U.S. Department
of Transportation

**United States
Coast Guard**

Load Line Technical Manual

American Bureau of Shipping

CHAPTER III

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Office of Marine Safety, Security and Environmental Protection

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Final Report

USCG-M-1-90

CHAPTER III

CONDITIONS OF ASSIGNMENT: Minimum Freeboard

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Preface to the electronic version

In 1990, the U.S. Coast Guard commissioned the American Bureau of Shipping (ABS) to prepare a report that integrated U.S. load line regulations & policies, ABS and IACS interpretations, IMO circulars, and the International Convention on Load Lines (ICLL) into a single reference document.

This *"Load Line Technical Manual"* is the result of that effort. It sets forth the technical procedures for evaluating, calculating and assigning ICLL load lines, using USCG and ABS policies where the Convention leaves certain requirements "to the satisfaction of the Administration" or is open to interpretation. This manual applies to U.S. vessels seeking an international ICLL assignment or a domestic U.S. load line assignment for unrestricted voyages by sea; it does not cover U.S. load line regulations for other types of domestic voyages (such as coastwise or Great Lakes).

This electronic version of the manual has been divided into five *Adobe .pdf* files:

LL Tech Manual-ToC.pdf	Table of Contents
LL Tech Manual-Ch1.pdf	Chapter I, General Items
LL Tech Manual-Ch2.pdf	Chapter II, Load Line Calculation
LL Tech Manual-Ch3.pdf	Chapter III, Cond of Assignment-Minimum Freebrd
LL Tech Manual-Ch4.pdf	Chapter IV, Cond of Assignment-Increased Freebrd

This Technical Manual was originally prepared in 1990; therefore, it only incorporates material up to that time. Since then, there has been further evolution of load line policies, additional IACS interpretations, new IMO Circulars, etc. The ICLL itself has been amended by the 1988 Protocol (which entered into force on February 3, 2000) as well as subsequent amendments that were adopted in 2003 (and will enter into force on 1 January 2005). There are no immediate plans to incorporate these into this manual.

Date of this Preface: 6 Nov 2003

ABBREVIATIONS and VARIABLES

A	Minimum req'd freeing port area; or
	Angle in freeing port calculation for deck sheathing
Aa	Actual area of freeing port
Ae	Effective area of freeing port
AB	American Bureau of Shipping
A_h	Actual height of freeing port opening
ABP	Bow planform area used in the bow height trim resistivity calculation
ABS	American Bureau of Shipping
AP	After Perpendicular
b	Breadth of superstructure at the middle of its length; *or*
b	Average breadth of deck obstruction; or
	Breadth of a local well in the freeboard deck
b_1	Breadth of extension at superstructure end bulkhead; *or*
	Breadth of recess at midpoint of its length
b_1	Average breadth of deck obstruction No. 1
b_2	Average breadth of deck obstruction No. 2
b_b	Average breadth of deck bin
b_4	Half breadth of second recess at the midpoint of its length
B	Breadth as defined in the ICLL
B	Angle used in freeing port calc for non-flush openings
B_1	Half breadth of superstructure at start of extension; *or*
	Breadth of superstructure at the midpoint of the recess
B_4	Half breadth of superstructure at midpoint of the length of the second recess
B-60	A Type 'B' freeboard that is reduced by 60% of the difference between a Type 'A' and a Type 'B' tabular freeboard
B-100	A Type 'B' freeboard that is reduced by 100% of the difference between a Type 'A' and a Type 'B' tabular freeboard
B_b	Average breadth of the vessel in way of the well formed by a deck bin.
Bhd	Bulkhead
Bs	Breadth of the vessel at the mid-length of the superstructure
C	Camber
C1	Subdivision load line mark
Cb	Block coefficient
Circ	Circular
CL	Center line
cm	Centimeter(s)

Cor	Correction
D	Molded displacement;
	Molded depth
Dr	Depth of a local well in the freeboard deck
d_1	85% of the least molded depth
Df	Depth for freeboard
dk	Deck
E	Effective length of superstructure
f	Tabular freeboard
f	Freeing port area adjustment factor
f_b	Freeing port area factor for bins
F	Minimum required freeing port area
F_1	Freeing port area non-continuous deck obstruction
F_2	Freeing port area - continuous deck obstruction
fbd	Freeboard
FFA	Free Flow Area
FP	Forward perpendicular
ft	Feet
FW	Fresh Water load line mark
GM	Metacentric Height
gt	Gross tons
h	Actual height of trunk
h_1	Least height of superstructure
h_b	Bulwark height in way of freeing port opening
h_c	Actual trunk hatch coaming height
h_i	Height of inboard end
h_L	Least height of superstructure
h_o	Height of lower edge of freeing port opening above the deck
h_{rc}	Required trunk hatch coaming height
h_s	Standard height of superstructure
IACS	International Association of Classification Societies
ICLL	International Convention on Load Lines
IMO	International Maritime Organization
in	Inch
ISO	International Standards Organization
ITB	Integrated Tug Barge
l	Length of deck sheathed area which extends from side to side; *or*
	Length of a local well in the fbd dk
l	Length of a well

l'	Length of well for freeing port area determination
l_1	Length of superstructure set-in from the side of the vessel; *or* Length of recess
l_1	Average length of deck obstruction No. 1
l_2	Equivalent length of superstructure in way of recess
l_2	Average length of deck obstruction No. 2
l_4	Equivalent length of second recess
l_c	Length of camber in the molded half breadth of the vessel
L	Length as defined in the ICLL
L'	The mean enclosed length of the poop or forecastle up to a maximum of 0.5L
LCF	Longitudinal center of floatation
LL	Load line
LLAC	Load Line Advisory Circular
LLC	Load Line Convention
m	Meter(s)
mm	Millimeter(s)
MSC	Marine Safety Center
NVIC	Navigation Vessel Inspection Circular
OCMI	Officer in Charge Marine Inspection
oz	Ounce
R	Coefficient used in the depth correction
Reg	Regulation
Rev	Revision
s	Sheer credit for excess height of a poop or forecastle
S	Mean length of superstructure; *or* Summer load line mark
SLF	IMO Subcommittee on Stability and Load Lines and on Fishing Vessels safety
sp.gr	Specific gravity
Ss	Sheer strake thickness
Stab	Stability
Stbd	Starboard
Std	Standard
sw	Saltwater
T	Mean thickness of the exposed deck sheathing clear of deck openings; *or* Tons per centimeter (inch) immersion in salt water at the molded summer load waterline; *or* Tropical load line mark
TF	Tropical Fresh load line mark

US	United States
USA	United States of America
USCG	United States Coast Guard
V	Volume of the molded displacement of the vessel
W	Winter load line mark
WNA	Winter North Atlantic load line mark
WP	Waterplane
x	Distance lower edge of freeing port opening is above top of the deck sheathing
y	Difference between the actual and standard height of superstructure at the end of sheer
Z	Least difference between the actual and standard height of superstructure for sheer credit on a full superstructure vessel

REFERENCE SYSTEM

Footnotes are used throughout this manual to designate sources of information, and for notes to clarify or elaborate on the text given. The footnotes are placed on the bottom of the same page where the footnote reference mark appears.

Reference Sources

The eleven (11) common reference sources are indicated on the "Reference Material" page. For simplification, the bracketed number [ ] that precedes each reference source listed is used in the footnotes throughout this manual in lieu of the complete title of the reference. The titles of other source material not listed on the "Reference Material" page are given in their entirety.

In certain instances the reference source given in the footnote may be followed by the word "{basis}", which means that the reference source was used as the basis of the text, however the wording has been changed or expanded for clarification.

Footnote Reference Mark Location

The footnote reference mark is placed in the subject heading if the entire subject is taken from the reference source, and in the paragraph heading if the entire paragraph is taken from the source referenced. Reference marks placed at the end of a sentence generally mean that only that particular sentence is from the source referenced.

Regulation Reference

The term "Regulation" or simply "Reg." used throughout this manual refers to the *International Convention on Load Lines,1966* unless otherwise specified.

REFERENCE MATERIAL

[1] International Convention on Load Lines, 1966

[2] Code of Federal Regulations, Title 46, 1984

[3] Marine Safety Manual

[4] IMO Correspondence

[5] IACS Unified Interpretations of the International Convention on Load Lines, 1966

[6] U.S.C.G. Navigation and Vessel Inspection Circulars

[7] A.B.S. Circular Letters of Instruction

[8] U.S.C.G. Correspondence

[9] A.B.S. Correspondence

[10] Ship Design and Construction

[11] U.S.C.G. Load Line Advisory Circulars

STRENGTH & STABILITY REQUIREMENTS

STRENGTH STANDARDS

General[1]

The assigning and issuing authority is to satisfy itself that the general structural strength of the vessel is sufficient for the draft corresponding to the freeboard assigned, and when requested is to furnish pertinent information to the Commandant.

Vessels built and maintained in conformity with the requirements of a classification society recognized by the Commandant are considered to possess adequate strength, unless deemed otherwise.

International Load Line Certificates issued to new vessels, or existing vessels that have previously not been issued a Load Line Certificate, *may not* contain any geographical restrictions. Consequently, for a vessel to receive an unrestricted International Load Line Certificate it must meet full ocean standards.[2]

Hull Strength Standards[3]

The following hull strength standards are to be used for vessels and barges receiving a load line:

Vessel Type	Strength Standard
All Barges except as provided below	ABS Rules for Building and Classing Steel Barges for Offshore Service
Tank Barges > 300 ft (91.441 m) and carrying cargoes regulated by 46 CFR Subchapter D.	ABS Rules for Building and Classing Steel Barges for Offshore Service as applicable. Loading information is also required.[4]

1 [1] Reg. 1 (basis)
2 [9] 21 April 1981
3 [9] 21 August 1985
4 [2] 31.10-32

Vessel Type	Strength Standard
Vessels < 200 ft (61 m)	ABS Rules for Building and Classing Steel Vessels under 200 ft as applicable.
Vessels > 200 ft (61 m)	ABS Rules for Building and Classing Steel Vessels as applicable.

Departures from strength standards are permitted on U.S. flag vessels *only* after consulting with the Commandant (MTH).

STRUCTURAL PLAN REVIEW[5]

Classed Vessels

The USCG/ABS Memorandum of Understanding (MOU III), controls ABS activities in plan approval and inspection of new vessel construction. NVIC 10-82, change 2, supplies details of the USCG acceptance of ABS plan review and inspection of vessels. If a vessel is classed by a classification society other than ABS, the provisions of NVIC 10-82, change 2, do not apply. As a minimum, the structural items listed below must be reviewed for compliance with the ABS Rules, not the rules of the other society. Also, any structural items in high-stress areas or appearing to be marginally adequate *must* meet ABS requirements. Those items required to comply with ABS Rules are:[6]

1) Midship section modulus;

2) Longitudinal strength calculations;

3) Deck and shell plating;

4) Midship section;

5) Tank bulkheads and ordinary watertight bulkheads; and

6) Scantling profile.

[5] [2] Vol. IV, 6.G.1.

[6] The framing and center vertical keel are also required to comply but were omitted since these items are normally included or addressed in one of the items given above.

Unclassed Load Line Only Vessels

In accordance with Regulations 1 and 10(1), the freeboard assignment, structural design, and loading restrictions *must* maintain hull stresses within safe limits. ABS[7] performs the load line assigning function on behalf of the USCG, which includes a review of the vessels:

a) Longitudinal strength;

b) Deck, shell, closures, frames etc.; and

c) Accomodations.

LOADING INFORMATION

Requirement

Regulation 10(1) requires that the master of every new ship is to be supplied with sufficient information, in an approved form, to enable the arrangement of the loading and ballasting of the ship without the creation of any unacceptable stresses in the ship's structure. This requirement need not apply to any particular length, design or class of vessel where the Commandant considers it to be unnecessary and so notifies the assigning and issuing authority.[8] In general, all vessels are to be furnished with information describing the loading conditions on which the design of the vessel has been based, including the permissible limits of still-water bending moment and shear force.[9]

Loading Manuals[10]

In general, a loading manual is to be prepared and submitted to the loadline assigning authority for review for vessels over 122 m (400 ft) in length of the following types:

1) Ore or bulk carriers;

2) Oil carriers;[11]

3) Specialized carriers such as container or barge carriers in which the cargo is designed to be stowed into specific cells or locations.

Loading manuals are to be prepared and submitted for review also for liquefied gas carriers and chemical carriers over 65 m (213 ft) in length. The manuals are to show the effects of various loaded and ballasted conditions upon the longitudinal bending, and are to be furnished to the master of each vessel for guidance.

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[7] Or other classification society approved by the Commandant

[8] [2] 42.15-1(a)

[9] ABS Rules for Building and Classing Steel Vessels, 1990, Section 6.9

[10] ABS Rules for Building and Classing Steel Vessels, 1990, Section 6.9

[11] Also see next section.

Loading Information for Tank Vessels[12]

All tank vessels over 91.441 m (300 ft) in length and certificated under 46 CFR Subchapter D *must* have approved loading information aboard. Similarly, unmanned tank barges over 91.441 m (300 ft) in length that carry certain dangerous cargoes, certificated under Subchapter I, *must* have approved loading information. This information *must* be written in a form that will enable an operator to determine stress and stability for any loading condition. Loading computers or calculators *may not* substitute for written loading information, although they *may* supplement it.

Annual Revalidation

At each Annual Load Line Inspection, before the Load Line Certificate is revalidated, the attending surveyor should verify that where required, the approved loading information is onboard the vessel.

STABILITY REQUIREMENTS

Stability Review

All vessels, having their load line assigned under the Convention are required to have a stability letter from the USCG before a Load Line Certificate may be issued.

Specific guidance regarding the various aspects of the stability reviews are contained in 46 CFR Subchapters E and S, Marine Safety Manual Vol. IV Chapter 6, NVIC 10-83, and NVIC 3-84.

Intact Stability Standard[13]

The intact stability standard that the USCG considers acceptable for load lined vessels are the same as those applied under Subchapter S to an inspected vessel of the same type and in the same service.

Subdivision and Damage Stability Standard

The subdivision and stability regulations for merchant vessels are primarily contained in 46 CFR, Subchapter S. Additionally, there are damage stability and subdivision standards for vessels receiving Type 'A' and reduced Type 'B' load lines in 46 CFR, Subchapter E.[14]

Stability Review Responsibility[15]

The USCG reviews and approves the stability calculations, for issuance of a Load Line Certificate, for the following types of vessels:

[12] [3] Vol. IV, 6.G.2.d
[13] [3] Vol. IV, 6.A.2.a
[14] [3] Vol. IV, 6.A.2.a
[15] [6] 3-84

1) Small Passenger Vessels (<100 gt)

2) Integrated Tug-Barges;

3) Hazardous Chemical Barges;

4) Mobile Offshore Drilling Units;

5) Hopper Dredges; and

6) Hull Forms with New and Unique Stability Characteristics.

Except as provided above, ABS reviews and approves the stability calculations where required for issuance of the Load Line Certificate to be issued by ABS.[16] However, the USCG has the responsibility to issue the stability approval letters. After ABS completes its damage stability review, any operating restrictions or GM limitations imposed *will* be supplied to the USCG for consideration before the stability letter is written.

APPROVED STABILITY INFORMATION

Requirement[17]

The master of every new vessel, which is not already provided with stability information under an International Convention for the Safety of Life at Sea in force, is to be supplied with sufficient information in a form approved by the Commandant, to give guidance as to the stability of the vessel under varying conditions of service, and a copy is to be furnished to the Commandant.

USCG Actions[18]

In general, the stability letters are issued by the Marine Safety Center (MSC) of the USCG. The following requirements are applied:

1) If the Vessel is Inspected and Load Lined

Issue a stability letter to the owner of the vessel, send a copy to the Officer in Charge Marine Inspection (OCMI) to be referenced on the Certificate of Inspection, and direct the load line assigning authority to reference the stability letter on the face of the Load Line Certificate.

2) If the Vessel is Load Lined but not Inspected

Issue a stability letter to the owner to be placed on the vessel and send a copy to the assigning authority, directing its attachment to

[16] For some types of existing vessels, damage stability review and approval is the responsibility of the USCG.

[17] [2] 42.15-1(b)

[18] [3] Vol. IV, 6.C.1.b

the Load Line Certificate and indication of the date and indicating same on the face of the certificate.

3) Stability Letter is Not Issued

If a stability letter will not be issued, such as in the case of an unmanned deck cargo barge, a statement is placed in the letter approving the stability calculations and authorizes the issuance of a Load Line Certificate indicating that the stability information has been reviewed and found satisfactory.

If the loading restrictions are brief, the MSC may elect not to issue a stability letter, in which case the OCMI and the load line assigning authority will be advised of any restrictions to be placed on the Certificate of Inspection or Load Line Certificate, as appropriate.

Assigning Authority Actions[19]

Assigning authorities such as ABS are to follow the directions received from the MSC regarding the information to be placed on or attached to Load Line Certificates.

Stability related plans and calculations in support of a load line by ABS may be submitted directly to ABS World Headquarters for review and approval. This applies only to new U.S. flag vessels being assigned a load line by ABS, whether classed by ABS or not.[20] NVIC 3-84 supplies details, and outlines the type of reviews which may be performed by ABS.

Annual Revalidation[21]

At each Annual Load Line Inspection, before the Load Line Certificate is revalidated, the attending surveyor should verify that the approved stability information is onboard the vessel.

[19] [3] Vol. IV, 6.C.1.c
[20] [6] 3-84
[21] [3] Vol. IV, 6.F.3.b

GENERAL ASSESSMENT CRITERIA

POSITION REQUIREMENTS[1]

Two positions are defined for assessing the arrangement of hatchways doors and ventilators:

Position 1

Upon exposed freeboard and raised quarter decks, and upon exposed superstructure decks situated forward of a point located a quarter of the vessel's length from the forward perpendicular.

Position 2

Upon exposed superstructure decks situated abaft a quarter of the vessel's length from the forward perpendicular.

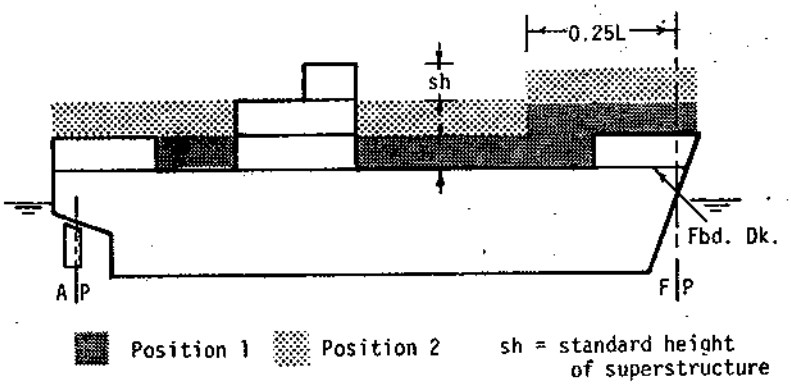

Figure 73. Position of Hatchways, Doorways, and Ventilators

SUPERSTRUCTURE VS. DECK HOUSE

Definitions

One of the primary objectives of the Convention is to maintain the weathertight/watertight[2] envelope of the vessel. The hull below the level of the freeboard deck is to be maintained watertight. The freeboard deck, enclosed superstructures, and deck houses protecting access below the freeboard deck or into enclosed superstructures are to be maintained weathertight.

[1] [1] Reg. 13

[2] Weathertight/watertight are defined in Chapter I.

A deck house is a deck structure which does not qualify as an enclosed superstructure.[3] There are two categories of deck houses:

A) Those which protect access(es) below the freeboard deck or to a space within an enclosed superstructure; and

B) Those which do not.

The requirements associated with deck houses addressed in category "A" are the same as those for an enclosed superstructure. However, if the access below the freeboard deck, or into a space within an enclosed superstructure, is protected by an efficient weathertight structure fitted with a proper closing appliance, and sill coaming of required height, *then* the surrounding deck house may be considered as a category "B" deck house.[4]

For category "B" deck houses, weathertight closing appliances are not required. However, if the deck house is not deemed to be weathertight, consideration should be given for the freeing of water that may possibly be entrapped.

Companionways[5]

A companionway is traditionally a small deck structure whose primary purpose is to protect an access opening. For load line purposes, a companionway is a weathertight deck structure protecting an access opening leading below the freeboard deck or into a space within an enclosed superstructure, which has *only* one access door, i.e. no alternate access. Generally, the access opening below is in close proximity to the external door.

Alternate Access

The term "alternate access" means there is access into the deck structure from more than one side.[6] Access from the deck above may also be considered as alternative access.[7] The rationale behind alternate access is that a vessel may be operating in rough weather, and seas are predominately boarding over one side, in the proximity of an access opening into the deck structure, the weathertight door may be kept secured and access into the structure gained through alternate safer means.

If alternate access is not provided, a deck structure protecting an access below *must* be considered as a companionway.

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3 See the definition of an enclosed superstructure in Chapter II.

4 [8] Electronic message 4 Dec 1986

5 [1] Reg, 18(2) {basis}

6 [9] 7 June 1968

7 [4] LL.8, LL.3/Circ.20, 26 May 1976

VERTICAL ACCESS OPENINGS

DOORS

General Requirements

All access openings in bulkheads at the ends of enclosed superstructures, or category "A" deck houses,[1] are to be fitted with doors permanently attached to the bulkhead, and framed, stiffened, and fitted so that the whole structure is of equivalent strength to the unpierced bulkhead, and weathertight when closed.[2]

Doors should generally open outwards to provide additional security against the impact of the sea. Doors which open inward are to be especially approved.[3]

Securing[4]

The means for securing doors weathertight is to consist of gaskets and clamping devices or other equivalent means and are to be permanently attached to the bulkhead or to the doors themselves. The doors are to be arranged so that they can be operated from both sides of the bulkhead.

Material

A door in the bulkhead of an enclosed superstructure, or a category "A" deck house, is to be made of steel, other equivalent material,[5] or a material of suitable strength consistent with the surrounding structure. Wood is not an acceptable material for doors located in Position 1 or 2 *unless* the vessel is predominately of wooden construction.

Sill Height

The sill height is defined as the vertical distance from the deck to the lower edge of the access opening, i.e. the downflooding point. If the deck in way of the opening has camber, the sill height to be considered is the least height of the opening above the deck.

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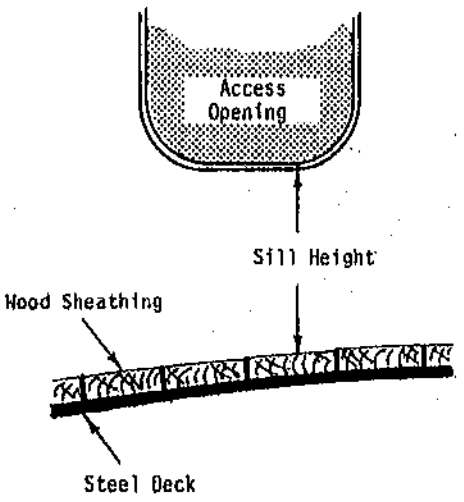
1 [1] Reg. 18(2)
2 [1] Reg. 12(1)
3 [4] LL.5, LL.3/Circ.20, 26 May 1976
4 [1] Reg. 12(1)
5 [1] Reg. 12(1)

Figure 74. Door Sill Height



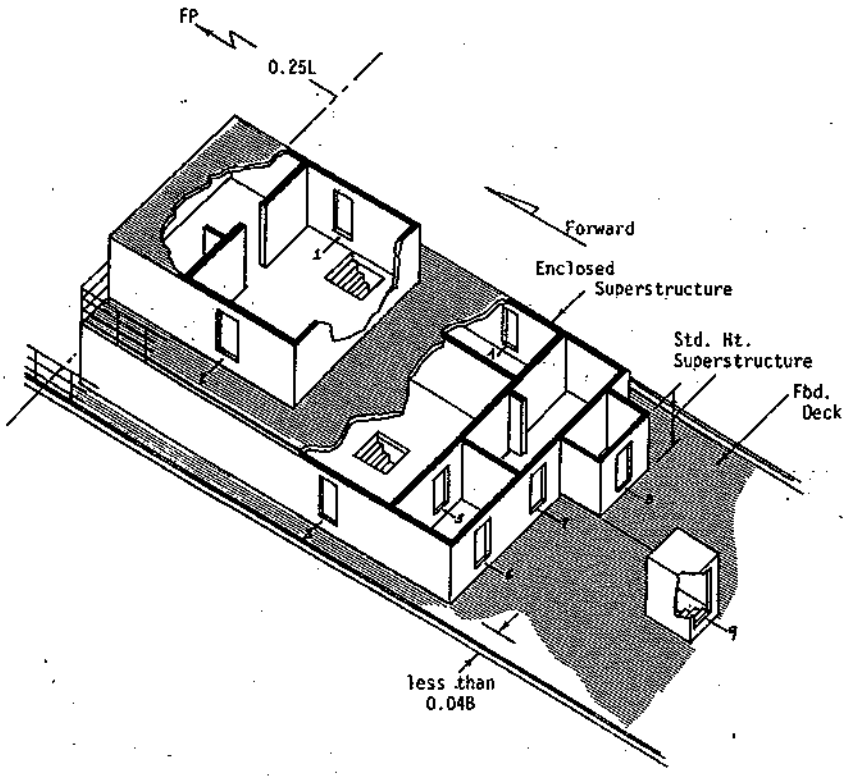
Minimum Sill Heights

	Pos. 1	Pos. 2	Above Pos. 2
Companionway	600 mm (23 1/2")	380 mm (15")	none
Superstructure or Dk House protecting access below (Cat. "A")	380 mm (15")	380 mm (15")	none none
Dk House without access below (Cat. "B")	150 mm (6")	none	none

Though not specifically required by the Load Line Convention, the USCG requires[6] a minimum sill height of 150 mm (6") for access openings into *all* deck structures located in Position 1. For category "B" deck houses, those which are not protecting access below, if the minimum sill height requirement would impede the specific operation of the vessel, special consideration may be given where warranted.

[6] [8] Electronic message 4 December 1986

Figure 75.
Minimum Required
Door Sill Height



Minimum Sill Heights (Illustrated in Above Figure)

Access Opening	Min. Sill Height
1	380 mm (15")
2	380 mm
3	380 mm (provided access to space is provided from above, otherwise 600 mm)
4	380 mm
5	none
6	380 mm
7	380 mm
8	150 mm (6")
9	600 mm (24")

Portable Sills[7]

Portable sills should be avoided. However, in order to facilitate the loading /unloading of heavy spare parts or similar equipment, portable sills may be fitted on the following conditions:

1) They must be installed before the vessel leaves port;

2) Sills are to be gasketed and fastened by closely spaced through bolts; and

[7] [4] LL.5, LL.3/Circ.20, 26 May 1976

3) Whenever the sills are replaced after removal, the weathertightness of the sills and the related doors is to be verified by hose testing. The dates of removal, replacing and hose testing are to be recorded in the vessel's log book.

Watertight Doors

If bulkheads are required to be watertight to comply with the damage stability requirements in the load line regulations, watertight doors in those bulkheads are to meet the requirements in 46 CFR 170, Subpart H.[8]

MACHINERY SPACE ACCESS OPENINGS

Protection[9]

Machinery space openings in position 1 or 2 are to be properly framed and efficiently enclosed by steel casings of ample strength, and where practicable, those in the freeboard deck are to be within superstructures or category "A" deck houses.[10] Where the casings are not protected by other structures their strength is to be specifically considered to the satisfaction of the assigning authority..

Access Openings[11]

Access openings in machinery casings are to be fitted with doors complying with the requirements associated to a companionway.

Minimum sill height:

Position 1 - 600 mm (23 1/2 in)

Position 2 - 380 mm (15 in)

Other openings in the machinery casing are to be fitted with equivalent covers, permanently attached in their proper positions.

On occasion, skylights are fitted on the weather deck above machinery spaces. The requirements associated with skylights are to be found in the "Side Scuttles" section of this chapter.

Type 'A', 'B-100' Freeboards[12]

Machinery casings are to be protected by an enclosed superstructure of at least standard height, or by a deckhouse of equal height and

[8] [3] Vol. IV, 6.F.10.e
[9] [1] Reg. 17(1) {basis}
[10] See the General Assessment Criteria Section for a clarification.
[11] [1] Reg. 17(1)
[12] [1] Reg. 26(1) & 27(9)

equivalent strength. Machinery casings may be exposed *provided* that there are no openings giving direct access from the freeboard deck to the machinery space. A door complying with the requirements of Regulation 12 *may*, however, be permitted in the machinery casing, *provided* that it leads to a space or passageway which is as strongly constructed as the casing and is separated from the stairway to the machinery space by a second weathertight door of steel or other equivalent material. An inner sill of 230 mm (9 in) in conjunction with an outer sill of 600 mm (23 1/2 in) is recommended.[13]

CARGO PORTS OR OTHER SIMILAR OPENINGS[14]

Requirement

Cargo ports or other similar openings in the sides of the vessel below the freeboard deck are to be fitted with doors so designed to ensure watertightness[15] and structural integrity commensurate with the surrounding shell plating, to the satisfaction of the assigning authority. The number of such openings are to be the minimum compatible with the design and proper working of the vessel.

Openings in the sides of the vessel above the freeboard deck level are not treated as cargo ports, for load line purposes; weathertight closures *may* be acceptable. However because of their vulnerablity to sea conditions the closures for such openings are to be to the satisfaction of the assigning authority.

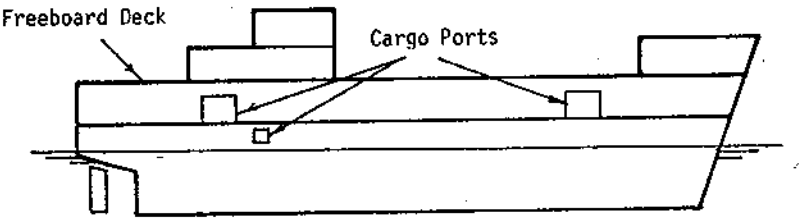


Figure 76. Cargo Ports

Testing

The arrangements are to be subject to tightness tests at the initial survey and at such subsequent surveys or more frequent intervals as deemed necessary.

[13] [4] LL.7, LL.3/Circ.20, 26 May 1976

[14] [1] Reg. 21(1)

[15] Watertightness is required, in lieu of weathertightness, since these openings are in the shell below the freeboard deck level.

Submergence[16]

The lower edge of any such opening is not to be below a line drawn parallel to the freeboard deck at side, which has at its lowest point the upper edge of the uppermost load line,[17] including all seasonal and density marks.

In 1972, the IMO adopted an interpretation of the Convention which permitted submergence of cargo ports and suggested an inner door plus operational precautions. The USCG has not permitted U.S. flag vessels to submerge any part of their cargo ports below the deepest operating waterline including all seasonal and density marks, whether in transit or at dockside. This policy is applicable to all vessels that are assigned a load line under the authority of the USCG.

TONNAGE OPENING CLOSURES

Concept[18]

Permanent enclosed erections, such as a forecastle, poop, or bridge, on the upper deck are generally included in the gross tonnage[19] of the vessel. Deck structures not deemed enclosed are excluded from the gross tonnage. For tonnage purposes, the spaces in question may be exempted *provided* they are considered non-tight. Conversely, for load line purposes, to receive possible credit the spaces must be deemed weathertight.

Tonnage Openings[20]

A permanent deck structure on or above the upper deck to the hull, with opening(s) in its sides or ends, not fitted with permanently attached means of closing[21] may be exempted from inclusion in the gross tonnage *provided* the openings conform with the following provisions:

1) Two 3 x 4 ft. one on each side of the centerline of one of the end bulkheads; or

2) One 4 x 5 ft. tonnage opening as near as practicable to the centerline of one of the end bulkheads.

Coamings, if fitted to the tonnage opening, *must* not exceed a 24 in. height above the deck at any part.

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[16] [8] LLAC No. 7, 9 September 1986

[17] [1] Reg. 21(1)

[18] [2] 69.03-67 {basis}

[19] The gross tonnage is intended to reflect a vessels approximate volume, and may vary depending on which formal system of measurement is used.

[20] [2] 69.03-67 {basis}

[21] Except as allowed in the following section.

Tonnage Opening Closures - Tonnage Requirements

Tonnage openings in the external boundaries of the permanent deck structures previously mentioned may be temporarily closed by:

1) Shifting boards dropped into channel sections at the sides, top, and bottom of such openings; or

2) A plate or boards held in place by bolts and cross pieces so arranged so that the securing devices do not penetrate the bulkhead; or

3) Plates or boards held in place by hook bolts, spaced not less than 1 ft. apart, fitting over the stiffener bar at the perimeter of the opening.

The cover plates must fay against the bulkhead. The use of battening, caulking, or gaskets of any material is not permitted.

Tonnage Opening Closures - Load Line Purposes[22]

For load line purposes, a tonnage opening in a superstructure end bulkhead secured by a steel plate faying directly to the bulkhead, of a strength and rigidity equal to that of the surrounding bulkhead, may be accepted as a weathertight closing appliance *provided* the:

1) plate is not removed while the vessel is at sea;

2) plate is securely hook-bolted;

3) opening has at least a 15" sill[23]; and

4) closure is hose tested[24] to verify weathertightness to the satisfaction of the attending surveyor.

[22] [8] 28 April 1966 {basis}, & practice since 1975

[23] [8] Electronic message 23 December 1986

[24] Hose test requirements are addressed later in this chapter in the hatch cover securing section.

HORIZONTAL ACCESS OPENINGS

PROTECTION OF OPENINGS[1]

Freeboard Deck

Openings in the freeboard deck other than hatchways, machinery space openings, manholes or flush scuttles are to be protected by an enclosed superstructure, or by a deckhouse or companionway of equivalent strength and weathertightness.

Top of First Tier Structures

Openings in an exposed superstructure deck or in the top of a deck house on the freeboard deck which gives access to a space below the freeboard deck or a space within an enclosed superstructure, are to be protected by an efficient deckhouse or companionway of sufficient strength and weathertightness.

Openings in the top of a deckhouse on a raised quarterdeck having a height equal to or greater than a standard height raised quarterdeck are to be provided with an acceptable means of closing, *but* need not be protected by an efficient deckhouse or companionway *provided* the height of the deckhouse is at least the height of a full superstructure.[2]

Higher Decks

Generally, all exposed horizontal openings should be provided with closures. For openings located above Position 2, the weathertightness requirements may be to the satisfaction of the assigning authority.

HATCHWAYS CLOSED BY PORTABLE COVERS[3]

General

Hatchways closed by portable covers and secured weathertight by tarpaulins and battening devices were the common standard many years ago. These type of closures are essentially extinct today, though they may still be seen on some older existing vessels.

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[1] [1] Reg. 18(2)

[2] [4] LL.46, LL.3/Circ.42, 13 April 1982

[3] [1] Reg. 15

Hatchway Coamings

The coamings of hatchways closed by portable covers secured weathertight by tarpaulins and battening devices are to be of substantial construction, and their height above the deck is to be at least:

Position 1	600 mm (23 1/2")
Position 2	450 mm (17 1/2")
Above Position 2	no coaming required

Hatch Covers - Material & Strength[4]

Wood: Where covers are made of wood, the finished thickness is to be at least 60 mm (2 3/8") in association with a span of not more than 1.5 m (4.9 ft). The wood is to be free from knots, sap, and shakes, and is to be examined before being coated.[5]

Steel: Where the covers are made of mild steel, the strength requirement is addressed in Reg. 15(4) & (5). The strength criteria applicable to pontoon covers is addressed in Reg. 15(7).

Other: The strength and stiffness of covers made of material other than steel are to be equivalent to those of steel and will be subject to special consideration by the assigning authority.

Portable Beams

Portable beams are used to support the individual hatch boards or covers. The strength criteria is addressed in Reg. 15(6)[6]. Carriers or sockets for portable beams are to be of substantial construction, and are to provide means for the efficient fitting and securing of the beams. Where rolling type beams are used, the arrangements are to ensure that the beams remain properly positioned when the hatchway is closed.

Securing Arrangements & Features[7]

Bearing Surface - the width of each bearing surface for hatchway covers is to be at least 65 mm (2 1/2"). Hatch rests are to be beveled where necessary to provide a solid bearing surface.[8]

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[4] Additional guidance for elements of variable cross section is given in [4] LL.20, LL.3/Circ.20, 26 May 1976

[5] Sec. 18.7.2, ABS Rules for Building and Classing Steel Vessels

[6] Additional guidance for elements of variable cross section is given in [4] LL.20, LL.3/Circ.20, 26 May 1976

[7] See Reg. 15(10)-(13)

[8] Additional guidance for elements of variable cross section is given in [4] LL.20, LL.3/Circ.20, 26 May 1976

Tarpaulins - at least two layers of tarpaulins thoroughly waterproofed and of ample strength are to be provided for each exposed hatchway. The material is to be guaranteed free from jute and are to be of an approved type.[9] Synthetic fabrics which have been demonstrated to the satisfaction of the assigning authority to be equivalent will be specially approved.[10]

Wedges - Wedges are to be made of tough wood or other equivalent material. They are to have a taper of not more than 1 in 6 and are to be not less than 13 mm (1/2") thick at the toes.

Cleats - are to be set to fit the taper of the wedges. They are to be at least 65 mm (2 1/2") wide and spaced not more than 600 mm (23 1/2") center to center. The cleats along each side or end are to be not more than 150 mm (6") from the hatch corners.

Battening Bars - are to be provided for properly securing the tarpaulins. They are to be made of steel and are to have a width of 64 mm (2 1/2") and a thickness of not less than 9.5 mm (3/8"). Hatchway covers of more than 1.5 m (4.9 ft) in length are to be secured by at least two such securing appliances. Devices and materials which will provide strength equivalent to, and elasticity not greater than that of, steel may be accepted as equivalent. Steel wire ropes cannot be regarded as satisfactory equivalent means. Care is to taken that the tarpaulins are adequately protected from the possibility of damage arising from the use of securing devices which do not provide a flat bearing surface.[11]

STEEL HATCH COVERS SECURED BY CLAMPING DEVICES[12]

Hatchway Coamings

The coamings of hatchways closed by steel or equivalent covers secured weathertight by clamping devices are to be of substantial construction, and their height above the deck is to be at least:

Position 1	600 mm (23 1/2")
Position 2	450 mm (17 1/2")
Above Position 2	none required

9 Generally #4 cotton canvas is the standard material used, with a weight of 24.54 oz. per square yard, a count of 29 threads per inch by 32 threads per inch. Each thread is made of 4 yarns. ([9] 7 March 1963)

10 A few of the trade named synthetic materials which have been accepted in the past are Herculite 80, Jaton, Weblon, and Vulcan Coverlight H. ([9] 22 March 1963)

11 [4] LL. 40, LL.3/Circ.42, 13 April 1982

12 [1] Reg. 16

Coaming Height Relaxation

Under certain circumstances, a relaxation of the required coaming height is permitted. In this regard the following guidance is given:

1) Cargo Hatches - (Normally secured at sea)

The height of these coamings may be reduced, or omitted entirely, on the condition that the assigning authority is satisfied that the safety of the vessel is not impaired in any sea conditions.[13] Sealing arrangements are to be weathertight if a coaming is fitted, and watertight for flush covers.[14]

2) Access Hatches[15]

Normally the standard coaming heights are required; seals are to be weathertight. If for operational reasons, flush access hatches are needed,[16] the seals *must* be watertight, and access *must* be restricted to emergency use only. Warning signs and a restrictive notation on the Load Line Certificate is required as deemed appropriate by the assigning authority.

Hatch Cover Materials

Where the covers are made of mild steel, the strength requirement are addressed in Reg. 16(2). The strength and stiffness of covers made of material other than steel are to be equivalent to those of steel and will be subject to special consideration by the assigning authority.

Fiberglass: Fiberglass has been accepted on a case by case basis for specific application, intended cargoes, and service.[17] Designs have been submitted that demonstrate compliance with the strength requirements, including the deflection criteria. As an additional precaution, conditional approval was given subject to close monitoring, and the notification of the Commandant in writing of the service experience over a period of a few years.

Aluminum: Aluminum hatch covers have been accepted on U.S. flag vessels since 1965, primarily because of the safety benefits derived from their lighter weight and greater ease of handling. However, due to the risk of melting in a fire, aluminum hatch covers are not to be used aboard new vessels carrying oil or other flammable or combustible liquids in bulk, *unless* the covers are used for dedicated wing ballast tanks and rake voids on tank barges.[18]

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[13] [2] 42.15-30

[14] [8] Electronic Message 9 March 1987

[15] [8] Electronic Message 9 March 1987

[16] Such as on the cargo deck of an offshore supply vessel.

[17] [9] 20 October 1977. (For unmanned hopper barges)

[18] [3] Vol. IV, 6.I.3

Cargo Loading - Where the hatchways are fitted with coamings of standard height as stipulated above, no extra strengthening is necessary for covers loaded with cargo, even dense cargo, *provided* the load does not exceed 1.75 tons/m^2 (position 1).[19]

Reduced Type 'B' Freeboards - For flush hatchway covers which are fitted on the freeboard deck forward of the quarter length the section modulus and moment of inertia are to be increased 15% over that required by Reg. 16.[20]

Securing Weathertight

The means of securing and maintaining weathertightness is to be to the satisfaction of the assigning authority. The arrangements are to ensure that the tightness can be maintained in any sea conditions. The covers are to be hose tested in position under a water pressure of at least 2.1 kg/cm^2 (30 psi) at the time of construction and, if considered necessary, at subsequent surveys.[21]

Normally gaskets are provided to ensure weathertightness at the joint formed by the hatch cover and coaming. Gasketless hatch covers are acceptable *provided*[22] the following items are met:

a) The vessel must be 410 ft (125 m) in length or more in load line length. The Commandant will not consider allowing gasketless covers for any lesser vessel lengths.

b) The height of the covers above the summer load line must be at least four superstructure levels. A standard superstructure height is defined in the Superstructure section of Chapter II of this manual.

c) Calculations and, if necessary, additional plans must be submitted demonstrating that the deflections of the hatch cover with respect to the hatchway framing in the ship structure system will not cause sealing surface misalignment and thus result in seal leakage.

Recognized assigning authorities may permit the installation of gasketless hatch covers on vessels *provided* the above conditions are met. They must review and approve the calculations/plans for the above requirements submitted by vessel owners/agents before assigning a load line to the vessel.

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19 [4] LL.6, LL.3/Circ.20, 26 May 1976
20 [4] LL.6, LL.3/Circ.20, 26 May 1976
21 [3] Vol. IV, 6.1.5
22 [11] LLAC 13, 22 June 1987

MANHOLES AND FLUSH SCUTTLES[23]

Requirements

Manholes and flush scuttles in position 1 or 2 or within deck structures other than enclosed superstructures are to be closed by substantial covers capable of being made watertight. The covers are to be permanently attached *unless*, secured by closely spaced bolts.

Materials

The covers are to made of steel or equivalent material of sufficient strength commensurate with the surrounding deck.

Fiberglass tank cleaning hatch covers are not acceptable for U.S. flag or foreign flag vessels visiting U.S. ports unless the manufacturer submits verification to the USCG that their material is equivalent to steel. That is, their hatch covers must be capable of preventing the passage of flame and smoke for at least one hour.[24]

Closures[25]

Single-dogged hatches and scuttles. Several designs of hatches and scuttles have only a single dog or bolt for securing. Some are mounted flush with the deck, while others are mounted on coamings. These type of closures are acceptable as being watertight and, therefore, may be used for access to compartments such as voids and ballast tanks in any type of vessel or service, subject to approval of the OCMI. However, these fittings are difficult to maintain gastight, and are not to be used in cargo or fuel tanks where lack of gastight seal possess a serious hazard.

Three-dogged circular fittings and **four-dogged** oblong fittings are acceptable, and appear to be the best arrangement for this service.

[23] [1] Reg. 18(1)
[24] [8] 15 July 1986
[25] [3] Vol. IV, 6.I.1

VENTILATORS

DEFINITION, TYPES, & GENERAL REQUIREMENTS

Definition

Weather deck ventilation fittings are used to provide the vessel with adequate air intakes and discharges suitably protected from the elements. Ventilators generally lead to dry spaces, i.e. accomodation, machinery, and dry cargo spaces.

Types[1]

There are numerous types of ventilation fittings that are used for marine application. Some of the more common types are:

Goosenecks can be used for both natural and mechanical ventilating systems, either supply or exhaust.

Cowls are used for natural supply to and exhaust from cargo holds or storage spaces. With the increased use of mechanical ventilation this type of fitting is becoming obsolete.

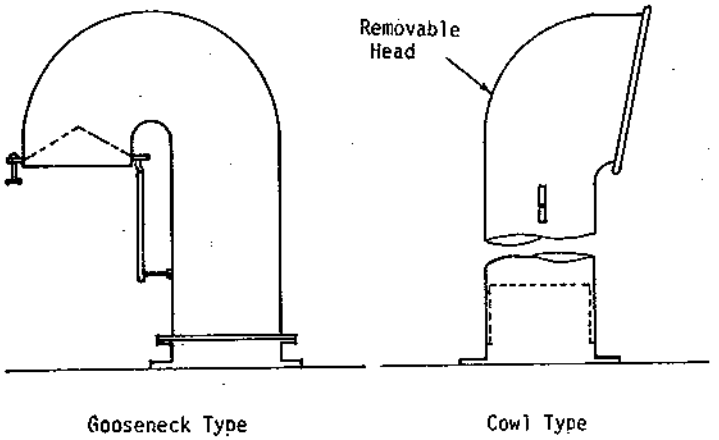


Figure 77. Gooseneck & Cowl Ventilators

[1] [10] Section 4

Mushroom ventilators come in various styles. The standard mushroom ventilator can be used for either natural or mechanical supply or exhaust systems. This type is generally not deemed weathertight and therefore should not be used in locations where a weathertight closing appliance is required. The screw-down type of mushroom which can be made weathertight is used almost exclusively for ventilating small compartments. The weathertight feature is provided by means of the screw-down type top, operated from above or below the deck.

Wall Ventilators are installed vertically in exterior bulkheads. They are generally used for large volume systems and are usually provided with a wire-mesh screen and louver blades.

Minimum Coaming Plate Thickness[2]

Ventilator Size (Open Cross Sec. Area)	Min. Plate Thickness Exposed Pos. 1 or 2	Partially Protected[3]
≤ 50 in^2	0.3 in	0.27 in
≥ 250 in^2	0.4 in	0.3 in

Intermediate values may be obtained by linear interpolation.

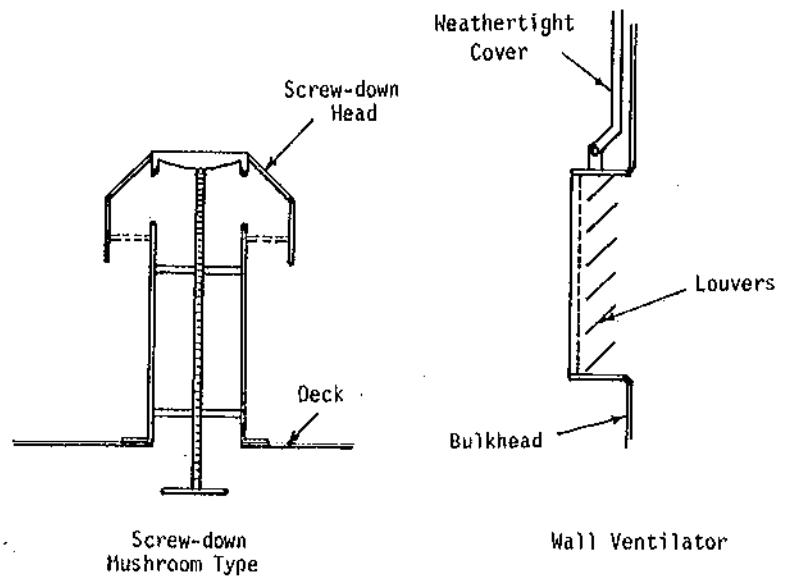


Figure 78. Mushroom & Wall Ventilators

[2] [8] Electronic Message 9 March 1987

[3] Thickness at the freeboard deck. Ventilator passing through a non-enclosed superstructure.

General Requirements[4]

Ventilators in position 1 or 2 to spaces below the freeboard deck, or decks of enclosed superstructures, or passing through deck structures other than enclosed superstructures are to have coamings of steel or other equivalent material, substantially constructed and efficiently connected to the deck.

COAMING HEIGHT REQUIREMENTS

Concept

The coaming height is defined as the vertical distance from the deck to the lower edge of the access opening, i.e. the downflooding point. If the deck in way of the opening has camber, the sill height to be considered is the least height of the opening above the deck.

For gooseneck vents, the coaming height is generally measured to the underside of the gooseneck. Wall vents often are fitted with an internal baffle which rises above the lower edge of the exterior opening. If such is the case, the coaming height is measured to the top of the baffle.

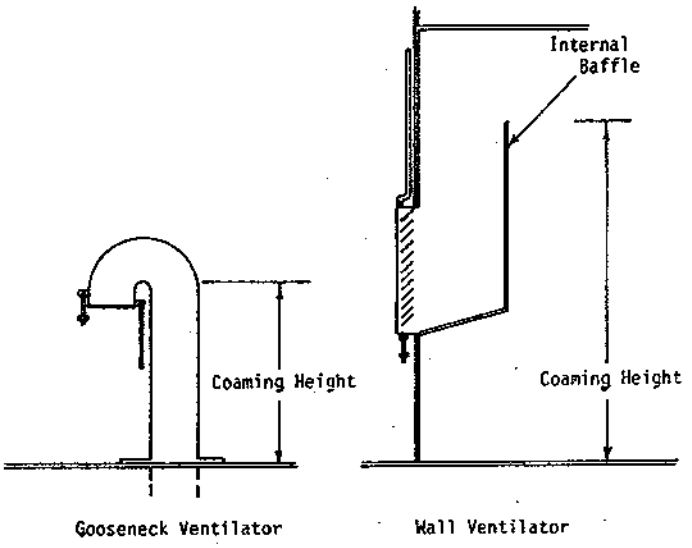


Figure 79. Ventilator Coaming Height

Requirements

Ventilators in position 1 are to have a minimum coaming height of 900 mm (35 1/2") above the deck; in position 2 the minimum coaming height is 760 mm (30") above the deck.[5]

[4] [1] Reg. 19(1) & (2)
[5] [1] Reg. 19(4)

Where the coaming of any ventilators exceeds 900 mm (35 1/2") in height, and it is not supported by an adjacent structure, it is to have additional strength and attachment[6]

In exposed positions, the height of coamings may be required to be increased to the satisfaction of the assigning authority.[7]

Required Height Relaxation

There is no provision in the Convention to allow a reduction in the minimum required coaming height for ventilators. Special consideration has been given to relatively small diameter gooseneck pipe ventilators fitted with automatic closing devices. Where the minimum required coaming height would interfere with the operation of the vessel, a height reduction has been allowed.[8]

CLOSING APPLIANCES

General Requirements

All ventilator openings are to be provided with a weathertight closing appliance, *except* as provided in the following paragraph. In vessels 100 m (328 ft) in length or less, the closing appliance is to be permanently attached. In larger vessels where not permanently attached, they are to be conveniently stowed near by.

Relaxation of Requirement

Ventilators in position 1 which have coamings which extend to more than 4.5 m (14.8 ft) above the deck, and in position 2 extend to more than 2.3 m (7.5 ft) above the deck, need not be fitted with closing arrangements *unless* specifically required by the assigning authority.[9]

The relaxation of the requirement for closures on ventilators with coamings exceeding the specified heights for positions 1 and 2 is generally confined to stand alone or free standing ventilators situated on the weather deck and not those situated within the bulkheads of a deck house or superstructure.[10]

Generally, weathertight closures are required on all ventilator openings adjacent to the side plating of an enclosed superstructure. Ventilator openings in the exterior bulkheads of superstructures or deck houses situated on the weather deck are also generally required to have weathertight closures even in cases where the weather deck is the second or higher deck above the deck from which the minimum freeboard could be assigned. The rationale of this interpretation is to

6 [1] Reg. 19(1) {basis}

7 [1] Reg. 19(5)

8 Telcon USCG 17 Feb 1982. The rationale is that these type of ventilators look and operate like an airpipe; a height reduction is allowed for airpipes.

9 [1] Reg. 19(3)

10 [9] 14 October 1983

protect the ventilator openings from "run up" of water due to waves on the vessel's sides or green water on deck so that water will not penetrate into the vessel under any sea condition.[11]

Types of Closures

Where required to be fitted, closing appliances for all ventilators in positions 1 or 2 are to be of steel or other equivalent materials[12] and deemed weathertight to the satisfaction of the assigning authority.

Fire dampers of the normal type are not considered as meeting the minimum requirement *unless* they are strongly constructed, gasketed and capable of being secured weathertight.

Steel louvers are acceptable where it can be shown they are capable of being closed weathertight, and remain tight under all sea conditions.

Wooden plugs with canvas covers were a common closing appliance for cowl type ventilators. To secure the ventilator opening, the removable cowl head is removed, a wooden plug is inserted, and a canvas cover placed over the plug and effectively secured in place. This arrangement is no longer acceptable.[13] Cowl or similar type ventilators with removable heads are to be provided with a strong weathertight cover of steel or equivalent material permanently attached, or conveniently stowed nearby where permitted.

[11] [9] 14 October 1983

[12] [4] LL.52, LL.3/Circ.69, 31 January 1985

[13] [4] LL.52, LL.3/Circ.69, 31 January 1985, confirmed by electronic message 16 Jan 1987.

AIRPIPES

DEFINITION & GENERAL REQUIREMENTS

Definition

Airpipes is the term applied to ventilation fittings for cofferdams, voids, tanks or other spaces generally designed to contained liquids, which are exposed to the elements.

General Requirements

Where airpipes extend above the freeboard deck, the exposed parts of the pipes are to be of substantial construction.[1]

Generally, airpipes are located around the periphery of the weather deck near the sides of the vessel, have an inverted gooseneck configuration, and are made of steel pipe or equivalent material.

Minimum Pipe Wall Thickness[2]

The exposed parts of airpipes extending above the freeboard and superstructure decks must be at least the standard thickness specified in the ABS Rules Section 36.39.2, the equivalent of ANSI Schedule 40 (ABS Rules Sec. 36.9.12).

COAMING HEIGHT REQUIREMENT

Concept

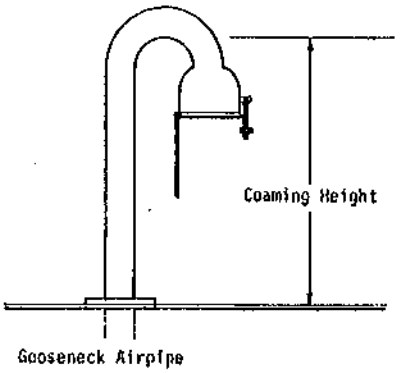
The coaming height is defined as the vertical distance from the deck to the lower edge of the access opening, i.e. the downflooding point. If the deck in way of the opening has camber, the sill height to be considered is the least height of the opening above the deck.

Unlike ventilators, the minimum required coaming height for airpipes is predicated on which deck it is located rather than position 1 or 2.

[1] [1] Reg. 20

[2] [8] Electronic Message 9 March 1987

Figure 80. Airpipe Coaming Height



Requirement

The minimum coaming height is to be 760 mm (30") on the freeboard deck, and 450 mm (17½") on the superstructure deck.[3]

In cases where the airpipes are led through the sides of superstructures, it is recommended that the height of their openings be more than 2.3 m (7.5 ft) above the summer load waterline.[4]

Occasionally, as a result of a damage stability analysis, airpipes are required to be raised so that their downflooding point is above the waterplane in the damaged condition.

Required Height Relaxation

Where these heights may interfere with the working of the vessel, a lower height may be approved, *provided* the assigning authority is satisfied that the closing arrangements and other circumstances justify a lower height.[5] One common application where special consideration is given is the after deck of a towing vessel. To avoid possible damage from the tow line it is desirable to keep the top of the airpipe below the top of the bulwark, which in some cases may be only 760 mm (30")[6] above the deck.

A lesser coaming height is permitted *only* when an automatic closing device is fitted. In such cases, the minimum coaming height generally permitted on the freeboard deck is 457 mm (18"), and 305 mm (12") on the superstructure deck.[7]

CLOSING APPLIANCES

General Requirement[8]

A permanently attached closing appliance is to be provided for closing the openings of airpipes.

[3] [1] Reg. 20
[4] [4] LL.3/Circ.69, 31 Jan 1985
[5] [2] 42.15-60(a)
[6] See the section on crew protection later in this chapter.
[7] Practice for at least 10 years.
[8] [1] Reg. 20

Types of Closures - Manual Devices

Manual devices, though they provide a weathertight seal against the elements, render the tank unusable while the closing devices are installed. Some of the more common types of closures that require manual application are:

A **hinged cover** of steel or equivalent material which is normally open on the outlet of the return bend and may be closed and secured weathertight by a toggle bolt and wing nut when deemed necessary.

Wooden plugs[9] which may be inserted in the outlet of the return bend to keep out the sea during bad weather and removed manually when no longer needed. The plugs are permanently attached to the airpipe by keeper chains.

Canvas hoods which may be installed over the vent head and secured in place during heavy weather and removed manually when no longer needed.

Types of Closures - Automatic Devices

Automatic closing devices provide constant unattended security against accidental downflooding through the airpipe opening. They allow the tank being vented to be used even in adverse weather conditions since they are normally open and only temporarily close when submerged by a wave. A few of the drawbacks of automatic devices are their expense, maintenance, and they generally do not provide as secure a seal when closed as do manually closed devices.

Automatic closures may be required due to stability considerations. A few of the more common type of automatic closing devices are:

A **trailing canvas hose,**[10] approximately 18" in length and the same diameter of the airpipe, attached to the outlet of the return bend is another type of closing appliance. The idea behind this closing device is that as the water level rises, the buoyancy of the hose causes the end to rise crimping the hose thereby effectively sealing off the airpipe opening. These type of closing devices should not be used in situations where the vessel operates in cold climates; if the trailing hose freezes, it may break off.

A **ball check valve** wherein the ball float, which is normally in the open position and resting at the bottom of the inverted assembly on the float support, will float upwards under the force of a submerging wave to seat and close the valve during the period of submergence. The valve must be designed so that the effective clear discharge area

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[9] Wooden plugs and trailing canvas hose are no longer considered a proper closing device per IMO LL.49, LL.3/Circ.69, 31 Jan 1985. These devices are still considered acceptable by the USCG for both manned and unmanned vessels. They are however, considered as points of downflooding for stability purposes per [8] LLAC No.2, 26 Dec 1985.

[10] See footnote 9.

through the valve with the float in the open position is not les than the inlet area of the vent pipe to which the valve is connected.

Pressure-Vacuum Valves

Pressure-vacuum valves presently installed on tankers do not theoretically provide complete watertightness or weathertightness. However, in view of experience with this type of valve and the position in which they are normally fitted they have been accepted.[11]

[11] [4] LL.49 (IACS)

SCUPPERS, INLETS and DISCHARGES

GENERAL REQUIREMENTS

General Definitions

Manned Machinery Space - A space containing the necessary machinery to propel or operate the vessel that is manned with personnel at all times.

Positive Means of Closing - Means is provided for "manually" closing the valve, e.g. gate valve, globe valve, stop-check etc. Reach rods may be necessary to provide positive means of closing from a remote location.

Substantial Thickness - Refers to the minimum wall thickness of pipes in relation to the external or nominal diameter.

Limitation of Shell Openings[1]

All inlets and discharges led through the vessel's side are to be fitted with efficient and accessible means for preventing the accidental admission of water into the vessel either through such pipes or in the event of fracture of such pipes.

The number of scuppers, sanitary discharges, tank overflows, and other similar openings are to be reduced to a minimum, either by making each discharge serve for as many as possible of the sanitary and other pipes, or in any other satisfactory manner.

SCUPPERS

Definition

A pipe leading overboard from what would be considered a non-tight space, i.e. a deck drain. Back flooding through such a pipe would not affect the reserve buoyancy of the vessel.

Pipe Failure Protection[2]

Scuppers originating at any level and penetrating the shell either:

1) more than 450 mm (17 1/2") below the freeboard deck; or

[1] [2] 56.50-95(a)
[2] [1] Reg. 22(3)

2) less than 600 mm (23 1/2") above the summer load waterline;

are to be provided with a nonreturn valve at the shell. This valve, *unless* required for other reasons, may be omitted if the piping is of substantial thickness.

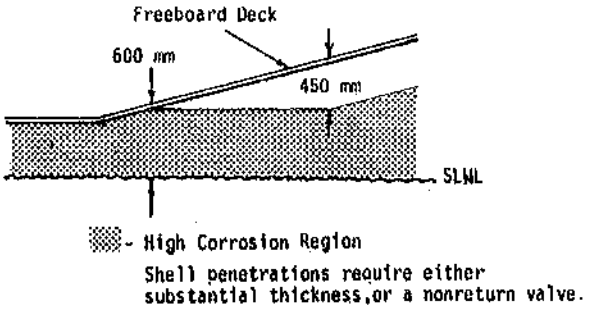


Figure 81. Pipe Failure Protection

Accidental Flooding Protection[3]

Scuppers leading from deck structures not deemed weathertight, are to be lead overboard; i.e. not to drain to internal spaces. In some cases, non-tight deck structures may necessitate freeing ports. For guidance in this regard see the section on freeing port later in this chapter.

OVERBOARD DISCHARGES

Definitions

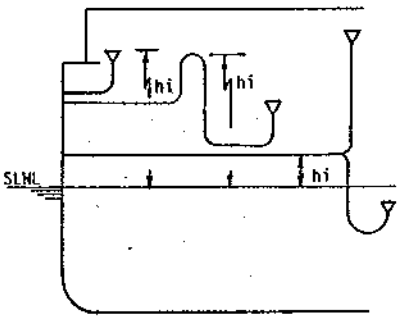
Discharge - A pipe leading overboard from an intact space above or below the freeboard deck. Back-flooding through such a pipe would affect the reserve buoyancy of the vessel.

Closed System - A system which penetrates the shell, but is essentially a closed loop through which no back-flooding can readily occur, e.g. main and auxiliary circulating systems.

Inboard End - The point where water would enter and flood the vessel if back-flooding were to occur due to a valve failure in the line. The highest point in the discharge line between the sea and the point where water would flood the vessel is referred to as the height of the inboard end. The least height of the inboard end will always be the level of the outlet in the shell.

[3] [1] Reg. 22(4) (basis)

Figure 82. Overboard Discharges-Inboard End



hi = height of inboard end

Open System - All discharges not considered in a closed system, e.g. sanitary drains, bilge, ballast, and eductors.

Indicator - Device attached to a positive action valve showing whether it is open or closed. A special indicator is not necessary if the valve is of the rising stem type.

General Provision[4]

It is considered that the requirements for nonreturn valves are applicable *only* to those discharges which remain open during the normal operation of the vessel. For discharges which must necessarily be closed at sea, such as gravity drains from topside ballast tanks, a single screw down valve operated from the deck is considered to provide efficient protection.

Pipe Failure Protection

Discharges originating at any level and penetrating the shell either:

1) more than 450 mm (17 1/2") below the freeboard deck; or

2) less than 600 mm (23 1/2") above the summer load waterline;

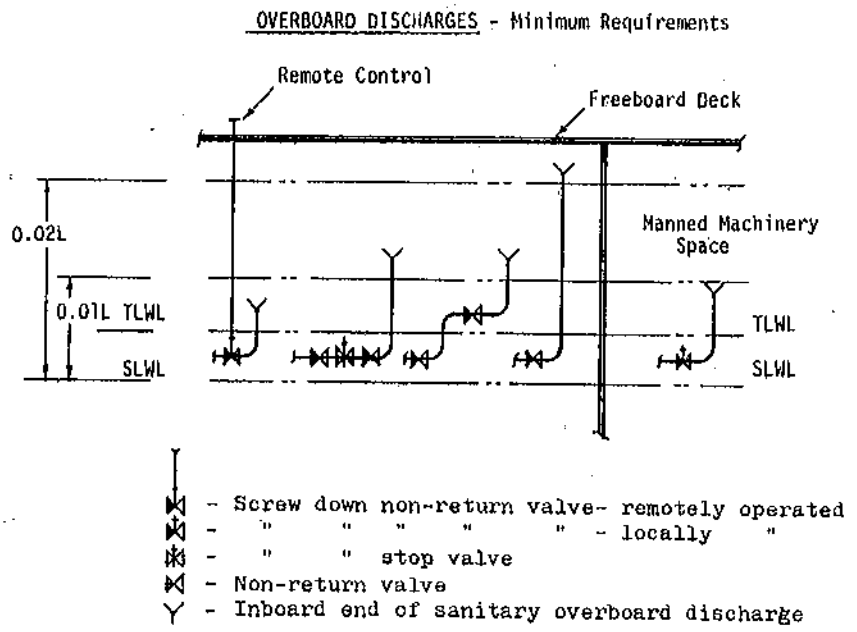
are to be provided with a nonreturn valve at the shell. This valve, *unless* required for other reasons, may be omitted if the piping is of substantial thickness.

Accidental Flooding Protection - Open Systems[5]

Discharges led through the shell originating either from spaces below the freeboard deck or from within enclosed structures on the freeboard deck are to be fitted with efficient and accessible means for preventing water from passing inboard. Normally each separate discharge is to have one nonreturn valve with a positive means of closing it from above the freeboard deck. Where, however, the vertical upward distance from the summer load line to the inboard end of the

[4] [4] LL.11, LL.8/Circ.20, 26 May 1976
[5] [2] 56.50-95(b)(2)

discharge pipe through which flooding can take place exceeds 0.01L, the discharge may have two nonreturn valves without positive means of closing, *provided* that the inboard valve is always accessible for examination under service conditions. Where the vertical distance exceeds 0.02L a single nonreturn valve without positive means of closing is acceptable. In an installation where the two nonreturn valves are used, the inboard valve *must* be above the tropical load waterline.[6] If this is not practicable, then provided a locally controlled stop valve is interposed between the two ANR valves, the inboard valve need not be fitted above the tropical load waterline. The means for operating the valve are to be readily accessible and provided with an indicator showing whether the valve is open or closed.



Note: All piping in above diagram is of substantial thickness.

Figure 83. Overboard Discharges-Valve Requirements

Sanitary pump discharges leading directly overboard or via a holding tank *must* meet the same general standards.[7]

Accidental Flooding Protection - Closed Systems[8]

Sea inlets and discharges, such as used in closed systems required for the operation of main and auxiliary machinery, as in pump connections, or scoop injection heat exchanger connections, need not meet the valve requirements stipulated for open systems but instead are to be fitted with a shutoff valve located as near the shell plating as practicable.

6 If timber marks are assigned, the valve is to be above the timber tropical load waterline.

7 [2] 56.50-95(b)(4)

8 [2] 56.50-95(d)

Manned Machinery Spaces[9]

In manned machinery spaces main and auxiliary sea inlets and discharges in connection with the operation of machinery may be controlled locally. The controls are to be readily accessible and are to be provided with indicators showing whether the valves are open or closed.

Where sanitary discharges and scuppers lead overboard through the shell in way of manned machinery spaces, locally operated positive closing valves with inboard nonreturn valves are permitted.[10]

Unmanned Machinery Spaces

In unmanned machinery spaces, all machinery inlets and discharges in connection with the operation of machinery, are to be remotely operable from a position above the freeboard deck, unless otherwise approved, and are to meet the accessibility and marking requirements previously stipulated in the section entitled "Accidental Flooding Protection - Open Systems."

Unmanned automated machinery spaces which are equipped with bilge flooding detection systems do not require remote operation of the inlet and discharge valves.[11]

PIPING THICKNESS REQUIREMENTS

International Standard

IMO LL.3/Circ.77, dated 13 October 1986, addresses the minimum wall thickness for pipes covered by the Convention, for those Administrations which do not have specific national requirements. The minimum wall thicknesses indicated are in millimeters, a basis which is not totally compatible with North American standards. For U.S. flag vessels, the following standard is to be used.

Standard for U.S. Flag Vessels[12]

Substantial thickness is to be provided for all inlet and discharge connections outboard of the nonreturn valves, and exclusive of the seachests.

Pipes which have a minimum wall thickness that complies with the following table are considered to have substantial thickness:

[9] [1] Reg. 22(2)
[10] [4] LL.11, LL.3/Circ.20, 26 May 1976 {basis}
[11] [8] Policy file memo 1 Mar 1976
[12] [2] 56.50-95(b)(1), Electronic Message 9 March 1987

SUBSTANTIAL PIPE THICKNESSES

Thickness	Nominal Pipe Diameter
Schedule 80	through 8" (203 mm)
Schedule 60	above 8" and below 16" (406 mm)
Schedule 40	16" and above

MATERIAL REQUIREMENTS

Metallic Materials[13]

Required valves and piping system components outboard of such valves are to be of steel, bronze, or ductile cast iron specification listed in [2] 56.60-1(a). Lead or other heat sensitive materials are not to be used in such service, or in any other application where the deterioration of the piping system in the event of a fire would give rise to the danger of flooding. Brittle materials such as ordinary cast iron is not to be used in such service.

Detailed requirements for metallic materials to be used in piping systems and components can be found in 46 CFR 56.60.

Non-metallic Materials

Where non-metallic materials are used in a piping system, and a valve(s) is required to comply with the provisions of the Convention, a positive closure metallic valve is required.[14]

Detailed requirements for non-metallic materials to be used in piping systems and components can be found in 46 CFR 56.60.

MISCELLANEOUS CONCEPTS

Shell Penetrations - Overflow Pipes [15]

Overflow pipes which discharge through the sides of the vessel are not subject to the requirements previously addressed for overboard discharges.

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[13] [2] 56.50-95(f)
[14] [2] 56.50-95(f)
[15] [2] 56.50-95(c) {basis}

Overflow pipes are to be located as far above the deepest load line as practicable and are to be fitted with two nonreturn valves.[16] The inboard valve is to be located above the tropical load waterline[17] in an accessible position. If it is impracticable to locate the inboard valve in an accessible position, one nonreturn valve with a positive means of closure from above the freeboard deck will be acceptable. The means of operating the positive action valve is to be readily accessible and provided with an indicator showing whether the valve is open or closed. A suitable arrangement is to be made to insure that the valve is not closed by unauthorized persons, and a notice is to be posted in a conspicuous place at the operating station to the effect that the valve is not to be closed except as required in an emergency.

Shell Penetrations - Engine Exhausts[18]

Whether or not engine exhaust lines, leading through the sides of the vessel below the freeboard deck, should have a means of closure has been questioned a few times in the past; particularly on smaller vessels. Strict interpretation of the provisions of the Convention would require either a nonreturn, or stop valve to be fitted into the line. As a practical matter, it is undesirable to fit a nonreturn valve in exhaust lines because of the excessive engine exhaust back-pressure created.

If possible, the installation should be so designed and arranged that no stop or nonreturn valve is necessary. A stop or nonreturn valve should only be fitted as a last resort, and then only with prior approval of the engine manufacturer or designer.

Valve Accessibility[19]

Where deck drains, soil lines, and sanitary drains discharge through the shell in way of cargo tanks on tank vessels, the required valves are to be located outside the cargo tanks.

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[16] The purpose of requiring two nonreturn valves instead of one nonreturn valve with a positive means of closure is to eliminate the possibility of the overflow being blocked, which could rupture the tank if pressed. In most cases, this result would be more serious than the admission of sea water to a tank through two inoperative nonreturn valves.

[17] If timber marks are assigned, the valve is to be above the timber tropical load waterline.

[18] [8] Policy file memo 10 May 1965, Electronic Message 9 March 1987

[19] [2] 56.50-95(h)

SIDE SCUTTLES and WINDOWS

GENERAL REQUIREMENTS

Concepts

Side Scuttle - The term side scuttle includes airports, portlights, portholes, and skylights. Side scuttles generally consist of a frame, a hinged or fixed glass frame, glass of approved construction, a securing arrangement, and where required a deadlight. Side scuttles are typically 450 mm (18") or less in diameter and are of heavy construction.[1] The requirements of the Load Line Convention apply *only* to exposed side scuttles.

Windows[2] - are defined as rectangular openings and are usually larger in size[3] than a side scuttle.

Deadlight - A steel or equivalent cover fitted to a side scuttle or window, which when secured provides a watertight/weathertight closing appliance.

LOCATION REQUIREMENT

Below the Freeboard Deck[4]

No window is permitted below the freeboard deck. No side scuttle is to be fitted in a position so that its sill is below a line drawn parallel to the freeboard deck at side and having its lowest point 2.5 percent of the breadth (B) above the load waterline[5], or 500 mm (19 1/2"), whichever is greater.

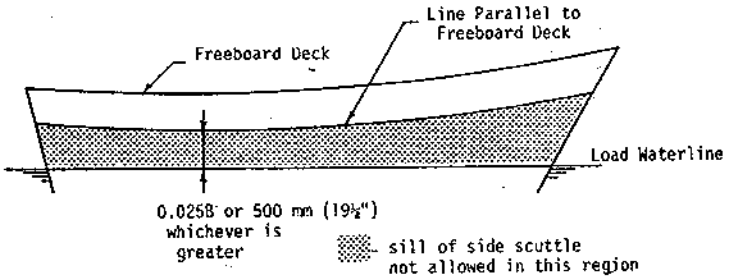

Figure 84. Side Scuttles Below The Freeboard Deck

[1] [8] 3 February 1987

[2] Larger rectangular windows are given special more stringent consideration by the USCG. [8] 3 Feb 1987

[3] [8] 3 February 1987

[4] [1] Reg. 23(2)

[5] Load waterline is interpreted as the summer waterline or timber summer waterline at the design trim if timber marks are assigned.

Stability and Subdivision Considerations[6]

For those vessels where the freeboard is reduced based on subdivision characteristics, side scuttles fitted outside the space considered flooded and which are below the final waterline are to be of the non-opening type.[7]

Windows are the exception to the above, and are considered as points of entry for damage stability calculations. Windows may be considered effective for intact stability if they are built to ISO standards and have a factor of safety of at least two on pressure loading.[8] Windows are not permitted in the first tier of superstructures which has a common boundary with the side shell, *unless* authorized by the Commandant.

DEADLIGHTS

Required Locations

Side scuttles and windows are to be fitted with efficient deadlights arranged so that they can be effectively closed and secured watertight in the following locations:

Below the freeboard deck

1) all locations;

Above freeboard deck- 1st tier of deck structures

1) to spaces within enclosed superstructures;

2) to spaces within category "A" deckhouses;[9]

Above freeboard deck- 2nd tier of deck structures

1) to spaces within second tier deckhouses which give direct access to an open stairway below to a space within an enclosed superstructure or a category "A" deckhouse. Direct access means there is no interior structure, such as a cabin, separating the glass closure and the open stairway. A cabin is considered to provide adequate protection against the minimal amount of water which will enter through a broken glass fitted on the second tier.[10]

2) Deckhouses situated on a raised quarterdeck may be treated as being on the second tier as far as the provisions of deadlights and side scuttles and windows are concerned, pro-

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6 [1] 3 February 1987

7 [4] LL.12, LL.3/Circ.20, 26 May 1976

8 [1] 3 February 1987. See the section on construction for further details.

9 Those which protect access below.

10 [ ] LL.8, LL.3/Circ.20, 26 May 1976 (basis)

vided the height of the raised quarterdeck is equal to or greater than the standard quarterdeck height.[11]

Above freeboard deck- above 2nd tier[12]

1) Generally deadlights are not required to be fitted unless sheer credit is given for the region of the structure where the side scuttle is located; e.g. the side shell plating extends up to a poop type structure on the weather deck where the freeboard deck is 2 decks below the weather deck.

Exception

If the bottom of the side scuttle or window is more than 4.5 m (14.8 ft) above the deck in Position 1, or more than 2.3 m (7.5 ft) above the deck in Position 2, a deadlight is not required unless the assigning authority deems it necessary for the location in question. The rationale is that a wall vent[13] meeting the same requirements would not require a weathertight closing appliance.[14]

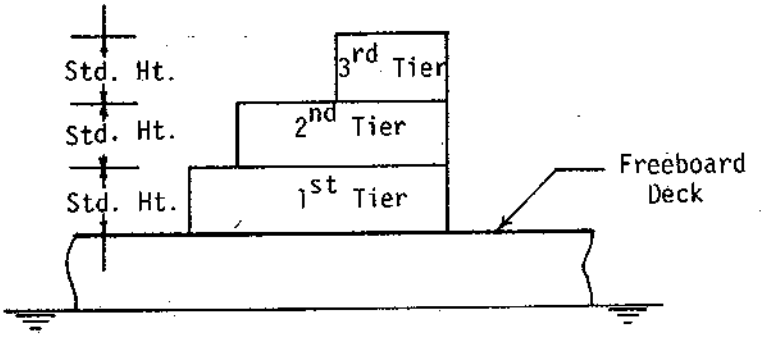


Figure 85. Deadlights-Required Location

Arrangement & Securing

For side scuttles below the freeboard deck and in the first tier of enclosed superstructures, deadlights are required to be fitted internally. They are to be permanently attached, usually by a hinge mechanism.[15]

In locations where deadlights are required for second tier side scuttles or windows, an acceptable equivalent to fitting of an internal permanently attached deadlight would be a strong permanently attached external steel or equivalent shutter, *if* easily accessible for closing from the outside to the satisfaction of the assigning authority.

[11] [4] LL.46, LL.3/Circ.69, 31 Jan 1985 {basis}
[12] General Convention philosophy.
[13] See Figure 78. Reg. 19(3) {basis}
[14] ABS practice since 1981.
[15] [1] Reg. 23(1) {basis}

Sufficient securing devices are to be provided to ensure that the deadlight, when secured, provides a watertight/weathertight seal for the opening.

Alternatives

In the case of category "A" deckhouses *either*:

1) on the freeboard deck;

2) on a superstructure deck; or

3) atop a category "A" deckhouse on the freeboard deck;

if the internal access(es) below is/are *properly protected* deadlights are not required.

Proper protection for **Item 1)** would consist of an efficient steel or equivalent weathertight companionway or hatchway fitted with a proper sill and closing appliance equivalent to that required for an exposed opening below.

Proper protection for **Items 2) & 3)** as a minimum, would consist of a companionway or hatchway of at least joiner type construction. The closure is to be provided at the top of the stairwell on the upper deck, not at the freeboard deck level.[16]

CONSTRUCTION[17]

General

The side scuttles, together with their glasses, if fitted, and deadlights, are to be of substantial and construction approved by the assigning authority.[18] Side scuttle and window strength and arrangement are to comply with the ISO standards.[19]

Windows

The designer *must* submit calculations which evaluate window and hull loads under all conditions of pitch and roll. Window arrangement and resistance to hull bending and torsional loads *must* be addressed in the designer's analysis. Wave loadings *must* be evaluated for the worst intended environmental conditions, and for critical seaway conditions to be defined by the designer and submitted for approval.

[16] [9] 7 July 1981
[17] [8] 3 February 1987
[18] [1] Reg. 23(3)
[19] [8] Electronic Message 9 March 1987

Side Scuttles

Side scuttles are to have strong frames (other than cast iron) and the opening type are to have noncorrosive hinge pins.[20]

Glass

The glass used in a side scuttle is to be of substantial and construction approved by the assigning authority. Calculations and data are to be submitted to the assigning authority verifying that the side scuttle and window locations do not result in loads exceeding the glass design pressures. The glass design pressures should be determined from a recognized standard, such as the ISO standard, or certified by the glass manufacturer.

Deadlights

Deadlights are to be of substantial and approved construction. They are to be made of a material, and to be of a strength, consistent with the surrounding structure.

[20] ABS Rules for Building and Classing Steel Vessels, Section 20.7.

FREEING PORTS

GENERAL CONCEPT & DEFINITIONS

Definitions

Well - Any area on a deck exposed to the weather, where water may be entrapped for an extended period of time. The entrapment of on-deck water may be caused by the vessel trimming, listing, rolling or pitching in a seaway. Normally wells are considered to be four-sided deck structures, however, depending on their particular configuration three-sided or even two-sided structures may be deemed a well and require freeing arrangements. Special attention should be given to the stowage of on deck cargo or equipment, as improper stowage may effectively create a well(s) that may entrap water.

Bulwark - For the consideration of freeing ports, a bulwark is a structure:

1) located on the weather decks within 0.04B of the sides of the vessel;[1]

2) with an average height exceeding 300 mm (12");[2] and

3) that can entrap water for a period of time, with due consideration given to trim, list, rolling, pitching, and the stowage of cargo or equipment.

Concept

Where wells are formed on the decks exposed to the weather, ample provision is to be made for rapidly freeing the decks of water and for draining them.[3] Drainage *must* be provided from all sections of the weather decks. Special attention is to be paid to the fitting of weather deck scuppers particularly when local recesses exist which for various reasons cannot be drained by means of freeing ports.

Water on deck should be viewed as a liability which is to be avoided if at all possible. Water on deck has four detrimental effects on a vessel's stability. It:

1) adds to the displacement of the vessel;

[1] Practice since 1980. See requirement for bins later in this section.

[2] Practice since 1972. A structure with a lesser average height is considered as a gutter bar and drainage may be provided solely by deck scuppers.

[3] [1] Reg. 24(1) (basis)

2) raises the center of gravity (VCG);

3) creates a free surface; and

4) may increase the rolling acceleration and the roll angle.

Numerous studies have looked at the various parts of this problem, yet a simple set of rules to accurately account for the effects of water on deck has not been developed.[4] It is therefore essential that ample drainage is provided to free the decks of loose water as rapidly as possible.

Calculation Approach

Area Check - The required freeing port area is determined by the characteristics of the well(s) in question, assuming that no freeing arrangements exist. The effective area of existing freeing arrangements is then assessed and compared to the required area. If the effective area is less than the required area, additional freeing arrangements are to be provided.

Location Check - An additional check is to be made that there is a proper distribution of the effective freeing port area, based on the characteristics of the well(s). If sufficient freeing port area is provided but not properly distributed, additional freeing ports may be necessary.

Symmetrical / Asymmetrical Configurations

For configurations symmetrical about the centerline of the vessel, only one minimum required freeing port area calculation is necessary, since it is applicable to each side.

For asymmetrical configurations, the port and starboard sides of the well are evaluated independently which necessitates two separate calculations.

WELL LENGTH

Definition

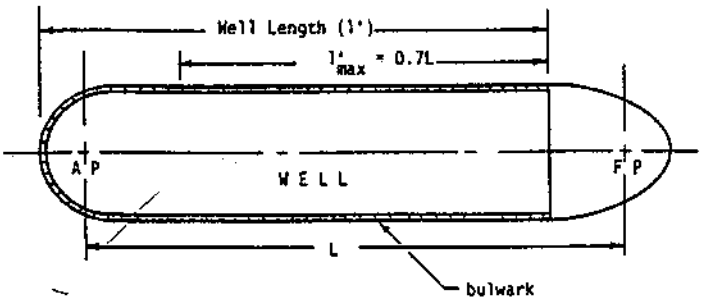
The length of the well (l') has two different meanings. It is the:

a) total length up to a maximum of 0.7L when determining the basic minimum required freeing port area; and

b) is the total length up to 1.0L when determining the height and sheer correction(s) which is/are applied to the basic minimum required freeing port area.

[4] [6] 5-86

Figure 86. Freeing Ports-Well Length



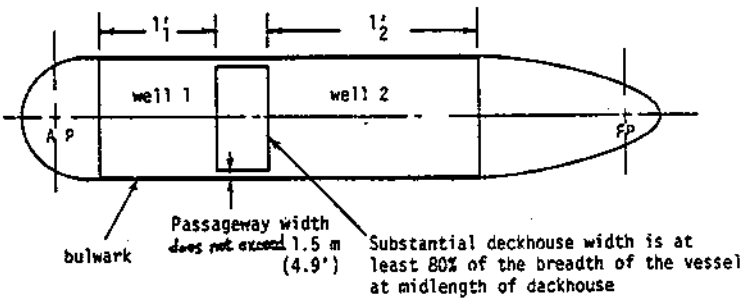
Multiple Wells[5]

Where superstructures or large deckhouses effectively divide the vessel to form two or more wells, each well is to be treated separately when determining the required freeing port area. The summation of the individual well lengths *may* exceed 0.7L.

In defining a substantial deckhouse it is suggested that the breadth of the deckhouse should be at least 80% of the beam of the vessel, and that the passageways along the side of the vessel should not exceed 1.5 m (4.9 ft) in width.

Where a screen bulkhead[6] is fitted completely across the vessel at the forward end of a midship deckhouse, this would effectively divide the exposed deck into two wells and no limitation on the breadth of the deckhouse is considered necessary.

Figure 87. Freeing Ports-Multiple Wells.



If an amidship deckhouse is not 80% of the beam of the vessel, or the width of the side passageways exceed 1.5 m (4.9 ft), the configuration is then considered as one well. In such a case the deckhouse would be considered as an athwartship obstruction and the "free flow"[7] area should be checked.

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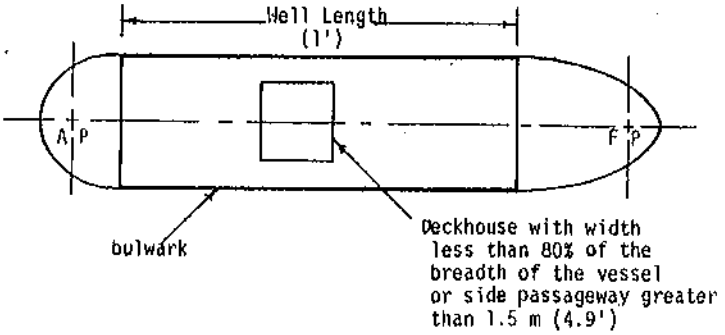
5 [4] LL.13, LL.3/Circ.20, 26 May 1976

6 A screen bulkhead is structure that extends from the side of a deckhouse or superstructure to the side of the vessel. As its name implies, its purpose is to act as a screen to block the passage of on-deck water from running aft and to direct it overboard.

7 The free flow area concept is explained later in this section.

Figure 88. Freeing Ports-Well Length Amidship Deckhouse



AVERAGE BULWARK HEIGHT

Concept

The average bulwark height throughout the length of the well is calculated for a comparison check with the standard bulwark height range. If the average bulwark height falls outside the standard range, a height correction is then applied to the basic minimum required freeing port area. The standard bulwark height range extends from 0.9 m (3 ft) to 1.2 m (3.9 ft) above the deck.[8]

Determination

If the bulwark height above the deck varies throughout the length of the well, the height of each segment is multiplied by its respective length to determine the area of each segment; freeing ports in the bulwark are ignored when determining the bulwark area for each segment. The segment areas are then summed and divided by the total length of the well to achieve the average bulwark height. Height variations of very limited length may be ignored for this calculation.

ACTUAL SHEER

Concept

The term "actual sheer", referred to in Regulation 24, is the profile **area** under the freeboard deck sheer profile curve, *only* for the portion in way of the well. The area to be considered is bounded by the freeboard deck, sheer reference line, and the forward and aft ends of the well. It may be calculated by numerical integration techniques or some alternate simplified method.

For wells located on decks other than the freeboard deck, it will not be necessary to calculate the actual sheer in way of the well *except*, for a well located on a superstructure deck which was used to measure the sheer ordinates for the sheer correction in Regulation 38.[9] The reason is that the actual sheer is used for a comparison with the standard sheer to determine if a sheer correction to the basic minimum required freeing port area is necessary. Within the context of the Load Line Regulations, there is no defined standard sheer profile for any other location other then the two addressed above.

[8] [1] Reg. 24(1)

[9] A superstructure of standard height or greater which extends over the whole length of the freeboard deck.

STANDARD SHEER[10]

Concept

The term "standard sheer", referred to in the Regulation 24, is the area under the standard sheer profile curve as defined in Regulation 38.[11] *Only* the area under the standard sheer profile curve for the portion in way of the well is to be considered. For example, if the well in question extends from the AP to a point 0.4L forward of the AP, only that portion of the area under the standard sheer profile curve between the same two points is considered.

The standard sheer profile curve is described by seven evenly spaced ordinates for the entire length (L) of the vessel. *Unless* the well extends for the full length of the vessel, it is cumbersome to find the area under the standard curve *only* for the desired portion in way of the well.

To simply the process the following procedure and table are given. The area under the standard sheer profile curve has been subdivided into increments of 0.05L and may be determined solely as a function of the length of the vessel (L).

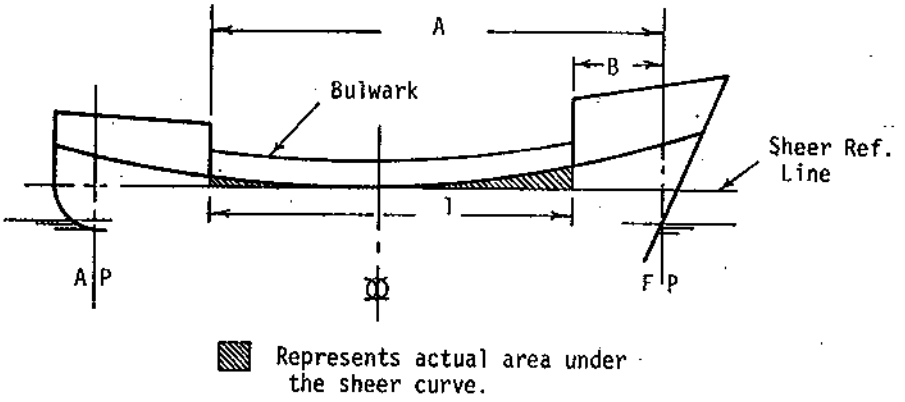


Figure 89. Freeing Ports-Standard Sheer

Procedure

1) Find the distance to the aft end of the well from the load line FP, as a function of the load line length of the vessel (L); distance designated as "A".

2) Enter the following table to find the area under the standard sheer profile curve for distance "A".

3) Find the distance to the forward end of the well from the load line FP, as a function of the load line length of the vessel (L); distance designated as "B".

[10] [1] Reg 38(8)

[11] For details see the section on Sheer in Chapter II of this manual.

4) Enter the following table to find the area under the standard sheer profile curve for distance "B".

5) The difference between the area determined for "A" and the area determined for "B" is the standard sheer profile area in way of the well with a length of "l".

STANDARD SHEER

Distance Abaft FP	Metric Units Area in m^2 (L is in meters)	English Units Area in ft^2 (L is in ft)
.05L	$0.000753L^2 + 0.02259L$	$0.000753L^2 + 0.0753L$
.10L	$0.001356L^2 + 0.4067L$	$0.001356L^2 + 0.1355L$
.15L	$0.001825L^2 + 0.05475L$	$0.001825L^2 + 0.1825L$
.20L	$0.002179L^2 + 0.06534L$	$0.002179L^2 + 0.2178L$
.25L	$0.002431L^2 + 0.07291L$	$0.002431L^2 + 0.2431L$
.30L	$0.002600L^2 + 0.07800L$	$0.002600L^2 + 0.2600L$
.35L	$0.002703L^2 + 0.08108L$	$0.002703L^2 + 0.2703L$
.40L	$0.002758L^2 + 0.08266L$	$0.002758L^2 + 0.2756L$
.45L	$0.002775L^2 + 0.08325L$	$0.002775L^2 + 0.2775L$
.50L	$0.002778L^2 + 0.08333L$	$0.002778L^2 + 0.2778L$
.55L	$0.002779L^2 + 0.08337L$	$0.002779L^2 + 0.2779L$
.60L	$0.002789L^2 + 0.08366L$	$0.002789L^2 + 0.2789L$
.65L	$0.002815L^2 + 0.08445L$	$0.002815L^2 + 0.2815L$
.70L	$0.002867L^2 + 0.08600L$	$0.002867L^2 + 0.2867L$
.75L	$0.002951L^2 + 0.08854L$	$0.002951L^2 + 0.2951L$
.80L	$0.003078L^2 + 0.09233L$	$0.003078L^2 + 0.3077L$
.85L	$0.003254L^2 + 0.09762L$	$0.003254L^2 + 0.3254L$
.90L	$0.003489L^2 + 0.10466L$	$0.003489L^2 + 0.3489L$
.95L	$0.003790L^2 + 0.11370L$	$0.003790L^2 + 0.3790L$
1.00L	$0.004167L^2 + 0.12500L$	$0.004167L^2 + 0.4167L$

Intermediate distances may be determined by linear interpolation.

REQUIRED FREEING AREA[12] FREEBOARD DECK LEVEL

General Concepts

The basic minimum required freeing port area is divided into two cases, based on the arrangement of deck structures and their influence on the possible free flow of water athwartships:

[12] [ ] Reg. 24(1)

1) no substantially continuous superstructure, deckhouse, trunks, or other deck obstructions set-in from the sides of the vessel, are fitted in way of the well; and

2) substantially continuous superstructure, deckhouse, or trunks set-in from the sides of the vessel are fitted in way of the well.

A deck obstruction is defined as any structure that would impede the free flow of water in a transverse direction from side to side across the vessel.

For all situations where a minimum required freeing port area calculation is made, the basic minimum required freeing area is first determined as if the well in question were located on the freeboard deck.

Corrections are then made to the basic area predicated on the actual height of the bulwark, sheer in way of the well, and location of the well if above the freeboard deck.

Minimum Required Area - No Continuous Obstruction[13]

The minimum required freeing port area (A) on each side of the vessel for each well on the freeboard deck, for cases where the average height of the bulwark is equal to the standard height range of bulwarks, *and* the sheer in way of the well is standard or greater than the standard sheer profile area, is given by the following formulas:

Well length (l) is 20 m (66 ft) or less:

$$A = 0.7 + 0.035l \text{ m}^2 \quad (7.6 + 0.115l \text{ ft}^2)$$

Well length exceeds 20 m (66 ft):

$$A = 0.07l \text{ m}^2 \quad (0.23l \text{ ft}^2)$$

Note: l_{max} is 0.7L in above formulas.

Minimum Required Area - Longitudinal Continuous Obstruction[14]

Where a substantially continuous deck obstruction exists which is continous for the entire length of the well, the minimum required freeing port on each side is determined as a function of the total bulwark area[15] and is *greater* than if the obstruction were not present. The reason is that even though the volume of the well which may contain water has been reduced by the deck area covered by the obstruction,

[13] [1] Reg. 24(1)

[14] [1] Reg. 24(3). USCG draft "T" Boat Rules take an opposite approach- giving credit for obstructions.

[15] No sheer correction is applied.

there is no free flow of water from side to side, and consequently the water may be trapped outboard creating a greater heeling moment.

The minimum required freeing port area (A) on each side of the vessel for each well on the freeboard deck, where a continuous deck obstruction, i.e. superstructure, deckhouse, or trunk set-in from the sides of the vessel, symmetrical about the longitudinal centerline, is fitted in way of the well, is determined from the following table:

Average Breadth of Continuous Deck Obstruction in Relation to the Breadth of the Vessel	Area of Freeing Ports in Relation to the Total Area of the Bulwarks
40% or less	20%
75% or more	10%

The minimum required area of freeing ports at intermediate breadths is to be determined by linear interpolation.

Average Breadth of Deck Obstruction- Longitudinally Symmetrical[16]

The average breadth of obstructions throughout the length of the well may be determined by the following formula. The variables indicated are exemplified in the following figure.

$$\text{Average } b = l_1(b_1) + l_2(b_2) \,/\, l_1 + l_2$$

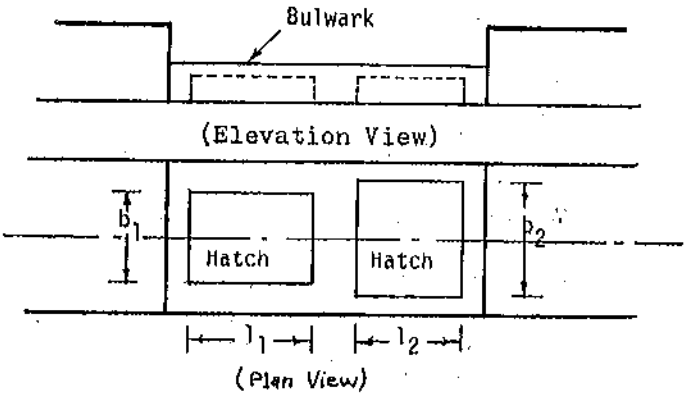


Figure 90. Freeing Ports-Avg Breadth of Deck Obstructions

[16] ABS policy since 1980.

Asymmetrical Deck Obstruction

If a or deck obstruction(s) is/are asymmetrical about the centerline of the vessel, the minimum required freeing port area with or without continuous deck obstructions is to be calculated for each side separately.

HEIGHT CORRECTION[17]

Calculation

The actual average height of the bulwark is compared to the standard height range of bulwarks, for wells where no continuous deck obstruction is fitted. If the actual is less or greater than the standard, a height correction is made to the minimum required freeing area.

[17] [1] Reg. 24(1)

Average Bulwark Height	Correction to Basic Min. Req'd Area (per side)
0 - 0.3 m (0 - 1 ft)	none- structure is considered as a gutter bar.
> 0.3 m but < 0.9 m	decreased by 0.004 m^2 per meter of length of well for each 0.1 m difference in height
(> 1 ft but < 3 ft)	(decreased by 0.04 ft^2 per foot of well length for each 1 ft difference in height)
0.9 m - 1.2 m (3 ft - 3.9 ft)	no correction
> 1.2 m	increased by 0.004 m^2 per meter of length of well for each 0.1 m difference in height up to the std. ht. of superstructure
(> 3.9 ft)	(increased by 0.04 ft^2 per foot of length of well for each 1.0 ft difference in height up to the std. ht. of superstructure)

For bulwarks with heights in excess of one standard height of superstructure, see later subsection addressing "Bulwarks of Excess Height & Wells Located above the Superstructure Deck Level."

SHEER CORRECTION[18]

Concept

A sheer correction is not applied where a continuous deck obstruction is fitted. The basic minimum required freeing port area calculated from the previously given equations, for wells where no continuous deck obstruction is fitted, is applicable *only* where the actual sheer in way of the well is equal to or greater than the corresponding standard sheer.

For vessels with no actual sheer in way of the well, the basic minimum required freeing port area, adjusted by the applicable height correction, is to be increased by 50%. Where there is actual sheer in

[18] [1] Reg. 24(2)

way of the well, but it is less than the corresponding standard, the percentage is to be obtained by linear interpolation.

There is no sheer correction for wells located on decks *other* than the freeboard deck, and superstructure deck if used to measure the sheer ordinates for the sheer correction in Regulation 38(5).

SUPERSTRUCTURE DECK LEVEL[19]

The superstructure deck level is considered to be located one standard height of superstructure above the freeboard deck. For a well located on a deck at the superstrucure deck level, the minimum required freeing port area is one-half of the area of a comparable configuration located on the freeboard deck; *except* that a sheer correction is not applied *unless* the well is on a superstructure deck was used to measure the sheer ordinates for the sheer correction in Regulation 38(5).

TYPE 'A' & 'B'- REDUCED FREEBOARDS[20]

General Requirements[21]

The minimum freeing port area requirements are generally more stringent for vessels fitted with bulwarks and assigned freeboards based on a subdivision standard, such as Type 'A' and 'B' with reduced freeboard; primarily due to the closer proximity of the weather deck to the sea. The minmum required area is simply a function of the total bulwark areain way of the well.

Type 'A' & 'B-100' Freeboards

A freeing port area, in the lower part of the bulwarks, of 33% of the total area of the bulwarks is required.

Type 'B-60' Freeboards

A freeing port area, in the lower part of the bulwarks, of 25% of the total area of the bulwarks is required.

FREE FLOW AREA[22]

Concept & Definition

The effectiveness of the freeing port area in bulwarks required by the equations for vessels *not* fitted with a continuous deck obstruction depends on the *free flow* across the deck.

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[19] [1] Reg. 24(1)
[20] [4] LL.23, LL.3/Circ.20, 26 May 1976 {basis}
[21] [1] Regs. 26(5) & 27(7)(b)
[22] [4] LL.44, LL.3/Circ.42, 13 April 1982

The free flow area on deck is defined as the net area of gaps between hatchways, superstructures, deckhouses, or other deck obstructions up to the actual height of the bulwark.

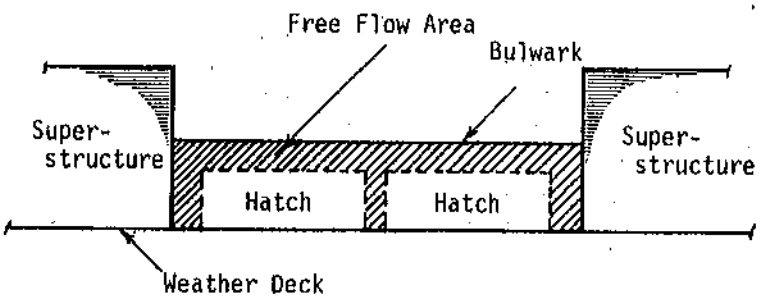


Figure 91. Freeing Ports-Free Flow Area

Procedure

1) Calculate the total free flow area (FFA) for the well in question.

2) Determine the minimum required freeing port area for the well *assuming*:

F_1- no continuous deck obstruction is fitted for the full length of the well; (min. req'd area includes possible height and sheer corrections) and

F_2- a continuous deck obstruction is fitted for the full length of the well. (min. req'd area does not include a height or sheer correction)

3) Compare the FFA to the minimum required freeing port areas determined in F_1 and F_2 above.

4) If FFA is $\geq F_2$ then F_1 will suffice.

5) If FFA is $\leq F_1$ then F_2 is required.

6) If FFA is $\leq F_2$ but $> F_1$, the minimum freeing port area (F) is to be determined from the following formula:

$$F = F1 + F2 - FFA \quad (m^2 \text{ or } ft^2)$$

BINS

Concept & Definition

The term "bin" is applied to a cargo bin, or structural barrier:

1) located on the weather decks inboard more than 0.04B from the sides of the vessel;[23]

2) with an average height exceeding 300 mm (12");[24] and

3) that can entrap water for a period of time, with due consideration given to trim, list, rolling, pitching, and the stowage of cargo or equipment.

The required freeing port area as defined in the Convention was established for "wells" formed by bulwarks on the weather decks. Cargo bins, non-tight deck structures and other miscellaneous wells that can entrap water are often found aboard modern merchant vessels. No explicit guidance is given by the Load Line Convention for these type of configurations. To directly apply the minimum required freeing port area for bulwarks to these type of configurations is not equitable for two basic reasons:

1) the heeling moment caused by entrapped water in the bin should be less than that of a bulwark of equal height and length located at the side of the vessel ; and

2) the more set-in from the side of the vessel, the probability of water entering the well is diminished.

To standardize the approach of determining the minimum required freeing port area for these type of wells, the following procedure is to be followed.

Calculation Procedure

1) The minimum required area is calculated following the same procedure that is used for a comparable bulwark, including a height correction if applicable. There is however, no sheer correction applied because the standard sheer curve defined in the Convention is applicable *only* at the side of the vessel.

2) The required area is then **reduced** by multiplying by a factor (f_b), which is determined from the following formula. The greater the dis-

[23] The rationale for setting the limit at 0.04B is to provide inter alia a "buffer zone" to account for bulwarks set-in from the side due to rounded gunwales.

[24] Practice since at least 1972. A structure with a lesser average height is considered as a gutter bar and drainage may be provided solely by deck scuppers.

tance the side of the bin is set-in from the side of the vessel, the smaller the f_b factor.[25]

$$f_b = 1.1815\ (0.5b_b/0.5B_b)^2; \quad \text{where: } 0.5b_b/0.5B_b \leq 0.92$$

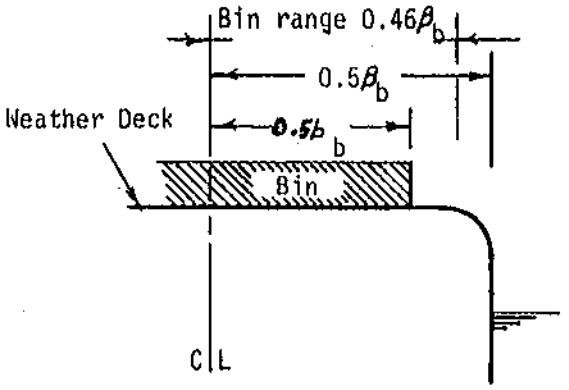


Figure 92. Freeing Ports-Bins

where: b_b = average breadth of the bin;
B_b = average breadth of the vessel in way of the well formed by the bin.

The bin factor (f_b) formula was derived by comparing heeling moment ratios for well configurations of similar height and length *but* varying breadth.

Wingwalled Structures[26]

The procedure outlined for bins may also be applied to wingwalled vessels where the wingwalls are greater than 0.04B in width. Watertight ducts or pipes are fitted through the wingwalls to provide rapid drainage of the inner well.

BULWARKS OF EXCESS HEIGHT & WELLS LOCATED ABOVE THE SUPERSTRUCTURE DECK LEVEL

Concept

Well configurations or locations often do not conform to the parameters stipulated in the Convention. No guidance is offered in the

[25] The constant 1.1815 given in the formula is equal to $(1/0.92)^2$.

[26] Wingwalled structures refers to the type of deck erections similar to those found on a floating drydock or barge carrier.

Convention for wells located on decks at a level higher than the superstructure deck level, or for bulwarks of excess height.

As the height of the well level increases, there are two counter parameters which influence the minimum required freeing port area:

1) the **probability** of water entering the well diminishes; and

2) the possible **heeling moment** caused by water entrapped in the well increases.

Regulation 24(1) gives guidance for determining the minimum required freeing port area for wells on the freeboard deck formed by bulwarks, predicated on the length of the well. It also stipulates that if the average height of the bulwark is more than a specified range, a correction is to be applied for each increment of excess height. It does not, however, specify a height at which the incremental increase in required area is no longer applied. Regulation 24(1) does stipulate that for wells on the superstructure deck the minimum required freeing port area is one-half the area required on the freeboard deck. The implication is that the minimum required area is increased by the height correction until the bulwark height reaches the standard height of a superstructure, at which point the required area diminishes as the height increases. Additionally, no guidance is given for assessing wells located on deck levels higher than the superstructure deck level.

For bulwarks with heights which exceed one standard height of superstructure, or for wells located on deck levels higher than the freeboard deck, an adjustment factor (f) is to be applied as follows:

1) The minimum required freeing port area is determined as if the well is located on the freeboard deck, and the bulwark height equals one standard height of superstructure.[27]

2) The area is then multiplied by the appropriate height factor (f) from the following table, based on the bulwark configuration and well location:

[27] Except for a sheer correction which is only occasionally applied for wells on the superstructure deck, and not applied for decks above the superstructure deck level.

f factors

Bulwark Height Std. Ht. of SS	Well Location (Tiers)				
	Fbd Dk	1st	2nd	3rd	4th
1.0	1.0	.50	.247	.146	.096
2.0	.667	.396	.257	.171	.123
3.0	.445	.313	.224	.167	.128
4.0	.334	.256	.197	.155	.124
5.0	.267	.216	.174	.143	
6.0	.222	.186	.155		

Note:

1) Intermediate values are to be determined by linear interpolation.
2) A tier is equal to one standard height of superstructure.

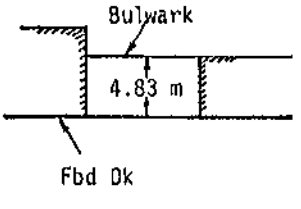
EXAMPLES- DETERMINING ADJUSTMENT FACTORS

General Requirement

For all cases, the adjustment factor(s) is/are multiplied times the minimum required freeing port area determined as if the well is formed by bulwarks and is located on the freeboard deck. Think of the f_b factor as a correction with horizontal parameters, and f as a factor with vertical parameters.

Freeboard Deck Level

Example 1



Example 2

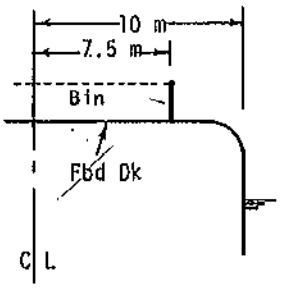


Figure 93. Freeing Ports- Adjustment Factors Freeboard Deck Level

Example 1 Std. Height = 2.3 m

1) Bulwark height as a function of the std. ht. of superstructure
= 4.83 m / 2.3 m = 2.1
2) From the *f* factor table *f* = 0.637.

Example 2 Std. Height = 2.3 m
Bin ht. is < 1 std. ht. of superstructure

1)$0.5b_b$ / $0.5B_b$ = 7.5 m / 10.0 m = 0.75
2) From the bin factor formula f_b = 0.665.

Above Freeboard Deck Level

Example 3 Example 4

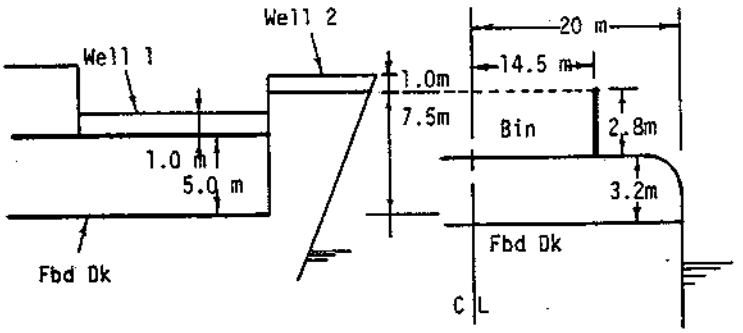


Figure 94. Freeing Ports-Adjustment Factors Above Freeboard Deck Level

Example 3 Std. Height = 2.3 m
Bulwark ht. is < 1 std. ht. of superstructure

Well 1
1) Determine on which tier the well is located:
5 m / 2.3 m = 2.174 std. hts.
2) From the *f* factor table, the 2nd tier value is 0.247, the 3rd tier value is 0.146, by interpolation the *f* factor 0.229.

Well 2
1) Determine on which tier the well is located:
7.5 m / 2.3 m = 3.261 std. hts.
2) From the *f* factor table , the 3rd tier value is 0.146, the 4th tier value 0.096, by interpolation the *f* factor is 0.133.

Example 4 — Std. Height = 2.3 m
Bin ht. is > std. ht. of superstructure

1) Determine on which tier the well is located:
   3.2 m / 2.3 m = 1.391 std. hts.
2) Bin height as a function of std. ht. of superstructure:
   2.8 m / 2.3 m = 1.217 std. hts.
3) From the *f* factor table, by interpolating between the 1st and 2nd tiers, and by interpolating between a bulwark height between 1 and 2 std, hts. of superstructure, the *f* value is **0.386.**
4) $b_b/0.5B_b$ = 14.5 m / 20 m = 0.725.
5) From the bin factor formula, f_b is **0.62.**
6) Total adjustment factor is $f \times f_b$ = **0.239.**

EFFECTIVE FREEING AREA

Concept

When evaluating a vessel's configuration to determine if there is sufficient freeing arrangements provided to rapidly drain the decks, there are two basic aspects to the process:

1) determine the minimum *required* freeing port area needed per side; and

2) determine the *effective* freeing port area per side of the vessel's actual arrangement, which is then compared to the minimum required area.

The effective area must equal or exceed the required area for the arrangement to be considered acceptable.

Location & Distribution

The lower edges of the freeing ports are to be as near the deck as practicable. Two thirds of the total freeing port area per side is to be provided in the half of the well nearest the lowest point of the sheer curve.[28] With zero or little sheer on the exposed deck in way of the well it is considered that the freeing port area should be spread along the length of the well.[29]

Some freeing port area should be placed as near the ends of the well as practicable, to rapidly drain the deck in trim and pitching conditions. These conditions may cause on deck water to "run up" the superstructure end bulkheads, or end transverse bulwark if no superstructure is fitted.

[28] [1] Reg. 24(5)
[29] [4] LL.13, LL.3/Circ.20, 26 May 1976

Wood Deck Sheathing[30]

Freeing ports are to be designed and maintained so that there is a clear unobstructed path for the on deck water to rapidly drain overboard. Wood deck sheathing may reduce the effectiveness of a freeing port(s) for *rapidly* freeing the deck. Deck sheathing is usually set in a small distance from the side of the vessel to provide a drainage area along the bulwark or gunwale plate. The effective height of the freeing port opening may be reduced depending on the thickness of the sheathing, distance the sheathing is set-in from the side of the vessel, and the location of the freeing port opening above the deck.

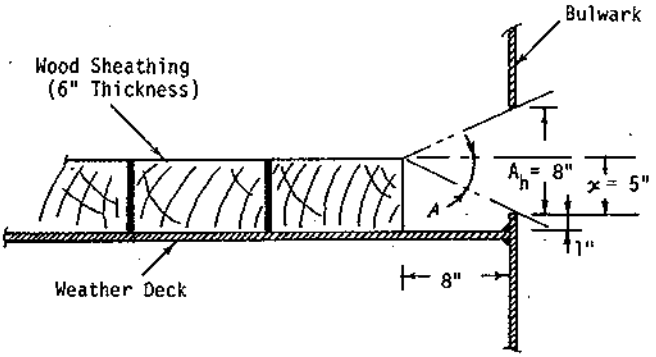


Figure 95. Freeing Ports-Deck Sheathing

Effective Height = $A_h - x(1 - \text{Cos } A)$

where: A_h = Actual height of opening;
x = Distance lower edge of opening is below top of sheathing (x_{min} is 0);
A = Angle as indicated in above figure.

Note: Effective height should be rounded off to the nearest 1/4" or cm.

Example

Particulars -Wood sheathing thickness 6";
-Sheathing set in 8" from bulwark; and
-Freeing port opening ht. = 8", with lower lip 1" above the deck.

Effective height of 8" opening is:

$A = \tan^{-1} 5/8 = 32°$;

$8" - (6" - 1")(1 - \text{Cos } 32°) = 7.24" = 7\ 1/4"$

The *effective* height of the freeing port opening in the above example is approximately 10% less than it's *actual* height.

[30] Practice since 1981

Freeing Ports Not Flush With the Deck

The lower edge of freeing ports are to be as near the deck as practicable. Some credit may be given for openings in the sides of a well that are not flush with the deck, however, their effectiveness is diminished. The higher the lower edge of the opening is above the deck the less effective the freeing area. No credit is to be given for openings with a lower edge more than 300 mm (12") above the deck.

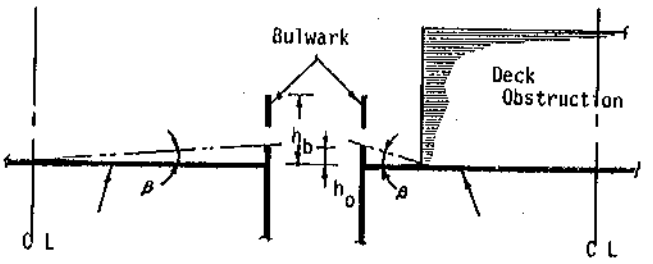


Figure 96. Freeing Ports-Openings Located Above The Deck

$$A_e = A_a [(1 - h_o/h_b)(1 - \tan B)]$$

Where:
A_e = Effective area of opening;
A_a = Actual area of opening;
h_b = Bulwark height in way of the opening;
h_o = Height of lower edge of opening, $h_{o\ max}$ is 300 mm (12"); and
B = Angle indicated in above figure.

For bulwarks or bins of extreme height that contain very large openings, no credit is given for the freeing area that extends above a standard superstructure height level.[31]

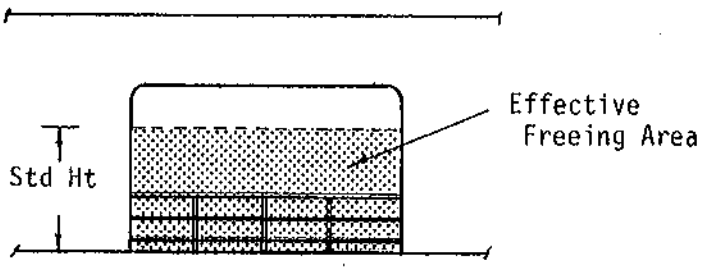


Figure 97. Freeing Ports-Very Large Openings

[31] Adequate crew protection is to be provided for large freeing port openings. See the requirements specified in the next section of this chapter.

OPENINGS IN THE END OF A WELL

Concept

Since the transverse stability of a vessel is usually more critical than it's longitudinal stability, freeing ports fitted at the fore and aft ends of a well are generally less effective to increase the "level of safety" of the vessel than those fitted in the port and starboard sides of a well. Consequently, less effective credit is given for the actual area of the opening(s) at the end(s) of a well.

To assess the effectiveness of an opening at the forward or aft end of a well, the vessel is hypothetically divided on it's longitudinal centerline, and the effective area of the portion of the opening(s) on each side of the vessel's centerline is added to the respective effective area for the port and starboard side of the well.

There are many factors which may influence the effectiveness of openings at the ends of a well. Some of which are:

1) the athwartship location of the opening, i.e. the farther outboard the opening, the more effective it is; (see next figure)

2) the slope of the deck towards or away from the opening;

3) the length/breadth ratio of the well, i.e. for a given breadth, the longer the well, the less effective the end opening; and

4) the free fore and aft passage for the water to reach the opening, unobstructed by deck equipment, fittings, or cargo stowage.

For wells that are completely open at one or both ends, the *maximum* effective area credit that may be apportioned to the effective area for each side of the well, is one half the area of the transverse opening(s) on each side of the vessels centerline to the top of the bulwark or standard height of superstructure level, whichever is less.

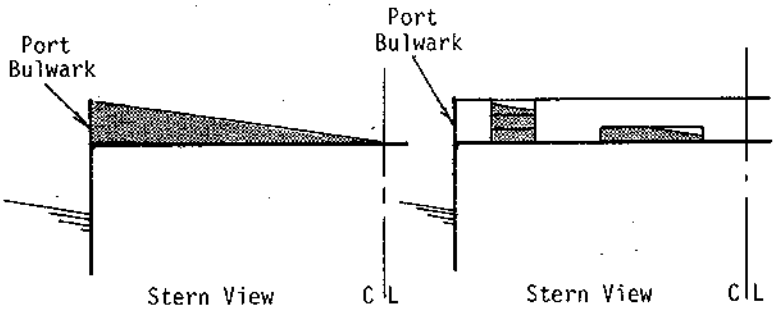


Figure 98. Freeing Ports-Openings At The Ends Of A Well

The effective area credit for openings at the end(s) of a well is/are assessed on a case by case basis weighing all the factors. *Maximum* credit is given *only* where it is justified by all the contributing factors,i.e. transverse location of the opening, slope of the deck

toward or away from the opening, width to length raio of the well, etc.

Superstructure or Deckhouse Recesses

For a variety of reasons, the end bulkhead of a deck structure may be recessed essentially creating a "pocket" or three sided well that may entrap water. The necessary freeing arrangements of such recesses are generally assessed on a case by case basis weighing the pros and cons of a particular configuration to arrive at an equitable requirement. For small recesses, deck drains may suffice, whereas longer recesses would necessitate freeing ducts. When determining the minimum required freeing port area, the bin adjustment factor (f_b) may be applied depending on the configuration.

The location and distribution of freeing ducts warrants special attention to ensure that proper drainage is provided. Too much freeing port area can sometimes be as detrimental as insufficient area, particularly for vessels with relatively small freeboards such as a tug or offshore supply vessel.

PROTECTIVE BARS OR RAILS

Requirement[32]

To prevent a person from possibily being washed overboard through a freeing port, openings in a bulwark of a height greater than 230 mm (9") require the fitting of a protective bar(s) or rail(s).

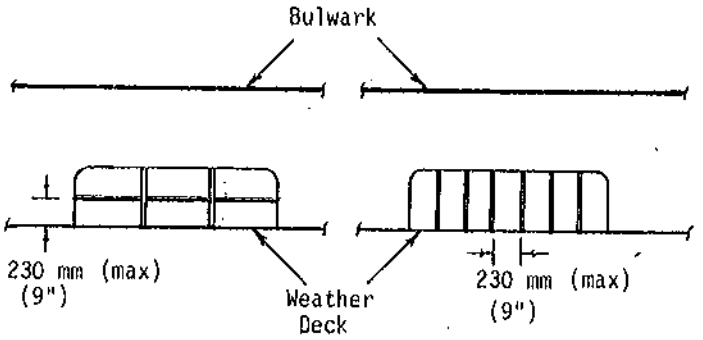


Figure 99. Freeing Ports-Protective Bars or Rails

The bar(s) may be fitted vertically or horizontally *provided* there is not more than a 230 mm (9") opening in any one direction.

[32] [1] Reg. 24(6)

HINGED FLAPS

Requirements[33]

If outboard shutters or hinged flaps are fitted to freeing port openings to minimize deck wetness, ample clearance is to be provided to prevent jamming. Hinges are to have pins or bearings of non-corrodible material and in general are to be located at or near the top of the flap. Hinged flaps are to be maintained free of overboard lines or equipment that may impede their operation. Special precautions are to be taken in Winter Seasonal Zones where icing may prevent their proper operation.

[33] [1] Reg. 24(6), ABS Rules 20.3.5

CREW PROTECTION

PRIMARY PROTECTION

Bulwarks & Guard Rails

Efficient crew protection in the form of bulwarks or guard rails is required around the periphery of the exposed weather decks which are accessed by the crew in the working of the vessel.

Guard Rails - Courses[1]

Guard rails consisting of *three tier* (courses) are required in the following exposed locations:

1) around the periphery of the freeboard deck;

2) around the periphery of the superstructure deck(s);

3) at the side or end of a deck in position 1 and 2, if within 0.04B of the side of the vessel.

Two tier guard rails are acceptable in all other locations.

Guard Rails - Course Spacing[2]

The opening below the lowest course of the guard rails is not to exceed 230 mm (9"). The other courses are to be not more than 380 mm (15") apart.[3] On two tier guard rails, the courses are to be evenly spaced.

The rationale for establishing the maximum allowable height for the lowest guard rail course at 230 mm (9"), is to prevent a person from being washed overboard. The height is measued from the deck or from the top of the gutter bar if fitted.

1 [1] Reg. 25(1), [4] LL.14, LL.3/Circ.20, 26 May 1976, [2] 32.01-10 {basis}
2 [1] Reg 25(3)
3 [1] Reg. 25(3)

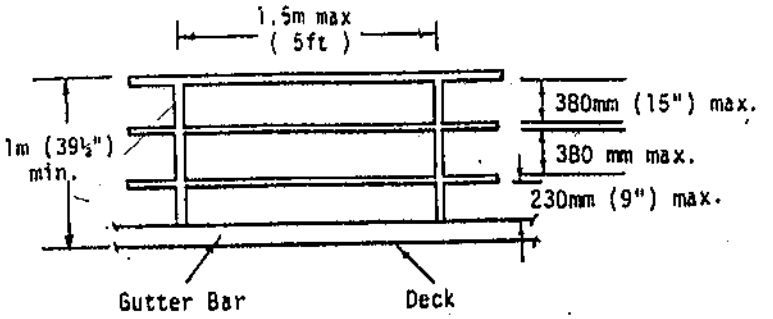


Figure 100 Guard Rails

Required Height - Guard Rails & Bulwarks

The height of the bulwarks or guard rails must be at least 1 m (39 1/2") from the deck. Where this height would interfere with the normal operation of the vessel, a lesser height *may* be approved if the assigning authority and the Commandant are satisfied that adequate protection is provided.[4]

For towing vessels[5] that are:

1) *exclusively* engaged in towing operations;[6] and

2) initially surveyed for a load line assignment after January 1, 1976

the minimum bulwark or guard rail height on the freeboard deck may be reduced to 760 mm (30") *provided* the assigning authority is satisfied that adequate grab rails[7] are provided around the periphery of the deckhouse.

For vessels which are engaged in part-time towing operations, such as tug-supply vessels, an acceptable arrangement is to have a 30" bulwark in the towing area with a portable rail[8] fitted atop the bulwark to achieve the minimum required height of 1 m (39 1/2"). The portable rail is to be kept in place for non-towing operations, and may be removed for towing operations.

Guard Rail Construction[9]

For guard rails to be considered efficient, and to provide for a maximum spacing between courses, they must be rigid. This rigidity should normally be achieved by solid or tubular sections, however, wire rope or chains made rigid by turnbuckles may be used in certain

4 [2] 42.15-75(b). On passenger ferries or excursion vessels, guard rails are required to have a height of 1070 mm (42") around the periphery of passenger decks.[2] 177.35-1

5 [2] 42.15-75(b)(2)

6 Pusher tugs are excluded from this provision.

7 Grab rails, sometimes referred to as storm rails, are usually made of pipe and are fitted to the exposed bulkhead approx. 36" above the deck.

8 See portable rail requirements.

9 [8] 22 September 1975

instances. For passenger vessels, the top course is to be solid or tubular to meet the intent of the regulations.

Guard Rail Stanchions

Support stanchions are to be fitted not more than 1.5 m (5 ft) apart, and at least every third stanchion is to be supported by a bracket or stay.[10] In the case of vessels with rounded gunwales the guard rails supports are to be placed on the flat of the deck.[11]

Portable Rails & Stanchions[12]

Wire ropes or chains[13] *may* only be accepted in lieu of rigid guard rails in special circumstances, and then *only* in limited lengths. There *must* be a specific operational reason to warrant their use. The wires and chains are to be made taut by means of turnbuckles. The requirement for openings between courses is the same as for rigid rails.

Removable or hinged stanchions are to be capable of being locked in the upright position. Other requirements associated with portable stanchions, such as support and spacing, are the same as for fixed or permanent stanchions.

SECONDARY PROTECTION

General Requirements[14]

In addition to the required primary crew protection previously specified, satisfactory means in the form of guard rails, lifelines, raised gangways, or underdeck passageways are to be provided for the protection of the crew in getting to and from their quarters, the machinery space and all other parts used in the necessary work of the vessel.

The following table addresses the minimum acceptable arrangements needed to comply with this requirement. The minimum acceptable arrangement is indicated for various locations on a vessel, and the type and amount of assigned freeboard. The specifications for each arrangement numeral indicated, both roman and arabic, are given following the next figure.

[10] [4] LL.47, LL.3/Circ.42, 13 April 1982

[11] [1] Reg. 25(3)

[12] [4] LL.47, LL.3/Circ.42, 13 April 1982.

[13] [8] 9 July 1985. Though LL.47 stipulates that chains may only be used between fixed stanchions, the USCG will allow the use of chains with portable rails.

[14] [1] Reg. 25(4)

REQUIRED SECONDARY CREW PROTECTION[15]

LOCATION (On exposed Fbd. or raised Qtr.Dk.)	Assigned Summer Fbd	*ARRANGEMENT* (Minimum Acceptable) Type of assigned Fbd			
		Type A	Type B-100	Type B-60	Type B & B+
1) Between Poop & Bridge[1]	≤3000 mm (9'-10")	II	II	III(1)	IV(3)
	>3000 mm	II	II	III2)	IV(3)
2) All Other Locations[2] from the forward to the aft end of the vessel	≤3000 mm	III(1)	III(2)	III(2)	IV(3)
	>3000 mm	III(1) IV(1)	III(2) IV(2)	IV(3)	IV(3)

Note: In the above table the arrangement indicated reflects the minimum acceptable. Those arrangements designated by a lesser roman or arabic numeral respectively are also acceptable:

e.g. Where a III(2) is indicated in the table, a I, II, or III(1) are also acceptable, however, a IV(1) or III(4) are not.

1 - Or deckhouse containing living accomodations or navigational equipment.

2 - Under [2] 32.01-5, life lines must be rigged on tank vessels between deckhouses spaced more than 150 ft apart, unless a raised gangway is installed. This requirement applies only to tankers having more than one deckhouse that contains accomodation spaces or that is normally manned continuously. [3] Vol. IV, 5.C.1.f. Other specific life line equipment requirements are also addressed in this subpart.

15 [4] LL.50, LL.3/Circ.77, 13 October 1986 {restructured for clarity}

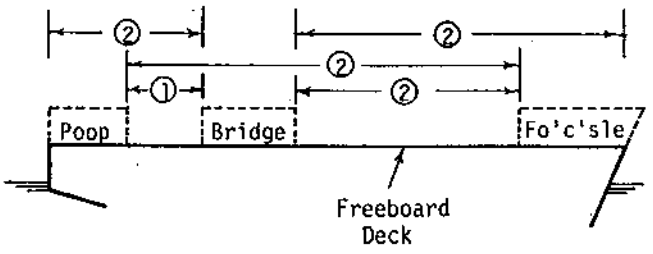


Figure 101. Secondary Crew Protection-Location

Locations 1 and 2 are indicated in the Required Secondary Crew Protection Table

Arrangements[16]

I- *Underdeck Passage*

A well lighted and ventilated underdeck passage with a clear opening 0.8 m (2'-7 1/2") wide, 2 m (6'-7") high, as close as practicable to the freeboard deck, connecting and providing access to the locations in question.

II- *Raised Gangway* (Catwalk)

On or near the centerline of the vessel, a permanent and efficiently constructed gangway fitted at the level of the superstructure deck, providing a continuous platform at least 0.6 m (2') in width and a non-slip surface, with guard rails extending on each side throughout its length. Guard rails should be at least 1 m (39 1/2") high with course number and spacing, and stanchion spacing as required for primary protection; a foot stop is also to be provided.

III- *Permanent Passageway*

A permanent passageway at least 0.6 m in width fitted at the freeboard deck level consisting of two rows of guard rails with stanchion spaced not more than 3 m (10'). The number of courses and their spacing is the same as required for primary protection. On Type 'B' vessels, hatchway coamings not less than 0.6 m in height *may* be regarded as forming one side of the passageway, *provided* that between the hatchways two rows of guard rails are fitted.

IV- *Life Lines*

A 10 mm (3/8") diameter wire rope life line supported by stanchions about 10 m (33') apart, or a single handrail or wire rope attached to hatch coamings, continued and adequately supported between hatchways.

[16] Also see "Additional Requirements" following next figure.

Alternative Transverse Locations for III & IV[17]

(1) On the deck or fitted on hatchways, at or near centerline of the vessel.

(2) Fitted on each side of the vessel.

(3) Fitted on one side, provision for being fitted on either side. This alternative does not apply to arrangement III since it is to be permanent.

(4) Fitted on one side only.

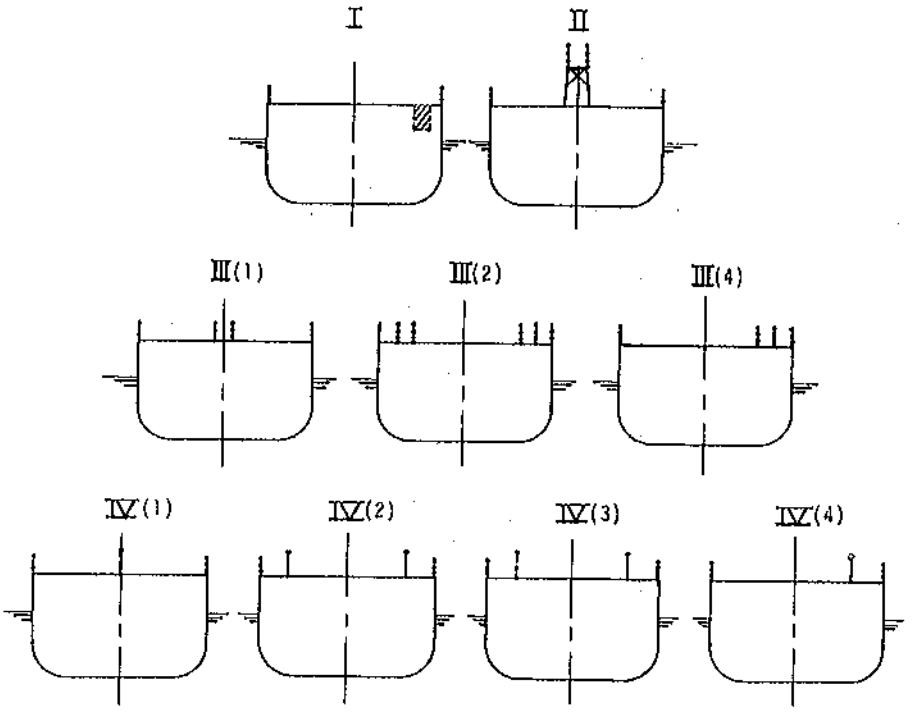


Figure 102. Secondary Crew Protection-Arrangements

Additional Requirements

a) In all cases where wire ropes are fitted, adequate devices are to be provided to ensure tautness.

b) In all cases, a proper step arrangement is to be provided in way of obstructions such as pipe lines, etc.

[17] See footnote 16.

c) Where stanchions are fitted every third stanchion is to be supported by a bracket or stay.

CREW ACCOMODATIONS

General Requirements [18]

The strength of the deckhouses used for the accomodation of the crew are to be to the satisfaction of the assigning authority. As a minimum, they are to have scantlings, attachment, and support in accordance with, or equivalent to, the applicable requirements for deckhouses given in the ABS Rules for Building and Classing Steel Vessels.

Portable Accomodations[19]

Portable accomodations are acceptable for installation in protected areas that will not be exposed to wave action. Additionally, the acceptance is based on the availability of a permanent deck house structure in which to seek refuge if necessary.

MISCELLANEOUS

Deck Cargo[20]

Effective protection for the crew in the form of guard rails or life lines are to be provided above the deck cargo if there is no convenient passage on the deck, nor an underdeck passage meeting the requirements previously specified.

Deck cargo is to be stowed so that it does not obstruct the operation of any opening which gives access to and from the crew's quarters, the machinery space or other parts used in the necessary operation of the vessel.

[18] [2] 42.15-75(a)
[19] [8] 16 April 1982
[20] [1] Reg. 25(5)

SPECIAL CONDITIONS[1]

DAMAGE STABILITY REQUIREMENTS

General Requirements

For vessels assigned a Type 'A' freeboard over 150 m in length, or a Type 'B' with reduced freeboard, there is a required damage stability analysis. The specifics of the review are addressed in the "Stability Requirements" section of this chapter.

MACHINERY CASINGS[2]

Type 'A' & 'B-100' Freeboards

Machinery casings are to be protected by an enclosed superstructure of at least standard height, or by a deckhouse of equal height and equivalent strength. Machinery casings may be exposed *provided* that there are no openings giving direct access from the freeboard deck to the machinery space. A door complying with the requirements of Regulation 12 *may*, however,, be permitted in the machinery casing, *provided* that it leads to a space or passageway which is as strongly constructed as the casing and is separated from the stairway to the machinery space by a second door complying with the requirements of Regulation 12. An inner sill of 230 mm (9 in) in conjunction with an outer sill of 600 mm (23 1/2") is recommended.[3]

CREW PROTECTION[4]

Type 'A', 'B-100' & 'B-60' Freeboards

Special consideration is necessary for protecting the crew in the working of a vessel with a Type 'A' or Type 'B' with reduced freeboard. The exposed freeboard deck is generally vulnerable to wave action due to the smaller assigned freeboard. In the preceeding section of this chapter, the primary and secondary crew protection requirements are specified for vessels assigned a Type 'A' and Type 'B' with reduced freeboard.

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1 [1] Reg. 26, 27(7) & (9)

2 [1] Reg. 26(1), 27(9)

3 [4] LL.7, Circ.3/Circ.20, 26 May 1976

4 [1] Reg. 26(2), 27(7) & (9), [4] LL.50, LL.3/Circ.77, 13 October 1986 {restructured for clarity}

HATCHWAYS[5]

Type 'B-100' & 'B-60' Freeboards

For flush hatchway covers which are fitted on the freeboard deck forward of the quarter length the section modulus and moment of inertia are to be increased 15% over that required by Reg. 16.[6]

Exposed hatchways on the freeboard deck and the forecastle decks or on the tops of expansion trunks on vessels assigned a Type 'B-100' freeboard are to be provided with efficient watertight covers of steel or equivalent material.

FREEING ARRANGEMENTS

General Requirements[7]

The minimum freeing port area requirements are generally more stringent for vessels fitted with bulwarks and assigned freeboards based on a damage stability standard, such as Type 'A' and 'B' with reduced freeboard; primarily due to the closer proximity of the weather deck to the sea.

Type 'A' & 'B-100' Freeboards

Vessels assigned Type 'A' & 'B-100' freeboards if fitted with bulwarks are to have open rails fitted for at least half the length of the exposed parts of the weather deck, *or* as an alternative, freeing port area in the lower part of the bulwarks of 33% of the total area of the bulwarks is required.

Type 'B-60' Freeboards

A freeing port area, in the lower part of the bulwarks, of 25% of the total area of the bulwarks is required.

[5] [1] Reg. 27(7) & (9)
[6] [4] LL.6, LL.3/Circ.20, 26 May 1976
[7] [1] Regs. 26(5) & 27(7)(b)