

## Chapter 13 SHIPS IN OPERATION, RENEWAL CRITERIA

### Section 1 MAINTENANCE OF CLASS

#### 1. General

##### 1.1 Application

###### 1.1.1

The survey requirements for the maintenance of class of bulk carriers are given in *UR Z10.2* for single side skin bulk carriers and *UR Z10.5* for double side skin bulk carriers.

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

This Chapter is intended to provide Owners, companies performing thickness measurements and Society's Surveyors with a uniform procedure in order to fulfill 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
- the analysis

of the thickness measurements.

###### 1.1.3

This Chapter also takes into account specific requirements for thickness measurements relevant to close-up surveys within the scope of the Enhanced Survey Program (*ESP*) of single side skin bulk carriers and double side skin bulk carriers.

##### 1.2 Definitions

###### 1.2.1 Local corrosion

Local corrosion is pitting corrosion, grooving, edge corrosion, necking effect or other corrosions of very local aspect.

###### 1.2.2 Substantial corrosion

Substantial corrosion is an extent of corrosion such that assessment of the corrosion pattern indicates a wastage in excess of 75% of allowable margins but within acceptable limits.

The allowable margin is the total corrosion addition  $t_C$ , as defined in **Ch 3, Sec 2**, adding  $t_{voluntary\_addition}$ , as defined in **Ch 3, Sec 2**, if any.

## Section 2 THICKNESS MEASUREMENTS AND ACCEPTANCE CRITERIA

### Symbols

For symbols not defined in this Section, refer to **Ch 1, Sec 4**.

- $t_{renewal}$  : *Renewal thickness*; Minimum allowable thickness, in *mm*, below which renewal of structural members is to be carried out
- $$t_{renewal} = t_{as\_built} - t_C - t_{voluntary\_addition}$$
- $t_{reserve}$  : Reserve thickness; Thickness, in *mm*, to account for anticipated thickness diminution that may occur during a survey interval of 2.5 *year*. ( $t_{reserve} = 0.5\text{ mm}$ )
- $t_C$  : Corrosion addition, in *mm*, defined in **Ch 3, Sec3**
- $t_{as\_built}$  : As built thickness, in *mm*, including  $t_{voluntary\_addition}$ , if any
- $t_{voluntary\_addition}$  : Voluntary thickness addition; Thickness, in *mm*, voluntarily added as the Owner's extra margin for corrosion wastage in addition to  $t_C$
- $t_{gauged}$  : Gauged 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.

### 1. Application

#### 1.1 General

##### 1.1.1

This section provides the following information:

- references to rule requirements and some additional information on the extent of the thickness measurements to be performed during surveys (see **2.1** and **2.2**)
- locations of the measurements for the main parts of the ship (see **2.3**)
- how to apply the acceptance criteria (see **3**).

Tables are also given to detail the above items. The sketches are given as an example to illustrate the requirements.

### 2. Rule requirements for the extent of measurements and the determination of locations

#### 2.1 General

##### 2.1.1

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

**Table 1** gives the references to the minimum requirements for thickness measurements related to the different types of surveys.

Table 1 References to rule requirements related to thickness measurements

Class renewal survey	Intermediate survey	Annual survey
<p><u>Outside the cargo length area:</u>  <i>UR Z7:</i>                      systematic measurements and suspect areas.                      where substantial corrosion is found, the extent of thickness measurements may be increased to the Surveyor's satisfaction.</p>	<p><u>Outside the cargo length area:</u>  <i>UR Z7:</i>                      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.</p>	<p><u>Outside the cargo length area:</u>  <i>UR Z7:</i>                      areas of substantial corrosion identified at previous class renewal or intermediate surveys;                      where substantial corrosion is found, the extent of thickness measurements may be increased to the Surveyor's satisfaction.</p>
<p><u>Within the cargo length area:</u>                      a) <u>single side skin bulk carriers:</u>  <i>UR Z10.2:</i>                      planning and general requirements                      measurements of elements                      subjected to close-up survey                      extent of systematic thickness measurements                      according to the different locations,                      where substantial corrosion is found</p> <p>b) <u>double side skin bulk carriers:</u>  <i>UR Z10.5:</i>                      planning and general requirements                      measurements of elements                      subjected to close-up survey                      extent of systematic thickness measurements                      according to the different locations,                      where substantial corrosion is found</p>	<p><u>Within the cargo length area:</u>                      a) <u>single side skin bulk carriers:</u>  <i>UR Z10.2:</i>  <i>Ships 10 years of age or less:</i>                      for cargo holds                      for salt ballast tanks                      according to the different locations,                      where substantial corrosion is found  <i>Ships over 10 years of age:</i>                      see references given for class renewal survey                      according to the different locations,                      where substantial corrosion is found</p> <p>b) <u>double side skin bulk carriers:</u>  <i>UR Z10.5:</i>  <i>Ships 10 years of age or less:</i>                      for cargo holds                      for salt ballast tanks                      according to the different locations,                      where substantial corrosion is found  <i>Ships over 10 years of age:</i>                      see references given for class renewal survey                      according to the different locations,                      where substantial corrosion is found</p>	<p><u>Within the cargo length area:</u>                      a) <u>single side skin bulk carriers:</u>  <i>UR Z10.2:</i>                      for cargo holds and when deemed necessary by the Surveyor                      for salt ballast tanks and when deemed necessary by the Surveyor                      according to the different locations,                      where substantial corrosion is found</p> <p>b) <u>double side skin bulk carriers:</u>  <i>UR Z10.5:</i>                      for cargo holds and when deemed necessary by the Surveyor                      for salt ballast tanks and when deemed necessary by the Surveyor                      according to the different locations,                      where substantial corrosion is found</p>

## 2.2 Class renewal survey

### 2.2.1

The thickness measurements required by the Rules consist of:

- systematic thickness measurements in order to assess the global and local strength of the ship
- thickness measurements as indicated in the program of close-up survey
- measurements of elements considered as suspect areas
- additional measurements on areas determined as affected by substantial corrosion.

### 2.2.2

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 related requirements of **Part B** and the relevant Sections of the following *IACS* Unified Requirements:

- for the hull structure and piping systems in way of cargo holds, cofferdams, pipe tunnels, void spaces and fuel oil tanks within the cargo length area and all ballast tanks:
  - *UR Z10.2* "Hull surveys of single skin bulk carriers"

- UR Z10.5 “Hull surveys of double skin bulk carriers”
- for the remainder of the ship outside the cargo length area:
  - UR Z7.

### 2.3 Number and locations of measurements

#### 2.3.1 Number of measurements

Considering the extent of thickness measurements as required by the Rules and indicated in 2.1 and 2.2, the locations of the points to be measured are given for the most important items of the structure.

#### 2.3.2 Locations of measurements

**Table 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.

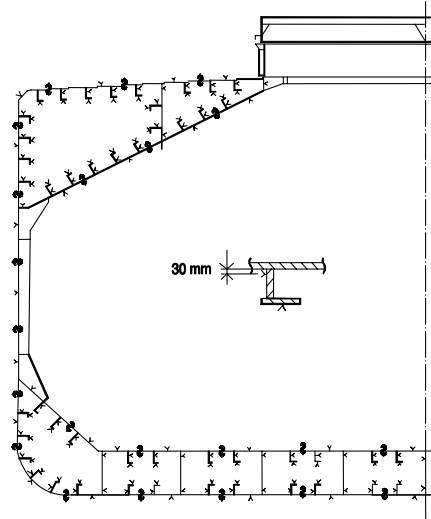
**Fig. 1** to **Fig. 5** are provided to facilitate the explanations and/or interpretations given in **Table 2**, to show typical arrangements of single side skin bulk carriers and double side skin bulk carriers.

Table 2 Interpretations of rule requirements for the locations and number of points to be measured

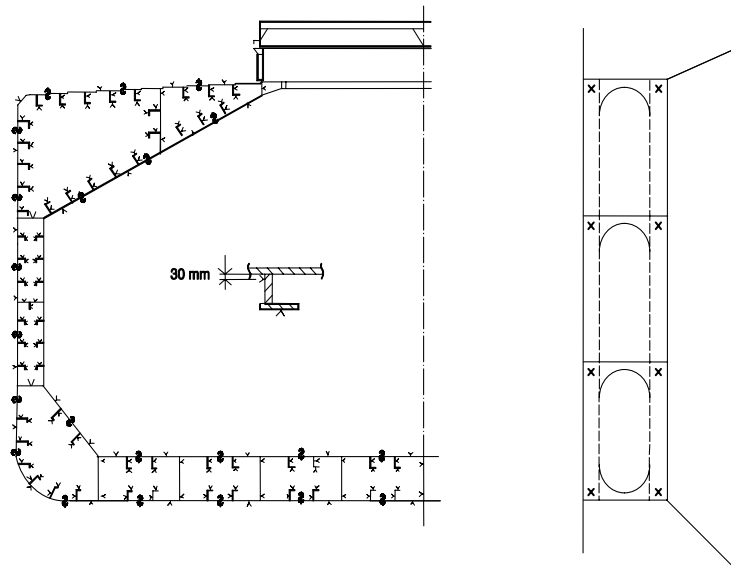
Item	Interpretation	Figure reference
Selected plates on deck, tank top, bottom, double bottom and wind-and-water area	«Selected» means at least a single point on one out of three plates, to be chosen on representative areas of average corrosion	
All deck, tank top and bottom plates and wind-and-water 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	<p><i>Single side skin bulk carrier:</i> A transverse section includes all longitudinal members such as plating, longitudinals and girders at the deck, side, bottom, inner bottom, hopper sides and top wing inner sides.</p> <p><i>Double side skin bulk carrier:</i> 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.</p>	<b>Fig 1</b> for single and double side skin bulk carriers
Cargo hold hatch covers and coamings		<b>Fig 2</b>
Selected internal structure such as floors and longitudinals, transverse frames, web frames, deck beams, girders	The internal structural items to be measured in each space internally surveyed are to be at least 10% outside the cargo length area	
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	

Item	Interpretation	Figure reference
Selected areas of all 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 in <i>UR Z10.2</i> for single side skin bulk carriers and <i>UR Z10.5</i> for double side skin bulk carriers
Selected side shell frames in cargo holds for single side skin bulk carriers	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 in <i>UR Z10.2</i> for single side skin bulk carriers. Locations of points are given in <b>Fig 3</b> for single side skin bulk carriers
Transverse frame in double skin tank		<b>Fig 1</b>
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 <i>UR Z10.2</i> for single side skin bulk carriers and <i>UR Z10.5</i> for double side skin bulk carriers. Locations of points are given in <b>Fig 4</b> .
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 <i>UR Z10.2</i> for single side skin bulk carriers and <i>UR Z10.5</i> for double side skin bulk carriers. Locations of points are given in <b>Fig 4</b> .
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 <b>Fig 5</b>
Transverse webs in ballast tanks	One of the representative tanks of each type (i.e. topside or hopper or side tank) is to be chosen in the forward part	Extent of areas is shown in <i>UR Z10.2</i> for single side skin bulk carriers and in <i>UR Z10.5</i> for double side skin bulk carriers. Locations of points are given in <b>Fig 3</b> .

Fig. 1 Transverse section of bulk carrier



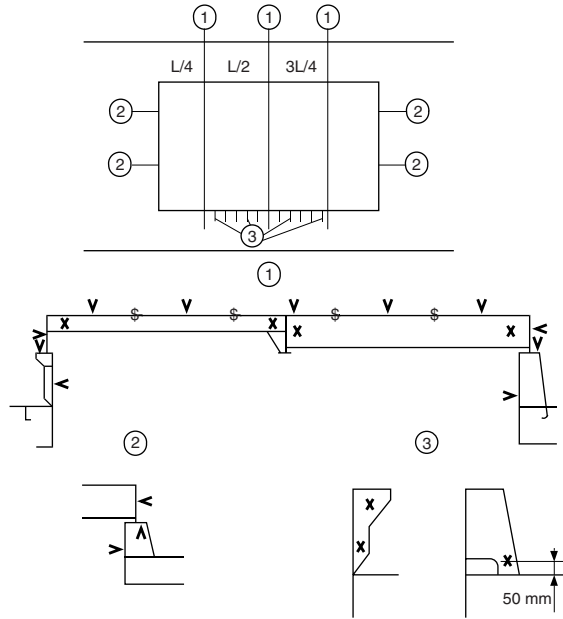
**Single side bulk carriers**



**Double side bulk carrier**

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

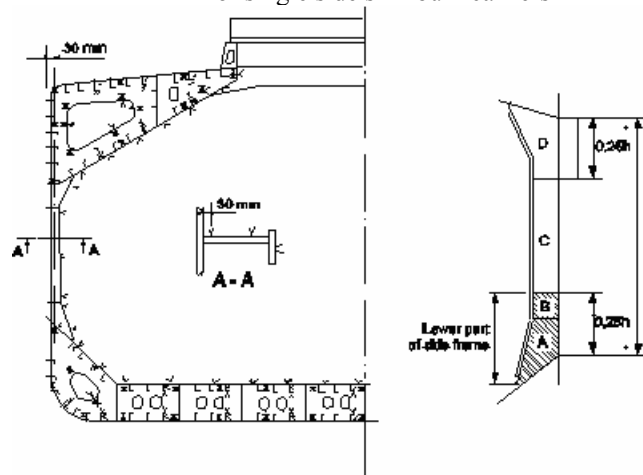
Fig. 2 Locations of measurements on hatch covers and coamings



Notes :

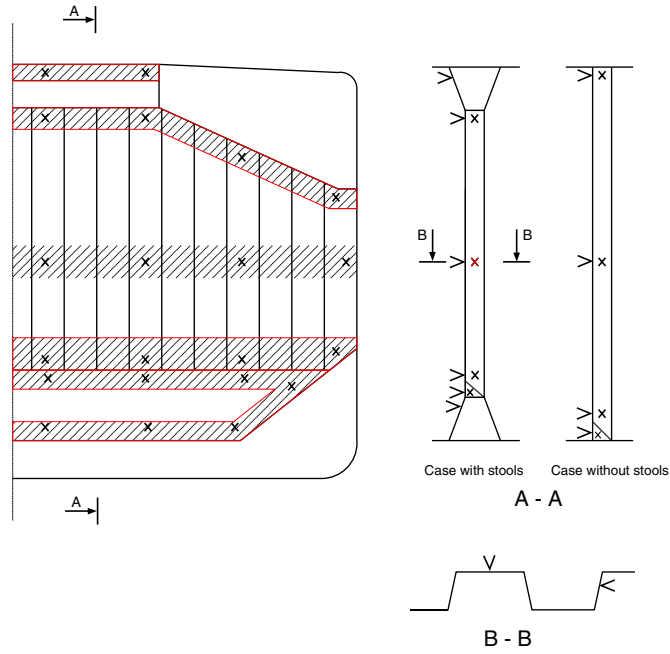
1. Three sections at  $L/4$ ,  $L/2$ ,  $3L/4$  of hatch cover length, including:
  - one measurement of each hatch cover plate and skirt plate
  - measurements of adjacent beams and stiffeners
  - one measurement of coaming plates and coaming flange, each side
2. Measurements of both ends of hatch cover 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

Fig. 3 Locations of measurements on structural members in cargo holds and ballast tanks of single side skin bulk carriers



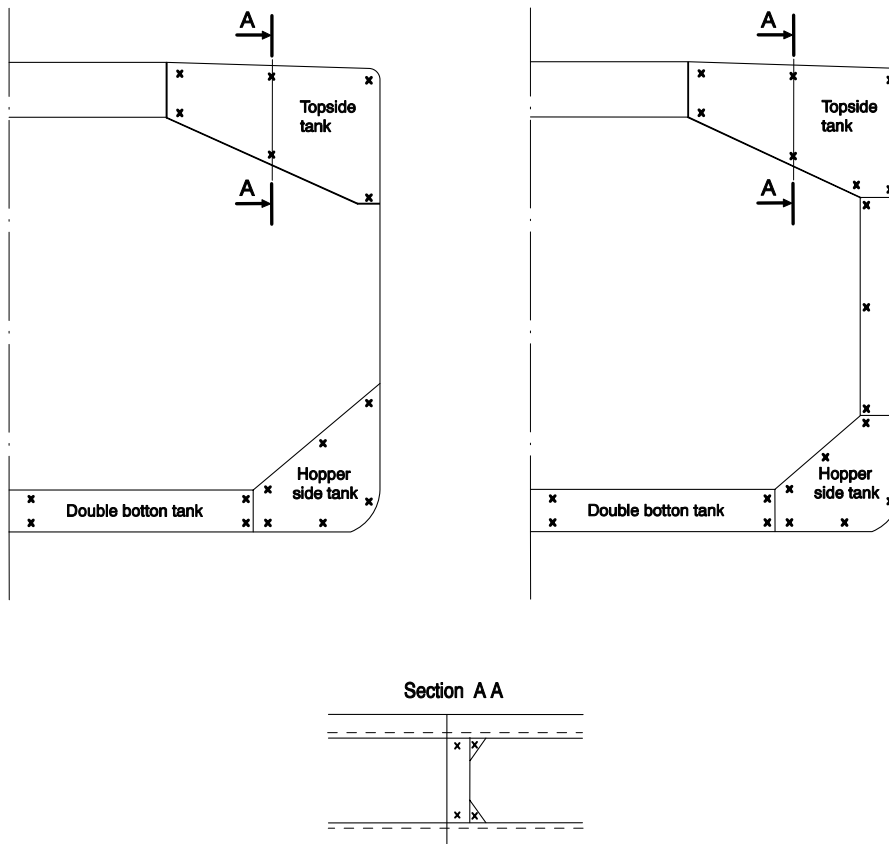
Note : The gauging pattern for web plating is to be a three point pattern for zones A, C and D, and a two point pattern for zone B (see figure). The gauging report is to reflect the average reading. The average reading is to be compared with the allowable thickness. If the web plating has general corrosion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

Fig. 4 Locations of measurements on cargo hold transverse bulkheads



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

Fig. 5 Locations of measurements on transverse bulkheads of topside, hopper, double hull and double bottom tanks



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

### **3. Acceptance Criteria**

#### **3.1 Definitions**

##### **3.1.1 Deck zone**

The deck zone includes all the following items contributing to the hull girder strength above the horizontal strake of the topside tank or above the level corresponding to  $0.9D$  above the base line if there is no topside tank:

- strength deck plating
- deck stringer
- sheer strake
- side shell plating
- top side tank sloped plating, including horizontal and vertical strakes
- longitudinal stiffeners connected to the above mentioned platings.

##### **3.1.2 Bottom zone**

The bottom zone includes the following items contributing to the hull girder strength up to the upper level of the hopper sloping plating or up to the inner bottom plating if there is no hopper tank:

- keel plate
- bottom plating
- bilge plate
- bottom girders
- inner bottom plating
- hopper tank sloping plating
- side shell plating
- longitudinal stiffeners connected to the above mentioned platings.

##### **3.1.3 Neutral axis zone**

The neutral axis zone includes the plating only of the items between the deck zone and the bottom zone, as for example:

- side shell plating
- inner hull plating, if any

#### **3.2 Local strength criteria**

##### **3.2.1 Items for the local strength criteria**

The items to be considered for the local strength criteria are those of the deck zone, the bottom zone and the neutral axis zone, as defined in **3.1**, and the additional following items:

- hatch coaming plating
- hatch coaming brackets
- hatch cover top plating
- hatch cover skirt plating
- hatch cover stiffeners
- transverse bulkheads plating
- transverse bulkheads stiffener web
- transverse bulkheads stiffener flange
- side shell frames web
- side shell frames flange
- side shell frames brackets
- web of topside and hopper tank web frames
- flange of topside and hopper tank web frames
- floors plating and stiffeners
- forward and aft peak bulkheads plating
- forward and aft peak bulkheads stiffener web
- forward and aft peak bulkheads stiffener flange
- stringers and girders.

### 3.2.2 Renewal thickness for corrosion other than local corrosion

For each item, steel renewal is required when the gauged thickness  $t_{gauged}$  is less than the renewal thickness, as specified in the following formula:

$$t_{gauged} < t_{renewal},$$

Where the gauged thickness  $t_{gauged}$  is such as:

$$t_{renewal} < t_{gauged} < t_{renewal} + t_{reserve}$$

coating applied in accordance with the coating manufacturer's requirements or annual gauging may be adopted as an alternative to the steel renewal. The coating is to be maintained in good condition.

### 3.2.3 Renewal thickness for local corrosion

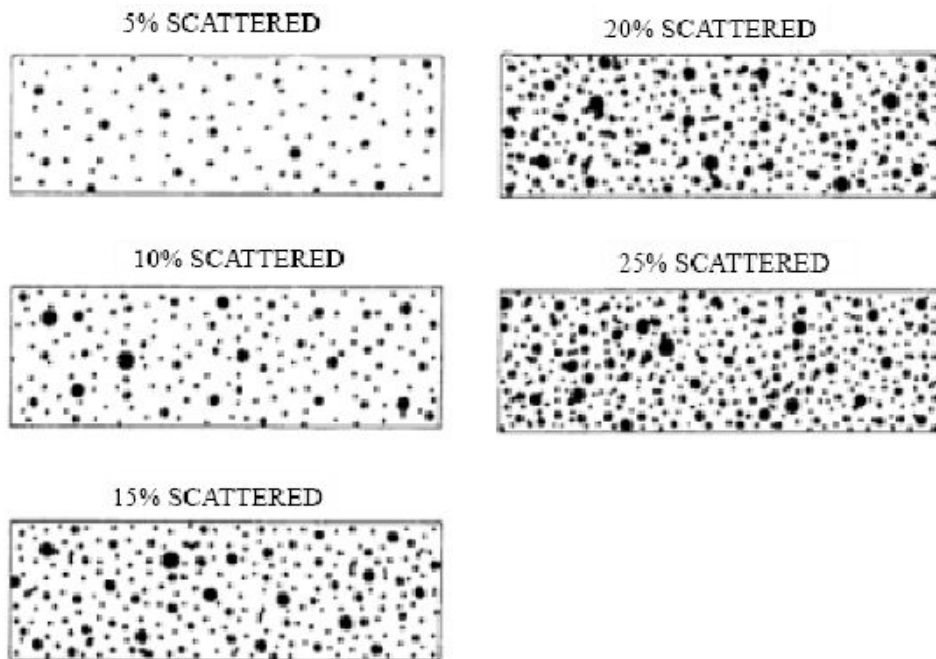
If pitting intensity in an area where coating is required, according to **Ch 3, Sec 5**, is higher than 15% (see **Fig 6**), thickness measurements are to be performed to check the extent of pitting corrosion. The 15% is based on pitting or grooving on only one side of a plate.

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 as defined in **Ch 13, Sec1, 1.2.1** is to be greater than:

- 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, without being greater than  $t_{renewal}$ .

Fig. 6 Pitting intensity diagrams (from 5% to 25% intensity)



## 3.3 Global strength criteria

### 3.3.1 Items for the global strength criteria

The items to be considered for the global strength criteria are those of the deck zone, the bottom zone and the neutral axis zone, as defined in **3.1**.

### 3.3.2 Renewal thickness

The global strength criteria is defined by the assessment of the bottom zone, deck zone and neutral axis zone, as detailed below.

a) bottom zone and deck zone:

The current hull girder section modulus determined with the thickness measurements is not to be less than 90% of the section modulus calculated according to **Ch 5, Sec 1** with the gross offered thicknesses.

Alternatively, the current sectional areas of the bottom zone and of the deck zone which are the sum of the gauged items area of the considered zones, are not to be less than 90% of the sectional area of the corresponding zones determined with the gross offered thicknesses.

b) neutral axis zone:

The current sectional area of the neutral axis zone, which is the sum of the gauged platings area of this zone, is not to be less than 85% of the gross offered sectional area of the neutral axis zone.

If the actual wastage of all items, of a given transverse section, which contribute to the hull girder strength is less than 10% for the deck and bottom zones and 15% for the neutral axis zone, the global strength criteria of this transverse section is automatically satisfied and its checking is no more required.