to be carried out for the maintenance of class, and the analysis of these measurements is a prominent factor in the determination and extent of the repairs and renewals of the ship's structure.

1.1.2 The Appendix is intended to provide Owners, companies performing thickness measurements and the Society's Surveyors with a uniform means with a view to fulfilling Rule requirements for thickness measurements. In particular, it will enable all the above-mentioned parties to carry out:

- the planning and preparation
- the determination of extent and location, and
- the analysis

of the thickness measurements in cooperation.

1.1.3 It is to be noted that this Appendix also takes into account specific requirements for thickness measurements relevant to close-up surveys of ships which are subject to the Enhanced Survey Program (ESP).

1.1.4 This Appendix is also to be used for the thickness measurements of ships assigned the notation **STAR-HULL** (see Ch 5, Sec 2 and Part F, Chapter 1). However, the acceptance criteria for thickness measurements specific to this notation are given in Pt F, Ch 1, Sec 1.

1.1.5 *(1/7/2013)*

For ships built under the Common Structural Rules, the acceptance criteria are according to App 3.

1.2 Scope of the Appendix

1.2.1 Separate Articles below provide the following information:

- references to rule requirements and some additional information on the extent of the thickness measurements to be performed during surveys according to types of ships and related surveys (see [2])
- locations of the measurements for the main parts of the ship (see [3])
- how to analyse the results of thickness measurements (see [4]).

Tables and sketches are also given to detail the above points according to the types of ships.

2 Rule requirements for the extent of measurements

2.1 General

2.1.1 For the maintenance of class, thickness measurements may be required during annual, intermediate and class renewal surveys.

Tab 1 gives the references to the requirements for minimum thickness measurements indicated in Chapter 3 and Chapter 4 for each service notation and related to the different types of surveys.

Some additional explanations are also given about the wording used in the Rules as well as the general principles of the required thickness measurements during class renewal surveys.

2.2 Class renewal survey: all ships except those submitted to ESP

2.2.1 The thickness measurements required by the Rules consist of:

- systematic thickness measurements, i.e. measurements of different parts of the structure in order to assess the overall and local strength of the ship
- measurements of suspect areas as defined in Sec 2, [2.2.10]
- additional measurements on areas determined as affected by substantial corrosion as defined in Sec 2, [2.2.9].

2.3 Class renewal survey: ships submitted to ESP or equivalent

2.3.1 The thickness measurements required by the Rules consist of:

- systematic thickness measurements in order to assess the overall and local strength of the ship
- thickness measurements as indicated in the program of close-up survey
- measurements of elements considered as suspect areas as defined in Sec 2, [2.2.10]
- additional measurements on areas determined as affected by substantial corrosion as defined in Sec 2, [2.2.9].

2.3.2 For the determination of close-up surveys and relevant thickness measurements as well as the areas considered as suspect areas, reference is to be made to the relevant Sections of Chapter 4 according to the different service notations of the ships subject to ESP.

Table 1 : References to Rule requirements related to thickness measurements *(1/7/2013)*

SERVICE NOTATION	TYPE OF SURVEY		
	CLASS RENEWAL	INTERMEDIATE	ANNUAL
all service notations except those in other rows	Ch 3, Sec 5, [2.5] and Ch 3, Sec 5, Tab 2: systematic measurements and suspect areas Where substantial corrosion is found, the extent of thickness measurements may be increased to the Surveyor's satisfaction, using Ch 3, Sec 5, Tab 3 as guidance	Ch 3, Sec 4, Tab 1 : thickness measurements to be taken if deemed necessary by the Surveyor Where substantial corrosion is found, the extent of thickness measurements may be increased to the Surveyor's satisfaction, using Ch 3, Sec 5, Tab 3 as guidance	Ch 3, Sec 3, [2.4.1]: areas of substantial corrosion identified at previous surveys Where substantial corrosion is found, the extent of thickness measurements may be increased to the Surveyor's satisfaction, using Ch 3, Sec 5, Tab 3 as guidance
bulk carrier ESP **ore carrier ESP**	Ch 4, Sec 2, [4.1] and Ch 4, Sec 2, [4.5] : planning and general requirements Ch 4, Sec 2, Tab 5 : measurements of elements subjected to close-up survey Ch 4, Sec 2, Tab 6 : extent of systematic thickness measurements Ch 4, Sec 2, Tab 7 to Ch 4, Sec 2, Tab 11, according to the different locations, where substantial corrosion is found	Ch 4, Sec 2, Tab 3 for cargo holds Ch 4, Sec 2, Tab 4 for salt ballast tanks Ch 4, Sec 2, Tab 7 to Ch 4, Sec 2, Tab 11, according to the different locations, where substantial corrosion is found	Ch 4, Sec 2, Tab 1, note (2) for cargo holds and when deemed necessary by the Surveyor Ch 4, Sec 2, [2.3.2] for salt ballast tanks and when deemed necessary by the Surveyor Ch 4, Sec 2, Tab 7 to Ch 4, Sec 2, Tab 11, according to the different locations, where substantial corrosion is found
bulk carrier ESP - double skin	Ch 4, Sec 9, [4.1] and Ch 4, Sec 9, [4.5]: planning and general requirements Ch 4, Sec 9, Tab 2: measurements of elements subjected to close-up survey Ch 4, Sec 9, Tab 4: extent of systematic thickness measurements Ch 4, Sec 9, Tab 5 to Ch 4, Sec 9, Tab 8, according to the different locations, where substantial corrosion is found	Ch 4, Sec 9, Tab 1 for both cargo holds and salt ballast tanks Ch 4, Sec 9, Tab 4 to Ch 4, Sec 9, Tab 8, according to the different locations, where substantial corrosion is found	Ch 4, Sec 9, [2.5] limited to salt ballast tanks and when deemed necessary by the Surveyor Ch 4, Sec 9, Tab 4 to Ch 4, Sec 9, Tab 8, according to the different locations, where substantial corrosion is found
oil tanker ESP **combination carrier/OBO ESP** **combination carrier/OOC ESP**	Ch 4, Sec 3, [6.1] and Ch 4, Sec 3, [6.4] : planning and general requirements Ch 4, Sec 3, Tab 3 : measurements of elements subjected to close-up survey Ch 4, Sec 3, Tab 4 : extent of systematic thickness measurements Ch 4, Sec 3, Tab 5 to Ch 4, Sec 3, Tab 8, according to the different locations, where substantial corrosion is found	Ch 4, Sec 3, Tab 1 for both cargo and salt ballast tanks Ch 4, Sec 3, Tab 5 to Ch 4, Sec 3, Tab 8, according to the different locations, where substantial corrosion is found	Ch 4, Sec 3, [2.4.2] limited to salt ballast tanks and when deemed necessary by the Surveyor Ch 4, Sec 3, Tab 5 to Ch 4, Sec 3, Tab 8, according to the different locations, where substantial corrosion is found
oil tanker ESP **double hull**	Ch 4, Sec 4, [4.1] and Ch 4, Sec 4, [4.4]: planning and general requirements Ch 4, Sec 4, Tab 2: measurements of elements subjected to close-up survey Ch 4, Sec 4, Tab 3: extent of systematic thickness measurements Ch 4, Sec 4, Tab 4 to Ch 4, Sec 4, Tab 8, according to the different locations, where substantial corrosion is found	Ch 4, Sec 4, Tab 1 for both cargo and salt ballast tanks Ch 4, Sec 4, Tab 4 to Ch 4, Sec 4, Tab 8, according to the different locations, where substantial corrosion is found	Ch 4, Sec 4, [2.4.2] limited to salt ballast tanks and when deemed necessary by the Surveyor Ch 4, Sec 4, Tab 4 to Ch 4, Sec 4, Tab 8, according to the different locations, where substantial corrosion is found

SERVICE NOTATION	TYPE OF SURVEY		
	CLASS RENEWAL	INTERMEDIATE	ANNUAL
chemical tanker ESP	Ch 4, Sec 5, [6.1] and Ch 4, Sec 5, [6.4] : planning and general requirements Ch 4, Sec 5, Tab 3 : measurements of elements subjected to close-up survey Ch 4, Sec 5, Tab 4 : extent of systematic thickness measurements Ch 4, Sec 5, Tab 5 to Ch 4, Sec 5, Tab 8, according to the different locations, where substantial corrosion is found	Ch 4, Sec 5, Tab 2 for both cargo and salt ballast tanks Ch 4, Sec 5, Tab 5 to Ch 4, Sec 5, Tab 8, according to the different locations, where substantial corrosion is found	Ch 4, Sec 5, [2.4.2] limited to salt ballast tanks and when deemed necessary by the Surveyor Ch 4, Sec 5, Tab 5 to Ch 4, Sec 5, Tab 8, according to the different locations, where substantial corrosion is found
liquefied gas carrier	Ch 4, Sec 6, [6.2] and Ch 4, Sec 6, [6.4]: planning and general requirements Ch 4, Sec 6, Tab 2 : measurements of elements subjected to close-up survey Ch 4, Sec 6, Tab 3 : extent of systematic thickness measurements	Ch 4, Sec 6, Tab 1 : thickness measurements to be taken if deemed necessary by the Surveyor	Ch 4, Sec 6, [2.1.6] and limited to salt ballast tanks and when deemed necessary by the Surveyor
ro-ro cargo ships, ro-ro passenger ships	Ch 4, Sec 7, [3.1.2] measurements of shell and inner doors	-	-
general dry cargo ships	Ch 4, Sec 8, Tab 1 measurements of elements subjected to close-up survey Ch 4, Sec 8, Tab 2: extent of systematic thickness measurements Ch 4, Sec 8, Tab 3 according to the different locations, where substantial corrosions is found	Ch 4, Sec 8, [3.2.2] to Ch 4, Sec 8, [3.2.4] for both cargo holds and salt ballast tanks Ch 4, Sec 8, Tab 3 according to the different locations, where substantial corrosion is found	Ch 4, Sec 8, [2.1.5] for cargo holds Ch 4, Sec 8, [2.1.6] for salt ballast tanks Ch 4, Sec 8, Tab 3 according to the different locations, where substantial corrosion is found

3 Number and locations of measurements

3.1 General

3.1.1 Considering the extent of thickness measurements as required by the Rules and indicated in [2] above, the locations of the points to be measured are given here for the most important items of the structure. Thus the number of points can be estimated.

3.2 Locations of points

3.2.1 Tab 2 provides explanations and/or interpretations for the application of those requirements indicated in the Rules which refer to both systematic thickness measurements related to the calculation of global hull girder strength and specific measurements connected to close-up surveys.

Figures are also given to facilitate the explanations and/or interpretations given in the table. These figures show typical arrangements of cargo ships, bulk carriers and oil tankers. Due to the various designs of the other ship types, figures are not given to cover all the different cases. However, the figures provided here may be used as guidance for ships other than those illustrated.

4 Acceptance criteria for thickness measurements

4.1 General

4.1.1 *(1/1/2003)*

Acceptance criteria stipulate limits of wastage which are to be taken into account for reinforcements, repairs or renewals of steel structure. These limits are generally expressed for each structural item as a maximum percentage of acceptable wastage (W). When the maximum percentage of wastage is indicated, the renewal thickness t_{ren} (minimum acceptable thickness) is that resulting from applying this percentage to the rule thickness (t_{rule}), according to the following formula:

$$t_{ren} = \left(1 - \frac{W}{100}\right) t_{rule}$$

However, when the rule thickness is not available, the as-built thickness can be used.

Only for criteria related to an item (see [4.3.4] b), the Society may establish a list of renewal thicknesses tailored to the different structural items. In such a case these thicknesses are used in lieu of the minimum thicknesses calculated from the percentage of wastage.

Table 2 : Interpretations of rule requirements for the locations and number of points to be measured *(1/7/2009)*

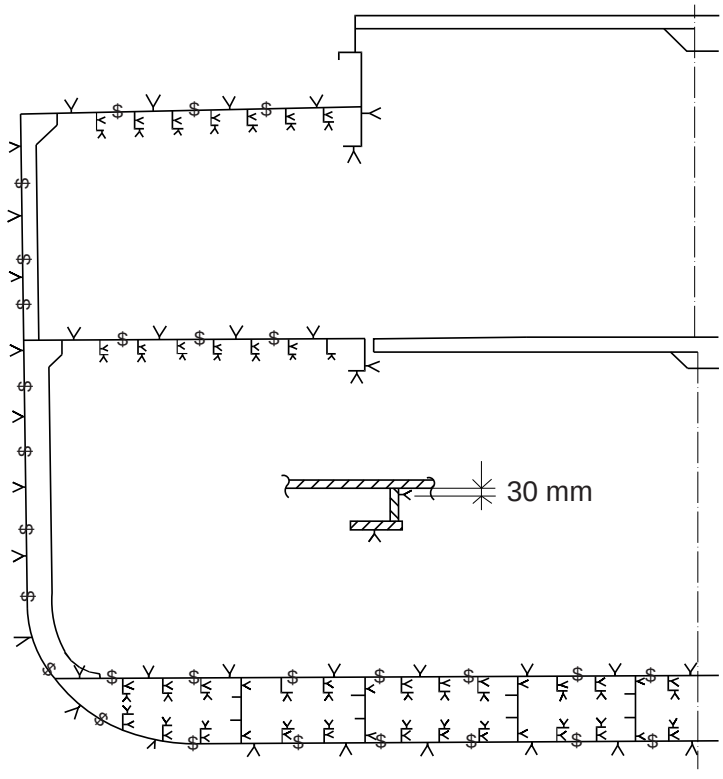
A) SYSTEMATIC MEASUREMENTS		
ITEM	INTERPRETATION	FIGURE
Selected plates on deck, tank top, bottom, double bottom and wind-and-water	"Selected" means at least a single point on one out of three plates, to be chosen on representative areas of average corrosion	No figure
All deck, tank top and bottom plates and wind-and-water strakes	At least two points on each plate to be taken either at each 1/4 extremity of plate or at representative areas of average corrosion	No figure
Transverse section	Refer to the definition given in Sec 2, [2.2.6]	Fig 1 for general cargo ships Fig 2 for bulk carriers Fig 3 for oil tankers For other ship types, see [3.2.1]
Cargo hold hatch covers and coamings		Fig 4 for ships fitted with hold hatch covers and coamings
Bulkheads on ships other than bulk carriers, oil tankers, chemical tankers and liquefied gas carriers (for these ships refer to B) and C) CLOSE-UP SURVEYS AND RELATED MEASUREMENTS)	"Selected bulkheads" means at least 50% of the bulkheads	Fig 5 for general cargo ships. It may also apply to other ship types (see [3.2.1])
Selected internal structure such as floors and longitudinals, transverse frames, web frames, deck beams, 'tweendecks, girders	The internal structural items to be measured in each space internally surveyed are to be at least 20% within the cargo area and 10% outside the cargo area	Fig 6 for general cargo ships. It may also apply to other ship types (see [3.2.1])
Transverse section of deck plating outside line of cargo hatch openings (for bulk carriers, ore carriers and combination carriers)	Two single points on each deck plate (to be taken either at each 1/4 extremity of plate or at representative areas of average corrosion) between the ship sides and hatch coamings in the transverse section concerned	No figure
One section of deck plating for the full beam of the ship within the cargo area (for oil tankers, chemical tankers and liquefied gas carriers)	Two single points on each deck plate (to be taken either at each 1/4 extremity of plate or at representative areas of average corrosion) in the transverse section concerned	No figure

B) CLOSE-UP SURVEYS AND RELATED MEASUREMENTS (for oil tankers, chemical tankers, gas carriers and combination carriers)		
ITEM	INTERPRETATION	FIGURE
Web frame ring (for oil tankers, chemical tankers and combination carriers)	Refer to the definition given in Ch 4, Sec 3, Tab 3 and Ch 4, Sec 5, Tab 3. "Adjacent structural members" means plating and stiffeners of deck, bottom, double bottom, sides and longitudinal bulkheads in the vicinity of the web frame ring	Extent of areas is shown as (1) in Ch 4, Sec 3, Fig 1 Locations of points are given in Fig 10
Transverse section (for chemical tankers and liquefied gas carriers)	Refer to the definitions given in Ch 4, Sec 5, Tab 3 and Ch 4, Sec 6, Tab 2. "Adjacent structural members" means plating and stiffeners of deck, bottom, double bottom, sides and longitudinal bulkheads in the vicinity of the web frame ring	No figure
Deck transverse	This is the upper part of the web frame ring including the adjacent structural members (see meaning given above). For chemical tankers it may be fitted on deck, i.e. outside the tank	Extent of areas is shown as (2) in Ch 4, Sec 3, Fig 1 Locations of points are given in Fig 10
Deck and bottom transverses (for oil tankers)	Refer to the definition given in Ch 4, Sec 3, Tab 3	Extent of areas is shown as (2) and (5) in Ch 4, Sec 3, Fig 1 Locations of points are given in Fig 10

B) CLOSE-UP SURVEYS AND RELATED MEASUREMENTS (for oil tankers, chemical tankers, gas carriers and combination carriers)		
ITEM	INTERPRETATION	FIGURE
Transverse bulkhead	"Complete" means the whole bulkhead including stringers and stiffeners and adjacent structural members as defined above	Extent of areas is shown as (3) in Ch 4, Sec 3, Fig 1 Locations of points are given in Fig 11
	"Lower part" means lower part of bulkhead up to 1/4 of ship's depth or 2 metres above the lower stringer, whichever is the greater (stringers, stiffeners and adjacent structural members included)	Extent of areas is shown as (4) in Ch 4, Sec 3, Fig 1 Locations of points are given in Fig 11
All plating and internal structures (for chemical tankers)	Refer to the definitions given inCh 4, Sec 5, Tab 3	No figure

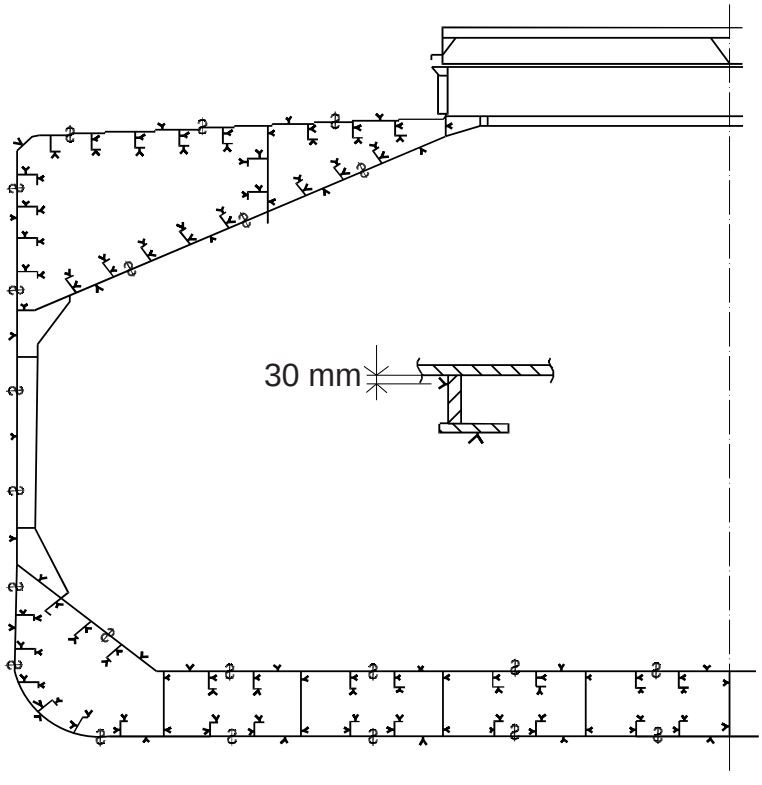
C) CLOSE-UP SURVEYS AND RELATED MEASUREMENTS (for bulk and ore carriers)		
ITEM	INTERPRETATION	FIGURE
Frames in cargo holds	25% of frames: one out of four frames should preferably be chosen throughout the cargo hold length on each side "Selected frames" means at least 3 frames on each side of cargo holds	Extent of areas is shown as (1) in Ch 4, Sec 2, Fig 1 Locations of points are given in Fig 7
Transverse bulkheads in cargo holds	Refer to the definition given in Ch 4, Sec 2, Tab 5 Two selected bulkheads: one is to be the bulkhead between the two foremost cargo holds and the second may be chosen in other positions	Areas of measurements are shown in Ch 4, Sec 2, Fig 2 Locations of points are given in Fig 8
One transverse bulkhead in each cargo hold	This means that the close-up survey and related thickness measurements are to be performed on one side of the bulkhead; the side is to be chosen based on the outcome of the overall survey of both sides. In the event of doubt, the Surveyor may also require (possibly partial) close-up survey on the other side	Areas of measurements are shown in Ch 4, Sec 2, Fig 2 Locations of points are given in Fig 8
Transverse bulkheads in one topside/side ballast tank	The ballast tank is to be chosen based on the history of ballasting among those prone to have the most severe conditions	Locations of points are given in Fig 9
Transverse webs in ballast tanks	Either of the representative tanks of each type (i.e. topside or hopper or side tank) is to be chosen in the forward part "Associated plating and longitudinals" means adjacent plating and longitudinals of deck, bottom, side shell, slope, hopper and longitudinal bulkhead, as applicable	Extent of areas is shown as (2) in Ch 4, Sec 2, Fig 1 Locations of points are given in Fig 7
Areas of deck plating inside line of hatch openings	"Selected" means at least a single point on one out of three plates, to be chosen on representative areas of average corrosion All deck plating means at least two points on each plate to be taken either at each 1/4 extremity of plate or at representative areas of average corrosion	Extent of areas is shown as (5) in Ch 4, Sec 2, Fig 1

Figure 1 : Transverse section of a general cargo ship



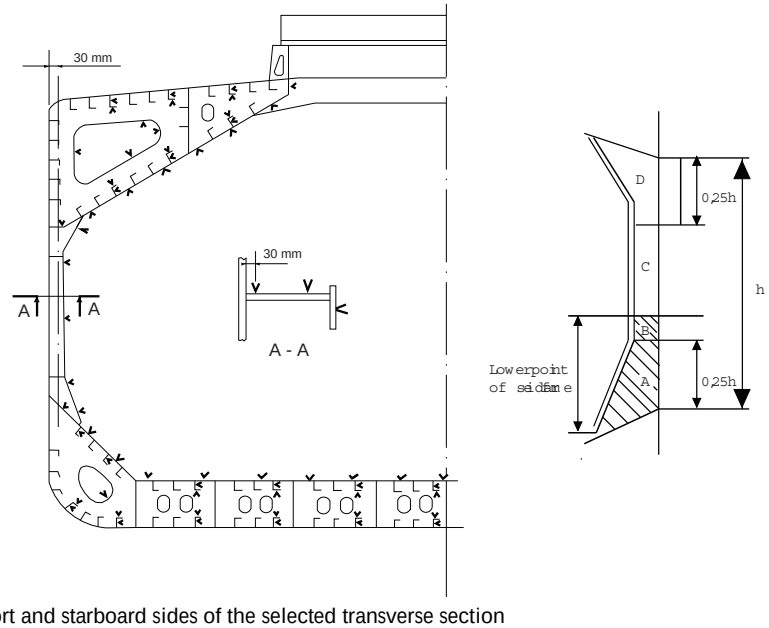
Measurements are to be taken on both port and starboard sides of the selected transverse section

Figure 2 : Transverse section of a bulk carrier



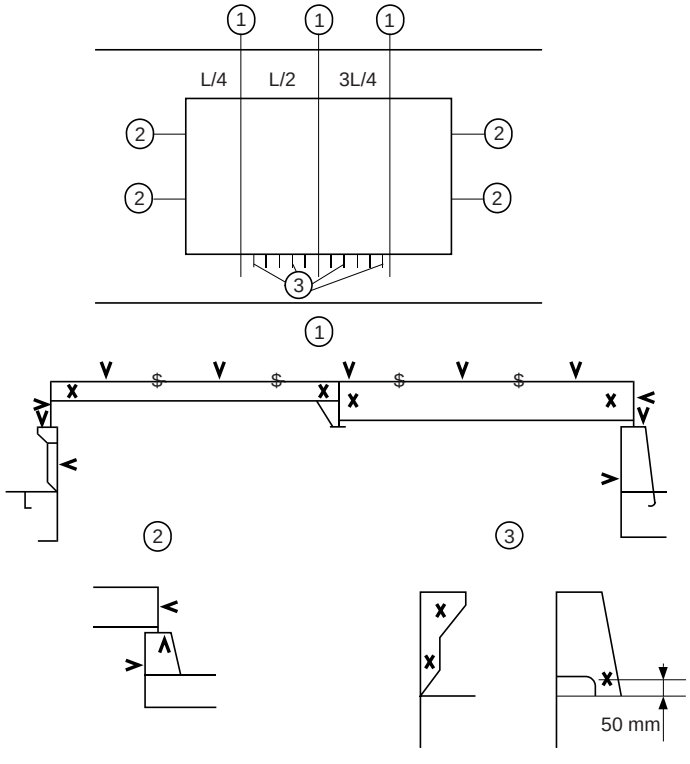
Measurements are to be taken on both port and starboard sides of the selected transverse section

Figure 3 : Transverse section of an oil tanker



Measurements are to be taken on both port and starboard sides of the selected transverse section

Figure 4 : Locations of measurements on hatch covers and coamings (valid for all ships fitted with hatch covers and coamings)



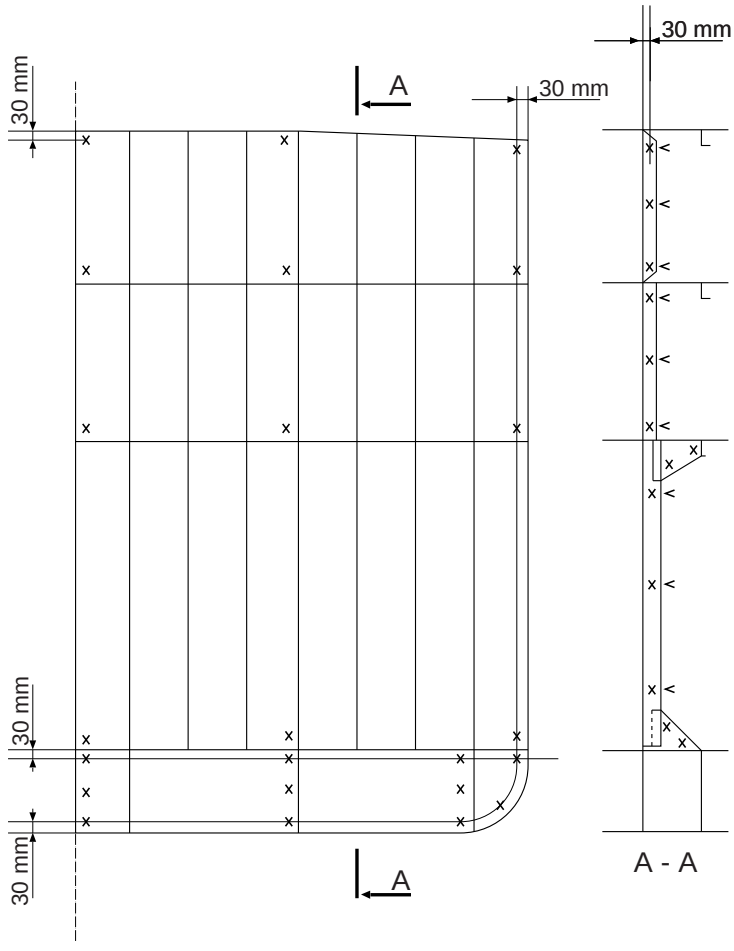
(1) Three sections at L/4, L/2, 3L/4 of hatch cover length, including:

- one measurement of each hatch cover plate and skirt plate
- measurements of adjacent beams and stiffeners
- one measurement of coaming plates and coaming flange, each side

(2) Measurements of both ends of hatch cover skirt plate, coaming plate and coaming flange

(3) One measurement of one out of three hatch coaming brackets and bars, on both sides and both ends

Figure 5 : Locations of measurements on bulkheads of general cargo ships



Cargo hold bulkhead/watertight floor plating to be measured as per main view

One stiffener out of three to be measured as per view A - A

Figure 6 : Locations of measurements on selected internal structural elements of general cargo ships

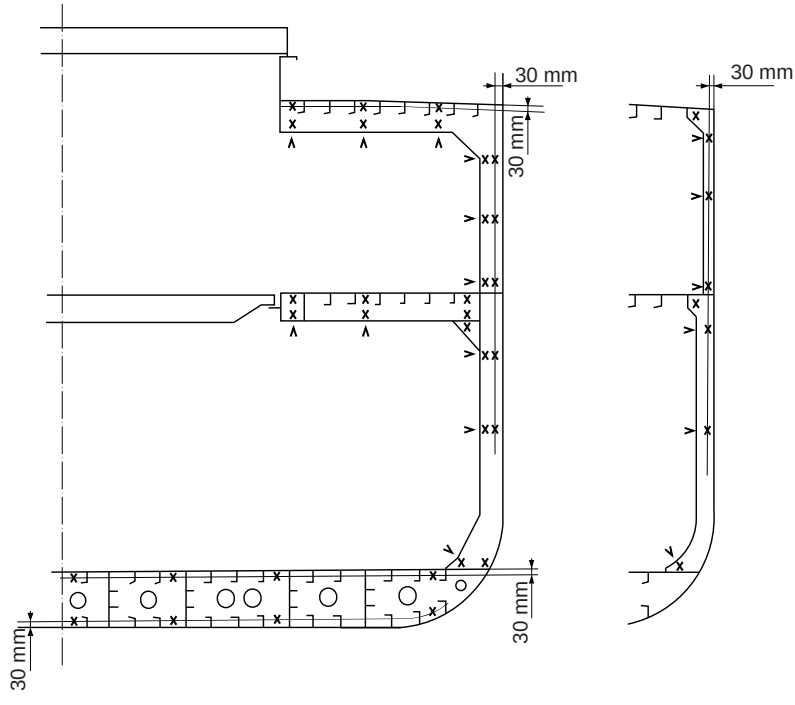


Figure 7 : Locations of measurements on structural members in cargo holds and ballast tanks of bulk carriers

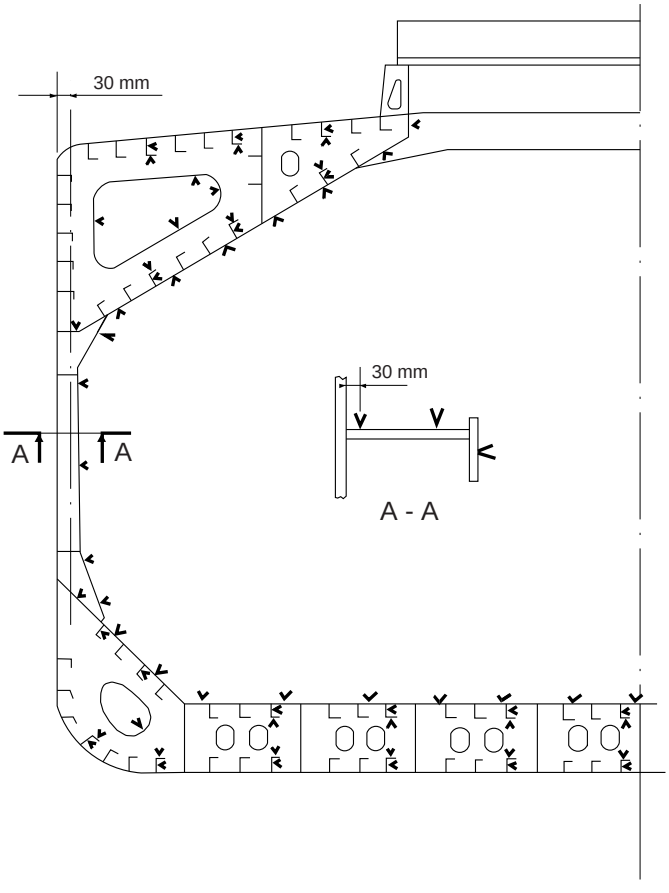
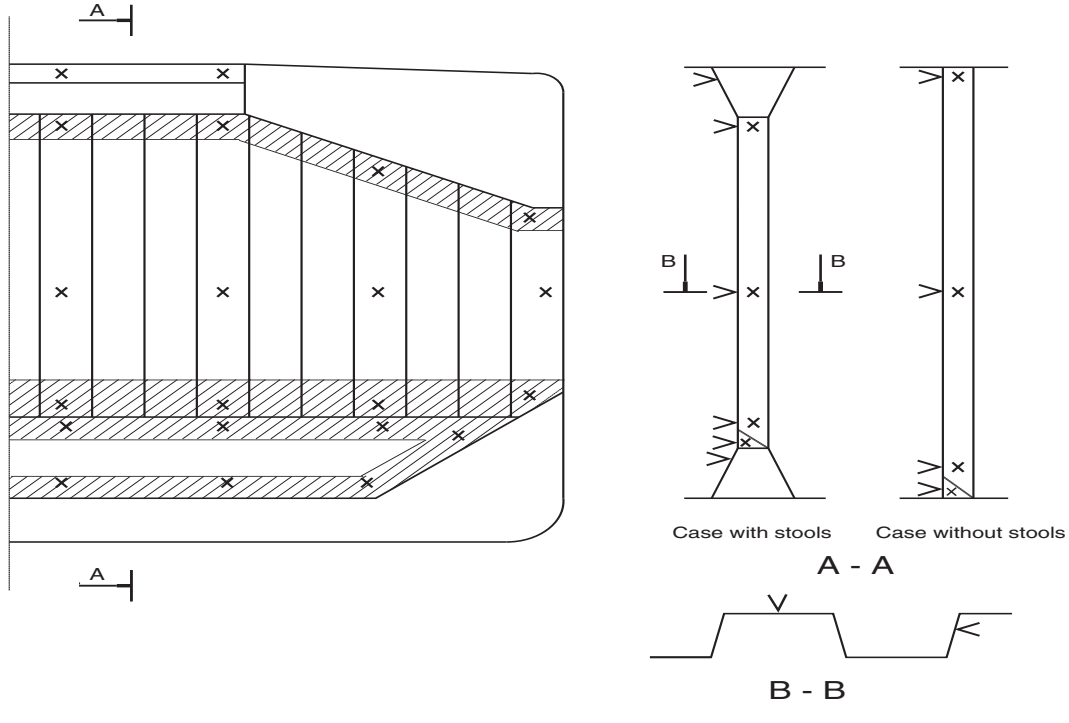
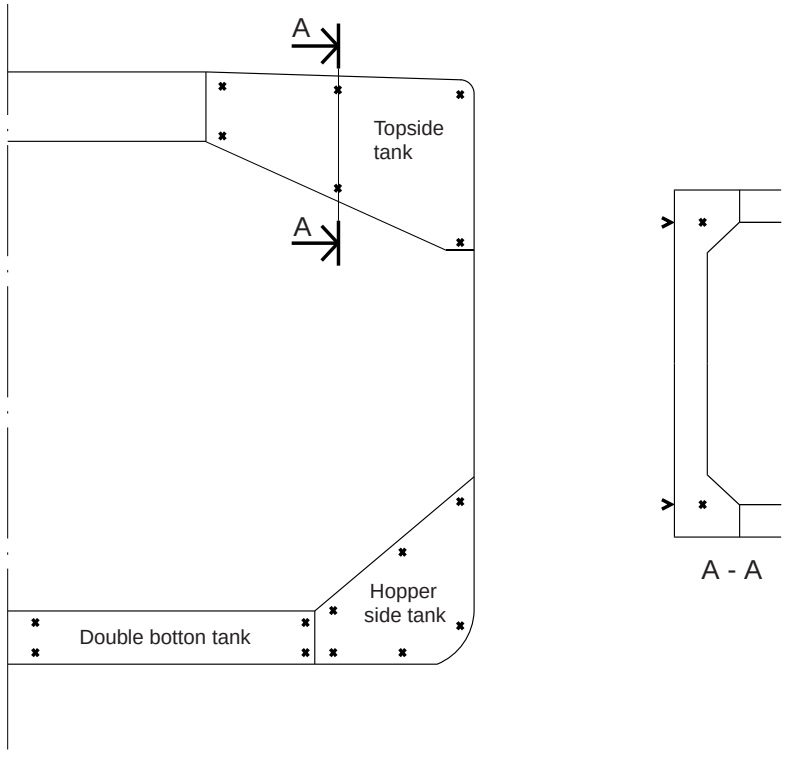


Figure 8 : Locations of measurements on cargo hold transverse bulkheads of bulk carriers



Measurements to be taken in each shaded area as per views A - A and B - B

Figure 9 : Locations of measurements on transverse bulkheads of topside, hopper and double bottom tanks of bulk carriers



Measurements to be taken in each vertical section as per view A - A

Figure 10 : Locations of measurements on web frame rings and longitudinal elements of oil tankers

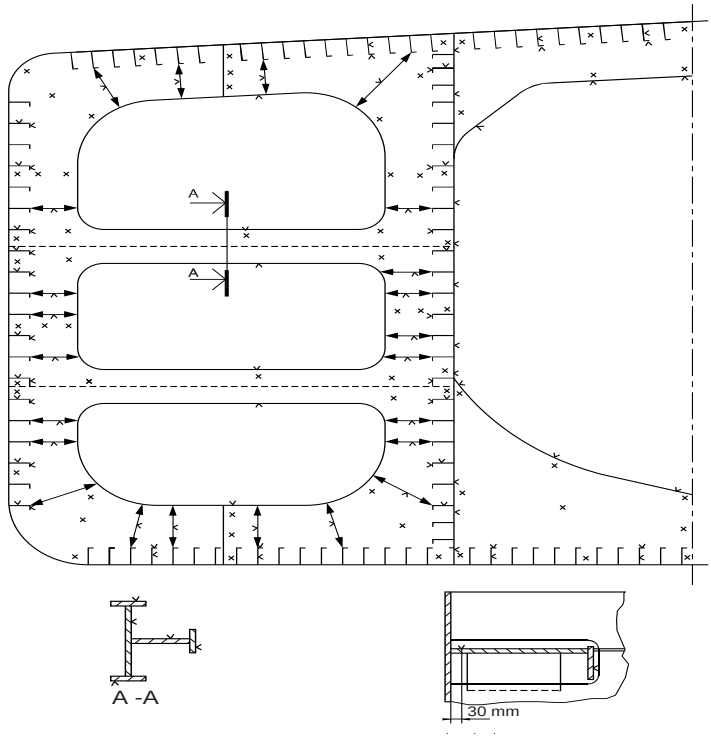
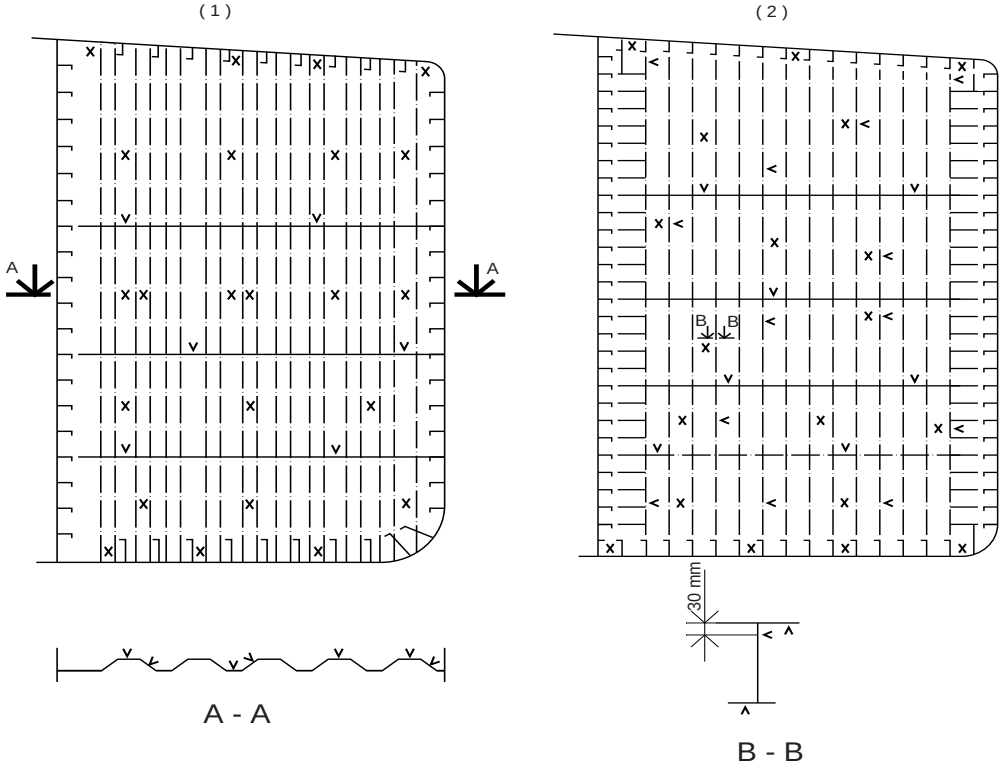


Figure 11 : Locations of measurements on tranverse bulkheads of oil tankers



(1) : Corrugated bulkhead

(2) : Plane bulkhead

Measurements are to be taken in a similar way on the centre tank bulkheads

Measurements are to cover the different thicknesses of strakes over the height of the bulkhead

Measurements are to be taken of the adjacent structural members

4.1.2 In cases where the ship has some structural elements with reduced wear margins (e.g. due to ship conversion, increase of draught), the renewal thickness t_{ren} (minimum acceptable thickness) for these elements is to be calculated with reference to the rule scantlings without taking account of any reduction originally agreed.

4.1.3 Decisions on steel renewals are taken by the attending Surveyor applying the criteria given in this Article and based on his judgment and the actual condition of the ship. Should advice be needed to support his decision, the Surveyor may refer to the relevant technical office of the Society.

4.2 Criteria

4.2.1 The acceptance criteria for the minimum thicknesses are divided into:

- criteria on local and global strength, given in [4.3]
- criteria on buckling strength, given in [4.4]
- criteria on pitting, given in [4.5].

4.2.2 *(1/7/2001)*

Each measured structural item is to be checked against the following criteria, as far as applicable. Where any of the criteria are not met, reinforcements, repairs and renewals are to be carried out as appropriate.

4.3 Local and global strength criteria

4.3.1 Local and global strength criteria are given for the following ship types:

- general cargo ships
- bulk carriers
- oil tankers.

These criteria may also be used for other ship types taking into consideration the equivalence or similarity of structural elements and their contribution to local and/or global strength.

4.3.2 For the evaluation of the ship longitudinal strength, it is a prerequisite that fillet welding between longitudinal members and deck, side and bottom plating is maintained effective so as to keep continuity of hull structures.

4.3.3 *(1/7/2009)*

Each structural item to be assessed is illustrated in a typical transverse section (see Fig 13 for general cargo ships, Fig 14 for bulk carriers, Fig 15 for oil tankers).

These structural items are also listed in appropriate tables grouped according to their position and contribution to the local or global strength of the ship and separately for ships contracted for construction either before or on/after 1 June 2000 (Tab 5 for general cargo ships contracted for construction on/after 1 June 2000, Tab 6 for general cargo ships contracted for construction before 1 June 2000, Tab 7 for bulk

carriers contracted for construction on/after 1 June 2000, Tab 8 for bulk carriers contracted for construction before 1 June 2000, Tab 9 for oil tankers contracted for construction on/after 1 June 2000, Tab 10 for oil tankers contracted for construction before 1 June 2000).

4.3.4 Each structural item is to be assessed according to four different criteria which vary with regard to the domain under which it is considered, namely:

a) an isolated area, which is meant as a part of a single structural item. This criterion takes into consideration very local aspects such as grooving of a plate or web, or local severe corrosion; however, it is not to be used for pitting for which separate criteria are considered (see [4.5])

b) an item, which is meant as an individual element such as a plate, a stiffener, a web, etc. This criterion takes into consideration the average condition of the item, which is assessed by determining its average thickness using the various measurements taken on the same item

c) a group of items, which is meant as a set of elements of the same nature (plates, longitudinals, girders) contributing either to the longitudinal global strength of the ship in a given zone or to the global strength of other primary transverse elements not contributing to the ship longitudinal strength, e. g. bulkheads, hatch covers, web frames

d) a zone, which is meant as all and only longitudinal elements contributing to the longitudinal strength of the ship; in this regard, the three main zones are defined as deck zone, neutral axis zone and bottom zone. This criterion takes into consideration the average condition of all groups of items belonging to the same zone.

4.3.5 *(1/7/2013)*

The assessment of the thickness measurements is to be performed using the values given in the tables for each structural element with regard to the criteria defined above, in the following order:

a) assessment of isolated areas (column 1 in all tables). If the criterion is not met, the wasted part of the item is to be dealt with as necessary.

b) assessment of items (column 2 in all tables). If the criterion is not met, the item is to be dealt with as necessary in the measured areas as far as the average condition of the item concerned is satisfactory. In cases where some items are renewed, the average thicknesses of these items to be considered in the next step are the new thicknesses.

   Example: to report the average value for each aft/forward deck plate, the criteria given in [4.3.5] b) are to be met. Some isolated areas may be accepted according to the criteria given in [4.3.5] a).

c) assessment of groups of items (column 3 in Tab 5, Tab 7 and Tab 9). If the criterion is not met, a sufficient number of elements are to be renewed in order to obtain an increased average thickness satisfying the considered criterion of the group (generally the elements to be renewed are those most wasted). As an example, for the assessment of the group "deck plates" all deck plates are measured and an average thickness of each of them is estimated. Then the average of all these values is to satisfy the criteria given for this group.

d) assessment of zones (column 4 in in Tab 5, Tab 7 and Tab 9). In principle, the criterion of the zone is met when all groups of items belonging to the zone meet their own criteria (see c) above). However, a greater diminution than those given in column 3 may be accepted for one group of items if, considering the other groups of items belonging to the same zone, the overall diminution of the zone does not exceed the criterion given for it in column 4.

   Example: The deck zone consists of two groups of items:

   - deck plating, which has an average diminution of 12% (criterion 10%)
   - deck longitudinals, which has an average diminution of 4% (criterion 10%)

   Even though the deck plating group exceeds its acceptance criterion, the average diminution of the zone, which can be very roughly estimated at 8%, is acceptable and thus the deck plating group can be accepted as it is.

e) assessment of zones (column 3 in Tab 6, Tab 8 and Tab 10, applicable to ships of 65 m in length and upwards). In principle, the criterion of the zone is met when the average diminution of all items belonging to the zone meets the criterion given for it in column 3.

   Example: The deck zone consists of two groups of items:

   - deck plating, which has an average diminution of 12%
   - deck longitudinals, which have an average diminution of 4%.

   The average diminution of the zone, which can be very roughly estimated at 8%, is acceptable.

f) Evaluation of longitudinal strength

   The hull girder strength assessment is to be performed in accordance with the criteria specified in App 4.

Table 3 : Buckling strength criterion *(1/7/2009)*

L > 120 m

ITEMS		RATIO	MATERIAL (R_{eH})					
			235		315		355 and 390	
			(1)	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**
Bottom and deck plates		s / t	56,0	65,0	51,0	60,0	49,0	55,0
Longitudinal ordinary stiffeners	flat bar web	h_w / t_w	20,0	20,0	18,0	19,0	17,5	18,0
Flanged longitudinal / girders	web	h_w / t_w	56,0	65,0	51,0	60,0	49,0	55,0
Flanged longitudinal / girders	symmetrical flange	b_f / t_f	34,0	40,0	30,0	38,0	29,0	36,0
Flanged longitudinal / girders	asymmetrical flange	b_f / t_f	17,0	20,0	15,0	19,0	14,5	18,0
Symbols: R_{eH} : minimum yield stress of the material, in N/mm^2; h_w : web height, in mm; t_w : web thickness, in mm;			s : spacing, in mm, of ordinary stiffeners; b_f : flange breadth, in mm;		t : actual plate thickness, in mm; t_f : flange thickness, in mm;			
(1) Applicable to ships contracted for construction on or after 1 June 2000 **(2)** Applicable to ships contracted for construction before 1 June 2000								

4.3.6 These criteria take into consideration two main aspects:

- the overall strength of the hull girder
- the local strength and integrity of the hull structure, such as hatch covers, bulkheads, etc.

As a rule, they are applicable to the structure within the cargo area of ships having a length greater than 90 metres. However, they may also be used for smaller ships and for structure outside the cargo area according to the following principles:

- for ships having a length less than 90 metres, the percentages of acceptable wastage given in the tables can be increased by 5 (%) (e.g. 15% instead of 10%, etc.), except for those of deck and bottom zones
- for structure outside the cargo area, the same 5 (%) increase can be applied

on the understanding, however, that both conditions cannot be applied at the same time.

4.4 Buckling strength criterion

4.4.1 This criterion is applicable to ships having a length greater than 120 metres.

In addition to the evaluation of structural elements according to [4.3] above, the structural items contributing to the longitudinal strength of the ship, such as deck and bottom plating, deck and bottom girders, etc., are also to be assessed with regard to their buckling strength. The values shown in Tab 3 are not to be exceeded.

Note 1: The minimum thickness will be specially considered for ships built with excess hull girder section modulus.

4.5 Pitting

4.5.1 The maximum acceptable depth for isolated pits is 35% of the as-built thickness.

4.5.2 *(1/7/2001)*

For areas with different pitting intensity, the intensity diagrams shown in Fig 12 are to be used to identify the percentage of affected areas.

For areas having a pitting intensity of 50% or more, the maximum acceptable average depth of pits is 20% of the as-built thickness. For intermediate values between isolated pits and 50% of affected area, the interpolation between 35% and 20% is made according to Tab 4.

Table 4 : Pitting intensity and corresponding maximum acceptable average depth of pitting *(1/7/2001)*

PITTING INTENSITY (%)	MAXIMUM ACCEPTABLE AVERAGE PITTING DEPTH (% of the as-built thickness)
Isolated	35,0
5	33,5
10	32,0
15	30,5
20	29,0
25	27,5
30	26,0
40	23,0
50	20,0

4.5.3 In addition, the thickness outside the pits in the area considered is to be assessed according to [4.3] and [4.4] above.

Note 1: Application of filler material (plastic or epoxy compounds) is recommended as a means to stop or reduce the corrosion process, but it is not considered an acceptable repair for pitting exceeding the maximum allowable wastage limits. Welding repairs may be accepted when performed in accordance with procedures agreed with the Society.

Figure 12 : Pitting intensity diagrams (from 1% to 50% intensity)

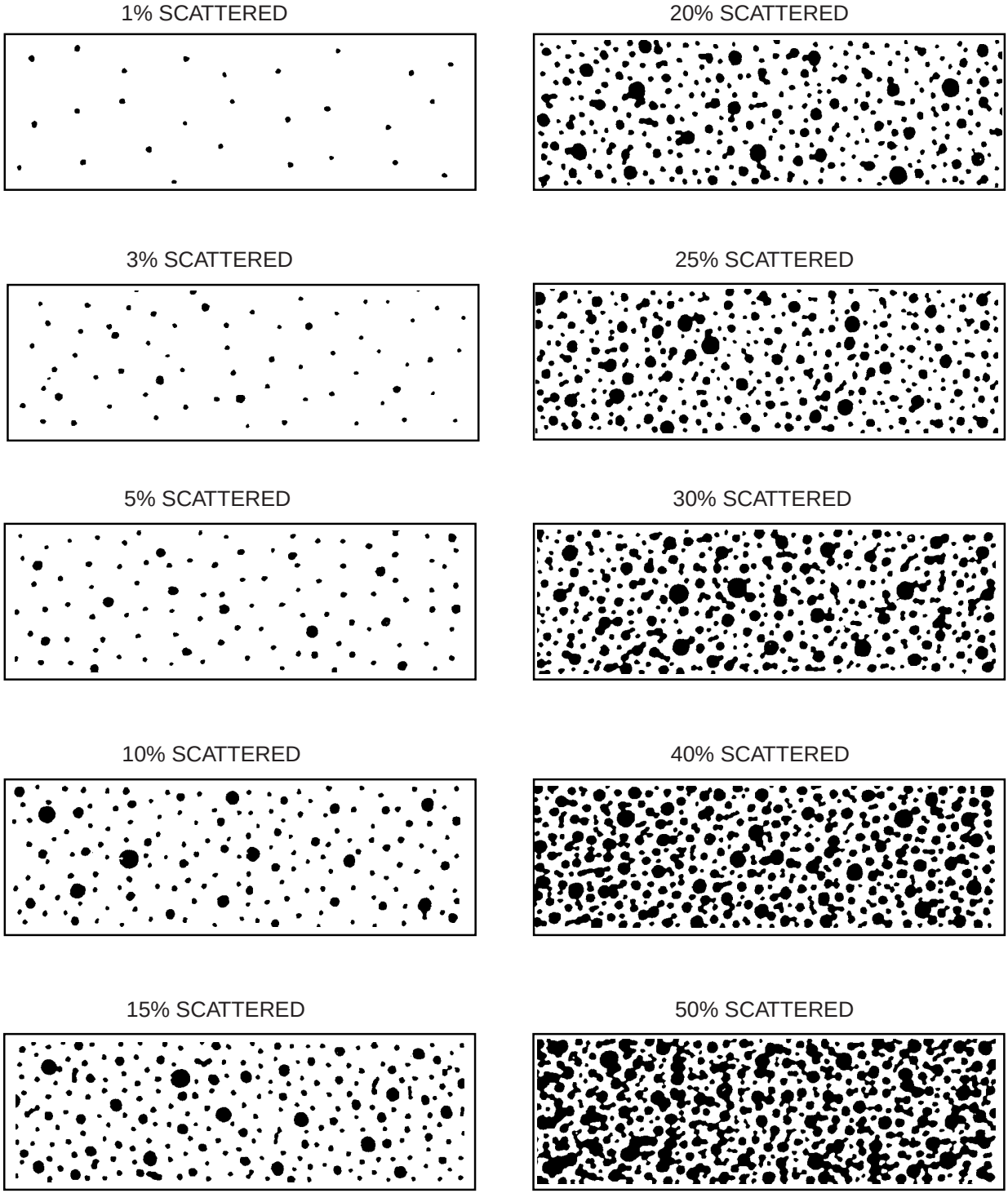


Figure 13 : General cargo ship: layout of items to be assessed

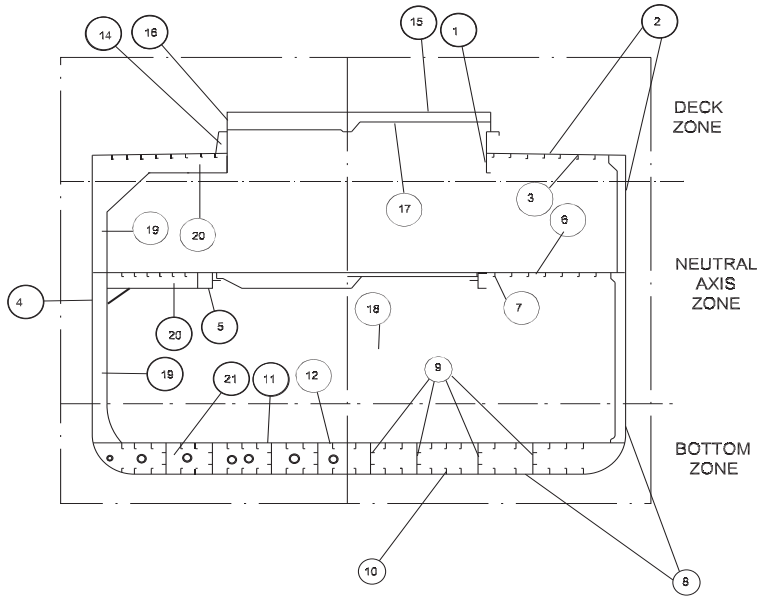


Table 5 : Local and global acceptance criteria for general cargo ships (given in % of wastage) (for ships contracted for construction on/after 1 June 2000) *(1/7/2012)*

Group of items	Description of items	1 Isolated area	2 Item	3 Group	4 Zone
ITEMS CONTRIBUTING TO THE LONGITUDINAL STRENGTH (TRANSVERSE SECTION)					
	DECK ZONE **(1)**	-	-	-	10
1	Hatch coaming underdeck girder web underdeck girder flange	- 25 20	- 20 15	10 - -	- - -
2	Upperdeck plating, deck stringer plates and sheer strakes	30	20	10	-
3	Deck longitudinals web flange	- 30 25	- 20 15	10 - -	- - -
	NEUTRAL AXIS ZONE **(1)**	-	-	-	15
4	Side shell plating	25	20	15	-
5	'Tweendeck hatch girder web flange	- 25 20	- 20 15	15 - -	- - -
6	'Tweendeck plating	30	20	15	-
7	'Tweendeck longitudinals web flange	- 30 25	- 20 15	15 - -	- - -

(1) Each zone is to be evaluated separately.

(2) If continuous, to be included in item 1.

(3) For ships, contracted for construction on or after 1 July 2012, the renewal criteria of all cargo hatch covers are as follows:

- for single skin hatch covers and for the plating of double skin hatch covers, steel renewal is required where the gauged thickness is less than t_{net} + 0,5 mm. Where the gauged thickness is within the range t_{net} + 0,5 mm and t_{net} + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal. Coating is to be maintained in good condition, as defined in Sec 2, [2.2.13].

  For the internal structure of double skin hatch covers, thickness gauging is required when plating renewal is to be carried out or when this is deemed necessary, at the discretion of the Surveyor, on the basis of the plating corrosion or deformation condition. In these cases, steel renewal for the internal structures is required where the gauged thickness is less than t_{net}.

  For weather deck hatches of container ships and passenger ships, the thickness for steel renewal is t_{net} and the thickness for coating or annual gauging is when gauged thickness is between t_{net} and t_{net} + 0,5 mm.

(4) For deep tank bulkheads, the values "average of item" and "average of group" are to be increased by 5 (%).

Group of items	Description of items	1 Isolated area	2 Item	3 Group	4 Zone
	BOTTOM ZONE **(1)**	-	-	-	10
8	Bilge and bottom strakes and keel plate	25	20	10	-
9	Bottom girders	25	20	10	-
10	Bilge and bottom longitudinals web flange	- 30 25	- 20 15	10 - -	- - -
11	Inner bottom plating	30	20	10	-
12	Inner bottom longitudinals web flange	- 30 25	- 20 15	10 - -	- - -
	OTHER ITEMS				
13	Hatch coaming plating **(2)**	25	20	-	-
14	Hatch coaming brackets	30	25	-	-
15	Hatch cover top plating **(3)**	25	20	15	-
16	Hatch cover skirt plating **(3)**	30	20	-	-
17	Hatch cover stiffeners	30	20	-	-
18	Transverse bulkheads **(4)** plating stringer web stringer flange stiffener web stiffener flange brackets	 30 30 25 30 25 30	 20 20 15 20 15 20	 15 - - - - -	 - - - - - -
19	Side frames web flange brackets	 30 25 30	 20 15 20	 - - -	 - - -
20	Deck/'tweendeck frames web flange	 30 25	 20 15	 - -	 - -
21	Floors plating	 30	 20	 -	 -
22	Forward and aft peak bulkheads plating stiffener web stiffener flange	 30 30 25	 20 20 15	 15 - -	 - - -

(1) Each zone is to be evaluated separately.

(2) If continuous, to be included in item 1.

(3) For ships, contracted for construction on or after 1 July 2012, the renewal criteria of all cargo hatch covers are as follows:

- for single skin hatch covers and for the plating of double skin hatch covers, steel renewal is required where the gauged thickness is less than t_{net} + 0,5 mm. Where the gauged thickness is within the range t_{net} + 0,5 mm and t_{net} + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal. Coating is to be maintained in good condition, as defined in Sec 2, [2.2.13].

  For the internal structure of double skin hatch covers, thickness gauging is required when plating renewal is to be carried out or when this is deemed necessary, at the discretion of the Surveyor, on the basis of the plating corrosion or deformation condition. In these cases, steel renewal for the internal structures is required where the gauged thickness is less than t_{net}.

  For weather deck hatches of container ships and passenger ships, the thickness for steel renewal is t_{net} and the thickness for coating or annual gauging is when gauged thickness is between t_{net} and t_{net} + 0,5 mm.

(4) For deep tank bulkheads, the values "average of item" and "average of group" are to be increased by 5 (%).

Table 6 : Local and global acceptance criteria for general cargo ships (given in % of wastage) (for ships contracted for construction before 1 June 2000)

Group of items	Description of items	1 Isolated area	2 Item	3 Zone
ITEMS CONTRIBUTING TO THE LONGITUDINAL STRENGTH (TRANSVERSE SECTION)				
	DECK ZONE **(1)**	-	-	10
1	Hatch coaming underdeck girder web and flange	- 25	- 20	- -
2	Upperdeck plating, deck stringer plates and sheer strakes	25	20	-
3	Deck longitudinals web and flange	25	20	-
	NEUTRAL AXIS ZONE **(1)**	-	-	-
4	Side shell plating	25	20	-
5	'Tweendeck hatch girder web and flange	-	-	-
6	'Tweendeck plating	25	20	-
7	'Tweendeck longitudinals web and flange	25	20	-
	BOTTOM ZONE **(1)**	-	-	10
8	Bilge and bottom strakes and keel plate	25	20	-
9	Bottom girders	25	20	-
10	Bilge and bottom longitudinals web and flange	25	20	-
11	Inner bottom plating	25	20	-
12	Inner bottom longitudinals web and flange	25	20	-
OTHER ITEMS				
13	Hatch coaming plating **(2)**	30	25	-
14	Hatch coaming brackets	30	25	-
15	Hatch cover top plating	30	25	-
16	Hatch cover skirt plating	30	25	-
17	Hatch cover stiffeners	30	25	-
18	Transverse bulkheads **(3)** plating stringer web and flange stiffener web and flange brackets	 30 30 30 30	 25 25 25 25	 - - - -
19	Side frames web and flange brackets	 30 30	 25 25	 - -
20	Deck/'tweendeck frames web and flange	 30	 25	 -
21	Floors plating	 30	 25	 -
22	Forward and aft peak bulkheads plating stiffener web and flange	 30 30	 25 25	 - -

(1) Each zone is to be evaluated separately.
(2) If continuous, to be included in item 1.
(3) For deep tank bulkheads, the values "average of item" are to be increased by 5 (%).

Figure 14 : Bulk carrier: layout of items to be assessed

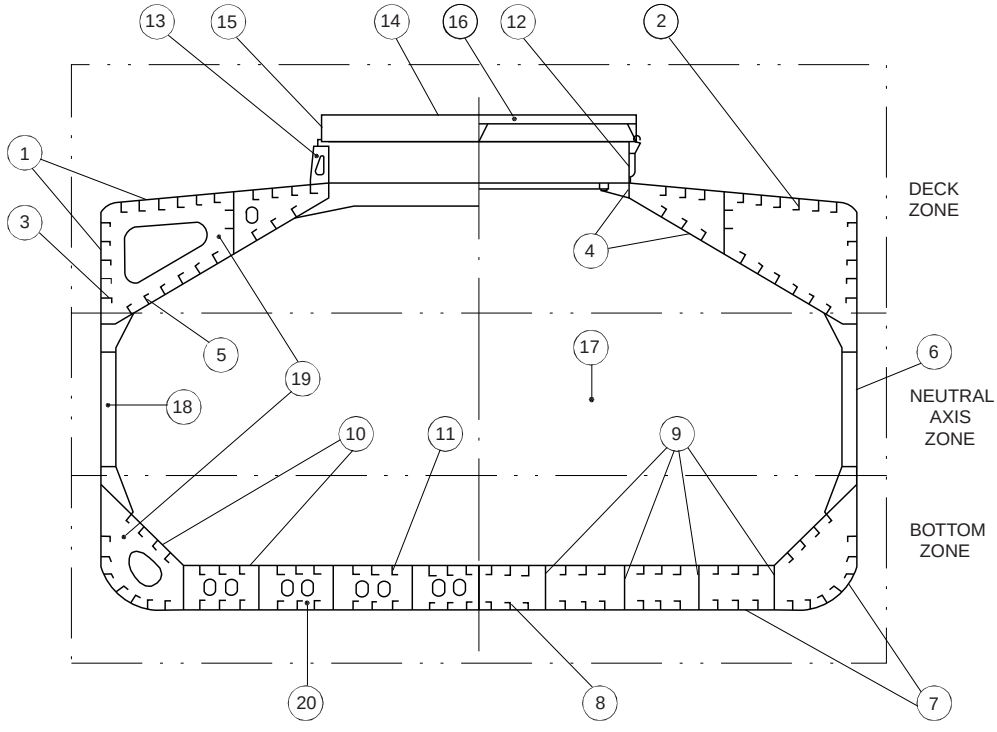


Table 7 : Local and global acceptance criteria for bulk carriers (given in % of wastage) (for ships contracted for construction on/after 1 June 2000) *(1/7/2009)*

Group of items	Description of items	1 Isolated area	2 Item	3 Group	4 Zone
ITEMS CONTRIBUTING TO THE LONGITUDINAL STRENGTH (TRANSVERSE SECTION)					
	DECK ZONE **(1)**	-	-	-	10
1	Strength deck plating, deck stringer, sheer strake and part of side shell plating in way of top side tanks	25	20	10	-
2	Deck longitudinals web flange	- 25 20	- 20 15	10 - -	- - -
3	Side shell longitudinals in way of top side tanks web flange	- 25 20	- 20 15	10 - -	- - -
4	Top side tank sloped plating, including horizontal and vertical strakes	25	20	10	-
5	Longitudinals connected to top side tank sloped plating web flange	- 25 20	- 20 15	10 - -	- - -
	NEUTRAL AXIS ZONE **(1)**	-	-	-	15
6	Side shell plating	25	20	15	-
	BOTTOM ZONE **(1)**	-	-	-	10
7	Bilge and bottom plating and keel plate	25	20	10	-
8	Bilge and bottom longitudinals web flange	- 25 20	- 20 15	10 - -	- - -
9	Bottom girders	25	15	10	-

(1) Each zone is to be evaluated separately.

(2) If continuous, to be included in item 1.

(3) For vertically corrugated transverse bulkheads in cargo holds:

- For ships indicated in Ch 6, Sec 2, [1.1] which are to comply with the retroactive requirements according to the schedule given in Ch 6, Sec 2, [1.2], the bulkhead between the two foremost cargo holds is to be assessed based on the criteria given in Ch 6, Sec 2, [1.3].
- For ships indicated in Pt E, Ch 4, Sec 3, [7.1.1], contracted for construction on or after 1 July 1998, all bulkheads are to be repaired by steel renewal where the gauged thickness is less than t + 0,5 mm, where t net is the thickness obtained by applying the strength criteria given in Pt E, Ch 4, Sec 3, [7.1]. However, where the gauged thickness is within the range t net + 0,5 mm and t net + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal.

(4) For ships indicated in Ch 1, Sec 2, [4.3.2], contracted for construction before 1 January 2004, the renewal criteria of all cargo hatch covers are as follows:

- for single skin hatch covers and for the plating of pontoon covers, steel renewal is required where the gauged thickness is less than t_{net} + 0,5 mm. Where the gauged thickness is within the range t_{net} + 0,5 mm and t_{net} + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal.
  For the internal structure of pontoon hatch covers, thickness gauging is required when plating renewal is to be carried out or when this is deemed necessary, at the discretion of the Surveyor, on the basis of the plating corrosion or deformation condition. In these cases, steel renewal for the internal structures is required where the gauged thickness is less than t_{net}.

(5) For ships indicated in Ch 1, Sec 2, [4.3.2] to Ch 1, Sec 2, [4.3.7], contracted for construction on or after 1 January 2004, the renewal criteria of forward and side hatch coamings on exposed decks in position 1, as defined in ILCC, are as follows:

- steel renewal is required where the gauged thickness is less than t_{net} + 0,5 mm. Where the gauged thickness is within the range t_{net} + 0,5 mm and t_{net} + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal. Coating is to be maintained in good condition, as defined in Sec 2, [2.2.13].

(6) For ships indicated in Ch 1, Sec 2, [4.3.2] to Ch 1, Sec 2, [4.3.7], contracted for construction on or after 1 January 2004, the renewal criteria of all cargo hatch covers are as follows:

- for single skin hatch covers and for the plating of double skin hatch covers, steel renewal is required where the gauged thickness is less than t_{net} + 0,5 mm. Where the gauged thickness is within the range t_{net} + 0,5 mm and t_{net} + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal. Coating is to be maintained in good condition, as defined in Sec 2, [2.2.13].
  For the internal structure of double skin hatch covers, thickness gauging is required when plating renewal is to be carried out or when this is deemed necessary, at the discretion of the Surveyor, on the basis of the plating corrosion or deformation condition. In these cases, steel renewal for the internal structures is required where the gauged thickness is less than t_{net}.

Group of items	Description of items	1 Isolated area	2 Item	3 Group	4 Zone
10	Inner bottom plating and hopper tank sloped plating	25	20	10	-
11	Longitudinals connected to inner bottom and hopper tank sloped plating web flange	- 25 20	- 20 15	10 - -	- - -
	OTHER ITEMS				
12	Hatch coaming plating **(2) (5)**	25	20	-	-
13	Hatch coaming brackets **(5)**	30	25	-	-
14	Hatch cover top plating **(4) (6)**	25	20	15	-
15	Hatch cover skirt plating **(4) (6)**	25	20	-	-
16	Hatch cover stiffeners **(4) (6)**	25	20	-	-
17	Transverse bulkheads **(3)** plating stiffener web stiffener flange	 25 25 20	 20 20 15	 15 - -	 - - -
18	Side shell frames web flange brackets	 25 20 20	 20 15 15	 - - -	 - - -
19	Topside and hopper tank web frames web flange	 25 20	 20 15	 - -	 - -

(1) Each zone is to be evaluated separately.

(2) If continuous, to be included in item 1.

(3) For vertically corrugated transverse bulkheads in cargo holds:

- For ships indicated in Ch 6, Sec 2, [1.1] which are to comply with the retroactive requirements according to the schedule given in Ch 6, Sec 2, [1.2], the bulkhead between the two foremost cargo holds is to be assessed based on the criteria given in Ch 6, Sec 2, [1.3].
- For ships indicated in Pt E, Ch 4, Sec 3, [7.1.1], contracted for construction on or after 1 July 1998, all bulkheads are to be repaired by steel renewal where the gauged thickness is less than t + 0,5 mm, where t net is the thickness obtained by applying the strength criteria given in Pt E, Ch 4, Sec 3, [7.1]. However, where the gauged thickness is within the range t net + 0,5 mm and t net + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal.

(4) For ships indicated in Ch 1, Sec 2, [4.3.2], contracted for construction before 1 January 2004, the renewal criteria of all cargo hatch covers are as follows:

- for single skin hatch covers and for the plating of pontoon covers, steel renewal is required where the gauged thickness is less than t_{net} + 0,5 mm. Where the gauged thickness is within the range t_{net} + 0,5 mm and t_{net} + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal.
  For the internal structure of pontoon hatch covers, thickness gauging is required when plating renewal is to be carried out or when this is deemed necessary, at the discretion of the Surveyor, on the basis of the plating corrosion or deformation condition. In these cases, steel renewal for the internal structures is required where the gauged thickness is less than t_{net}.

(5) For ships indicated in Ch 1, Sec 2, [4.3.2] to Ch 1, Sec 2, [4.3.7], contracted for construction on or after 1 January 2004, the renewal criteria of forward and side hatch coamings on exposed decks in position 1, as defined in ILCC, are as follows:

- steel renewal is required where the gauged thickness is less than t_{net} + 0,5 mm. Where the gauged thickness is within the range t_{net} + 0,5 mm and t_{net} + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal. Coating is to be maintained in good condition, as defined in Sec 2, [2.2.13].

(6) For ships indicated in Ch 1, Sec 2, [4.3.2] to Ch 1, Sec 2, [4.3.7], contracted for construction on or after 1 January 2004, the renewal criteria of all cargo hatch covers are as follows:

- for single skin hatch covers and for the plating of double skin hatch covers, steel renewal is required where the gauged thickness is less than t_{net} + 0,5 mm. Where the gauged thickness is within the range t_{net} + 0,5 mm and t_{net} + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal. Coating is to be maintained in good condition, as defined in Sec 2, [2.2.13].
  For the internal structure of double skin hatch covers, thickness gauging is required when plating renewal is to be carried out or when this is deemed necessary, at the discretion of the Surveyor, on the basis of the plating corrosion or deformation condition. In these cases, steel renewal for the internal structures is required where the gauged thickness is less than t_{net}.

Group of items	Description of items	1 Isolated area	2 Item	3 Group	4 Zone
20	Floors plating	 25	 15	 -	 -
21	Forward and aft peak bulkheads plating stiffener web stiffener flange	 25 25 20	 20 20 15	 15 - -	 - - -

(1) Each zone is to be evaluated separately.

(2) If continuous, to be included in item 1.

(3) For vertically corrugated transverse bulkheads in cargo holds:

- For ships indicated in Ch 6, Sec 2, [1.1] which are to comply with the retroactive requirements according to the schedule given in Ch 6, Sec 2, [1.2], the bulkhead between the two foremost cargo holds is to be assessed based on the criteria given in Ch 6, Sec 2, [1.3].
- For ships indicated in Pt E, Ch 4, Sec 3, [7.1.1], contracted for construction on or after 1 July 1998, all bulkheads are to be repaired by steel renewal where the gauged thickness is less than t + 0,5 mm, where t net is the thickness obtained by applying the strength criteria given in Pt E, Ch 4, Sec 3, [7.1]. However, where the gauged thickness is within the range t net + 0,5 mm and t net + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal.

(4) For ships indicated in Ch 1, Sec 2, [4.3.2], contracted for construction before 1 January 2004, the renewal criteria of all cargo hatch covers are as follows:

- for single skin hatch covers and for the plating of pontoon covers, steel renewal is required where the gauged thickness is less than t_{net} + 0,5 mm. Where the gauged thickness is within the range t_{net} + 0,5 mm and t_{net} + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal.
  For the internal structure of pontoon hatch covers, thickness gauging is required when plating renewal is to be carried out or when this is deemed necessary, at the discretion of the Surveyor, on the basis of the plating corrosion or deformation condition. In these cases, steel renewal for the internal structures is required where the gauged thickness is less than t_{net}.

(5) For ships indicated in Ch 1, Sec 2, [4.3.2] to Ch 1, Sec 2, [4.3.7], contracted for construction on or after 1 January 2004, the renewal criteria of forward and side hatch coamings on exposed decks in position 1, as defined in ILCC, are as follows:

- steel renewal is required where the gauged thickness is less than t_{net} + 0,5 mm. Where the gauged thickness is within the range t_{net} + 0,5 mm and t_{net} + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal. Coating is to be maintained in good condition, as defined in Sec 2, [2.2.13].

(6) For ships indicated in Ch 1, Sec 2, [4.3.2] to Ch 1, Sec 2, [4.3.7], contracted for construction on or after 1 January 2004, the renewal criteria of all cargo hatch covers are as follows:

- for single skin hatch covers and for the plating of double skin hatch covers, steel renewal is required where the gauged thickness is less than t_{net} + 0,5 mm. Where the gauged thickness is within the range t_{net} + 0,5 mm and t_{net} + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal. Coating is to be maintained in good condition, as defined in Sec 2, [2.2.13].
  For the internal structure of double skin hatch covers, thickness gauging is required when plating renewal is to be carried out or when this is deemed necessary, at the discretion of the Surveyor, on the basis of the plating corrosion or deformation condition. In these cases, steel renewal for the internal structures is required where the gauged thickness is less than t_{net}.

Table 8 : Local and global acceptance criteria for bulk carriers (given in % of wastage)(for ships contracted for construction before 1 June 2000)

Group of items	Description of items	1 Isolated area	2 Item	3 Zone
ITEMS CONTRIBUTING TO THE LONGITUDINAL STRENGTH (TRANSVERSE SECTION)				
	DECK ZONE **(1)**	-	-	10
1	Strength deck plating, deck stringer, sheer strake and part of side shell plating in way of top side tanks	25	20	-
2	Deck longitudinals, web and flange	25	20	-
3	Side shell longitudinals in way of top side tanks, web and flange	25	20	-
4	Top side tank sloped plating, including horizontal and vertical strakes	25	20	-
5	Longitudinals connected to top side tank sloped plating, web and flange	25	20	-
	NEUTRAL AXIS ZONE **(1)**	-	-	-
6	Side shell plating	25	20	-
	BOTTOM ZONE **(1)**	-	-	10
7	Bilge and bottom plating and keel plate	25	20	-
8	Bilge and bottom longitudinals, web and flange	25	20	-
9	Bottom girders	25	20	-
10	Inner bottom plating and hopper tank sloped plating	25	20	-
11	Longitudinals connected to inner bottom and hopper tank sloped plating, web and flange	25	20	-
OTHER ITEMS				
12	Hatch coaming plating **(2)**	30	25	-
13	Hatch coaming brackets	30	25	-
14	Hatch cover top plating **(5)**	30	25	-
15	Hatch cover skirt plating **(5)**	30	25	-
16	Hatch cover stiffeners **(5)**	30	25	-
17	Transverse bulkheads **(3)** plating stiffener web and flange	 25 25	 20 20	 - -

(1) Each zone is to be evaluated separately.

(2) If continuous, to be included in item 1.

(3) For vertically corrugated transverse bulkheads in cargo holds:

- For ships indicated in Ch 6, Sec 2, [1.1] which are to comply with the retroactive requirements according to the schedule given in Ch 6, Sec 2, [1.2], the bulkhead between the two foremost cargo holds is to be assessed based on the criteria given in Ch 6, Sec 2, [1.3].
- For ships indicated in Pt E, Ch 4, Sec 3, [7.1.1], contracted for construction on or after 1 July 1998, all bulkheads are to be repaired by steel renewal where the gauged thickness is less than t net + 0,5 mm, where t net is the thickness obtained by applying the strength criteria given in Pt E, Ch 4, Sec 3, [7.1]. However, where the gauged thickness is within the range t net + 0,5 mm and t net + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal.

(4) For ships whose side shell frames are to comply with the retroactive requirements given in Ch 6, Sec 2, [7] the acceptance criteria for the thickness diminution of the webs of frames and brackets are not to be considered the values indicated in the Table (20% of wastage), but rather the specific value obtained by the structural assessment carried out in accordance with the criteria given in Ch 6, Sec 2, [7]. For flanges, the acceptance criteria indicated in the Table (20% of wastage) are to be applied in addition to the criteria given in Ch 6, Sec 2, [7].

(5) For ships indicated in Ch 1, Sec 2, [4.3.2], contracted for construction on or after 1 July 1998, the renewal criteria of all cargo hatch covers are as follows:

- for single skin hatch covers and for the plating of pontoon covers, steel renewal is required where the gauged thickness is less than t_{net} + 0,5 mm. Where the gauged thickness is within the range t_{net} + 0,5 mm and t_{net} + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal.

  For the internal structure of pontoon hatch covers, thickness gauging is required when plating renewal is to be carried out or when this is deemed necessary, at the discretion of the Surveyor, on the basis of the plating corrosion or deformation condition. In these cases, steel renewal for the internal structures is required where the gauged thickness is less than t_{net}.

Group of items	Description of items	1 Isolated area	2 Item	3 Zone
18	Side shell frames **(4)** web and flange brackets	 25 25	 20 20	 - -
19	Topside and hopper tank web frames, web and flange	25	20	-
20	Floors plating	 25	 20	 -
21	Forward and aft peak bulkheads plating stiffener web and flange	 25 25	 20 20	 - -

(1) Each zone is to be evaluated separately.

(2) If continuous, to be included in item 1.

(3) For vertically corrugated transverse bulkheads in cargo holds:

- For ships indicated in Ch 6, Sec 2, [1.1] which are to comply with the retroactive requirements according to the schedule given in Ch 6, Sec 2, [1.2], the bulkhead between the two foremost cargo holds is to be assessed based on the criteria given in Ch 6, Sec 2, [1.3].
- For ships indicated in Pt E, Ch 4, Sec 3, [7.1.1], contracted for construction on or after 1 July 1998, all bulkheads are to be repaired by steel renewal where the gauged thickness is less than t net + 0,5 mm, where t net is the thickness obtained by applying the strength criteria given in Pt E, Ch 4, Sec 3, [7.1]. However, where the gauged thickness is within the range t net + 0,5 mm and t net + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal.

(4) For ships whose side shell frames are to comply with the retroactive requirements given in Ch 6, Sec 2, [7] the acceptance criteria for the thickness diminution of the webs of frames and brackets are not to be considered the values indicated in the Table (20% of wastage), but rather the specific value obtained by the structural assessment carried out in accordance with the criteria given in Ch 6, Sec 2, [7]. For flanges, the acceptance criteria indicated in the Table (20% of wastage) are to be applied in addition to the criteria given in Ch 6, Sec 2, [7].

(5) For ships indicated in Ch 1, Sec 2, [4.3.2], contracted for construction on or after 1 July 1998, the renewal criteria of all cargo hatch covers are as follows:

- for single skin hatch covers and for the plating of pontoon covers, steel renewal is required where the gauged thickness is less than t_{net} + 0,5 mm. Where the gauged thickness is within the range t_{net} + 0,5 mm and t_{net} + 1,0 mm, coating (applied in accordance with the coating Manufacturer's requirements) or annual gauging may be adopted as an alternative to steel renewal.

  For the internal structure of pontoon hatch covers, thickness gauging is required when plating renewal is to be carried out or when this is deemed necessary, at the discretion of the Surveyor, on the basis of the plating corrosion or deformation condition. In these cases, steel renewal for the internal structures is required where the gauged thickness is less than t_{net}.

Figure 15 : Oil tanker: layout of items to be assessed

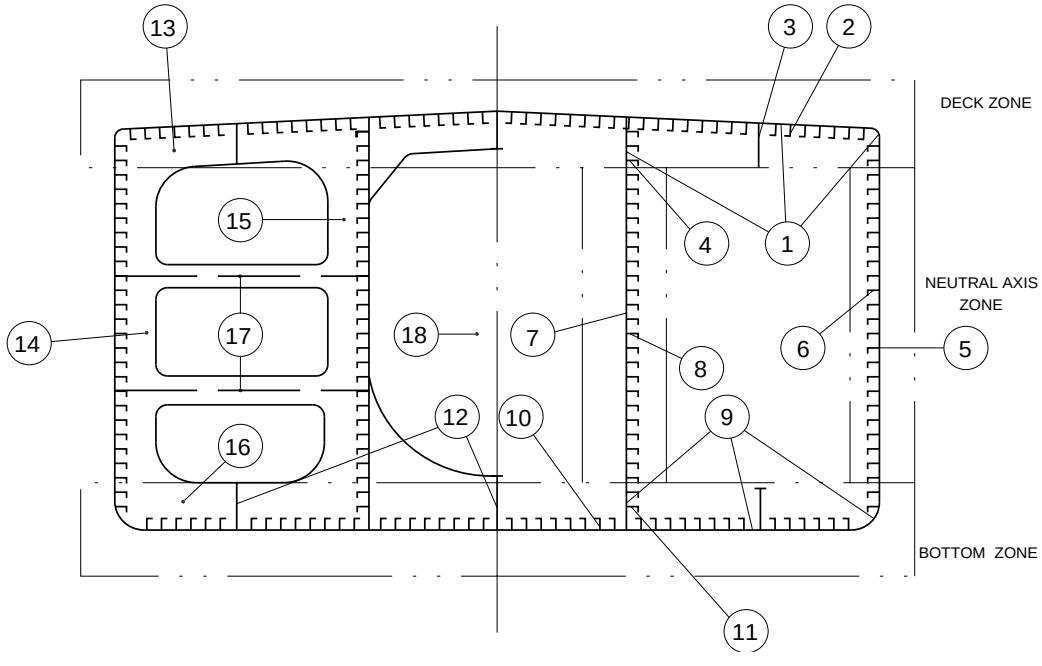


Table 9 : Local and global acceptance criteria for oil tankers (given in % of wastage)(for ships contracted for construction on/after 1 June 2000) *(1/7/2009)*

Group of items	Description of items	1 Isolated area	2 Item	3 Group	4 Zone
ITEMS CONTRIBUTING TO THE LONGITUDINAL STRENGTH (TRANSVERSE SECTION)					
	DECK ZONE **(1)**	-	-	-	10
1	Deck plating, deck stringer, sheer strake and longitudinal bulkhead upper strake **(2)**	25	20	10	-
2	Deck and sheer strake longitudinals web flange	- 25 20	- 20 15	10 - -	- - -
3	Deck longitudinal girders web flange	- 25 20	- 20 15	10 - -	- - -
4	Longitudinals connected to long. bulkhead upper strake **(2)** web flange	- 25 20	- 20 15	10 - -	- - -
	NEUTRAL AXIS ZONE **(1)**	-	-	-	15
5	Side shell plating **(2)**	25	20	15	-
6	Side shell longitudinals and stringers **(2)** web flange	- 25 20	- 20 15	15 - -	- - -
7	Longitudinal bulkhead plating	25	20	15	-
8	Longitudinal bulkhead longitudinals and stringers web flange	- 25 20	- 20 15	15 - -	- - -
	BOTTOM ZONE **(1)**	-	-	-	10
9	Bilge and bottom strakes, longitudinal bulkhead lower strake and keel plate **(2)**	25	20	10	-
10	Bilge and bottom longitudinals **(2)** web flange	- 25 20	- 20 15	10 - -	- - -
11	Longitudinals connected to longitud. bulkhead lower strake web flange	- 25 20	- 20 15	10 - -	- - -
12	Bottom girders web flange	- 25 20	- 20 15	10 - -	- - -
OTHER ITEMS					
13	Deck transverse web frame web flange brackets / stiffeners	 25 20 25	 20 15 20	 - - -	 - - -
14	Side shell web frame web flange brackets / stiffeners	 25 20 25	 20 15 20	 - - -	 - - -

(1) Each zone is to be evaluated separately.

(2) For double hull oil tankers, the structural elements of the inner skin (plating, longitudinals, girders, bulkheads) are to be included in the corresponding elements of the outer skin.

(3) Including swash bulkheads, forward and aft peak bulkheads.

Group of items	Description of items	1 Isolated area	2 Item	3 Group	4 Zone
15	Longitudinal bulkhead web frame				
	web	25	20	-	-
	flange	20	15	-	-
	brackets / stiffeners	25	20	-	-
16	Bottom transverse web frame				
	web	25	20	-	-
	flange	20	15	-	-
	brackets / stiffeners	25	20	-	-
17	Cross tie				
	web	25	15	-	-
	flange	20	15	-	-
	brackets / stiffeners	20	15	-	-
18	Transverse bulkheads **(3)**				
	plating	25	20	15	-
	stringer web	25	20	-	-
	stringer flange	20	15	-	-
	stiffener web	30	20	-	-
	stiffener flange	25	15	-	-

(1) Each zone is to be evaluated separately.

(2) For double hull oil tankers, the structural elements of the inner skin (plating, longitudinals, girders, bulkheads) are to be included in the corresponding elements of the outer skin.

(3) Including swash bulkheads, forward and aft peak bulkheads.

Table 10 : Local and global acceptance criteria for oil tankers (given in % of wastage) (for ships contracted for construction before 1 June 2000)

Group of items	Description of items	1 Isolated area	2 Item	3 Zone
ITEMS CONTRIBUTING TO THE LONGITUDINAL STRENGTH (TRANSVERSE SECTION)				
	DECK ZONE **(1)**	-	-	10
1	Deck plating, deck stringer, sheer strake and longitudinal bulkhead upper strake **(2)**	25	20	-
2	Deck and sheer strake longitudinals, web and flange	25	20	-
3	Deck longitudinal girders, web and flange	25	20	-
4	Longitudinals connected to long. bulkhead upper strake **(2)** web and flange	25	20	-
	NEUTRAL AXIS ZONE **(1)**	-	-	-
5	Side shell plating **(2)**	25	20	-
6	Side shell longitudinals and stringers **(2)** web and flange	25	20	-
7	Longitudinal bulkhead plating	25	20	-
8	Longitudinal bulkhead longitudinals and stringers, web and flange	25	20	-
	BOTTOM ZONE **(1)**	-	-	10
9	Bilge and bottom strakes, longitudinal bulkhead lower strake and keel plate **(2)**	25	20	-

(1) Each zone is to be evaluated separately.

(2) For double hull oil tankers, the structural elements of the inner skin (plating, longitudinals, girders, bulkheads) are to be included in the corresponding elements of the outer skin.

(3) Including swash bulkheads, forward and aft peak bulkheads.

Group of items	Description of items	1 Isolated area	2 Item	3 Zone
10	Bilge and bottom longitudinals **(2)** web and flange	25	20	-
11	Longitudinals connected to longitud. bulkhead lower strake, web and flange	25	20	-
12	Bottom girders, web and flange	25	20	-
	OTHER ITEMS			
13	Deck transverse web frame web and flange brackets / stiffeners	 25 25	 20 20	 - -
14	Side shell web frame web and flange brackets / stiffeners	 25 25	 20 20	 - -
15	Longitudinal bulkhead web frame web and flange brackets / stiffeners	 25 25	 20 20	 - -
16	Bottom transverse web frame web and flange brackets / stiffeners	 25 25	 20 20	 - -
17	Cross tie web and flange brackets / stiffeners	 25 25	 20 20	 - -
18	Transverse bulkheads **(3)** plating stringer web and flange stiffener web and flange	 25 25 25	 20 20 20	 - - -

(1) Each zone is to be evaluated separately.

(2) For double hull oil tankers, the structural elements of the inner skin (plating, longitudinals, girders, bulkheads) are to be included in the corresponding elements of the outer skin.

(3) Including swash bulkheads, forward and aft peak bulkheads.

APPENDIX 3 THICKNESS MEASUREMENTS: NUMBER, LOCATIONS AND ACCEPTANCE CRITERIA FOR SHIPS BUILT UNDER THE COMMON STRUCTURAL RULES

1 General

1.1 Field of application

1.1.1 *(1/1/2016)*

This App 3 applies to ships subject to:

- Chapter 13 of the "Common Structural Rules for Bulk Carriers" (see Note 1), or
- Section 12 of the "Common Structural Rules for Double Hull Oil Tankers" (see Note 1), or
- Part 1 Chapter 13 Section 2 of the "Common Structural Rules for Bulk Carriers and Oil Tankers", (see Note 1).

Note 1: see Sec 2, [2.2.1].

1.2 Aim of the Appendix

1.2.1 *(1/7/2013)*

Thickness measurements are a major part of surveys to be carried out for the maintenance of class, and the analysis of these measurements is a prominent factor in the determination and extent of the repairs and renewals of the ship's structure.

1.2.2 *(1/7/2013)*

The Appendix is intended to provide Owners, companies performing thickness measurements and the Society's Surveyors with a uniform means with a view to fulfilling Rule requirements for thickness measurements. In particular, it will enable all the above-mentioned parties to carry out:

- the planning and preparation
- the determination of extent and location, and
- the analysis

of the thickness measurements in cooperation.

1.2.3 *(1/7/2013)*

It is to be noted that this Appendix also takes into account specific requirements for thickness measurements relevant to close-up surveys of the Enhanced Survey Program (ESP).

1.2.4 *(1/7/2013)*

This Appendix is also to be used for the thickness measurements of ships assigned the notation **STAR-HULL** (see Ch 5, Sec 2 and Part F, Chapter 1). However, the acceptance criteria for thickness measurements specific to this notation are given in Pt F, Ch 1, Sec 1.

1.3 Scope of the Appendix

1.3.1 *(1/7/2013)*

The articles below provide the following information:

- references to rule requirements and some additional information on the extent of the thickness measurements to be performed during surveys according to types of ships and related surveys
- locations of the measurements for the main parts of the ship
- how to analyse the results of thickness measurements.

Tables and sketches are also given to detail the above points according to the types of ships.

2 Rule requirements for the extent of measurements

2.1 General

2.1.1 *(1/7/2013)*

For the maintenance of class, thickness measurements may be required during annual, intermediate and class renewal surveys. Tab 1 gives the references to the requirements for minimum thickness measurements indicated in Chapter 3 and Chapter 4 for each service notation and related to the different types of surveys.

Some additional explanations are also given about the wording used in the Rules as well as the general principles of the required thickness measurements during class renewal surveys.

2.2 Class renewal survey: ships submitted to ESP built under CSR

2.2.1 *(1/7/2013)*

The thickness measurements required by the Rules consist of:

- systematic thickness measurements in order to assess the overall and local strength of the ship
- thickness measurements as indicated in the program of close-up survey
- measurements of elements considered as suspect areas as defined in Sec 2, [2.2.10]
- additional measurements on areas determined as affected by substantial corrosion as defined in Sec 2, [2.2.9].

2.2.2 *(1/7/2013)*

For the determination of close-up surveys and relevant thickness measurements as well as the areas considered as suspect areas, reference is to be made to the relevant Sections of Chapter 4 according to the different service notations of the ships subject to ESP.

Table 1 : References to Rule requirements related to thickness measurements *(1/7/2013)*

SERVICE NOTATION	TYPE OF SURVEY		
	CLASS RENEWAL	INTERMEDIATE	ANNUAL
all service notations	Ch 3, Sec 5, [2.5] and Ch 3, Sec 5, Tab 2: systematic measurements and suspect areas Where substantial corrosion is found, the extent of thickness measurements may be increased to the Surveyor's satisfaction, using Ch 3, Sec 5, Tab 3 as guidance	Ch 3, Sec 4, Tab 1: thickness measurements to be taken if deemed necessary by the Surveyor Where substantial corrosion is found, the extent of thickness measurements may be increased to the Surveyor's satisfaction, using Ch 3, Sec 5, Tab 3 as guidance	Ch 3, Sec 3, [2.4.1]: areas of substantial corrosion identified at previous surveys Where substantial corrosion is found, the extent of thickness measurements may be increased to the Surveyor's satisfaction, using Ch 3, Sec 5, Tab 3 as guidance
bulk carrier ESP CSR	Ch 4, Sec 2, [4.1] and Ch 4, Sec 2, [4.2]: planning and general requirements Ch 4, Sec 2, Tab 5 : measurements of elements subjected to close-up surveyCh 4, Sec 2, Tab 6: extent of systematic thickness measurements Ch 4, Sec 2, Tab 7 to Ch 4, Sec 2, Tab 11, according to the different locations, where substantial corrosion is found	Ch 4, Sec 2, Tab 3 for cargo holds Ch 4, Sec 2, Tab 4 for salt ballast tanks Ch 4, Sec 2, Tab 7 to Ch 4, Sec 2, Tab 11, according to the different locations, where substantial corrosion is found	Ch 4, Sec 2, Tab 1, note (2) for cargo holds and when deemed necessary by the Surveyor Ch 4, Sec 2, [2.5] for salt ballast tanks and when deemed necessary by the Surveyor Ch 4, Sec 2, Tab 7 to Ch 4, Sec 2, Tab 11, according to the different locations, where substantial corrosion is found
bulk carrier ESP CSR - double skin	Ch 4, Sec 9, [4.1] and Ch 4, Sec 9, [4.5]: planning and general requirements Ch 4, Sec 9, Tab 2: measurements of elements subjected to close-up survey Ch 4, Sec 9, Tab 4: extent of systematic thickness measurements Ch 4, Sec 9, Tab 5 to Ch 4, Sec 9, Tab 8, according to the different locations, where substantial corrosion is found	Ch 4, Sec 9, Tab 1 for both cargo holds and salt ballast tanks Ch 4, Sec 9, Tab 4 to Ch 4, Sec 9, Tab 8, according to the different locations, where substantial corrosion is found	Ch 4, Sec 9, [2.5] limited to salt ballast tanks and when deemed necessary by the Surveyor Ch 4, Sec 9, Tab 4 to Ch 4, Sec 9, Tab 8, according to the different locations, where substantial corrosion is found
oil tanker ESP CSR double hull	Ch 4, Sec 4, [4.1] and Ch 4, Sec 4, [4.4]: planning and general requirements Ch 4, Sec 4, Tab 2: measurements of elements subjected to close-up survey Ch 4, Sec 4, Tab 3: extent of systematic thickness measurements Ch 4, Sec 4, Tab 4 to Ch 4, Sec 4, Tab 8, according to the different locations, where substantial corrosion is found	Ch 4, Sec 4, Tab 1 for both cargo holds and salt ballast tanks Ch 4, Sec 4, Tab 4 to Ch 4, Sec 4, Tab 8, according to the different locations, where substantial corrosion is found	Ch 4, Sec 4, [2.4.2] limited to salt ballast tanks and when deemed necessary by the Surveyor Ch 4, Sec 4, Tab 4 to Ch 4, Sec 4, Tab 8, according to the different locations, where substantial corrosion is found

3 Single skin bulk carriers

3.1 Number and locations of measurements

3.1.1 Application *(1/1/2016)*

This item [3] only applies to ships built under the Common Structural Rules for Bulk Carriers or the "Common Structural Rules for Bulk Carriers and Oil Tankers". For ships not built under the Common Structural Rules, the requirements for number and locations of measurements are according to App 2 or other specific requirements established by the Society.

3.1.2 Number of measurements *(1/7/2012)*

Considering the extent of thickness measurements according to the different structural elements of the ship and surveys (special, intermediate and annual), the locations of the points to be measured are given for the most important items of the structure.

3.1.3 Locations of measurements *(1/7/2012)*

Tab 2 provides explanations and/or interpretations for the application of those requirements indicated in the Rules, which refer to both systematic thickness measurements related to the calculation of global hull girder strength and specific measurements connected to close-up surveys.

Fig 1 to Fig 6 are provided to facilitate the explanations and/or interpretations given in Tab 2, to show typical arrangements of single side skin bulk carriers.

3.2 Acceptance criteria

3.2.1 General *(1/1/2016)*

For ships built under Common Structural Rules, the Acceptance Criteria is according to:

- Chapter 13 of the "Common Structural Rules for Bulk Carriers" for ships having notation "**bulk carrier ESP CSR**", contracted for construction on or after 1 April 2006 but before 1 July 2015, or
- Part 1 Chapter 13 Section 2 of the "Common Structural Rules for Bulk Carriers and Oil Tankers" for ships having notation "**bulk carrier ESP CSR**", contracted for construction on or after 1 July 2015

and as specified in [3.2.2], [3.2.3] and [3.2.4].

For ships not built under the Common Structural Rules, the acceptance criteria are according to App 2 or other specific requirements established by the Society.

3.2.2 Acceptance criteria for pitting corrosion of CSR ships *(1/1/2019)*

a) Side structures

If pitting intensity in an area where coating is required, according to Ch 3, Sec 5 of the Common Structural Rules for Bulk Carriers or Part 1 Ch 3 Sec 4 of "Common Structural Rules for Bulk Carriers and Oil Tankers", is higher than 15% (see App 2, Fig 12), thickness measurements are to be performed to check the extent of pitting corrosion. The 15% is based on pitting or grooving on only one side of a plate.

In cases where pitting is exceeding 15%, as defined above, an area of 300 mm or more, at the most pitted part of the plate, is to be cleaned to bare metal and the thickness is to be measured in way of the five deepest pits within the cleaned area. The least thickness measured in way of any of these pits is to be taken as the thickness to be recorded.

The minimum remaining thickness in pits, grooves or other local areas is to be greater than the following without being greater than the renewal thickness (t_{ren}):

- 75% of the as-built thickness, in the frame and end brackets webs and flanges
- 70% of the as-built thickness, in the side shell, hopper tank and topside tank plating attached to the each side frame, over a width up to 30 mm from each side of it.

b) Other structures

For plates with pitting intensity less than 20%, see App 2, Fig 12, the measured thickness, tm of any individual measurement is to meet the lesser of the following criteria:

$t_m \geq 0,7\ (t_{as\text{-}built} - t_{vol\ add})$ mm

$t_m \geq t_{ren} - 1$ mm

where:

$t_{as\text{-}built}$: As-built thickness of the member, in mm

$t_{vol\ add}$: Voluntary thickness addition; thickness, in mm, voluntarily added as the Owner's extra margin for corrosion wastage in addition to t_C

t_{ren} : Renewal thickness; minimum allowable thickness, in mm, below which renewal of structural members is to be carried out

t_C : Total corrosion addition, in mm, defined in Ch 3, Sec 3 of the "Common Structural Rules for Bulk Carriers" or Part 1 Ch 3 Sec 3 of "Common Structural Rules for Bulk Carriers and Oil Tankers"

t_m : Measured thickness, in mm, on one item, i.e. average thickness on one item using the various measurements taken on this same item during periodical ship's in service surveys.

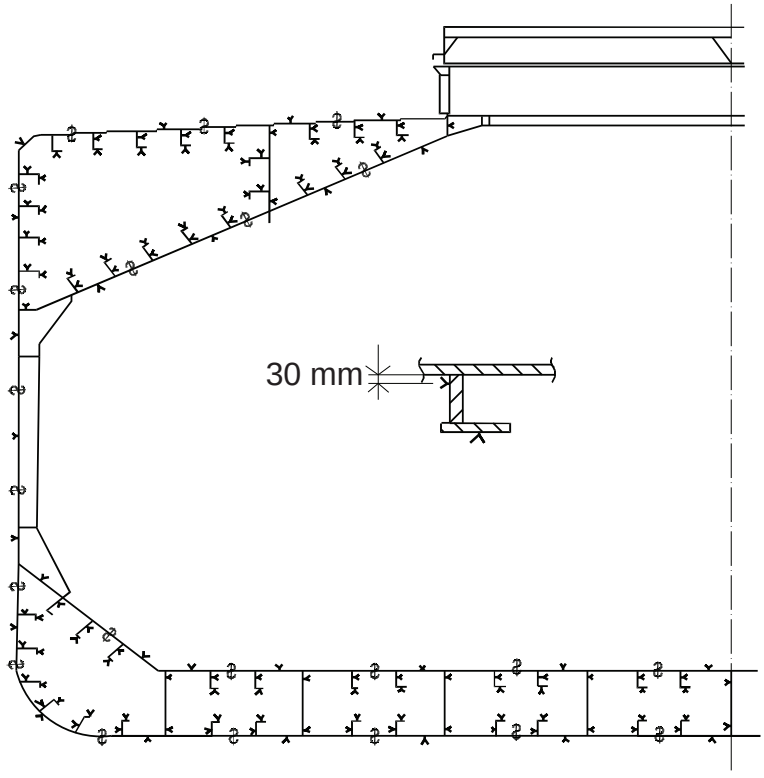
The average thickness across any cross section in the plating is not to be less than the renewal criteria for general corrosion given in Chapter 13 of the Common Structural Rules for Bulk Carriers" or Part 1 Ch 13 of "Common Structural Rules for Bulk Carriers and Oil Tankers".

Table 2 : Interpretations of rule requirements for the locations and number of points to be measured for CSR bulk carriers (single skin) *(1/7/2012)*

Item	Interpretation	Figure reference
Selected plates on deck, tank top, bottom, double bottom and wind-and- water area	"Selected" means at least a single point on one out of three plates, to be chosen on representative areas of average corrosion	
All deck, tank top and bottom plates and wind-and-water strakes	At least two points on each plate to be taken either at each 1/4 extremity of plate or at representative areas of average corrosion	
Transverse section	A transverse section includes all longitudinal members such as plating, longitudinals and girders at the deck, side, bottom; inner bottom and hopper side plating, longitudinal bulkhead and bottom plating in top wing tanks.	Fig 1
All cargo hold hatch covers and coamings	Including plates and stiffeners	Locations of points are given in Fig 2

Item	Interpretation	Figure reference
Transverse section of deck plating outside line of cargo hatch openings	Two single points on each deck plate (to be taken either at each 1/4 extremity of plate or at representative areas of average corrosion) between the ship sides and hatch coamings in the transverse section concerned	
All deck plating and underdeck structure inside line of hatch openings between cargo hold hatches	"All deck plating" means at least two points on each plate to be taken either at each 1/4 extremity of plate or at representative areas of average corrosion. "Under deck structure": at each short longitudinal girder: three points for web plating (fwd/middle/aft), single point for face plate, one point for web plating and one point for face plating of transverse beam in way. At each ends of transverse beams, one point for web plating and one point for face plating	Extent of areas is shown in Ch 4, Sec 2, Fig 1 Location of points are given in Fig 6
Selected side shell frames in cargo holds	Includes side shell frame, upper and lower end attachments and adjacent shell plating. 25% of frames: one out of four frames should preferably be chosen throughout the cargo hold length on each side. 50% of frames: one out of two frames should preferably be chosen throughout the cargo hold length on each side. "Selected frames" means at least 3 frames on each side of cargo holds	Extent of areas is shown in Ch 4, Sec 2, Fig 1 Locations of points are given in Fig 3
Transverse bulkheads in cargo holds	Includes bulkhead plating, stiffeners and girders, including internal structure of upper and lower stools, where fitted. Two selected bulkheads: one is to be the bulkhead between the two foremost cargo holds and the second may be chosen in other positions	Areas of measurements are shown in Ch 4, Sec 2, Fig 1 Locations of points are given in Fig 4
One transverse bulkhead in each cargo hold	This means that the close-up survey and related thickness measurements are to be performed on one side of the bulkhead; the side is to be chosen based on the outcome of the overall survey of both sides. In the event of doubt, the Surveyor may also require (possibly partial) close-up survey on the other side	Areas of measurements are shown in Ch 4, Sec 2, Fig 1 Locations of points are given in Fig 4
Transverse bulkheads in one topside, hopper and double bottom ballast tank	Includes bulkhead and stiffening systems. The ballast tank is to be chosen based on the history of ballasting among those prone to have the most severe conditions	Locations of points are given in Fig 5
Transverse webs in ballast tanks	Includes web plating, face plates, stiffeners and associated plating and longitudinals. One of the representative tanks of each type (i.e. topside or hopper or side tank) is to be chosen in the forward part	Areas of measurements are shown in Ch 4, Sec 2, Fig 1 Locations of points are given in Fig 3

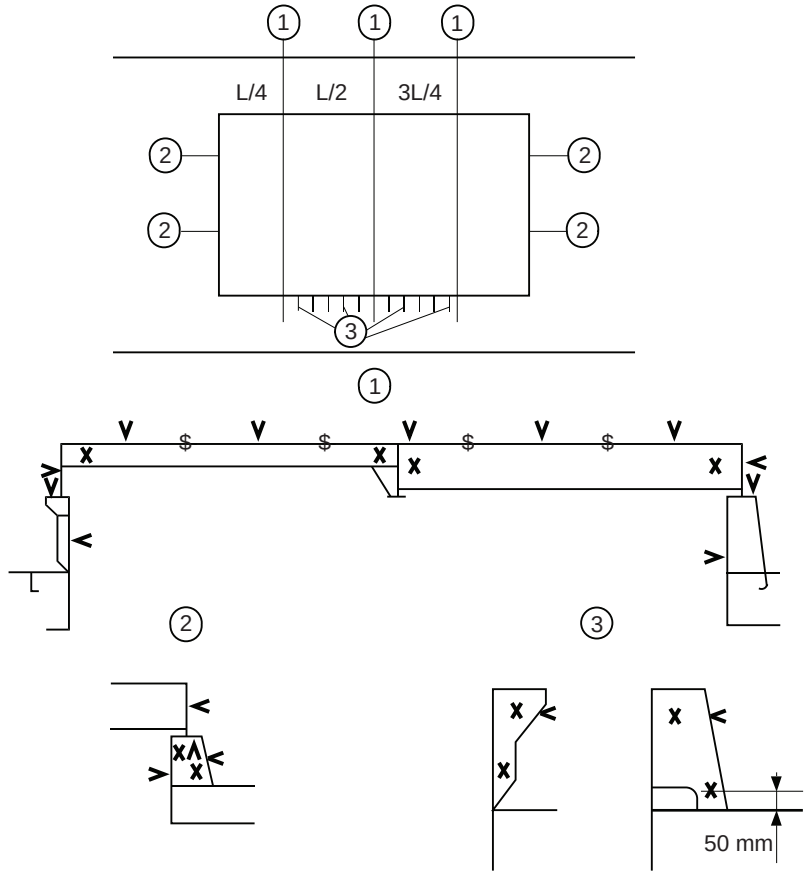
Figure 1 : Transverse section of a single skin bulk carrier *(1/7/2012)*



Single side bulk carriers

Measurements are to be taken on both port and starboard sides of the selected transverse section.

Figure 2 : Locations of measurements on hatch covers and coamings *(1/7/2012)*



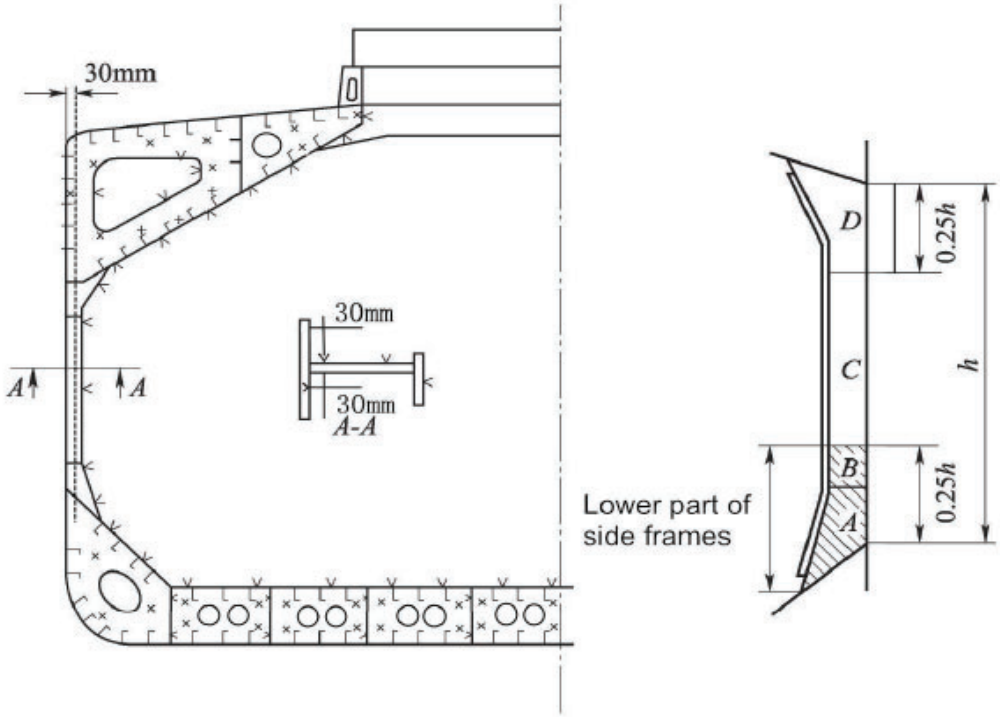
(1) Three sections at L/4, L/2, 3L/4 of hatch cover length, including:

- one measurement of each hatch cover plate and skirt plate
- measurements of adjacent beams and stiffeners
- one measurement of coaming plates and coaming flange, each side

(2) Measurements of both ends of hatch cover skirt plate, coaming plate and coaming flange

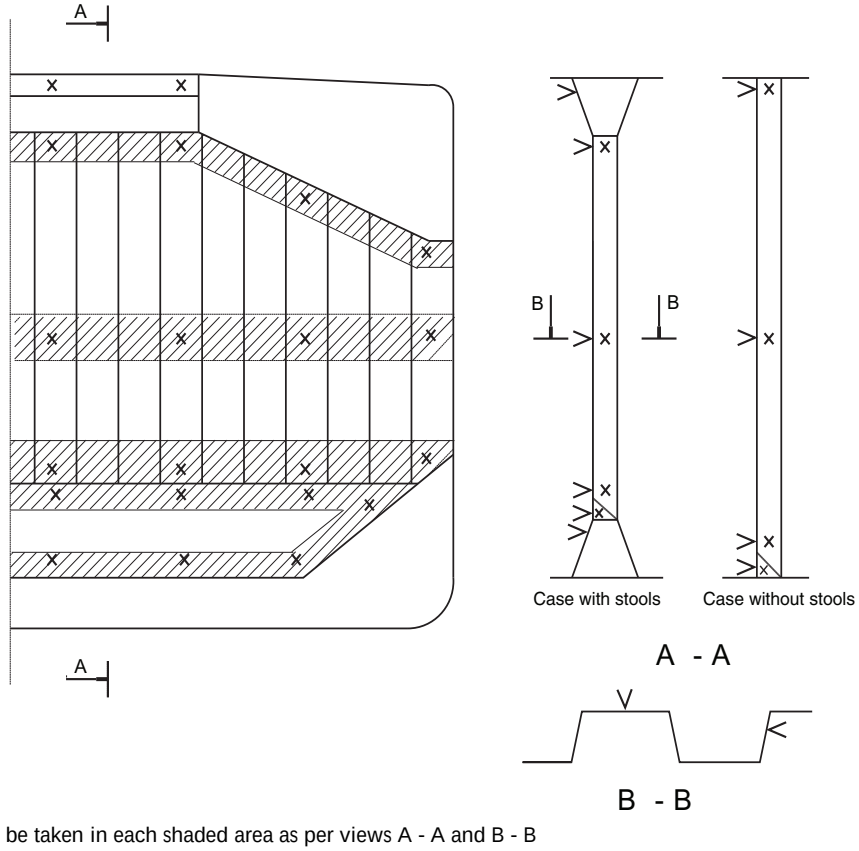
(3) One measurement of one out of three hatch coaming brackets and bars, on both sides and both ends

Figure 3 : Locations of measurements on structural members in cargo holds and ballast tanks of single side skin bulk carriers *(1/1/2019)*



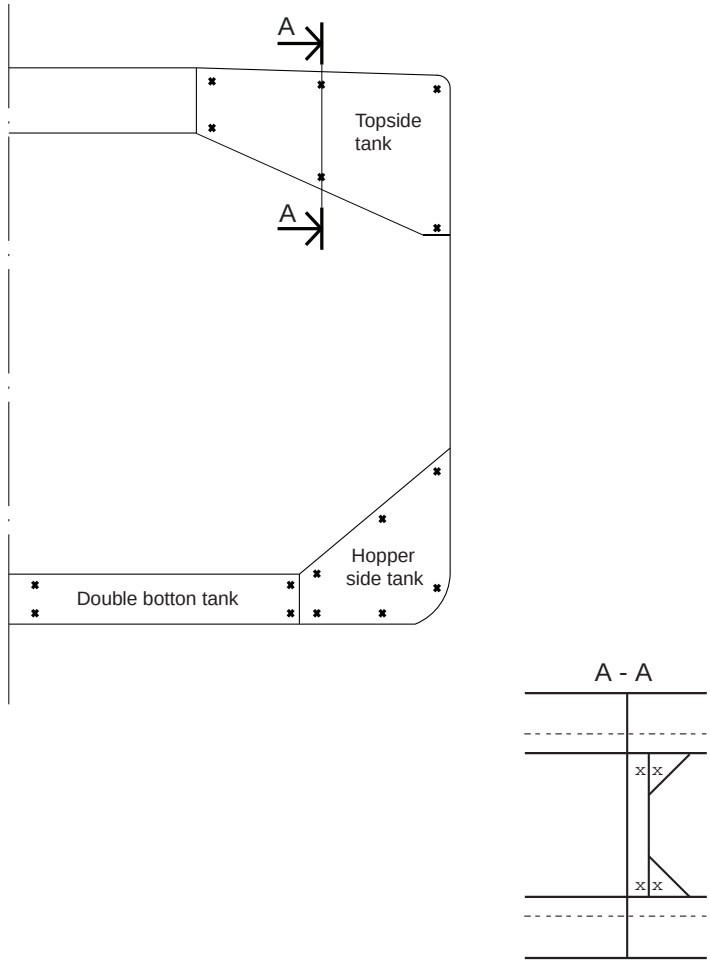
Note: The gauging pattern for web plating is to be a three point pattern for zones A, C and D, and a two point pattern for zone B (see figure). The gauging report is to reflect the average reading. The average reading is to be compared with the allowable thickness. If the web plating has general corrosion then this pattern is to be expanded to a five-point pattern.

Figure 4 : Locations of measurements on cargo hold transverse bulkheads (additional measurements to internal structure of upper and lower stools to be added, e. g. two points in the upper and two points in the lower stools to be indicated in section A - A) *(1/7/2012)*



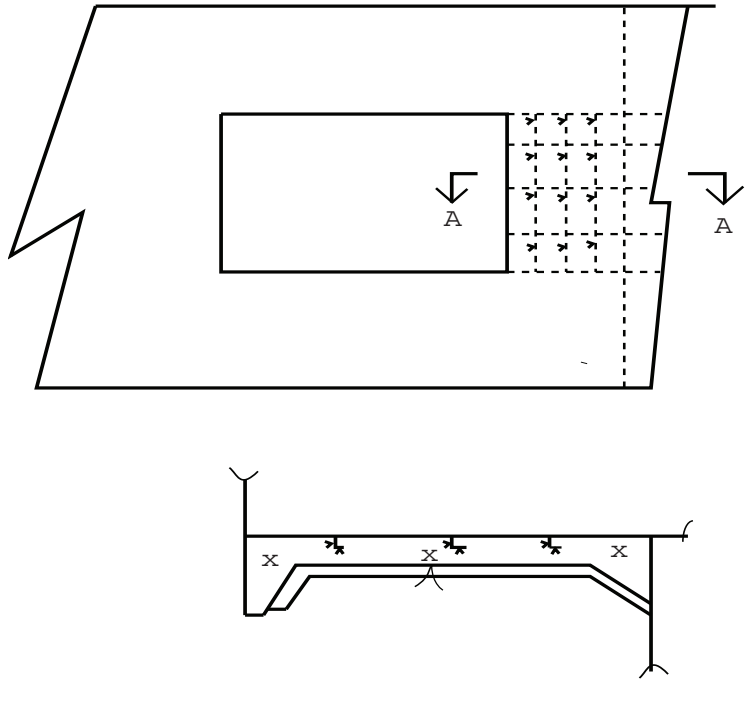
Note: Measurements to be taken in each shaded area as per views A - A and B - B

Figure 5 : Locations of measurements on transverse bulkheads of topside, hopper and double bottom tanks (two additional measurements to internal structure of double bottom tank to be added at midspan) *(1/7/2012)*



Note: Measurements to be taken in each vertical section as per view A - A

Figure 6 : Locations of measurements on underdeck structure *(1/7/2012)*



3.2.3 Acceptance criteria for edge corrosion of CSR ships *(1/1/2019)*

Provided that the overall corroded height of the edge corrosion of the flange, or web in the case of flat bar stiffeners, is less than 25%, see Sec 2, Fig 1, of the stiffener flange breadth or web height, as applicable, the measured thickness, tm, is to meet the lesser of the following criteria:

$t_m \geq 0,7\ (t_{as\text{-}built} - t_{vol\ add})$ mm

$t_m \geq t_{ren} - 1$ mm

The average measured thickness across the breadth or height of the stiffener is not to be less than that defined in Chapter 13 of the "Common Structural Rules for Bulk Carriers" or Part 1 Ch 13 of "Common Structural Rules for Bulk Carriers and Oil Tankers".

Plate edges at openings for manholes, lightening holes etc. may be below the minimum thickness given in Chapter 13 of the "Common Structural Rules for Bulk Carriers" or Part 1 Ch 13 of "Common Structural Rules for Bulk Carriers and Oil Tankers" provided that the maximum extent of the reduced plate thickness, below the minimum given in Chapter 13 of the "Common Structural Rules for Bulk Carriers" or Part 1 Ch 13 of "Common Structural Rules for Bulk Carriers and Oil Tankers" from the opening edge is not more than 20% of the smallest dimension of the opening and does not exceed 100 mm.

Rough or uneven edges may be cropped-back provided that the maximum dimension of the opening is not increased by more than 10% and the remaining thickness of the new edge is not less than t_{ren} - 1 mm.

3.2.4 Acceptance criteria for grooving corrosion of CSR ships *(1/1/2019)*

a) Where the groove breadth is a maximum of 15% of the web height, but not more than 30mm, see Sec 2, Fig 2, the measured thickness, t_m, in the grooved area is to meet the lesser of the following criteria:

   $t_m \geq 0,75\ (t_{as\text{-}built} - t_{vol\ add})$ mm

   $t_m \geq t_{ren} - 0,5$ mm

   but is not to be less than

   $t_m = 6$ mm

b) Structural members with areas of grooving greater than those in a) are to be assessed based on the criteria for general corrosion as defined in Chapter 13 of the "Common Structural Rules for Bulk Carriers" or Part 1 Ch 13 of "Common Structural Rules for Bulk Carriers and Oil Tankers" using the average measured thickness across the plating/stiffener.

4 Double skin bulk carriers

4.1 Number and Locations of measurements

4.1.1 Application *(1/1/2016)*

This item [4] only applies to ships built under the Common Structural Rules of Bulk Carriers or the "Common Structural Rules for Bulk Carriers and Oil Tankers". For ships not built under the Common Structural Rules, the requirements for number and locations of measurements are according to Appendix 2 or other specific requirements established by the Society.

4.1.2 Number of measurements *(1/7/2012)*

Considering the extent of thickness measurements according to the different structural elements of the ship and surveys (special, intermediate and annual), the locations of the points to be measured are given for the most important items of the structure.

4.1.3 Locations of measurements *(1/7/2012)*

Tab 3 provides explanations and/or interpretations for the application of those requirements indicated in the Rules, which refer to both systematic thickness measurements related to the calculation of global hull girder strength and specific measurements connected to close-up surveys.

Fig 7 to Fig 12 are provided to facilitate the explanations and/or interpretations given in Tab 3, to show typical arrangements of double side skin bulk carriers.

4.2 Acceptance criteria

4.2.1 General *(1/1/2016)*

For vessels built under the Common Structural Rules, the Acceptance Criteria is according to:

- Chapter 13 of the "Common Structural Rules for Bulk Carriers" for ships having notation "**bulk carrier ESP CSR - double skin**", contracted for construction on or after 1 April 2006 but before 1 July 2015, or
- Part 1 Chapter 13 Section 2 of the "Common Structural Rules for Bulk Carriers and Oil Tankers" for ships having notation "**bulk carrier ESP CSR - double skin**", contracted for construction on or after 1 July 2015

and as specified in [4.2.2], [4.2.3] and [4.2.4].

For ships not built under the Common Structural Rules, the acceptance criteria are according to App 2 or other specific requirements established by the Society.

4.2.2 Acceptance criteria for pitting corrosion of CSR ships *(1/1/2019)*

a) Side structures

   If pitting intensity in an area where coating is required, according to Ch 3, Sec 5 of the "Common Structural Rules for Bulk Carriers" or Part 1 Ch 3 Sec 4 of the "Common Structural Rules for Bulk Carriers and Oil Tankers", is higher than 15% (see App 2, Fig 12), thickness measurements are to be performed to check the extent of pitting corrosion. The 15% is based on pitting or grooving on only one side of a plate.

   In cases where pitting is exceeding 15%, as defined above, an area of 300 mm or more, at the most pitted part of the plate, is to be cleaned to bare metal and the thickness is to be measured in way of the five deepest pits within the cleaned area. The least thickness measured in way of any of these pits is to be taken as the thickness to be recorded.

   The minimum remaining thickness in pits, grooves or other local areas is to be greater than 70% of the as-built thickness, in the side shell, hopper tank and topside tank plating attached to the each side frame, over a

width up to 30 mm from each side of it, without being greater than t_{ren}.

b) Other structures

For plates with pitting intensity less than 20%, see App 2, Fig 12, the measured thickness, tm of any individual measurement is to meet the lesser of the following criteria:

$t_m \geq 0,7\ (t_{as\text{-}built} - t_{vol\ add})$ mm

$t_m \geq t_{ren} - 1$ mm

Where:

$t_{as\text{-}built}$: As-built thickness of the member, in mm

$t_{vol\ add}$: Voluntary thickness addition; thickness, in mm, voluntarily added as the Owner's extra margin for corrosion wastage in addition to t_C

t_{ren} : Renewal thickness; minimum allowable thickness, in mm, below which renewal of structural members is to be carried out

t_C : Total corrosion addition, in mm, defined in Ch 3, Sec 3 of the “Common Structural Rules for Bulk Carriers” or Part 1 Ch 3 Sec 3 of "Common Structural Rules for Bulk Carriers and Oil Tankers"

t_m : Measured thickness, in mm, on one item, i.e. average thickness on one item using the various measurements taken on this same item during periodical ship's in service surveys.

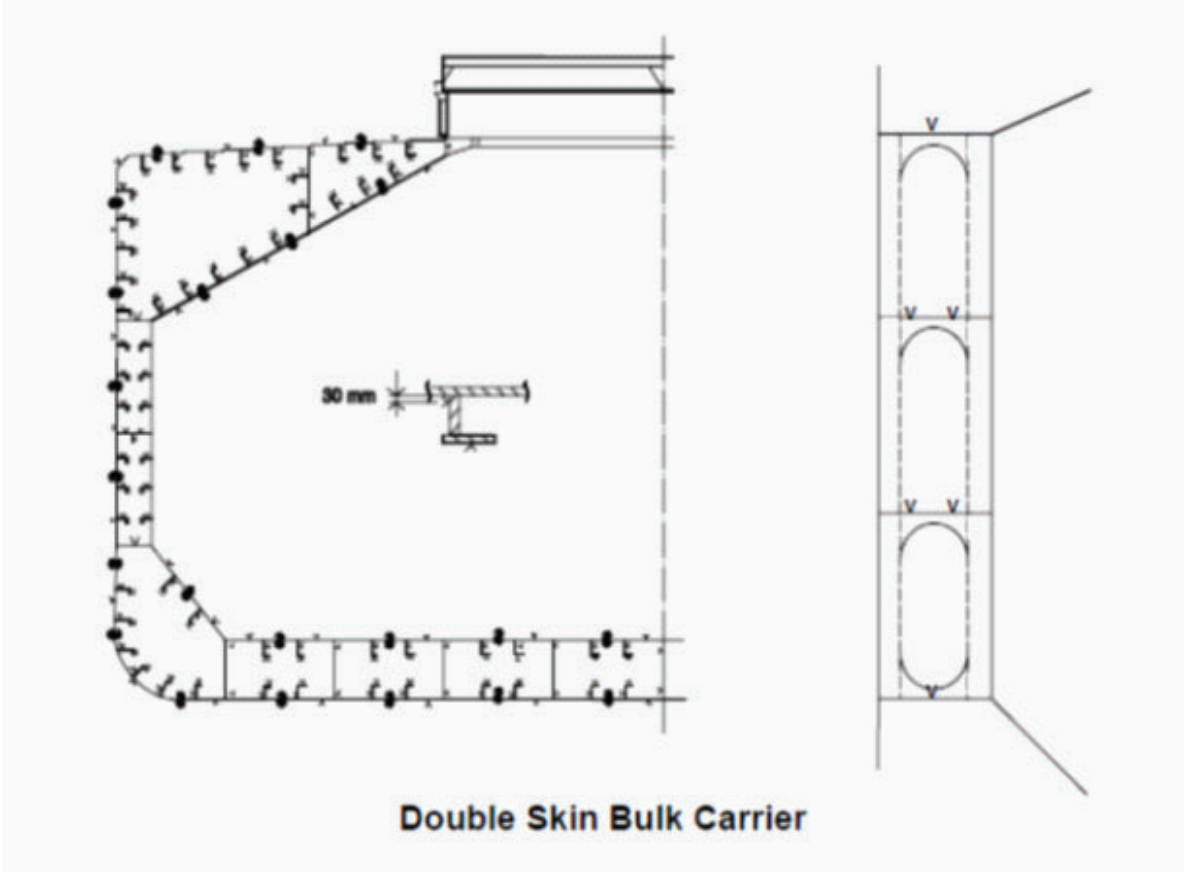
The average thickness across any cross section in the plating is not to be less than the renewal criteria for general corrosion given in Chapter 13 of the “Common Structural Rules for Bulk Carriers" or Part 1 Ch 13 of "Common Structural Rules for Bulk Carriers and Oil Tankers".

Table 3 : Interpretations of rule requirements for the locations and number of points to be measured for CSR bulk carriers (double skin) *(1/7/2012)*

Item	Interpretation	Figure reference
Selected plates on deck, tank top, bottom, double bottom and wind-and-water area	"Selected" means at least a single point on one out of three plates, to be chosen on representative areas of average corrosion	
All deck, tank top and bottom plates and wind-and-water strakes	At least two points on each plate to be taken either at each 1/4 extremity of plate or at representative areas of average corrosion	
Transverse section	A transverse section includes all longitudinal members such as plating, longitudinals and girders at the deck, sides, bottom, inner bottom, hopper sides, inner sides and top wing inner sides.	Fig 7
All cargo hold hatch covers and coamings	Including plates and stiffeners	Locations of points are given in Fig 8
Transverse section of deck plating outside line of cargo hatch openings	Two single points on each deck plate (to be taken either at each 1/4 extremity of plate or at representative areas of average corrosion) between the ship sides and hatch coamings in the transverse section concerned	
All deck plating and underdeck structure inside line of hatch openings between cargo hold hatches	"All deck plating" means at least two points on each plate to be taken either at each 1/4 extremity of plate or at representative areas of average corrosion. "Under deck structure": at each short longitudinal girder: three points for web plating (fwd/middle/aft), single point for face plate, one point for web plating and one point for face plating of transverse beam in way. At each ends of transverse beams, one point for web plating and one point for face plating	Extent of areas is shown in Ch 4, Sec 9, Fig 1 Locations of points are given in Fig 12
Transverse frame in double skin tank		Fig 7
Transverse bulkheads in cargo holds	Includes bulkhead plating, stiffeners and girders, including internal structure of upper and lower stools, where fitted. Two selected bulkheads: one is to be the bulkhead between the two foremost cargo holds and the second may be chosen in other positions	Areas of measurements are shown in Ch 4, Sec 9, Fig 1 Locations of points are given in Fig 10

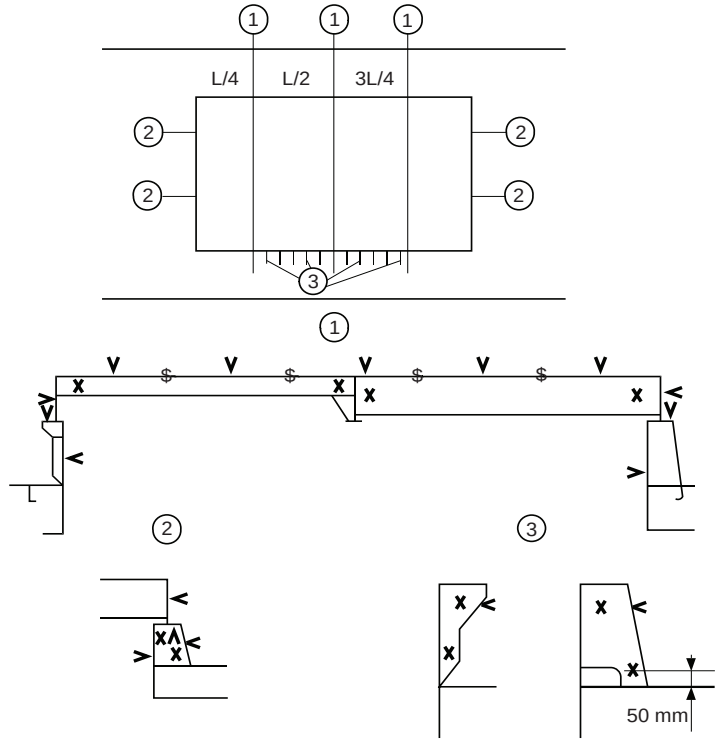
Item	Interpretation	Figure reference
One transverse bulkhead in each cargo hold	This means that the close-up survey and related thickness measurements are to be performed on one side of the bulkhead; the side is to be chosen based on the outcome of the overall survey of both sides. In the event of doubt, the Surveyor may also require (possibly partial) close-up survey on the other side	Areas of measurements are shown in Ch 4, Sec 9, Fig 1 Locations of points are given in Fig 10
Transverse bulkheads in one topside, hopper and double bottom ballast tank	Includes bulkhead and stiffening systems. The ballast tank is to be chosen based on the history of ballasting among those prone to have the most severe conditions	Locations of points are given in Fig 11
Transverse webs in ballast tanks	Includes web plating, face plates, stiffeners and associated plating and longitudinals. One of the representative tanks of each type (i.e. topside or hopper or side tank) is to be chosen in the forward part	Areas of measurements are shown in Ch 4, Sec 9, Fig 1 Locations of points are given in Fig 9

Figure 7 : Transverse section of a double skin bulk carrier *(1/7/2016)*



Note: Measurements are to be taken on both port and starboard sides of the selected transverse section.

Figure 8 : Locations of measurements on hatch covers and coamings *(1/7/2012)*



(1) Three sections at L/4, L/2, 3L/4 of hatch cover length, including:

- one measurement of each hatch cover plate and skirt plate
- measurements of adjacent beams and stiffeners
- one measurement of coaming plates and coaming flange, each side

(2) Measurements of both ends of hatch cover skirt plate, coaming plate and coaming flange

(3) One measurement of one out of three hatch coaming brackets and bars, on both sides and both ends

Figure 9 : Locations of measurements on structural members in ballast tanks of double skin bulk carriers (topside or hopper or side tanks) *(1/7/2016)*

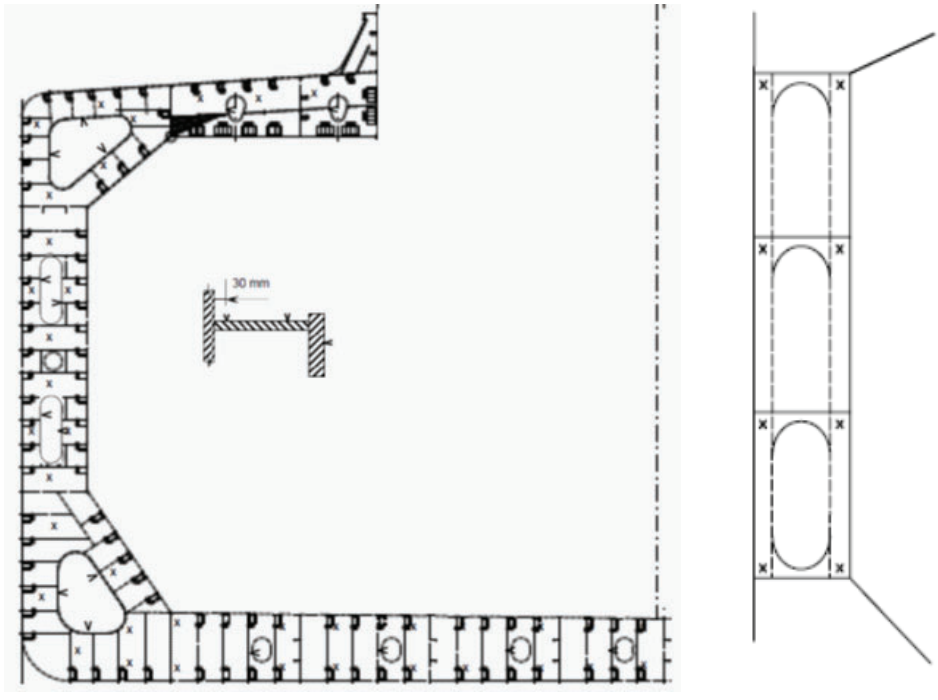
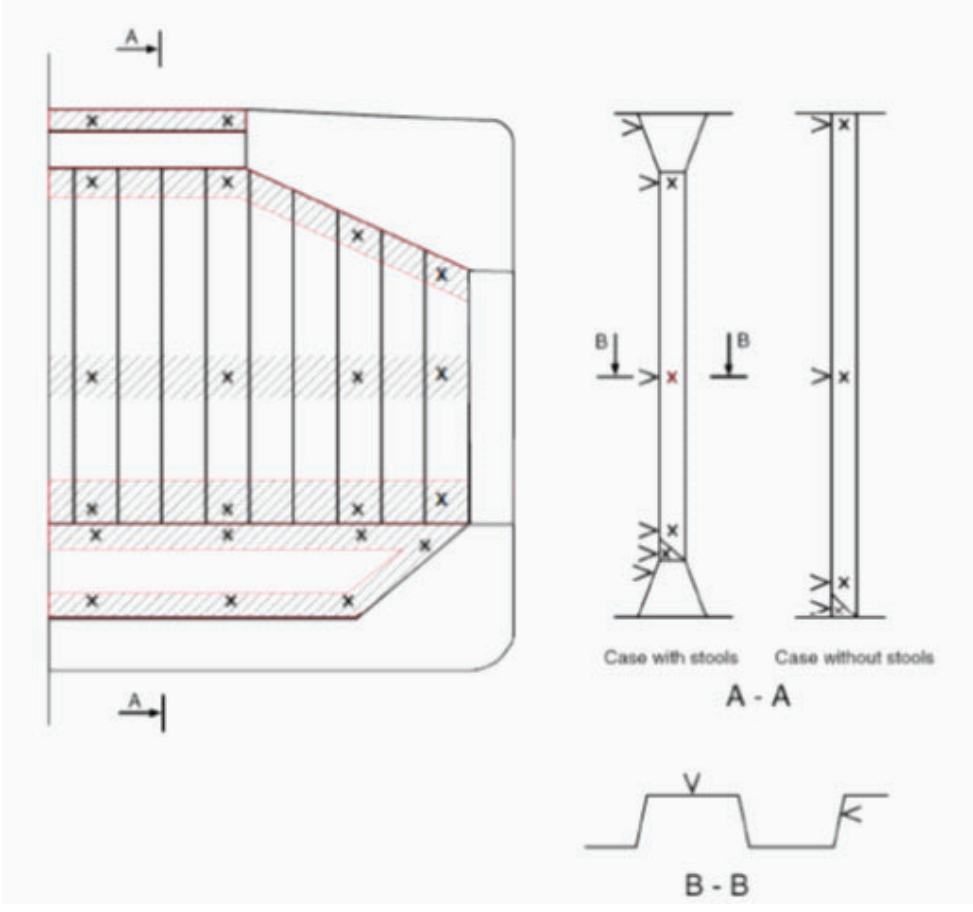
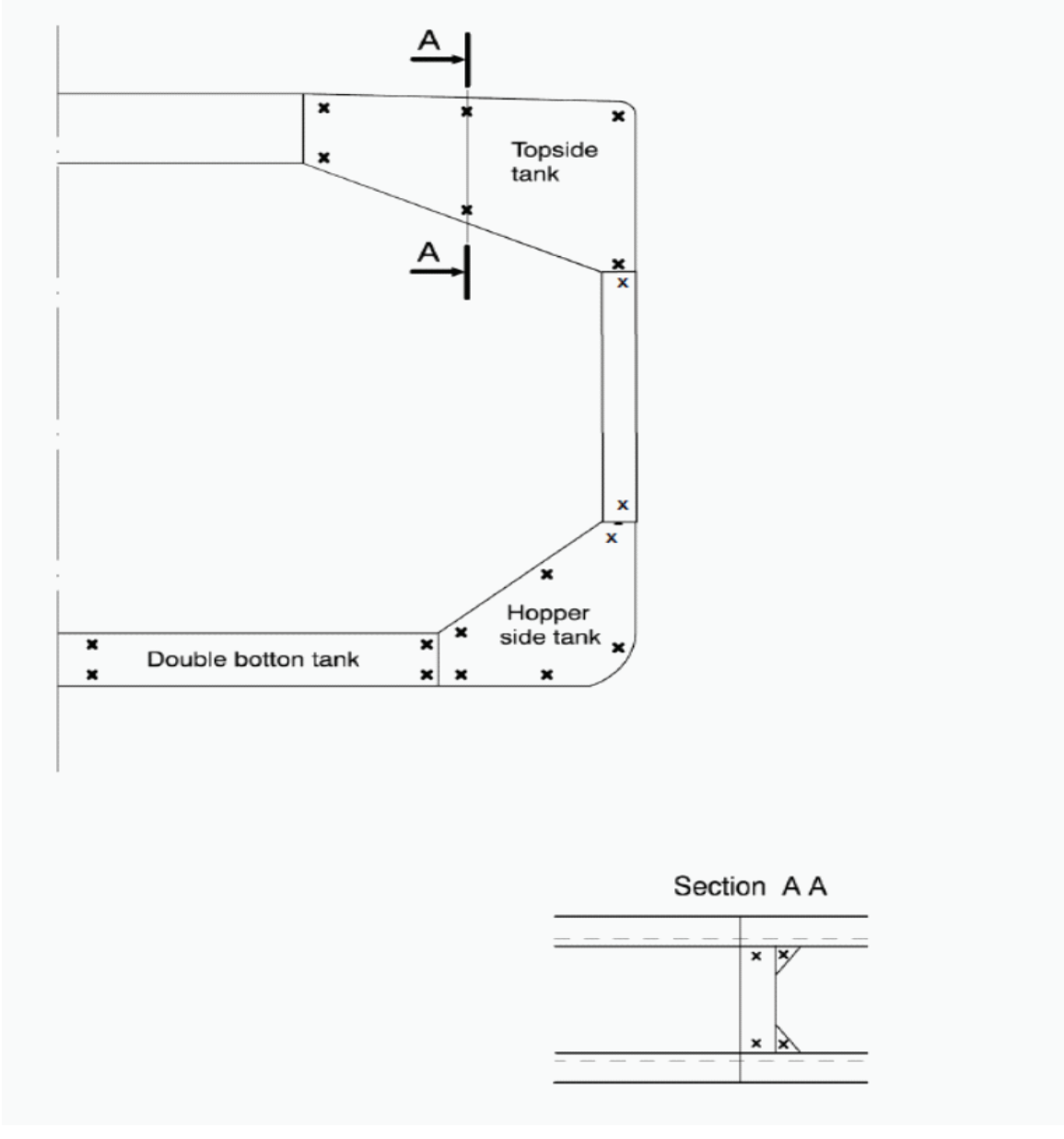


Figure 10 : Locations of measurements on cargo hold transverse bulkheads (additional measurements to internal structure of upper and lower stools to be added, e.g. two points in the upper and two points in the lower stools to be indicated in section A - A) *(1/7/2016)*



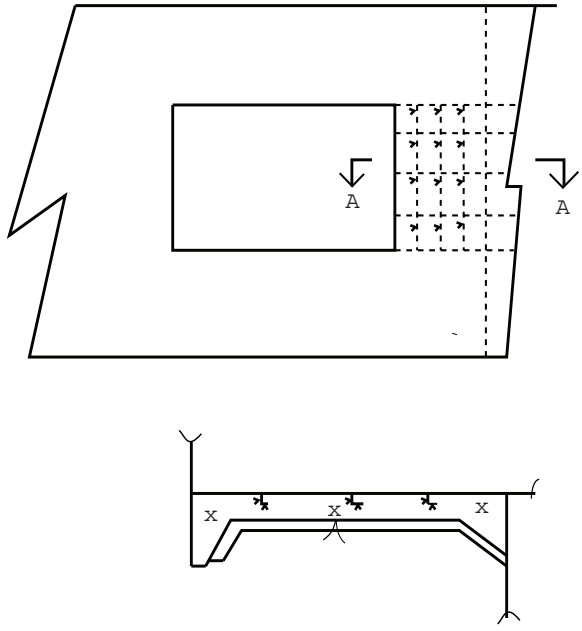
Note: Measurements to be taken in each shaded area as per views A - A and B - B

Figure 11 : Locations of measurements on transverse bulkheads of topside, hopper and double bottom tanks (two additional measurements to internal structure of double bottom tank to be added at midspan) *(1/7/2016)*



Note: Measurements to be taken in each vertical section as per view A - A

Figure 12 : Locations of measurements on underdeck structure *(1/7/2012)*



4.2.3 Acceptance criteria for edge corrosion of CSR ships *(1/1/2019)*

Provided that the overall corroded height of the edge corrosion of the flange, or web in the case of flat bar stiffeners, is less than 25%, see Sec 2, Fig 1, of the stiffener flange breadth or web height, as applicable, the measured thickness, tm, is to meet the lesser of the following criteria:

$t_m \geq 0,7\ (t_{as\text{-}built} - t_{vol\ add})$ mm

$t_m \geq t_{ren} - 1$ mm

The average measured thickness across the breadth or height of the stiffener is not to be less than that defined in Chapter 13 of the "Common Structural Rules for Bulk Carriers" or Part 1 Ch 13 of "Common Structural Rules for Bulk Carriers and Oil Tankers".

Plate edges at openings for manholes, lightening holes etc. may be below the minimum thickness given in Chapter 13 of the "Common Structural Rules for Bulk Carriers" or Part 1 Ch 13 of "Common Structural Rules for Bulk Carriers and Oil Tankers" provided that:

a) the maximum extent of the reduced plate thickness, below the minimum given in Chapter 13 of the "Common Structural Rules for Bulk Carriers" or Part 1 Ch 13 of "Common Structural Rules for Bulk Carriers and Oil Tankers", from the opening edge is not more than 20% of the smallest dimension of the opening and does not exceed 100 mm.

b) rough or uneven edges may be cropped-back provided that the maximum dimension of the opening is not increased by more than 10% and the remaining thickness of the new edge is not less than $t_{ren} - 1$ mm.

4.2.4 Acceptance criteria for grooving corrosion of CSR ships *(1/1/2019)*

a) Where the groove breadth is a maximum of 15% of the web height, but not more than 30mm, see Sec 2, Fig 2, the measured thickness, t_m, in the grooved area is to meet the lesser of the following criteria:

$t_m \geq 0,75\ (t_{as\text{-}built} - t_{vol\ add})$ mm

$t_m \geq t_{ren} - 0,5$ mm

but is not to be less than

$t_m = 6$ mm

b) Structural members with areas of grooving greater than those in a) are to be assessed based on the criteria for general corrosion as defined in Chapter 13 of the "Common Structural Rules for Bulk Carriers" or Part 1 Ch 13 of "Common Structural Rules for Bulk Carriers and Oil Tankers" using the average measured thickness across the plating/stiffener.

5 Double hull oil tankers

5.1 Number and locations of measurements

5.1.1 Application *(1/1/2016)*

This item [5] only applies to ships built under the Common Structural Rules of Double Hull Oil Tankers or the "Common Structural Rules for Bulk Carriers and Oil Tankers". For ships not built under the Common Structural Rules, the requirements for number and locations of measurements are according to App 2 or other specific requirements established by the Society.

5.1.2 Number of measurements *(1/7/2012)*

Considering the extent of thickness measurements according to the different structural elements of the ship and surveys (special, intermediate and annual), the locations of the points to be measured are given for the most important items of the structure.

5.1.3 Locations of measurements *(1/7/2012)*

Tab 4 provides explanations and/or interpretations for the application of those requirements indicated in the Rules, which refer to both systematic thickness measurements related to the calculation of global hull girder strength and specific measurements connected to close-up surveys.

Fig 13 to Fig 16 are provided to facilitate the explanations and/or interpretations given in Tab 4, to show typical arrangements of double hull oil tankers.

Table 4 : Interpretations of rule requirements for the locations and number of points to be measured *(1/7/2012)*

Item	Interpretation	Figure reference
Selected plates	"Selected" means at least a single point on one out of three plates, to be chosen on representative areas of average corrosion	
Deck, bottom plates and wind-and-water strakes	At least two points on each plate to be taken either at each 1/4 extremity of plate or at representative areas of average corrosion	
Transverse section	Measurements to be taken on all longitudinal members such as plating, longitudinals and girders at the deck, side, bottom, longitudinal bulkheads, inner bottom and hopper. One point to be taken on each plate. Both web and flange to be measured on longitudinals, if applicable. For tankers older than 10 years of age: within 0,1D (where D is the ship's moulded depth) of the deck and bottom at each transverse section to be measured, every longitudinal and girder is to be measured on the web and face plate, and every plate is to be measured at one point between longitudinals.	Fig 13
Transverse rings (see **(1)**) in cargo and ballast tanks	At least two points on each plate in a staggered pattern and two points on the corresponding flange where applicable. Minimum 4 points on the first plate below deck. Additional points in way of curved parts. At least one point on each of two stiffeners between stringers / longitudinal girders.	Fig 14
Transverse bulkheads in cargo tanks	At least two points on each plate. Minimum 4 points on the first plate below main deck. At least one point on every third stiffener to be taken between each stringer. At least two points on each plate of stringers and girders, and two points on the corresponding flange. Additional points in way of curved part. Two points of each diaphragm plate of stools if fitted.	Fig 15
Note 1: Transverse rings means all transverse material appearing in a cross-section of the ship's hull, in way of a double bottom floor, vertical web and deck transverse (definition from the Common Structural Rules)		

Item	Interpretation	Figure reference
Transverse bulkheads in ballast tanks	At least 4 points on plates between stringers / longitudinal girders, or per plate if stringers / girders not fitted. At least two points on each plate of stringers and girders, and two points on the corresponding flange. Additional points in way of curved part. At least one point on two stiffeners between each stringer / longitudinal girder.	Fig 16
Adjacent structural members	On adjacent structural members one point per plate and one point on every third stiffener / longitudinal.	
Note 1: Transverse rings means all transverse material appearing in a cross-section of the ship's hull, in way of a double bottom floor, vertical web and deck transverse (definition from the Common Structural Rules)		

Figure 13 : Transverse section *(1/7/2012)*

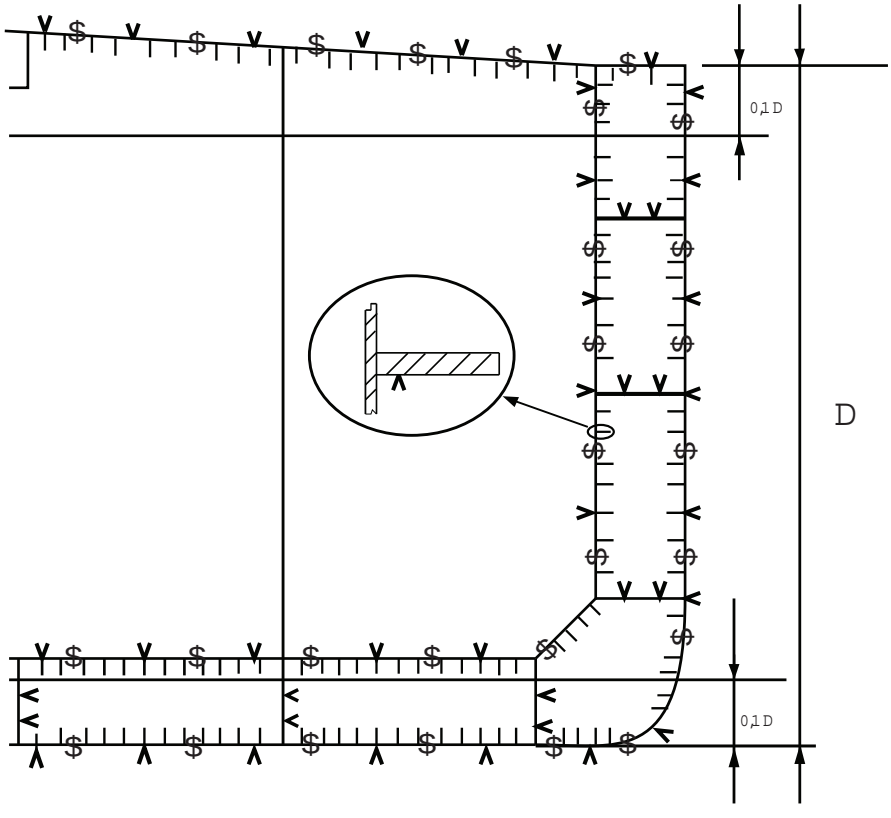


Figure 14 : Transverse rings in cargo and ballast tanks *(1/7/2012)*

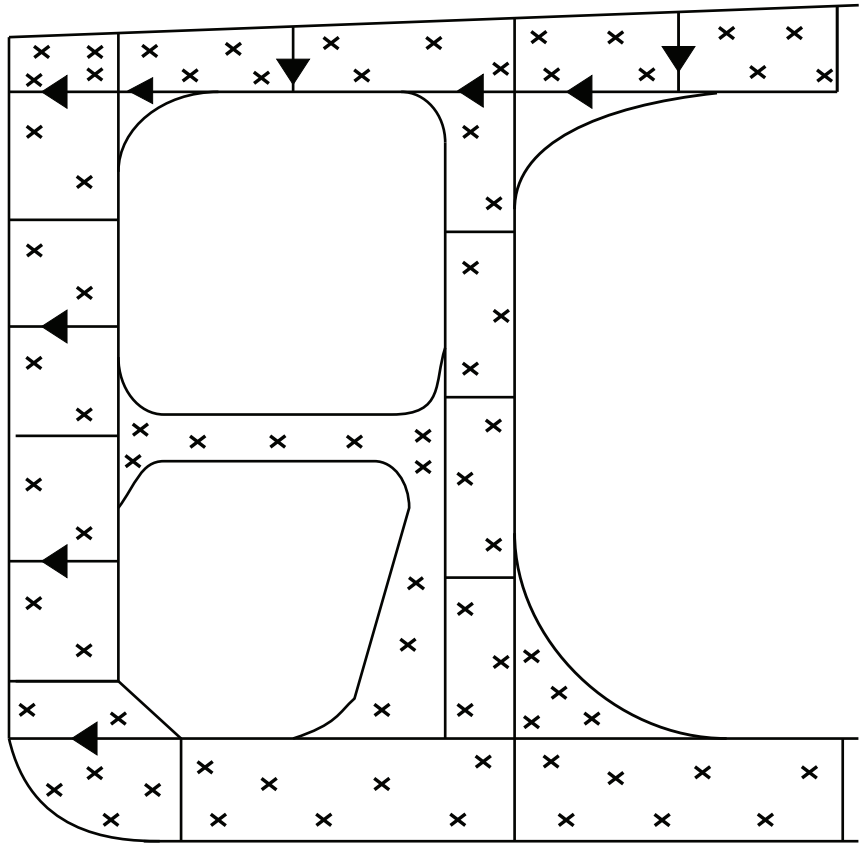


Figure 15 : Transverse bulkheads in cargo tanks *(1/7/2012)*

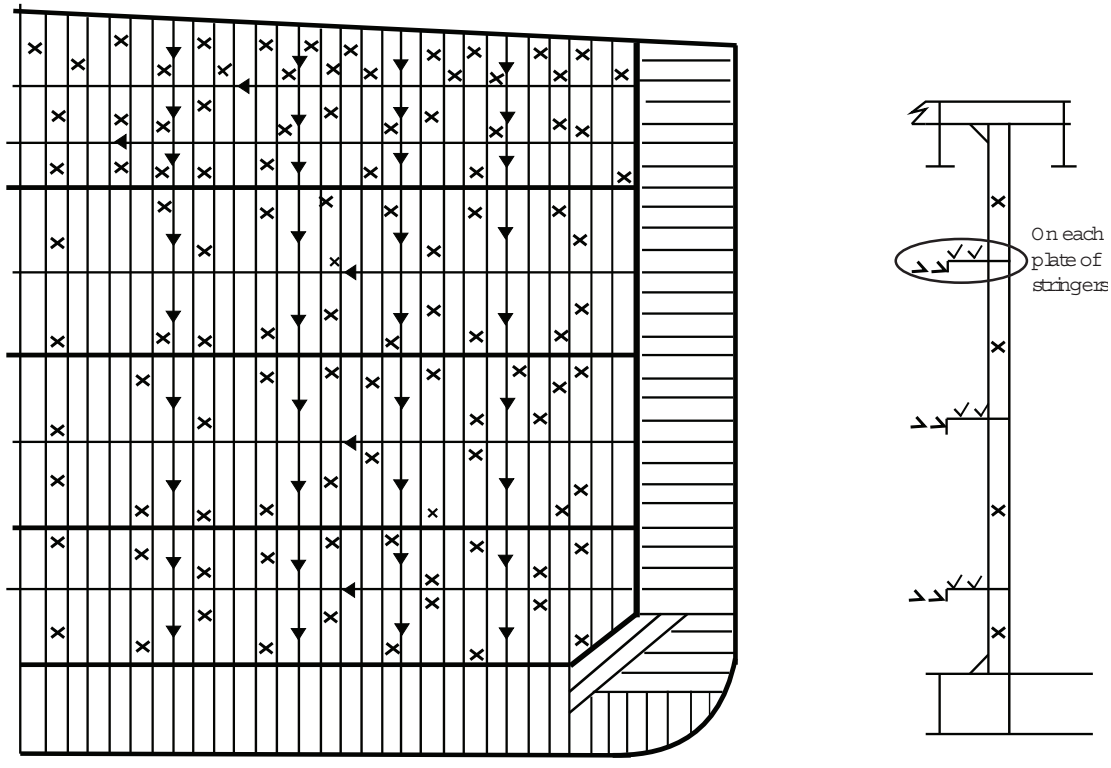
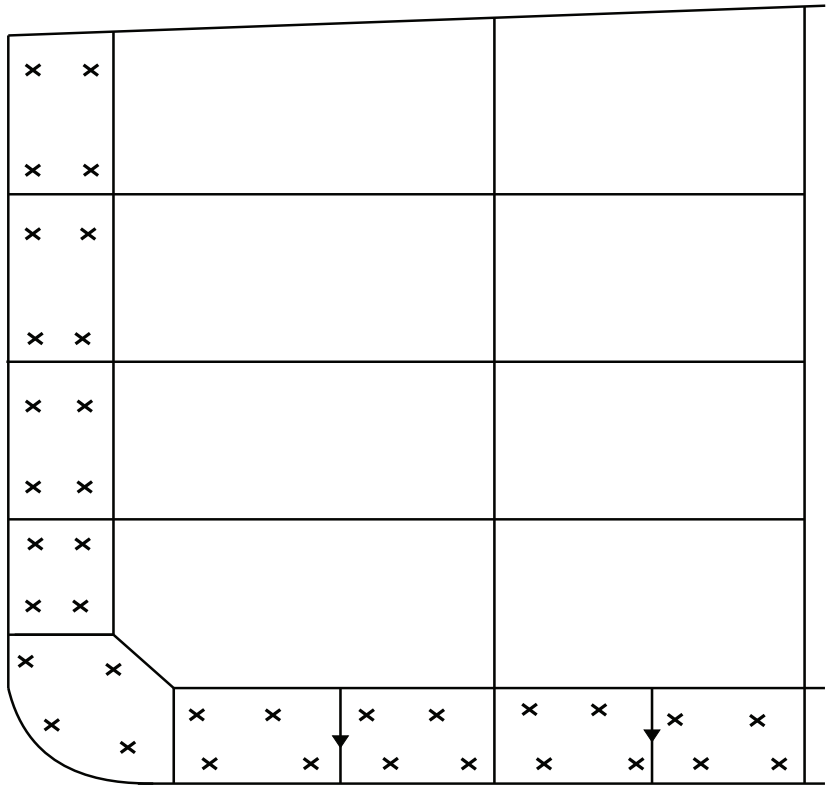


Figure 16 : Transverse bulkheads in ballast tanks *(1/7/2012)*



5.2 Acceptance criteria

5.2.1 General *(1/1/2019)*

For vessels built under the Common Structural Rules, the Acceptance Criteria is according to:

- Section 12 - Ship in Operation Renewal Criteria of the "Common Structural Rules for Double Hull Oil Tankers" for ships having notation "**Oil Tanker ESP CSR - double hull**", contracted for construction on or after 1 April 2006 but before 1 July 2015, or
- Part 1 Chapter 13 of the "Common Structural Rules for Bulk Carriers and Oil Tankers" for ships having notation "**Oil Tanker ESP CSR - double hull**", contracted for construction on or after 1 July 2015

and as specified in [5.2.2], [5.2.3] and [5.2.4].

For ships not built under the Common Structural Rules, the acceptance criteria are according to App 2 or other specific requirements established by the Society

5.2.2 Acceptance criteria for pitting corrosion of CSR ships *(1/1/2019)*

For plates with pitting intensity less than 20%, see App 2, Fig 12, the measured thickness, t_m, in mm, of any individual measurement is to meet the lesser of the following criteria:

$t_m \geq 0,7\ (t_{as\text{-}built} - t_{vol\ add})$

$t_m \geq t_{ren} - 1$

where:

$t_{as\text{-}built}$: As-built thickness of the member, in mm

$t_{vol\ add}$: Voluntary thickness addition; thickness, in mm, voluntarily added as the Owner's extra margin for corrosion wastage in addition to t_C

t_{ren} : Renewal criteria for general corrosion as defined in [1.4.2.1] of Section 12 of "Common Structural Rules for Double Hull Oil Tankers" or [2.1.1] of Section 2 Chapter 13 Part 1 of the "Common Structural Rules for Bulk Carriers and Oil Tankers"

The average thickness across any cross section in the plating is not to be less than the renewal criteria for general corrosion given in [1.4.2.1] of Section 12 of the "Common Structural Rules for Double Hull Oil Tankers" or [2.1.1] of Section 2 Chapter 13 Part 1 of the "Common Structural Rules for Bulk Carriers and Oil Tankers".

5.2.3 Acceptance criteria for edge corrosion of CSR ships *(1/1/2019)*

Provided that the overall corroded height of the edge corrosion of the flange, or web in the case of flat bar stiffeners, is less than 25%, see Sec 2, Fig 1, of the stiffener flange breadth or web height, as applicable, the measured thickness, t_m, in mm, is to meet the lesser of the following criteria:

$t_m \geq 0,7\ (t_{as\text{-}built} - t_{vol\ add})$

$t_m \geq t_{ren} - 1$

where:

$t_{as\text{-}built}$: As-built thickness of the member, in mm

$t_{vol\ add}$: Voluntary thickness addition; thickness, in mm, voluntarily added as the Owner's extra margin for corrosion wastage in addition to t_C

t_{ren} : Renewal criteria for general corrosion as defined in [1.4.2.1] of Section 12 of the "Common Structural Rules for Double Hull Oil Tankers" or [2.1.1] of Section 2 Chapter 13 Part 1 of the "Common Structural Rules for Bulk Carriers and Oil Tankers".

The average measured thickness across the breadth or height of the stiffener is not to be less than that defined in [1.4.2] of Section 12 of the "Common Structural Rules for Double Hull Oil Tankers" or [2.1] of Section 2 Chapter 13 Part 1 of the "Common Structural Rules for Bulk Carriers and Oil Tankers".

Plate edges at openings for manholes, lightening holes etc. may be below the minimum thickness given in [1.4.2] of Section 12 of the "Common Structural Rules for Double Hull Oil Tankers" or [2.1] of Section 2 Chapter 13 Part 1 of the "Common Structural Rules for Bulk Carriers and Oil Tankers" provided that:

a) the maximum extent of the reduced plate thickness, below the minimum given in [1.4.2] of Section 12 of the "Common Structural Rules for Double Hull Oil Tankers" or [2.1] of Section 2 Chapter 13 Part 1 of the "Common Structural Rules for Bulk Carriers and Oil Tankers", from the opening edge is not more than 20% of the smallest dimension of the opening and does not exceed 100 mm

b) rough or uneven edges may be cropped-back provided that the maximum dimension of the opening is not increased by more than 10% and the remaining thickness of the new edge is not less than t_{ren} - 1 mm.

5.2.4 Acceptance criteria for grooving corrosion of CSR ships *(1/1/2019)*

a) Where the groove breadth is a maximum of 15% of the web height, but not more than 30 mm, see Sec 2, Fig 2, the measured thickness, t_m, in mm, in the grooved area is to meet the lesser of the following criteria:

$t_m \geq 0,75\ (t_{as\text{-}built} - t_{vol\ add})$

$t_m \geq t_{ren} - 0,5$

but is not to be less than

$t_m = 6$ mm

where:

$t_{as\text{-}built}$: As-built thickness of the member, in mm

$t_{vol\ add}$: Voluntary thickness addition; thickness, in mm, voluntarily added as the Owner's extra margin for corrosion wastage in addition to t_C

t_{ren} : Renewal criteria for general corrosion as defined in [1.4.2.1] of Section 12 of "Common Structural Rules for Double Hull Oil Tankers" or [2.1.1] of Section 2 Chapter 13 Part 1 of the "Common Structural Rules for Bulk Carriers and Oil Tankers".

b) Structural members with areas of grooving greater than those in a) are to be assessed based on the criteria for general corrosion as defined in [1.4.2] of Section 12 of the "Common Structural Rules for Double Hull Oil Tankers" or [2.1] of Section 2 Chapter 13 Part 1 of the "Common Structural Rules for Bulk Carriers and Oil Tankers" using the average measured thickness across the plating/stiffener.