

## PART 2

### STRENGTH, CONSTRUCTION AND WATERTIGHT SUBDIVISION

#### 2.1 Definitions (Regulation 2)

The following notes are for the guidance of surveyors in the interpretation of the definitions of terms given in Regulation 2(2) of Part 1 of the Regulations when calculating the maximum length of watertight compartments in accordance with Schedule 2 to Merchant Shipping Notice MSN 1698 (M).

##### 2.1.1 Machinery space

In the case of unusual arrangements, the MCA shall advise ship owners and shipbuilders of the limits of the machinery space to be taken for the purpose of the Regulations.

##### 2.1.2 Margin line

2.1.2.1 For a ship which has a continuous bulkhead deck, the margin line is to be taken as a line drawn not less than 76 mm below the upper surface of the bulkhead deck at side, except that where there is a variation in the thickness of the bulkhead deck at side the upper surface of the deck should be taken at the least thickness of deck at side above the beam. If desired however, the upper surface of the deck may be taken at the mean thickness of the deck at side above the beam as calculated for the whole length of the deck, provided that the thickness is no greater than the least thickness plus 50 mm. See figure 2.1.2.1 a) and 2.1.2.1 b).

2.1.2.2 In the case of Ro-Ro ferries where the vehicle deck slopes downward forward of the collision bulkhead the margin line abaft the collision bulkhead may be carried forward as an assumed line above the rammed portion of the vehicle deck. See figure 2.1.2.2.

2.1.2.3 (i) If the bulkhead deck is not continuous, a margin line should be assumed which is at no point less than 76 mm below the upper surface of the deck at side to which the bulkheads concerned and the shell plating are carried watertight, special attention being given to the provisions of paragraph 6(1)(d) of Section 2 of Schedule 2 to Merchant Shipping Notice MSN 1698 (M). See figure 2.1.2.3.

(ii) Where a portion of an assumed margin line is appreciably below the deck to which bulkheads are carried, a limited relaxation may be permitted in the watertightness of those portions of the bulkheads which are above the margin line and immediately under the higher deck.

2.1.2.4 Where the bulkhead deck is stepped, as shown in figure 2.1.2.4, either level may be used as that from which the margin line is measured. If the lower level "A" is used the line of the bulkhead, and margin line, is projected to the shell. However, if the higher level "B" is adopted, the shaded portion shown must also be considered flooded for the purpose of satisfying subdivision (floodable length).

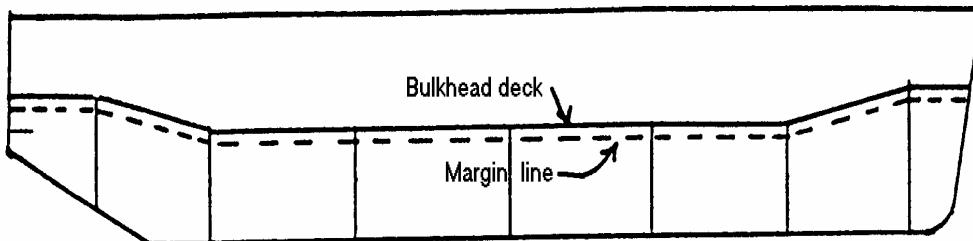


figure 2.1.2.1 a)

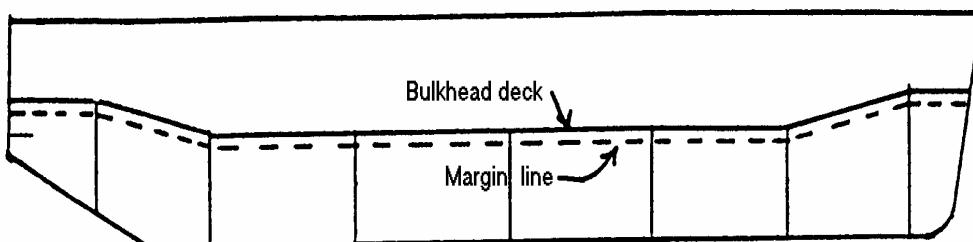


figure 2.1.2.1 b)

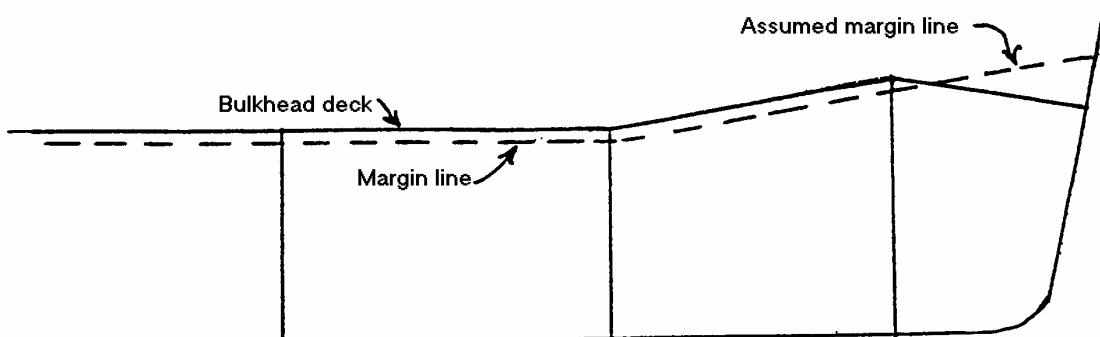


figure 2.1.2.2

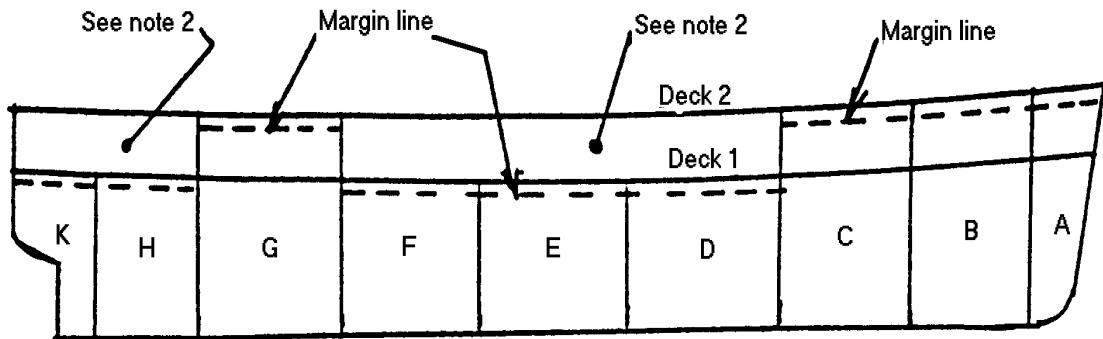


figure 2.1.2.3

.1 For compartments A, B, C and G the margin line derived from Deck 2 may be used. For the remaining compartments the margin line derived from Deck 1 is to be used. The combined lengths C and D, F and G, and G and H are each not to exceed the permissible length determined by reference to the Deck 1 margin line.

.2 Openings in the shell plating below Deck 2 in these areas of the ship are to comply with Regulation 16.

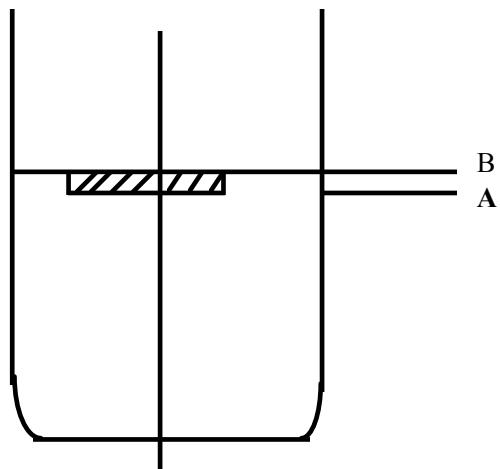


figure 2.1.2.4

### **2.1.3 Passenger space**

Surveyors should note that as indicated in paragraph 1(4) of Section 1 of Schedule 2 to Merchant Shipping Notice MSN 1698 (M), the expression "passenger space" includes galleys, laundries and other similar spaces provided for the service of passengers, in addition to space provided for the use of passengers, but excludes baggage, store, provisions and mail rooms.

### **2.2 Application (Regulation 3)**

It is to be noted that if a ship has certification as a Passenger Ship only, the requirements of the regulations are still to be complied with even when, for the time being, it may be carrying less than 13 passengers. The exception to this is when the ship is also certificated other than as a passenger ship.

### **2.3 Exemptions (Regulation 4)**

Pleasure vessels will only be considered for exemption on an individual case basis.

### **2.4 Strength of the Hull (Regulation 7)**

The structural plans and particulars are dealt with in paragraph 1.1.2.1 of these Instructions.

### **2.5 Watertight Subdivision (Regulation 8)**

#### **2.5.1 Floodable length**

2.5.1.1 To enable the permissible length of compartments to be determined in accordance with Section 2 of Schedule 2 to Merchant Shipping Notice MSN 1698 (M), it is necessary to develop flooding curves which will indicate the floodable length at any point in the ship's length. Flooding curves should be developed by a method of calculation which takes into account the form, draught and other characteristics of the ship in question.

2.5.1.2 Alternatively, equivalent damage calculations may be accepted in lieu of the calculations referred to in 2.5.1.1.

2.5.1.3 Where any arrangement proposed includes the provision of a long compartment inboard of longitudinal bulkheads situated below the bulkhead deck, the surveyor should draw attention to the designer and owner that an alternative calculation needs to be made to show compliance with subdivision requirements. A long compartment is one which exceeds the length AB as shown in figure 2.5.1.3.1. The surveyor should also seek early assurance that they are aware of the MCA's thinking and policy, as given below, regarding such arrangements. Details of the proposals should also be forwarded to Headquarters for comment.

(i) Application of subdivision requirements to designs which incorporate long internal spaces is problematic because traditional subdivision calculations (flooding curves) were developed to assess the survivability of vessels subdivided by plain transverse bulkheads. The further the design of a ship departs from this idealised arrangement, the less effective the traditional subdivision calculations, incorporating equivalent plane bulkheads for example, are at predicting the survivability of the vessel following the flooding of spaces beyond any longitudinal division.

Consequently, where proposals are submitted for a vessel which incorporate one or more long internal compartments, such designs must be assessed for subdivision purposes by the application of alternative damage calculations.

(ii) The alternative calculation will be based on the consideration of side damages extending to the centreline (irrespective of any longitudinal bulkheads on the side of damage). Within this damage all spaces not protected by transverse bulkheads which extend transversely from shell to shell and vertically from baseline to the bulkhead deck will be considered flooded. This calculation is a separate calculation to that performed for normal damage stability considerations and as such, regardless of the compartmentation standard of the vessel, only one compartment damage will need to be considered for the purposes of this alternative calculation. However, where a transverse division of the long inboard compartment is not in line with the main transverse subdivision bulkheads, such division should be considered damaged. The extent of damage for this equivalent calculation will be from base line upwards.

(iii) Internal buoyant spaces should be considered to remain intact where they lie outwith the assumed damage extent. The method of allowances for local subdivision as set down in paragraph 2.5.6 shall not be applied. It may be necessary to consider damage from both sides of the vessel where internal buoyant spaces within the damaged compartment(s) are asymmetric, noting that the vessel will be permitted to heel during direct calculation and that this may affect margin line immersion.

(iv) Although traditional floodable lengths are not a regulatory requirement at trimmed waterlines, and on even keel residual stability requirements are not stipulated, these conditions should be considered when undertaking appropriate calculations for side damage penetration in excess of B/5. The valuable benefit of fitting B/5 longitudinal bulkheads should not to be degraded by the provision of overlong inboard spaces resulting in a reduction in survivability with regard to subdivision when compared to "conventionally" subdivided ships.

(v) A typical example of damage requiring to be considered is shown at figure 2.5.1.3.1 where damage between say AB requires consideration of flooding of the area shown shaded.

(vi) When requesting the submission of equivalent subdivision damage calculations for vessels with proposed long internal compartments, surveyors should advise the owners and builders of reasons for conducting such an examination. In any case where it does not prove possible to achieve agreement in meeting the recommended standards of residual stability, Headquarters should be consulted.

(vii) The recommended standards referred to in (vi) above are as follows:-

(a) new ships are to comply fully with the provisions of Res.A.265(viii);

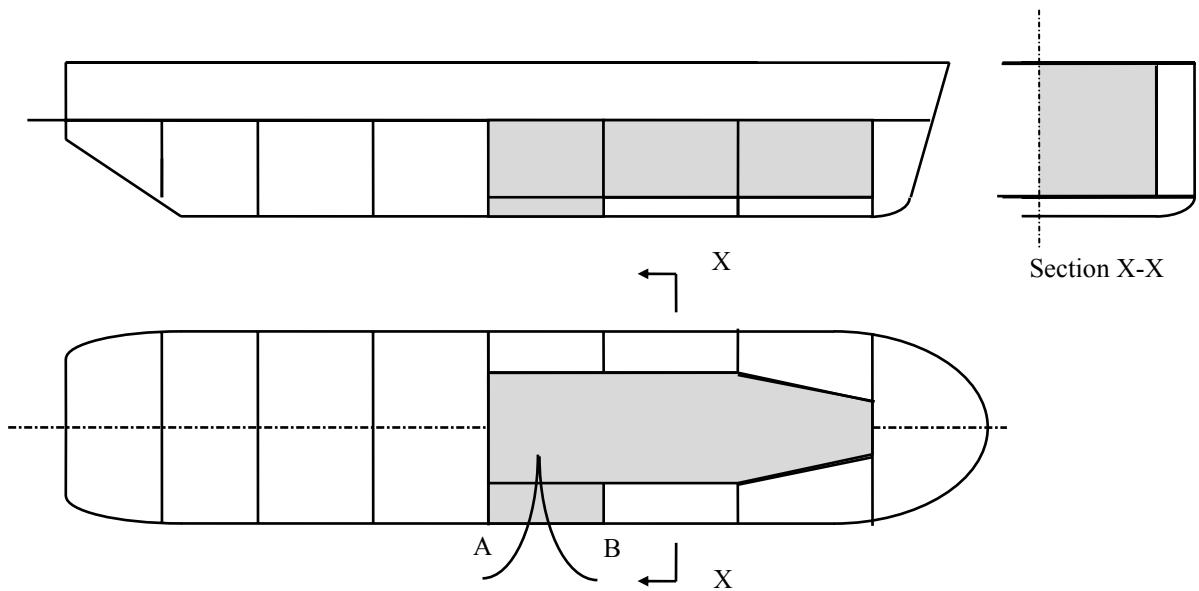
(b) existing ships undergoing major modifications are to comply with SOLAS 90 at level keels and a minimum of STAB 80 over the operational trim range. In the case of Ro-Ro ships, STAB 80 may be accepted over the full range of trims provided that SOLAS 90 is attained by the date of compliance with the Stockholm Agreement determined in accordance with the A/Amax value. In any case, the required standard will be no less than that existing prior to conversion.

(c) Ships changing to UK flag are to comply with Res.A.265(viii) or SOLAS 90 over the full operational trim range.

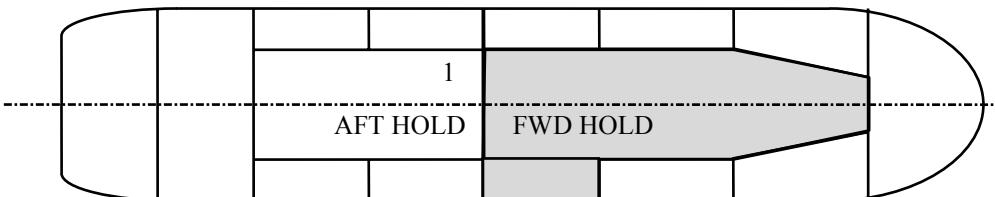
## 2.5.2 Permeability

2.5.2.1 The assumed average permeabilities of portions of the ship forward and aft of the machinery space, will in general be determined by the appropriate formula given in paragraph 3(2)(a)(i) of Section 2 or paragraph 8(1) of Section 3 of Schedule 2 to Merchant Shipping Notice MSN 1698 (M). For ships having unusual arrangements, where it is considered that the average permeability determined by direct calculation shall be greater than that given by the formulae, a detailed calculation will be required. After consideration, the permeability to be used will be agreed by the Administration.

2.5.2.2 The Certifying Authority will be prepared to consider applications for the use of a detailed calculation in any case where it can be shown that the average permeabilities of the portions forward and aft of the machinery space so obtained are less than those given by the appropriate formula, providing the permeabilities of the spaces within those portions are in accordance with either paragraph 3 or 8 of Schedule 2 to Merchant Shipping Notice MSN 1698 (M) whichever is applicable.

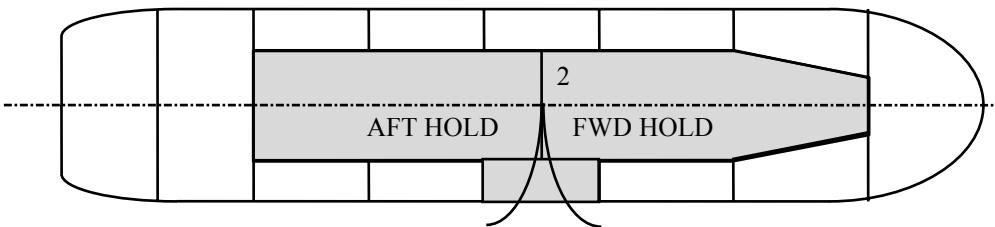


**figure 2.5.1.3.1 - One Long Compartment**



**figure 2.5.1.3.2 - Continuous Transverse Bulkhead**

Note : For damage in way of side compartment shown shaded, bulkhead in position 1 would not be considered damaged i.e. FWD hold only flooded



**figure 2.5.1.3.3 - Stepped Transverse Bulkhead**

Note : For damage in way of side compartment shown shaded, bulkhead in position 2 would be considered damaged i.e. AFT & FWD holds flooded

2.5.2.3 For ships of Classes II and II(A), the subdivision of which is calculated in accordance with Section 3 of Schedule 2 to Merchant Shipping Notice MSN 1698 (M), the Certifying Authority must be satisfied that the greater part of the cargo space is occupied by cargo before either a permeability of 60% may be used in the formula in paragraph 8 or a permeability less than 95% may be used in the detailed calculation referred to in paragraph 8.

2.5.2.4 In cases coming under paragraph 8 of Section 3 of Schedule 2 to Merchant Shipping Notice MSN 1698 (M) the surveyor should ascertain and report the type, disposition, weight and stowage rate of cargo which the owner intends to be carried by the ship in normal service conditions.

2.5.2.5 In ships which have a "long lowerhold", as described in paragraph 2.5.1.3 of these Instructions, in which vehicles are intended to be carried, the permeability of the space is to be taken as 90%.

### 2.5.3 Factor of subdivision

2.5.3.1 Where in ships of Classes II and II(A) the carriage of appreciable quantities of cargo in spaces below the bulkhead deck will render it impracticable to apply a factor of subdivision not exceeding .50 aft of the collision bulkhead, consideration may be given to the calculation of a factor of subdivision in accordance with paragraph 9(2) of Section 3 of Schedule 2 to Merchant Shipping Notice MSN 1698 (M) (the cargo clause) at the request of the owner. Full details of all cargoes intended to be carried by the ship in normal service conditions should be submitted by the surveyor to Headquarters for consideration. Cargo carried above the bulkhead deck cannot be taken into account in a submission relating to paragraph 9(2).

2.5.3.2 If, in the case of any ship of Classes II or II(A) whose factor of subdivision falls to be dealt with under paragraph 9(2)(c) and (d) of Section 3 of Schedule 2 to Merchant Shipping Notice MSN 1698 (M), the Certifying Authority is satisfied that it is impracticable to comply with a unity factor of subdivision in particular compartments, such exemptions in respect of those compartments as appear to be justified may be granted. In which event, having regard to all the circumstances, provided that the aftermost compartment and as many as possible of the forward compartments (between the forepeak and the after end of the machinery space) shall be kept within the floodable length.

### 2.5.4 Criterion of Service

2.5.4.1 For ships not having a continuous bulkhead deck the volumes used for the purpose of calculating the Criterion of Service Numeral should be taken up to the actual margin lines used in determining floodable length. Paragraph 2.1.3 of these Instructions defines those passenger spaces, whose volumes may be used to determine the value of P in the Criterion of Service Numeral formulae.

2.5.4.2 The volumes of all permanent fuel tanks which are positioned above the line of the inner bottom and below the bulkhead deck, and not just those which are adjacent to the machinery space, are to be added to the machinery space volume used in the formulae for Criterion of Service Numeral.

2.5.4.3 In the case of multi-hulled ships which do not fall within the limits which require a unity standard of subdivision to be applied, full details should be submitted in order that Headquarters may indicate the standard of subdivision required.

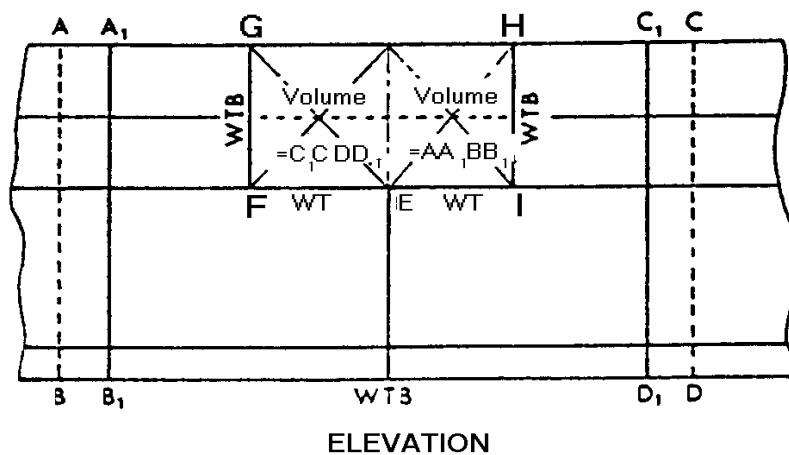
## 2.5.5 Special rules for subdivision

### 2.5.5.1 *A compartment exceeding its permissible length*

- (i) Paragraph 6(1) of Section 2 of Schedule 2 to Merchant Shipping Notice MSN 1698 (M) states the circumstances under which a compartment may exceed the permissible length.
- (ii) In exceptional circumstances consideration may be given to non-structural means of providing buoyancy in compartments which do not achieve the required standard of subdivision, providing such means are fitted inboard of the B/5 line and below the margin line. Such buoyancy should be fitted as high as possible in the compartment, especially if the stability of the ship is marginal when the compartment is assumed damaged.

### 2.5.5.2 *Steps and recesses in bulkheads and equivalent plane bulkheads*

Paragraphs 6(3)(b), 6(4) and 6(5) of Section 2 of Schedule 2 to Merchant Shipping Notice MSN 1698 (M) which deal with steps and recesses in bulkheads and equivalent plane bulkheads respectively, are illustrated by figures 2.5.5.2 a, b and c.



**figure 2.5.5.2 a)**

Dotted lines show transverse subdivision with plane bulkheads.  
Full lines show arrangement to compensate for step created by EFGHI and to maintain the same measure of safety.

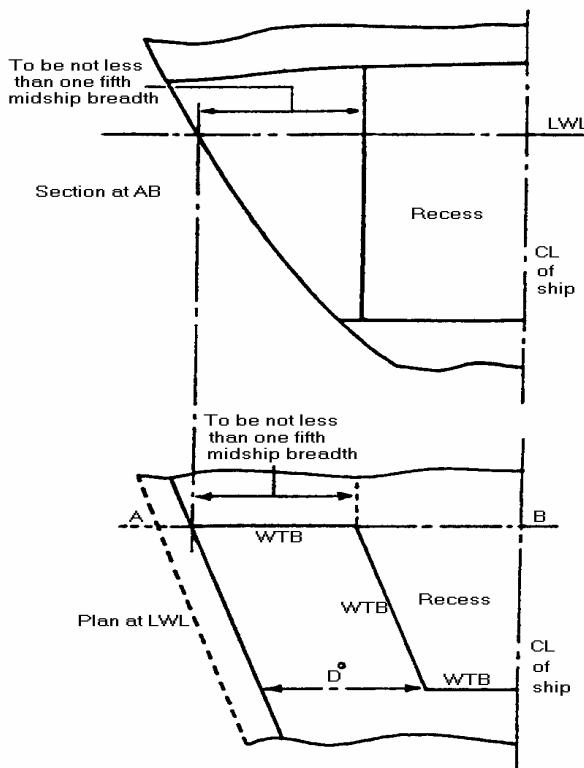


figure 2.5.5.2 b)

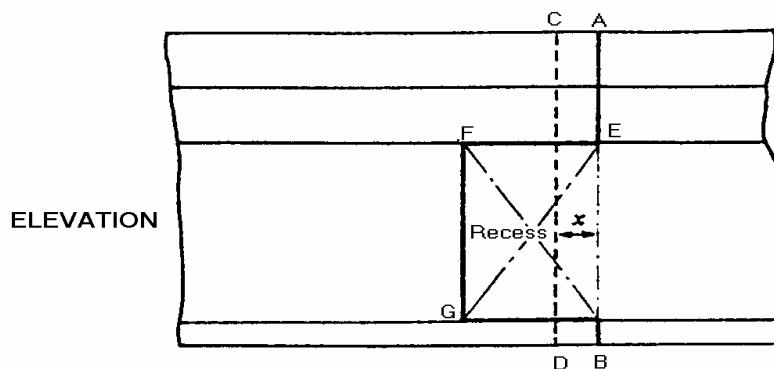


figure 2.5.5.2 c)

Bulkhead AB is recessed as shown in sketch. The position of equivalent plane bulkhead is given by  $x = \text{volume } FH / \text{A}$ , where 'A' is the sectional area to margin line approximately midway between AB and CD.

## 2.5.6 Allowance for local subdivision

2.5.6.1 Any claim for an allowance for local subdivision under the provisions of paragraph 6(7) of Section 2 of Schedule 2 to Merchant Shipping Notice MSN 1698 (M), in the consideration of flooding curves only should be accompanied by plans showing the proposed local subdivision and the

volume of the main and sub-compartments concerned. No allowance should be made where these compartments are liable to be in open communication below the margin line through air, sounding or other pipes, or otherwise.

2.5.6.2 When alternative damage calculations are considered in accordance with paragraph 2.5.1 of these Instructions, local allowance shall only be allowed for those spaces symmetrical about the centreline which can be shown to remain intact following side damage of standard length extending to the centreline.

2.5.6.3 In order to comply with this paragraph, the subdivision of multi-hull ships must be considered symmetrically i.e. compartments must be assumed to be flooded in centre, port and starboard hulls at the same time. Corresponding bulkheads in each hull should normally be in the same longitudinal position. Where this is not compatible with the design, the shipbuilder should submit details of the measures which are to be adopted in order to maintain the same measure of safety presented by a plane bulkhead.

#### 2.5.7 Verification of subdivision particulars

2.5.7.1 The surveyor is to ensure that the submitted particulars are correct, and that all measurements upon which flooding curves or equivalent calculations are based closely correspond to the ship as building, and adequately define the volumes used in the computation.

2.5.7.2 The designers/builders of the ship should be informed that, in the event of any alteration to the lines plan or subdivision arrangements, all relevant plans should be revised immediately, and forwarded to the surveyor for consideration with revised flooding curves or equivalent calculations.

#### 2.5.8 Verification of watertight subdivision arrangements

When the watertight subdivision arrangements have been accepted, the surveyor should satisfy himself that the ship is built in accordance with the accepted arrangements. The procedure described below should generally be followed:

##### *2.5.8.1 Spacing of watertight bulkheads*

The positions of the main transverse bulkheads should be checked at ship against the accepted subdivision plans, together with those of the accepted steps and recesses in the watertight bulkheads, and the arrangements of the longitudinal watertight and non-watertight bulkheads.

##### *2.5.8.2 Appropriation of spaces*

The surveyor should examine each space, and satisfy himself that it has been fitted out in accordance with the appropriation of spaces upon which the calculations for average permeabilities, and criterion of service numeral, have been calculated, and as shown on the accepted plans. If it appears that a

space will be used for another purpose, which would involve a higher average permeability throughout the portion of the ship in which the space is situated, or an increase in the criterion of service numeral, the surveyor should draw the attention of the builders to the matter, and request updated calculations.

#### 2.5.8.3 *Survey of watertight subdivision arrangement before painting, etc.*

The survey of a ship during construction is for the purpose of enabling the surveyor to form an opinion of the construction and workmanship and the surveyor should not undertake the survey of a new ship after the hull is painted, cemented or otherwise coated. Where such coatings have been applied prior to survey the surveyor should report full particulars to the lead surveyor for the ship in question, and await instructions about the action to be taken. Particular care should be exercised by the surveyor to satisfy himself that the integrity of the watertight subdivision, where pipes etc. pass through steps or recesses in watertight bulkheads, is not impaired.

### **2.6 Construction of Watertight Bulkheads, etc. (Regulation 9)**

In the application of paragraph 1(2) of Schedule 4 to Merchant Shipping Notice MSN 1698 (M) the strength and construction of every watertight subdivision bulkhead, or other portion of the internal structure forming part of the watertight subdivision of the ship, shall be of sufficient strength capable of supporting, with an adequate margin of resistance, the pressure due to the maximum head of water which it might have to sustain in the event of damage to the ship. The pressure head is not to be less than the pressure due to a head of water up to the margin line, including any additional head estimated to result from flooding or heeling, when calculating stability in the damaged condition.

#### **2.6.1 Initial tests of bulkheads, etc.**

The requirements for initial tests of bulkheads, watertight flats are contained in Section 1 of Schedule 4 of Merchant Shipping Notice MSN 1698 (M).

2.6.1.1 All watertight bulkheads, decks, etc. should be examined by the surveyor.

2.6.1.2 Main compartments may be tested by filling with water, but this is NOT compulsory. Where this is not carried out, a hose test should be applied to the bulkheads.

2.6.1.3 A hose or flooding test should be applied to watertight decks, and a hose test to watertight trunks, ventilators and tunnels.

2.6.1.4 Hose testing of watertight bulkheads, including the watertight doors and the attachments of the door frame to the bulkheads, decks and tunnels, should be simultaneously inspected on both sides of the plating while the water is being played upon all connections.

2.6.1.5 The pressure of the water in the hose should not be less than 207 kN/m<sup>2</sup>.

2.6.1.6 These tests are for the purpose of ensuring that the subdivision structural arrangements are watertight, and should not be regarded as a test of the fitness of any compartment for the storage of liquids, or for other special purposes for which a test of a superior character may be required; such superior tests may be accepted in substitution, depending on the height to which the liquid has access in the tank or its connections.

2.6.1.7 The hose and pressure tests should be carried out in the presence and to the satisfaction of the surveyor, who should record the results of the test on the appropriate file.

2.6.1.8 When testing arrangements considered equivalent to the above are proposed, full details should be submitted to Headquarters.

## **2.7 Collision, Machinery Space and Afterpeak Bulkheads and Shaft Tunnels (Regulation 10)**

### **2.7.1 Extension to the collision bulkhead**

2.7.1.1 Where a ramp or door forms part of the extension to the collision bulkhead, the intention of Regulations 10(6) and 10(7) is that it shall open forward.

2.7.1.2 In ships fitted with a bow ramp to facilitate the loading and/or unloading of vehicles at the fore end, such a ramp may be accepted as the extension to the collision bulkhead in compliance with Regulation 10(1). Details of the position, construction and means of making the ramp weathertight should be submitted for consideration by Headquarters.

2.7.1.3 The requirement for ships constructed before 1 July 1997 is to ensure that if fore end damage occurs resulting in damage to the bow visor, where fitted, that the integrity of the bow ramp forming the extension to the collision bulkhead is not at risk. This effectively excludes those existing arrangements which have an articulated outer portion of the ramp stowed horizontally under the deckhead from being considered as an extension to the collision bulkhead. However, arrangements have been accepted where the two portions are disconnected when in the stowed position. Where unusual arrangements exist, surveyors are to submit as much detail as is available to Headquarters for consideration.

2.7.1.4 Some existing Class II(A) ships have been found to have extensions not complying with the new requirements and, in lieu of retrofitting, "open bow" model tests have been accepted. As it is considered that all existing ships have been identified and considered, no details of the test requirement is considered necessary. Surveyors are advised to note the foregoing when

surveying such ships, which should be in possession of documentation showing that the arrangement has been considered and is acceptable.

#### 2.7.2 Shaft tunnels

2.7.2.1 The watertight shaft tunnel, or other watertight space in which, under Regulation 10(3), the stern gland is to be situated, should be of sufficient height and width to allow proper attention to be given to shaft couplings, bearings etc. within the space.

2.7.2.2 The stern tube should be enclosed a watertight compartment the volume of which should be the smallest compatible with the proper design of the ship.

### 2.8 **Double Bottoms (Regulation 11)**

#### 2.8.1 Inner bottom

The inner bottom may be pierced by the minimum number of access manholes compatible with the design and safe working of the ship, providing such manholes are fitted with efficient covers and provided the joint between the cover and the inner bottom is watertight.

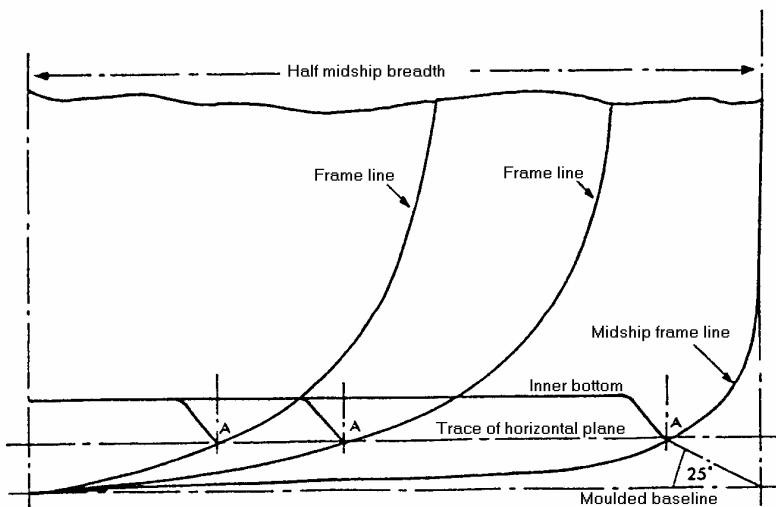
#### 2.8.2 Air and sounding pipes

All air and sounding pipes to double bottom compartments are to be effectively protected against the risk of damage and located so far as practical to avoid damage.

#### 2.8.3 Depth of double bottom and suitability to protect the turn of bilge

2.8.3.1 The moulded depth of a double bottom in millimetres measured at the centreline should not be less than 406 plus 4.17 times the length of the ship in metres.

2.8.3.2 The requirement of Regulation 11(3) regarding the suitability of the inner bottom protecting the turn of bilge is illustrated by figure 2.8.3.



**figure 2.8.3**

Intersection of outer edge of margin plate with bilge plating not to be lower than AAA.

#### 2.8.4 Wells

2.8.4.1 The surveyor's attention is drawn to the fact that Regulation 11(4) does not permit either the depth of drain wells to be more than the depth of the double bottom at centre less 460 mm, or the wells to extend below the horizontal plane referred to in Regulation 11(3).

2.8.4.2 If wells for purposes other than drainage are proposed, and the surveyor considers they are essential, they should be as small as possible and full particulars of the method to be adopted for maintaining the protection given by the double bottom should be submitted to Headquarters to establish whether or not an exemption from Regulation 11(5) can be granted.

#### 2.9 Weather-deck (Regulation 12)

2.9.1 The bulkhead deck is only required to be weathertight when it is not protected by a higher deck which is weathertight. However, in ships where the bulkhead deck is so protected, the portion of deck which forms the step between the fore peak bulkhead and its extension, when they are not in line, is still required to be weathertight in accordance with Regulation 11(1). The portion of deck which forms the step between a main subdivision bulkhead and a partial bulkhead or web, fitted to limit the spread of water along the deck, is required to be watertight in accordance with Regulation 13.

2.9.2 In Ro-Ro ships, although Regulation 12 and the above indicates that the deck may not be required to be weathertight, in order to meet the intention provided for in Regulation 32 (see also paragraph 4.2 of Part 4 to these Instructions), the deck must be at least weathertight.

## **2.10 Partial Subdivision Above the Bulkhead Deck (Regulation 13)**

2.10.1 If the margin line is submerged during the flooding of one or more compartments within the extent of damage outlined in Schedule 3 to Merchant Shipping Notice MSN 1698 (M), means shall be provided to limit the spread of water along the bulkhead deck to a minimum, and help to maintain positive stability through all stages of flooding.

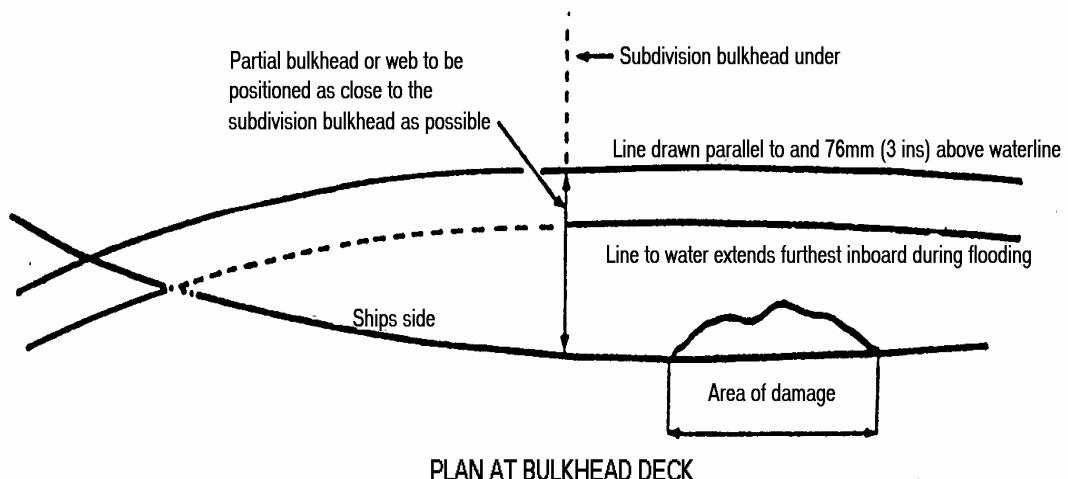
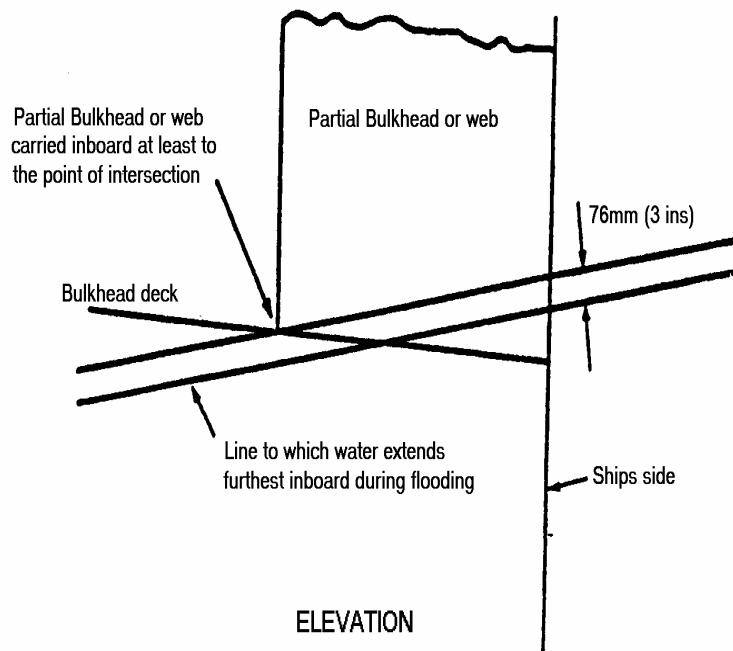
2.10.2 If partial watertight bulkheads or webs are fitted to provide such means, they should be fitted immediately above the main subdivision bulkheads of the damaged compartment or compartments, or as close to them as possible, but not in such a position that they could be involved in the damage. Such partial bulkheads or webs should extend inboard from the ship's side, to at least the point of intersection between a line drawn parallel to, and 76 mm above, the heeled waterline and the bulkhead deck. This heeled waterline is the one which extends furthest inboard, at the longitudinal position of the partial bulkhead or web during the flooding of the compartment or compartments (see figure 2.10.2). The plating and stiffeners of partial bulkheads or webs are to be constructed in accordance with Section 1 of Schedule 4 to Merchant Shipping Notice MSN 1698 (M), as if they formed part of the bulkhead immediately below the bulkhead deck.

2.10.3 In ships where fire resisting bulkheads forming the boundaries of main vertical zones are fitted on the bulkhead deck, such bulkheads, together with any additional bulkheads or webs which are considered necessary, may be accepted as complying with Regulation 13 providing they are suitably positioned, and any openings in them are above the line defined in the preceding paragraph.

2.10.4 In ships which, due to their particular service, are not fitted with bulkheads on the bulkhead deck, alternative means for limiting the spread of water along the bulkhead deck may be considered.

2.10.5 In ships where it is not intended to fit any means to limit the spread of water along the bulkhead deck, the damage stability calculations must show that the margin line is not submerged at any stage of flooding (see paragraph 5.6 of Part 5 of these Instructions).

2.10.6 In order to show that progressive flooding cannot take place when the margin line is submerged, a trace of the line to which the water extends furthest inboard during any stage of flooding should be shown on a plan of the bulkhead deck which indicates the partial subdivision arrangements, and the position of openings in the deck and bulkheads. If air and overflow pipes terminate on the bulkhead deck, the trace should also be shown on a profile to show that progressive flooding cannot take place through the pipes.



**figure 2.10.2**

## **2.11 Openings in Watertight Bulkheads (Regulation 14)**

### **2.11.1 Position of watertight doors**

2.11.1.1 It has always been accepted that some access openings, closed by means of watertight doors, will be required in some watertight bulkheads for essential purposes, for example, to inspect vital items of machinery, provide emergency or alternative means of escape. Acceptance of the location of any watertight door will be dependent upon the Certifying Authority being satisfied that its presence is essential for the proper working of the ship.

2.11.1.2 Every effort should be made to reduce, as far as practicable, the number of watertight doors fitted in any passenger ship. In any new design reducing the number of openings in watertight bulkheads might be achieved in a number of ways. For example, in the accommodation spaces, efforts should be made to arrange access and escape routes in a manner which would minimise the need for people to pass through watertight bulkheads below the level of the bulkhead deck. In the case of service spaces and other working compartments normal access should where possible be available without the need for continual passage through main bulkheads.

2.11.1.3 The possible effects of progressive flooding through an unclosed opening should always be taken into account when deciding upon the position and size of any watertight door. An unclosed door, lying wholly below the level of the waterline, obviously presents a great potential hazard. To lessen such dangers, watertight doors should be kept as small as possible and be positioned, whenever practicable, close to the centreline with their sills as high as is possible and consistent with safe access and preferably above the level of the waterline.

2.11.1.4 The effectiveness of subdivision arrangements is dependant on any watertight door being closed when breaching occurs, or almost immediately afterwards. It is also essential to limit the number of access openings placed in the divisional bulkheads and also to exercise the strictest control over the operation of the watertight doors provided to close such openings.

2.11.1.5 Watertight doors should be fitted inboard of the B/5 line and with their sills as high as possible above the keel. A door positioned outboard of the B/5 may be permitted if the surveyor, and Headquarters, is satisfied that it is necessary for the proper working of the ship and cannot be located elsewhere.

2.11.1.6 Where watertight doors are permitted to be fitted in bulkheads dividing two between deck cargo spaces they must be located inboard of the B/5 line.

2.11.2 Regarding the requirements of Regulation 14(3) and paragraph 29 of Section 4 of Schedule 4 to Merchant Shipping Notice MSN 1698 (M) that a watertight door must be fitted at one end of a tunnel, surveyors should note that

an exemption from this requirement can be considered for short tunnels situated near the centre line of the ship, if the safety of the ship in the event of damage is not impaired. In other cases, where the tunnel is used as a passage at sea, access shall also be obtained by means of a trunkway extending watertight to above the margin line.

2.11.3 Under the provision of Regulations 14(5) watertight bulkheads outside the spaces containing machinery may not be pierced by openings which are capable of being closed only by portable bolted plates. Such openings may, however, be permitted for special purposes in watertight bulkheads within such spaces.

#### 2.11.4 Valves in piping systems

2.11.4.1 Valves which are fitted in piping systems in order to maintain the integrity of the watertight bulkheads in the event of damage, should normally be screw-down valves capable of being controlled manually at the valve, and in the case of ships constructed on or after 1 September 1984, also from a position above the bulkhead deck by means of extended spindles. The spindles and controls to such valves should be fitted inboard of the B/5 line, but in ships such as vehicle ferries, with casings on the bulkhead deck outboard of the B/5 line, the Certifying Authority may permit the spindles and controls to be taken to casings outboard of the B/5 line providing they are positioned on the side of the bulkhead which provides the greater protection, and kept as close to the bulkhead as possible. The Certifying Authority may consider any alternative means of controlling the valves, and if it is from a central control, it must be such that damage to any valve or operating equipment within the extent of damage specified in paragraph 1(3) of Schedule 3 to Merchant Shipping Notice MSN 1698 (M) does not render the system inoperable in the remaining intact portion of the ship. The system should also be such that the valves will automatically close if the means of operating them fails.

2.11.4.2 Lead or other heat sensitive materials may be used in systems which penetrate watertight subdivision bulkheads or other watertight divisions provided that measures are taken to prevent the possibility of deterioration due to fire.

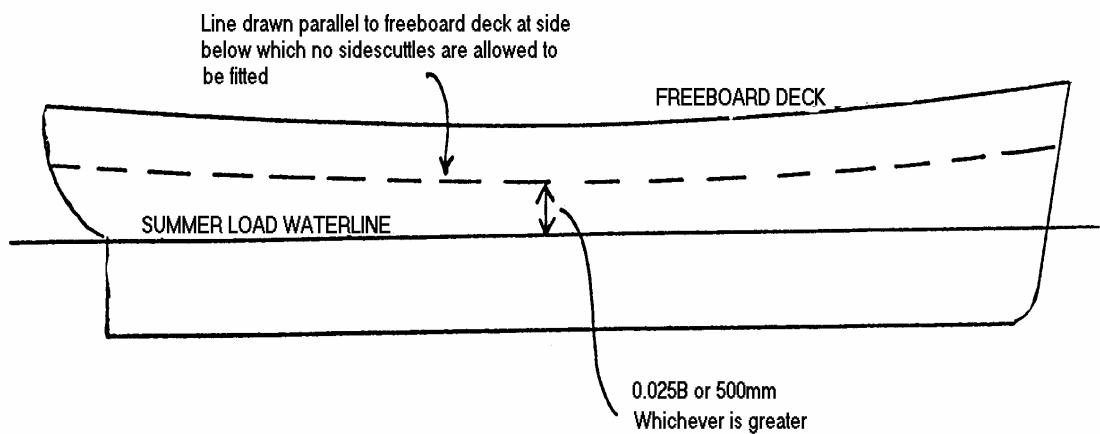
2.11.4.3 The use of plastics for piping systems which pierce subdivision bulkheads, or for valves in such systems will not be permitted, unless they comply with IMO Res. A753(18) - "Guidelines for the application of plastic pipes in ships", with respect to heat sensitivity.

2.11.4.4 When it is intended to use any other material, which the surveyor may consider to be heat sensitive, for piping and/or parts of valves which maintain the integrity of the watertight bulkheads, details should be submitted to Headquarters for consideration.

## **2.12 Openings in the Shell Plating Below the Bulkhead Deck (Regulation 15)**

### **2.12.1 General requirements**

The general requirements for openings in the shell plating below the bulkhead deck, and their means of closing, are set out in Schedule 10 to Merchant Shipping Notice MSN 1698 (M). The requirements of paragraph 1(2) of Schedule 10 are illustrated by figure 2.12.1.



**figure 2.12.1**

### **2.12.2 Side scuttles**

2.12.2.1 The arrangements of side scuttles should be re-examined for compliance when an increase in draught is proposed. Any side scuttle found not to comply must be blanked off.

2.12.2.2 Where it is proposed to fit heavy duty side scuttles bolted to the shell, particular attention should be made where the connection is not bolted through the shell plating in ships of Class I.

2.12.2.3 For the side scuttles for ships built before 1st September 1984, referred to in paragraph 1(1) of Schedule 10 to Merchant Shipping Notice MSN 1698 (M), the Certifying Authority may indicate the mean draught at which the sills of these side scuttles will not be below the line at which it will be permissible, on the responsibility of the master of the ship, to depart from port without previously closing and locking them. In the application of this sub-paragraph, the appropriate allowance for fresh water may be made when applicable. The surveyor should, therefore, report to the Certifying Authority

in appropriate cases such particulars as will enable the limiting mean draught to be determined. The limiting draught is that at which the side scuttles will have their sills above a line drawn parallel to the bulkhead deck at side and having its lowest point 1.4 metres plus 25% of the breadth of the ship above the waterline corresponding to the limiting mean draught. For this purpose, the distance of the sill below the bulkhead deck at side should be reported for the opening type side scuttle which has its sill the greatest distance below the bulkhead deck at side, this dimension being measured vertically at the side scuttle.

The limiting mean draught resulting from the information supplied should be included in the stability information provided to the master.

2.12.2.4 The general requirements for side scuttles is contained in paragraph 1.3 of these Instructions.

### **2.12.3 Inlets and discharges**

2.12.3.1 The arrangement of scuppers and discharges is, in addition to the following paragraphs, to comply with the requirements of the International Convention on Load Lines.

2.12.3.2 Lead or other heat sensitive materials shall not be used in any other place where the deterioration of such pipes in the event of a fire would give rise to the danger of flooding.

2.12.3.3 Discharge pipes, fitted in accordance with the provisions of the Regulations, should have a sufficient bend to provide for expansion of the pipe and also any movement due to the working of the ship.

2.12.3.4 All discharge pipes led through the shell below the bulkhead deck and the valves relating thereto shall be protected from damage.

2.12.3.5 The arrangements of scuppers and discharges should be re-examined when an increase in draught is proposed, and where such an increase warrants a more positive means of preventing water from passing inboard, such means must be fitted to the scuppers and discharges.

2.12.3.6 In order to satisfy the requirements of Schedule 6 and 10 to Merchant Shipping Notice MSN 1698 (M), inlets and discharges led through the shell below the bulkhead deck should be arranged as follows:-

#### *2.12.3.7 Discharges from spaces below the bulkhead deck*

- (i) Efficient means shall be provided for the drainage of all watertight decks below the bulkhead deck and any drainage pipes shall be so fitted with valves or otherwise arranged as to avoid the danger of water passing from a damaged to an undamaged compartment.

(ii) Where one automatic non-return valve is fitted in a ship which is marked with a summer load line, the means of closure should be from a position above the bulkhead deck or the freeboard deck, whichever is the higher. See figure 2.12.3.7.(ii).

(iii) Where the vertical distance from the inboard end of the discharge pipe to the summer load waterline exceeds  $0.01L$ , (where L is the length of the ship as defined in the Merchant Shipping (Load Line) Regulations 1998, two automatic non-return valves having no positive means of closure may be fitted. In any ship which is not marked with a summer load waterline the vertical distance shall be measured to the ships deepest subdivision load waterline; one such value shall be situated as close to the ship's shell as practicable and substantially connected thereto. The inboard valve shall, where practicable, be fitted above the deepest load waterline; where this is not practicable, a locally controlled sluice valve interposed between the two automatic non-return valves shall be fitted. See figures 2.12.3.7.(iii) a) and b).

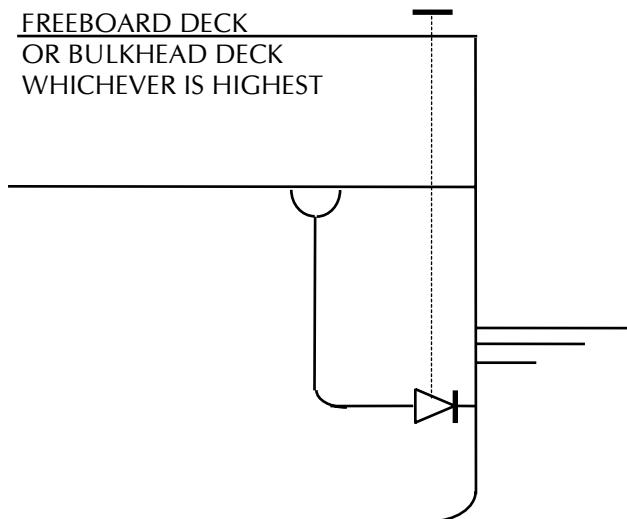
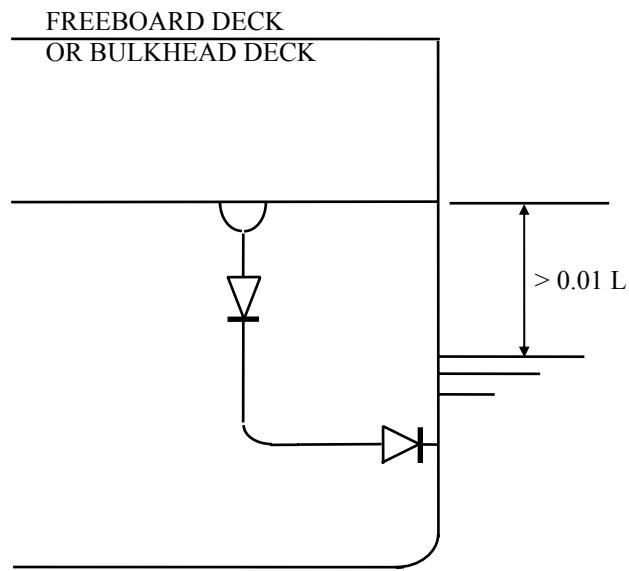


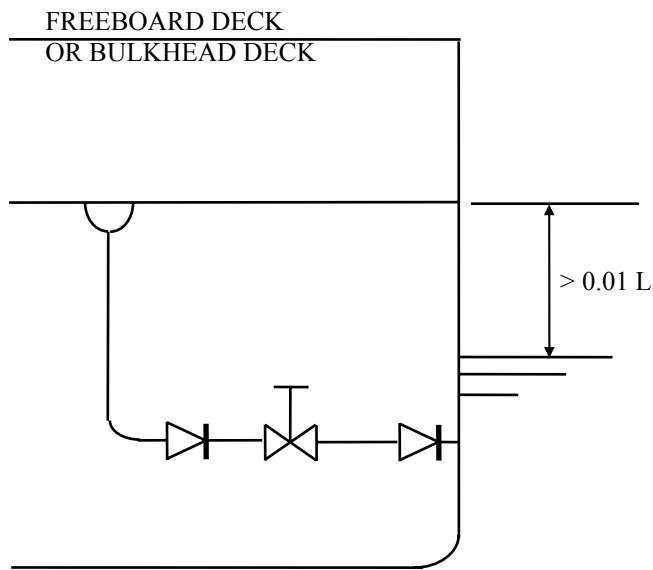
figure 2.12.3.7.(ii)

One automatic non-return valve at the shell with positive means of closure above the bulkhead or freeboard deck and fitted with open/shut indicator.



**figure 2.12.3.7.(iii) a)**

Two automatic non-return valves without positive means of closure. One valve fitted at the shell and one valve above the deepest load waterline and always accessible under service conditions.



**figure 2.12.3.7.(iii) b)**

Two automatic non-return valves without positive means of closure, one of which is fitted at the shell, and a readily accessible locally controlled sluice valve fitted between the two non-return valves.

#### 2.12.4 Drainage from cargo spaces on the bulkhead deck

The requirements are included in paragraph 7 of Schedule 6 of Merchant Shipping Notice MSN 1698 (M).

#### 2.12.5 Drainage of vehicle spaces

2.12.5.1 In vehicle ferries or similar ships with large open or enclosed spaces, means should be provided to free rapidly such spaces of water which may have accidentally entered the ship, or may be present as a result of operating a fire extinguishing system, because of the adverse effect of such water on stability.

2.12.5.2 Normally, scuppers of 152 mm diameter should be fitted on each side of such an enclosed space, and spaced not more than 9.15 m apart when the maximum breadth of the deck in the space is 18.3 m or less. When the maximum breadth is in excess of 18.3 m, the scupper spacing should be decreased in direct proportion to the maximum breadth to 18.3 m.

2.12.5.3 In ships having ramped vehicle decks or unusual sheer on the deck the number and spacing of the scuppers will require to be determined having regard to such features.

2.12.5.4 If the scuppers are fitted with valves having positive means of closure, the position for operating such means should be accessible from outside the vehicle spaces and above the bulkhead deck.

2.12.5.5 The efficiency of the scuppers should not be impaired by kerbs, fenders, etc, and openings in gratings should be sufficiently large to prevent them becoming choked by rubbish.

2.12.5.6 Before the ship is permitted to enter into service the efficiency of the scupper arrangements is to be demonstrated to show that there is no build-up of water on any portion of the deck and that the deck is rapidly cleared of water.

2.12.5.7 The freeing arrangements for open spaces will be specially considered by the Certifying Authority in view of the greater risk which they present, and if it is considered that such spaces could hazard the safety of the ship, they should be enclosed.

#### 2.12.6 Water-closets

When water-closets of the under-waterline type are to be fitted, plans should be specially submitted for acceptance.

## **2.12.7 Ash and rubbish chutes, etc.**

2.12.7.1 Every ash chute, rubbish chute, etc., should have a watertight cover and, if the inboard opening is below the bulkhead deck, be fitted with an automatic non-return valve in the chute in a readily accessible position above the deepest subdivision load waterline.

2.12.7.2 Where an automatic non-return valve is to be fitted, the valve should be of the horizontal balanced type and should normally be kept closed and provided with local means for securing it in a closed position. When the chute is not in use, both the cover and the valve should be kept closed and secured in accordance with Regulation 22(8) and a permanent notice to this effect should be fixed near the hopper. In ships constructed before 1 September 1984 the requirements of this paragraph should not apply to ash ejectors and expellers the inboard openings of which are in the ship's stokehold and below the deepest subdivision load waterline. Such ejectors and expellers should be fitted with means which will prevent water entering the ship.

## **2.12.8 Storm valve**

2.12.8.1 The storm valve fitted at the ship's side is to be of a substantial back-balanced type, or of a type in which the valve face is at an angle of not less than  $15^{\circ}$  to the vertical when closed. Valves mounted on a spigot, instead of being attached directly to the shell, may be accepted provided that the spigot is:

- (i) not more than 305 mm (12 in) in length;
- (ii) efficiently welded and bracketed to the shell; and
- (iii) its thickness is not less than the thickness of the shell plating in which it is situated.

## **2.12.9 Closure versus heel**

In all ships the incidence of the calculation made under the provisions of Schedule 3 to Merchant Shipping Notice MSN 1698 (M) relating to stability and angle of heel in the damaged condition will be taken into account in accepting the means of closing scuppers, discharges and other side openings from spaces above the margin line.

# **2.13 Side and Other Openings Above the Bulkhead Deck (Regulation 16)**

## **2.13.1 Side scuttles**

The provisions of paragraph 2.12.2 of these Instructions also apply to side scuttles fitted to openings in the ship's sides above the margin line.

## 2.13.2 Window sizes

2.13.2.1 Where proposed window sizes exceed those defined within a recognised standard, these may be accepted providing they are situated in the fourth and higher tiers of superstructures for category 1 windows, and in the third and higher tiers of superstructures for category 2 windows. The Certifying Authority may require the glass in such windows to be thicker than the maximum standard size.

2.13.2.2 Category 1 means windows situated in the ships' sides and in exposed casings or deckhouse sides set inboard not more than 4% of the breadth of the ship or 1.5 m whichever is the greater, and windows facing forward.

2.13.2.3 Category 2 means windows situated in the side screens and in exposed casings or deckhouse sides set inboard more than 4% of the breadth of the ship, or 1.5 m whichever is the greater.

## 2.13.3 Deadlights

2.13.3.1 Deadlights should comply with the following:-

(i) In enclosed spaces below the first deck above the bulkhead deck or freeboard deck, whichever is the higher, efficient hinged deadlights which can be effectively closed and secured watertight must be fitted to all side scuttles.

(ii) In other enclosed superstructures, side scuttles and windows should be provided with deadlights or shutters, which may be fixed or portable, except that only fixed deadlights or shutters should be fitted to side scuttles and windows situated in the bridge front of the first tier of superstructures immediately above the weather-deck. Portable deadlights and shutters should be provided to the extent shown in the following table:-

Tier of superstructure above the bulkhead deck or freeboard deck, whichever is the higher	Required number of portable deadlights or shutters, expressed as a percentage of the total number of side scuttles or windows of each type or size, excluding those fitted with fixed deadlights or shutters
2nd tier	50
3rd tier	25
4th and higher tiers	May be required, subject to consideration

(iii) Shutters should be of steel of not less than 3.5 mm in thickness, or of an equivalent material, and provided with means of securing them to the frame sufficient to withstand the pressures likely to be experienced in service.

#### **2.13.4 Glass for side scuttles and windows**

2.13.4.1 Glass for side scuttles and windows fitted in all ships should be in accordance with paragraph 1.3 of these Instructions.

2.13.4.2 The number of spare glasses which are to be provided for the side scuttles and windows fitted in ships of Classes I and II should not be less than 4% of the total number of glasses for each size fitted, with a minimum of 2 glasses for each size.

2.13.4.3 For ships of Class II(A) the number of spare glasses should not be less than 2 glasses for each size of side scuttle and window.

### **2.14 Construction and Testing of Watertight Doors (Regulation 17)**

#### **2.14.1 Construction**

2.14.1.1 Every watertight door should be of such design, material and construction as will maintain the integrity of the watertight bulkhead in which it is fitted. For this purpose it may be necessary, particularly with large sliding watertight doors, to arrange points of support in way of the leading and trailing edges of the door at the closed position. The design stress in the door should be such that a factor of safety of approximately three, based on the ultimate tensile strength of the material, will be obtained.

2.14.1.2 Every sliding watertight door should be fitted with rubbing faces of brass or similar material which may be fitted either on the door itself or on the door frame, and which, if they are less than 25 mm in width, should be fitted in recesses. In the case of ships constructed after 1 February 1992, other methods of sealing sliding watertight doors may be acceptable.

2.14.1.3 If screw gear is used for operating such a door, the screw and nut should be of suitable metals which are resistant to corrosion.

2.14.1.4 The frame of every vertically sliding watertight door should have no groove at the bottom thereof in which dirt may lodge. The bottom of such a frame, if it is of skeleton form, should be so arranged that dirt cannot lodge therein. The bottom edge of every such door should be tapered or bevelled.

2.14.1.5 Every vertically sliding watertight door which is operated by power should be so designed and fitted that, if the power supply ceases, there should be no danger of the door dropping.

2.14.1.6 Every horizontally sliding watertight door should be so installed as to prevent its moving if the ship rolls, and if necessary a clip or other suitable device should be provided for that purpose. The device should not interfere with the closing of the door when the door is required to be closed.

2.14.1.7 In the case of sliding watertight doors, care should be taken to ensure a satisfactory connection where the door frame beds on to the bulkhead plating. In compartments where oil fuel may catch fire, these connections should be metal to metal. Any jointing used should not be adversely affected by heat or the local environment.

## 2.14.2 Testing

2.14.2.1 Every watertight door should be tested at the works in the presence of the surveyor by hydraulic pressure equivalent to the head of water measured from the bottom of the door to the margin line in way of the bulkhead to which the door is to be fitted, but in no case should the test pressure be less than 6 m head for sliding doors or less than 3 m head for hinged doors. The framework to which the door frame is secured for the purpose of testing at the works should not give greater reinforcement to the frame than the stiffening of the bulkheads to which it is to be fitted. The purpose of the test is to show whether the door is of sufficient strength and reasonably watertight under pressure. The rate of leakage and deflection of the door at the centre should be reported.

2.14.2.2 After a satisfactory hydraulic test, each watertight door and its frame should be stamped with the following identification marks:-

CERTIFYING AUTHORITY

TESTED TO

METRES HEAD

DATE

SURVEYOR'S INITIALS

2.14.2.3 After being fitted in place on the bulkhead in the ship, the door and the attachment of the door frame to the bulkhead should be included in the hose test required for watertight bulkheads.

2.14.2.4 All sliding watertight doors should be operated by hand and, if power operated, by power in the presence of the surveyor, who should note and record the times taken to close the doors.

2.14.2.5 The surveyor should see that the warning signals are efficient and comply with the provisions of paragraph 3.1.2.5 (ii) of these Instructions and that the indicators register properly.

2.14.2.6 Hinged watertight doors are to be inspected and tried. The surveyor should see that the lever operated clips are in order and that the joints are watertight.