

Rules for Building and Classing

Steel Barges



January 2024



RULES FOR BUILDING AND CLASSING

STEEL BARGES
JANUARY 2024

**American Bureau of Shipping
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RULES FOR BUILDING AND CLASSING

STEEL BARGES

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PART 3

Hull Construction and Equipment

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1 Application

The following definitions of symbols and terms are to be understood (in the absence of other specifications) where they appear in the Rules.

3 Length

The length, L , shall be taken as 96 percent of the total length, in meters (feet), on a waterline at 85 percent of the least molded depth, D . In barges designed with a rake of keel, the waterline on which this length is measured shall be parallel to the designed waterline.

5 Breadth

The breadth, B , is the greatest molded breadth, in meters (feet).

7 Depth

The depth, D , is the molded depth, in meters (feet), measured at amidships from the molded baseline to the molded line of the strength deck plating at the side of the barge.

9 Molded Baseline

The *Molded Baseline* is a horizontal line extending through the upper surface of the bottom shell plating at the centerline, amidships.

11 Draft

The draft, d , is the molded draft, in meters (feet), from the molded baseline to the summer load line.

13 Freeboard Deck

The *Freeboard Deck* is normally the uppermost deck having permanent means for closing all openings.

15 Forecastle Deck

The *Forecastle Deck* is the deck above the freeboard deck forward to which the side shell plating extends.

17 Truss (2020)

A *Truss* is a system of internal framing members comprised of top and bottom chords extending either fore and aft or athwartships in association with regularly spaced stanchions and diagonals. The spacing of the stanchions generally is not to exceed the depth of the truss so that the diagonal members will not have angles of inclination with the horizontal less than approximately 45°. A single-laced truss is one having diagonal bracing in only one direction in each space between stanchions; a double-laced truss is one having diagonal bracing in both directions in each space. See 5-1-1/Figure 1 through Figure 3 and 3-1-2/25.

19 Side Shell Plating Amidships

The term *Side Shell Plating Amidships* refers to the plating of the side shell from the upper turn of the bilge to the deck at the side between 0.2L forward and 0.2L aft of amidships.

21 Bottom Shell Plating Amidships

The term *Bottom Shell Plating Amidships* refers to the plating of the bottom shell from the keel to the upper turn of the bilge between 0.2L forward and 0.2L aft of amidships.

23 Tonne

The term *Tonne (t)*, as contained within the Rules, refers to a metric ton of one thousand kilograms.

25 Ton

The term *Ton (Lt)*, as contained within these Rules, refers to a long ton of 2240 lbs.

27 Perpendiculars

The *Forward and After Perpendiculars* shall be taken at the forward and after ends of the length, *L*. The forward perpendicular shall coincide with the foreside of the stem on the waterline on which the length, *L*, is measured. (See 3-1-1/39).

29 Amidships

Amidships is the middle of the length, *L*.

31 Block Coefficient (C_b)

The *Block Coefficient (C_b)*, is given by

$$C_b = \nabla / L B d$$

where ∇ is the volume of molded displacement, excluding appendages, in cubic meters (cubic feet).

33 Bottom Forward Plating

- i) In rake end barges, the *Bottom Forward Plating* is the bottom plating of the forward rake from the forward headlog to the lower turn of the rake or to the collision bulkhead, if located aft of the lower turn of the rake.
- ii) In ship-shape bow barges, the *Bottom Forward Plating* is the flat of bottom plating forward of 0.3L from amidships.

35 Yield Point

The *Yield Point* is the first stress in a material, less than the maximum obtainable stress, at which an increase in strain occurs without an increase in stress. Yield point may be determined by the halt of the

pointer or autographic diagram. The 0.5% total extension under load method will also be considered acceptable.

37 Yield Strength

The *Yield Strength* is the stress at which a material exhibits a specified limiting deviation from the proportionality of stress to strain. Yield strength is to be determined by the 0.2% offset method. Alternatively, for material whose stress-strain characteristics are well known from previous tests in which stress-strain diagrams were plotted, the 0.5% extension under load method may be used.

39 Double Ended Rake Barge

A *Double Ended Rake Barge* is a barge with similar rakes at each end and fitted with towing bits arranged in such a manner that the barge in normal circumstances may be towed from either end. Each end of barges with this configuration is to be considered as the forward end in the application of these Rules.

41 Oil

As used in these Rules, the term *Oil* refers to petroleum products having flash points at or below 60°C (140°F), (closed cup test).

43 Superstructure

A *Superstructure* is a decked structure on the freeboard deck extending from side to side of the barge or with the side plating not being inboard of the shell plating more than 0.04B.

45 Deadweight

The term *Deadweight (Dwt)*, as used in these Rules, means the difference, in tonnes (tons), between the displacement of a barge in water of specific gravity 1.025 at the assigned summer load line and the lightweight of the barge.

47 Cargo Area

The *Cargo Area* is that part of a barge that contains cargo tanks, slop tanks and cargo pump rooms and includes ballast and void spaces, cofferdams and pump rooms adjacent to cargo tanks and also deck areas throughout the entire length and breadth of that part of the barge over the above mentioned spaces. In chemical tank barges having independent cargo tanks installed in hold spaces, cofferdams or ballast or void spaces aft of the after most hold space bulkhead or forward of the forward-most hold space bulkhead are excluded from the cargo area.

49 Cargo Pump Room

A *Cargo Pump Room* is a space containing pumps and their accessories for the handling of the cargo.

51 Control Stations

Control Stations are those spaces in which the barge's radio or emergency source of power is located or where the fire recording or fire control equipment is centralized, but does not include special fire control equipment which can be most practically located in the cargo area.

53 Machinery Spaces

Machinery Spaces are those spaces and trunks to such spaces which contain propelling machinery (such as for a bow thruster), boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling station, refrigerating, stabilizing, ventilation and air-conditioning machinery, and similar spaces.

55 Pump Rooms

Pump Rooms are spaces, located in the cargo area, containing pumps and their accessories for the handling of ballast or fuel oil.

57 Service Spaces

Service Spaces are those spaces used for galleys, pantries containing cooking appliances, lockers, mail and specie rooms, storerooms, workshops other than those forming part of the machinery spaces and similar spaces and trunks to such spaces.

59 Units

These Rules are written in three systems of units, i.e., SI units, MKS units and US customary units. Each system is to be used independently of any other system.

Unless indicated otherwise, the format of presentation in the Rules of the three systems of units is as follows:

SI units (MKS units, US customary units)

1 Materials and Fabrication

1.1 Materials

1.1.1 Steel

These Rules are intended for barges of welded construction using steels complying with the requirements of Chapters 1 and 2 of the *ABS Rules for Materials and Welding (Part 2)*. Use of steels other than those in Chapters 1 and 2 of the above Part 2 and the corresponding scantlings will be specially considered.

1.1.2 Aluminum Alloys

The use of aluminum alloys in hull structures will be considered upon submission of the proposed specification for the alloy and the method of fabrication.

1.1.3 Design Consideration

Where scantlings are reduced in connection with the use of higher-strength steel or where aluminum alloys are used, adequate buckling strength is to be provided. Where it is intended to use material of cold flanging quality for important longitudinal strength members, this steel is to be indicated on the plans.

1.1.4 Guidance for Repair

Where a special welding procedure is required for the special steels used in the construction, including any low temperature steel and those materials not in Chapters 1 and 2 of the *ABS Rules for Materials and Welding (Part 2)*, a set of plans showing the following information for each steel should be placed aboard the barge.

- Material Specification
- Welding procedure
- Location and extent of application

These plans are in addition to those normally placed aboard which are to show all material applications.

3 Application of Steel Material 100 mm (4.0 in.) and Under in Thickness (2023)

Steel materials are to be of the grade required by 3-1-2/3 TABLE 2 for the material class given in 3-1-2/3 TABLE 1 for the particular location. Note that the use of ASTM A36 steel is limited to components identified as “Class I” in 3-1-2/3 TABLE 1. Therefore, the vast majority of the plating located within the amidships 0.4L region of a vessel should be Grade A steel or better as required by 3-1-2/3 TABLE 1 and 3-1-2/3 TABLE 2. Outside of the amidships 0.4L region, the substitution of ASTM A36 material for Grade A is more widely acceptable as described in Note 2 below 3-1-2/3 TABLE 2.

TABLE 1
Material Class of Structural Members

<i>Structural Member</i>	<i>Material Class ⁽¹⁾</i>	
	<i>Within 0.4L Amidships</i>	<i>Outside 0.4L Amidships</i>
Shell		
Bottom Plating including keel plate	III	I
Bilge strake	IV ^(2,3,4)	III ^(5,6)
Side plating	II	I
Sheer strake at strength deck ⁽⁷⁾	IV ^(3,4,8)	III ^(5,6)
Decks		
Strength deck plating ⁽⁹⁾	III	I
Stringer plate in strength deck ⁽⁷⁾	IV ^(3,4,8)	III ^(5,6)
Strength deck plating within line of hatches and exposed to weather, in general	II	I
Strength deck strake on tank barges at longitudinal bulkhead ⁽¹⁰⁾	IV ^(3,4)	III ^(5,6)
Longitudinal Bulkheads		
Lowest strake in single bottom barges	II	I
Uppermost strake including that of the top wing tank	III	I
Other Structures in General		
Continuous longitudinal members above strength deck	III	I
Strength members not referred to in above categories and local structures	I	I

Notes:

- 1 Special consideration will be given to barges in restricted service.
- 2 May be of class III in barges with a double bottom over the full breadth and with a length, *L*, less than 150 m (492 ft).
- 3 Single strakes required to be of material class IV and V grade or grade E are to have breadths not less than $800 + 5L$ mm ($31.5 + 0.06L$ in.), but need not exceed 1800 mm (71 in.).
- 4 Below 90 m (295 ft) in length, *L*, this may be class III.
- 5 May be class II outside 0.6L amidships.
- 6 Below 90 m (295 ft) in length, *L*, this may be class I.

- 7 A radius gunwale plate may be considered to meet the requirements for both the stringer plate and the sheer strake, provided it extends suitable distances inboard and vertically. For formed material, see 3-1-2/5.
- 8 To be class V in barges with length, L , exceeding 250 m (820 ft).
- 9 Plating at the corners of large hatch openings are to be specially considered.
- 10 For tank barges having a breadth exceeding 70 m (230 ft) at least the centerline strake and one strake port and starboard at the longitudinal bulkheads are to be class IV.

TABLE 2
Material Grade (2017)

Grade CS may be used in place of Grade E.
 Grade DS may be used in place of Grade D.

Plate Thickness, t , mm (in.)	Material Class				
	I	II	III	IV	V
$t < 15$ ($t < 0.60$)	A ⁽²⁾ ,AH	A,AH	A,AH	A,AH	D,DH
$15 < t \leq 20$ ($0.60 < t \leq 0.79$)	A,AH	A,AH	A,AH	B,AH	D1,DH
$20 < t \leq 25$ ($0.79 < t \leq 0.98$)	A,AH	A,AH	B,AH	D,DH	E,EH
$25 < t \leq 30$ ($0.98 < t \leq 1.18$)	A,AH	A,AH	D,DH	D ⁽¹⁾ ,DH	E,EH
$30 < t \leq 35$ ($1.18 < t \leq 1.38$)	A,AH	B,AH	D,DH	E,EH	E,EH
$35 < t \leq 40$ ($1.38 < t \leq 1.57$)	A,AH	B,AH	D,DH	E,EH	E,EH
$40 < t \leq 100$ ($1.57 < t \leq 4.0$)	B,AH	D,DH	E,EH	E,EH	E,EH

Notes:

- 1 Grade D and DS of these plate thicknesses to be normalized.
- 2 (2017) ASTM A36 steel otherwise manufactured by an ABS approved steel mill, tested and certified to the satisfaction of ABS may be used in lieu of Grade A for a thickness up to and including 12.5 mm (0.5 in.) for plate and up to and including 19 mm (0.75 in.) for sections.

When tensile stresses through the thickness (Z direction) exceed approximately 50% of the minimum specified yield stress (as defined in the applicable ABS Rules), consideration is to be given to applying Z grade steel (refer to 2-1-1/17 of the *ABS Rules for Materials and Welding (Part 2)*). Alternatives to applying Z grade may be proposed provided it is demonstrated by ultrasonic testing before and after welding that no through thickness tearing has occurred, and/or the welding preparation, weld size and bead sequence is such that damaging through thickness loads induced by weld shrinkage are avoided.

5 Forming

Steel is not to be formed between the upper and lower critical temperatures. Forming in the range between 205°C (400°F) and 425°C (800°F) should be avoided. If the forming temperature exceeds 650°C (1200°F) for as-rolled, controlled rolled, thermo-mechanical controlled rolled or normalized steels, or is not at least 28°C (50°F) lower than the tempering temperature for quenched and tempered steels, mechanical tests are to be performed to assure that these temperatures have not adversely affected the mechanical properties of the steel.

For applications where toughness is of particular concern (such as Class IV or Class V of 3-1-2/3 TABLE 1, when steel is formed below 650°C (1200°F) beyond 3% strain on the outer fiber calculated on the basis of:

$$\% \text{ strain} = \frac{65 \times \text{plate thickness}}{\text{outer radius}}$$

supporting data is to be provided to the satisfaction of the Surveyor indicating that the impact properties meet minimum requirements after forming. After straining, specimens used in Charpy impact tests are to be subjected to an artificial aging treatment of 288°C (550°F) for 1 hour before testing. Rule steels or equivalent steels used for bilge strakes or radius gunwales (in accordance with 3-1-2/3 TABLE 1) may be cold formed without requiring stress relieving or other supporting data. For barges of 90 m (295 ft) or more in length, the radius is to be at least 15*t*.

7 Scantlings

7.1 General (2020)

The amidships scantlings as specified in the Rules are to apply throughout the midship 0.4*L*. End scantlings are not to extend for more than 0.1*L* from each end of the barge. The reduction from the midship to the end scantlings is to be effected in as gradual a manner as practicable. Sections having appropriate section moduli or areas, in accordance with their functions in the structure as stiffeners, columns or combinations of both, are to be adopted, due regard being given to the thickness of all parts of the sections to provide a proper margin for corrosion. It may be required that calculations be submitted in support of resistance to buckling for any part of the barge's structure. Buckling calculations are required to be submitted for barges > 76 meters (250 feet) in length (see 3-2-1/13).

9 Workmanship

All workmanship is to be of commercial marine quality and acceptable to the Surveyor. Welding is to be in accordance with the requirements of Section 3-2-12. The Surveyors are to satisfy themselves that all operators to be employed in the construction of barges to be classed are properly qualified in the type of work proposed and in the proper use of the welding processes and procedures to be followed.

11 Drydocking

For barges 225 m (738 ft) and over in length, information indicating docking arrangements is to be prepared and furnished for guidance.

13 Structural Sections

13.1 Required Section Modulus (2019)

The scantling requirements of these Rules are applicable to structural angles, channels, bars, and rolled or built-up sections. The required section modulus of members such as girders, webs, etc., supporting frames and stiffeners is to be obtained with an effective width of plating basis as described below, unless otherwise noted. The section modulus is to include the structural member in association with an effective width of plating equal to one-half the sum of the spacing on each side of the member or 33% of the unsupported span, *ℓ*, whichever is less. For girders and webs along hatch openings, an effective breadth of plating equal to one-half the spacing or 16.5% of the unsupported span, *ℓ*, whichever is less, is to be used. Where channel construction is adopted, as permitted by 3-2-4/3.1 and as illustrated in 5-1-1/15.11 FIGURE 1 and 5-2-1/17 FIGURE 1, the required section modulus is to be obtained solely by the channel.

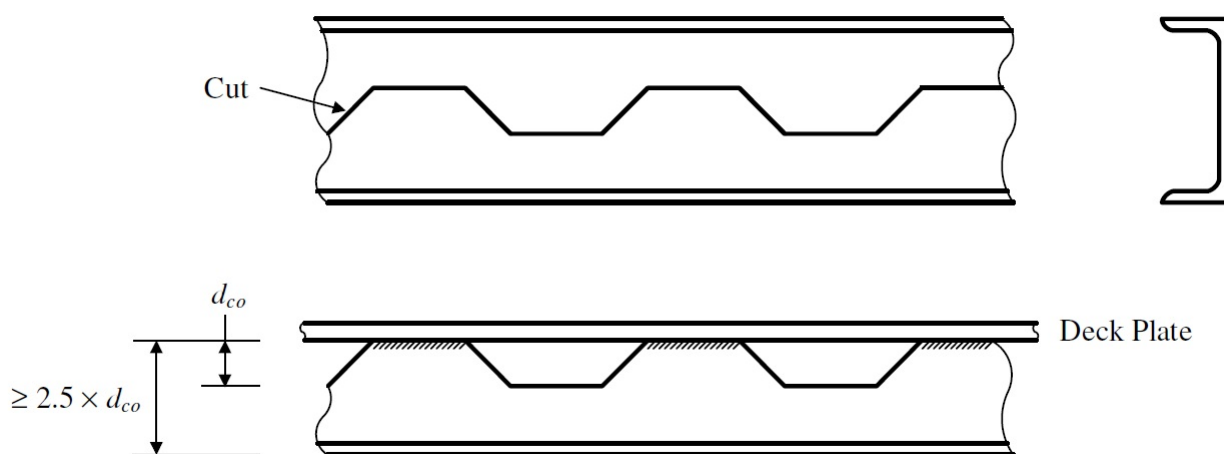
The required section modulus of frames and stiffeners is assumed to be provided by the stiffener and one frame space of the plating to which it is attached. Where it is proposed to cut holes in the outstanding

flanges or large openings in the webs, the net section is to be used in determining the section modulus, in association with the plating to which it is attached.

13.3 Serrated Sections (2017)

Serrated sections may be used for girders, webs, frames and stiffeners, but the depth of the member is not to be less than 2.5 times the depth of any cutout. The cutouts are to be arranged to provide regularly spaced points of contact with the plating sufficient to obtain the welding required. See 3-1-2/13.3 FIGURE 1 below:

**FIGURE 1
Serrated Section (2017)**



13.5 Frames, Beams and Stiffeners (2016)

13.5.1 Section Modulus

The required section modulus is assumed to be provided by the stiffener and a maximum of one frame space of the plating to which it is attached.

13.5.2 Web Thickness

The ratio of depth to thickness of the web portion of members is not to exceed the following:

Members with flange $50C_1C_2$

Members without flange $15C_1C_2$

where

$C_1 = 0.95$ (horizontal web within tank)

$= 1.0$ (all other cases)

$C_2 = 1.0$ (ordinary strength steel)

$= 0.92$ (HT32)

$= 0.90$ (HT36)

15 Structural Design Details

15.1 General

The designer shall give consideration to the following:

15.1.1

The thickness of internals in locations susceptible to rapid corrosion.

15.1.2 (2016)

The proportions of built-up members to comply with established standards for buckling strength. Also see 3-2-4/3.3.

15.1.3

The design of structural details, such as noted below, against the harmful effects of stress concentrations and notches:

- i)* Details of the ends, the intersections of members and associated brackets.
- ii)* Shape and location of air, drainage, or lightening holes.
- iii)* Shape and reinforcement of slots or cut-outs for internals.
- iv)* Elimination or closing of weld scallops in way of butts, “softening” of bracket toes, reducing abrupt changes of section or structural discontinuities.

15.1.4

Proportions and thickness of structural members to reduce fatigue response due to cyclic stresses, particularly for higher-strength steels.

15.3 Termination of Structural Members (2015)

Unless permitted elsewhere in the Rules, structural members are to be effectively connected to the adjacent structures in such a manner as to avoid hard spots, notches and other harmful stress concentrations. Where members are not required to be attached at their ends, special attention is to be given to the end taper, by using soft-toed concave brackets or by a sniped end of not more than 30°. Where the end bracket has a face bar, it is to be sniped and tapered not more than 30°. Bracket toes or sniped ends are to be kept within 25 mm (1.0 in.) of the adjacent member, and the depth at the toe or snipe end is generally not to exceed 15 mm (0.60 in.). Where a strength deck or shell longitudinal terminates without end attachment, it is to extend into the adjacent transversely framed structure or stop at a local transverse member fitted at about one transverse frame space beyond the last floor or web that supports the longitudinal. Longitudinals, where allowed to terminate on either side of transverse bulkheads per 3-2-4/3.3, are to end not more than 50.8 mm (2.0 in.) from the bulkhead plating.

15.5 Side Shell Reinforcement (2021)

Cargo, gangway, or fueling ports in the sides of barges are to be capable of being made thoroughly watertight. Where frames are cut in way of such ports, web frames are to be fitted on each side of the opening, and arrangements are to be provided for the support of beams over the opening. Thick insert plates are to be fitted in the shell to compensate for such openings.

15.7 Doubler Plates (2021)

Shell doubler plates are not to be used unless allowed by the specific Rules. Doubler plates are not acceptable in tanks carrying flammable liquids. Where doubler plates are proposed in way of equipment foundations when large tensile forces normal to the doubler plates could exist, the doubler plate and welds are to be assessed for yielding and buckling, as applicable.

Small landing plates for pipe hangers, sounding tube striking plates, and wear plates in way of cargo/ballast suction sumps installed in accordance with industry practice are acceptable.

15.9 Bolted Connections (2021)

Unless indicated otherwise, the structural design and fabrication of bolted connections is to be in compliance with a recognized bolting standard (AISC, API, etc.). The bolted connections, including the connection type, materials and methods are to be suitable for the intended application. Workmanship of these connections is to be in accordance with 3-1-2/9 of the Rules.

17 Tanks Forward of the Collision Bulkhead

Tanks forward of the collision bulkhead are not to be arranged for the carriage of oil or other liquid substances that are flammable.

19 Water Ballast Spaces (2011)

Any compartment designated for salt water ballast is to have a corrosion resistant hard type coating such as epoxy or zinc on all internal surfaces. Where a long retention of salt water ballast is expected due to the type of barge, special consideration for the use of inhibitors or sacrificial anodes may be given.

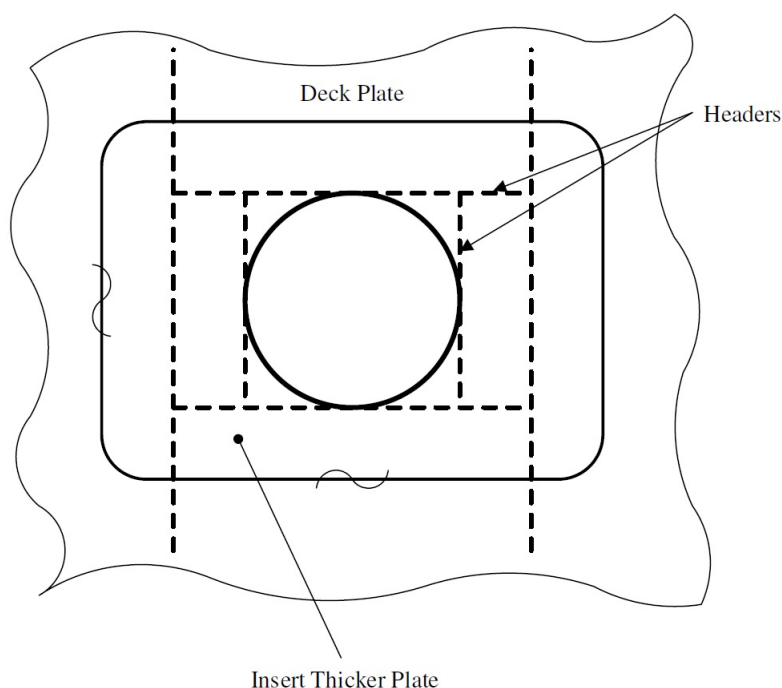
21 Testing

Tank testing is to be as required by Section 3-4-1.

23 Deck Fittings (2017)

All barges are to have a sufficient number of cleats and chocks of substantial design. The structure in way of these fittings is to be suitably reinforced by installation of headers, additional beams, brackets or doubling plates. See 3-1-2/23 FIGURE 2 below:

FIGURE 2
Reinforcing Structure in Way of Deck Fittings (2017)



25 Stanchions & Trusses (2023)

Stanchion and trusses are normally to be arranged for the support of frames and may extend either fore and aft or athwartship. Lone stanchions (those without adjacent diagonals and deep deck and bottom members which would form an effective truss arrangement) will typically only be considered as supporting the deck structure. However, the bottom structure must be capable of supporting the load from the stanchion in this situation. No counteracting hydrostatic force should be considered for the bottom structure. This could be an issue for deck cargo barges with a high uniform deck cargo load. For deck cargo barges, stanchions and trusses are in general to be arranged in accordance with 5-1-1/Figures 1 through 3. Lone stanchions without an effective truss are to be demonstrated by transverse strength analysis in 3-2-1/15.

Stanchions which are part of an effective truss can support both the deck and bottom structure. An effective truss transfers the loads to the side shell and/or bulkheads. An effective longitudinal truss consists of a deep deck girder, a deep bottom girder, stanchions and adjacent diagonal(s) arranged as shown in the various figures in Part 5. An effective transverse truss consists of a deep deck transverse, a deep bottom transverse, stanchions and adjacent diagonal(s) arranged as shown in various figures in Part 5. The stanchions should be checked for the loads (deck cargo load or hydrostatic load) acting on them and sized for the greater load as described elsewhere in these Rules.

The truss diagonals should not be oriented at an angle of less than 45 degrees with the horizontal. In barges with raked ends, the angle of the diagonals to the horizontal could become an issue as the depth of the hull decreases towards its ends. The designer should keep this in mind and arrange the truss members accordingly.

PART 3

CHAPTER 2

Hull Structures and Arrangements

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1 General (1 July 2021)

Barges intended to be classed for unrestricted ocean service are to have longitudinal strength in accordance with the requirements of this Section. A breadth to depth ratio up to approximately 4 is acceptable in association with longitudinal bulkheads and trusses arranged at suitable intervals. A breadth to depth ratio greater than 4 can be specially considered.

3 Longitudinal Hull Girder Strength

3.1 Strength Standard

The required hull girder section modulus SM_R amidships, to the deck and bottom is to be obtained from the following equation:

$$SM_R = KSM_b \quad \text{cm}^2 - \text{m}(\text{in}^2 - \text{ft})$$

where

$$K = 0.629 + M_s / (f_p SM_b) \text{ but is not to be taken less than } 1.0$$

$$M_s = \text{maximum still-water bending moment in the governing loaded or ballasted condition in kN-m (tf-m, Ltf-ft). When still-water bending moment calculations are not submitted, } K \text{ will be taken as } 1.0.$$

$$f_p = 17.5 \text{ kN/cm}^2 (1.784 \text{ tf/cm}^2, 11.33 \text{ Ltf/in}^2)$$

$$SM_b = C_1 C_2 L^2 B (C_b + 0.7) \text{ cm}^2\text{-m (in}^2\text{-ft)}$$

$$C_1 = 4.11 \quad 30 \leq L < 45 \text{ m}$$

$$= 16.33(L/100)^2 - 15.47(L/100) + 7.77 \quad 45 \leq L < 95 \text{ m}$$

$$= 10.75 - \left(\frac{300-L}{100}\right)^{1.5} \quad 95 \leq L \leq 300 \text{ m}$$

$$= 10.75 \quad 300 < L < 350 \text{ m}$$

$$= 10.75 - \left(\frac{L-350}{150}\right)^{1.5} \quad 350 \leq L \leq 500 \text{ m}$$

$$\begin{aligned}
 &= 4.11 && 100 \leq L < 150 \text{ ft} \\
 &= 16.33(L/328)^2 - 15.47(L/328) + 7.77 && 150 \leq L < 310 \text{ ft} \\
 &= 10.75 - \left(\frac{984-L}{328}\right)^{1.5} && 310 \leq L \leq 984 \text{ ft} \\
 &= 10.75 && 984 < L < 1148 \text{ ft} \\
 &= 10.75 - \left(\frac{L-1148}{492}\right)^{1.5} && 1148 \leq L \leq 1640 \text{ ft}
 \end{aligned}$$

$$C_2 = 0.01 (1.44 \times 10^{-4})$$

L = length, in meters (feet), as defined in 3-1-1/3

B = breadth, in meters (feet), as defined in 3-1-1/5

C_b = block coefficient, as defined in 3-1-1/31

3.3 Section Modulus Calculation (2019)

In general, the following items may be included in the calculation of the section modulus, provided they are continuous or effectively developed throughout the midship $0.4L$ and gradually tapered beyond. The sectional areas of the decks may be gradually reduced to one half of the amidships deck area at $0.15L$ from the ends.

- Deck plating (strength deck and other effective decks)
- Shell and inner-bottom plating
- Deck and bottom girders
- Plating and longitudinal stiffeners of longitudinal bulkheads, longitudinals of deck, sides, bottom and inner bottom.
- Regarding the effectiveness of the corrugated longitudinal bulkheads for bending and shear resistance: Horizontally corrugated longitudinal bulkheads can be included in the hull girder strength calculation for bending strength but not for shear strength. Vertically corrugated longitudinal bulkheads are to be excluded from the hull girder bending strength calculation but may be considered for shear strength.

In general, the net sectional areas of longitudinal-strength members are to be used in the hull girder section modulus calculations. The section modulus to the deck or bottom is obtained by dividing the moment of inertia by the distance from the neutral axis to the molded deck line at side amidships plus the height of an effective trunk, if fitted (see 3-2-3/3), or to the baseline, respectively.

Where strength deck longitudinal hatch coamings of length greater than $0.14L$ are effectively supported by underdeck longitudinal bulkheads or deep girders, the coaming and longitudinal stiffeners are to be in accordance with 3-2-9/5.9. The section modulus amidships to the top of the coaming is to be obtained by dividing the moment of inertia by the distance from the neutral axis to the deck at side plus the coaming height. This distance need not exceed y_t as given by the following equation, provided y_t is not less than the distance to the molded deck line at side.

$$y_t = y(0.9 + 0.2x/B) \text{ m(ft)}$$

where

y = distance, in m (ft), from the neutral axis to the top of the continuous coaming

x = distance, in m (ft), from the top of the continuous coaming to the centerline of the barge

B = breadth of the barge as defined in 3-1-1/5 in m (ft)

x and y are to be measured to the point giving the largest value of y_t . In way of continuous hatch coamings, the section modulus to the deck at side, excluding the coamings, need not be determined.

5 Hull Girder Moment of Inertia

The hull girder moment of inertia I amidships is to be not less than obtained from the following equation:

$$I = 0.03SM_R L \quad \text{cm}^2 - \text{m}^2(\text{in}^2 - \text{ft}^2)$$

where

L = length of barge as defined in 3-1-1/3

SM_R = hull girder section modulus required for the barge per 3-2-1/3.1, in $\text{cm}^2\text{-m}$ ($\text{in}^2\text{-ft}$)

7 Still-water Bending Moment and Shear Force Calculations (2022)

Still-water bending moment and shear force calculations are to be submitted for barges:

- 76 meters (250 feet) in length and above.
- All chemical tank barges.
- Deck cargo barges with deck cargo rating above 9.765 tf/m^2 (2000 lbf/ft^2)
- where special consideration is required.

These calculations are to:

- Show bending moment and shear force values along the length of the barge.
- Include at least the full load and ballast conditions
- Include contemplated loading conditions that might be expected to have an unfavorable influence on the hull girder strength
- Where bending moment calculations indicate maximum values outside the midship $0.4L$, the midship scantlings may be required to be extended.

The calculated still-water nominal shear stress in any condition shall not exceed:

- 58 N/mm^2 (5.91 kgf/mm^2 , $8,406 \text{ psi}$) at the quarter-length points of the barge
- 74 N/mm^2 (7.55 kgf/mm^2 , $10,667.5 \text{ psi}$) at amidships and at the ends
- Elsewhere values are to be interpolated.

In general for vessels without continuous longitudinal bulkheads, the nominal total shear stress f_s in the side shell plating may be obtained from the following equation:

$$f_s = (F_{sw})m/2t_s I$$

where

- I = moment of inertia of the hull girder at the section under consideration, in cm^4 (in^4)
- m = first moment, in cm^3 (in^3), about the neutral axis, of the area of the effective longitudinal material between the horizontal level at which the shear stress is being determined and the vertical extremity of effective longitudinal material, taken at the section under consideration
- t_s = thickness of the side shell plating at the position under consideration, in cm (in.)
- F_{sw} = hull girder shearing force in still-water, in kN (tf, Ltf)

For vessels having continuous longitudinal bulkheads, the total shear stresses in the side shell and the longitudinal bulkheads are to be calculated by an acceptable method. In determining the still-water shear force, consideration is to be given to the effects of non-uniform athwartship distribution of loads. The method described in Appendix 3-2-A1 of the *ABS Rules for Building and Classing Marine Vessels (Marine Vessel Rules)* may be used as a guide in calculating the nominal total shear stress related to the shear flow in the side shell or longitudinal bulkhead plating.

9 Barges on Station

Barges, such as accommodation barges, intended for operation at one site may be specially considered.

11 Longitudinal Strength with Higher-Strength Materials

11.1 General

Barges in which the effective longitudinal material of either the upper or lower flanges of the main hull girder, or both, is constructed of materials having mechanical properties greater than those of ordinary-strength hull structural steel, are to have longitudinal strength generally in accordance with the preceding paragraphs of this Section, but the value of the hull girder section moduli may be modified as permitted by the following paragraphs. Applications of higher-strength material are to be continuous over the length of the barge to locations where the stress levels are suitable for the adjacent mild-steel structure. Higher-strength steel is to be extended to suitable locations below the strength deck and above the bottom, so that the stress levels will be satisfactory for the remaining mild steel structure. Longitudinal framing members are to be continuous throughout the required extent of higher-strength steel. Calculations showing that adequate strength has been provided against buckling are to be submitted for review, and care is to be taken against the adoption of reduced thicknesses of material that may be subject to damage during normal operation.

11.3 Hull Girder Section Modulus (1 July 2018)

When either the top or bottom flange of the hull girder, or both, is constructed of higher-strength material, the section modulus as obtained from 3-2-1/3.1 may be reduced by the factor Q .

$$SM_{hts} = Q(SM_R)$$

where

- Q = 0.78 for H32 strength steel
- Q = 0.72 for H36 strength steel
- Q = 0.68⁽¹⁾ for H40 strength steel

H32, H36, H40 are as specified in Section 2-1-3 of the *ABS Rules for Materials and Welding (Part 2)*

Notes:

- 1 The material factor for H40 may be taken as 0.66, provided that the hull structure is additionally verified for compliance with the requirements of:

- ABS Guide for 'SafeHull-Dynamic Loading Approach' for Vessels
- ABS Guide for Spectral-Based Fatigue Analysis for Vessels

Q factor for steels having other yield points or yield strengths will be specially considered.

11.5 Hull Girder Moment of Inertia (2012)

The hull-girder moment of inertia is to be not less than required by 3-2-1/5 using the mild steel section modulus obtained from 3-2-1/3.1.

13 Buckling Calculations (2024)

Buckling calculations are to be submitted to verify the acceptability of the scantlings of decks, shell, longitudinal bulkheads, hatch side coamings etc., for barges:

- 76 meters (250 feet) in length and above,
- All chemical tank barges **irrespective of length**,
- Deck cargo barges with deck cargo rating above 9.765 tf/m² (2000 lbf/ft²) **irrespective of length**,
- and where special consideration is required.

Buckling calculations are to be in accordance with Appendix 3-2-A4 of the *ABS Rules for Building and Classing Marine Vessels (Marine Vessel Rules)*.

For barges less than 76 meters (250 feet) in length, the total hull girder bending moment to be used in the calculations is to consist of the maximum still-water bending moment in kN-m, (tf-m, Ltf-ft) plus a wave-induced bending moment of $S_w SM_b$, kN-m (tf-m, Ltf-ft) where $S_w = 11.0$ kN/cm² (1.122 tf/cm², 7.123 Ltf/in²) and SM_b is as defined in 3-2-1/3.1. **Buckling due to shear need not to be considered for barges less than 76 meters (250 feet) in length.**

For barges greater than or equal to 76 meters (250 feet) in length, the wave Induced bending moment is to be per 3-2-1/3.5 of the *Marine Vessel Rules* or is to be calculated by means of a statistical analysis based on the ship motion calculation in realistic sea states. In such cases, the calculations, computer programs used, and the computed results are to be submitted for review.

15 Transverse Strength (2020)

15.1 General (1 July 2021)

Bulkheads and/or an efficient truss arrangement should be provided to maintain the transverse strength and stiffness of the hull. Where the uniform deck load equals or exceeds 147 kN/m² (15 tf/m², 1.5 Ltf/ft²), or there are lone stanchions without an efficient truss arrangement as in 3-1-2/25, transverse strength analysis is to be carried out to demonstrate the hull structure is adequate for the anticipated loads.

15.3 Transverse Strength Assessment (1 July 2022)

The transverse strength assessment is to be carried out applying transverse hull girder loads in combination with local loads and typical deck loading conditions in combination with internal and external pressures considering:

- i) Homogeneous full load condition at scantling draft
- ii) Partial load condition (50% full)
- iii) Partial load condition (33% full)
- iv) Normal ballast condition (if applicable)

Under the loading conditions specified above, the following criteria to be complied with:

<i>Stress Component</i>	<i>Criteria</i>
Compressive or tensile stresses in transverse members	$0.67 * S_m * F_y$
Shear Stress in transverse members	$0.40 * S_m * F_y$

where

S_m = 1.0 for mild steel

= 0.95 for HT32

= 0.908 for HT36

F_y = Specified minimum material yield of the considered structural member

In addition, buckling strength is to be adequate for the critical locations and high-stress areas subject to compressive and/or shear stresses. The buckling strength of such locations/areas is to be in compliance with the latest version of the ABS *Requirements for Buckling and Ultimate Strength Assessment for Offshore Structures*, or other recognized standard acceptable to ABS.

17 Loading Instrument (2021)

For tank barges loaded within the approved range of loading conditions, loading instruments are generally not required by these Rules. However, when fitted, a loading instrument is to be in accordance with 3-2-A2/9 and 3-3-1/9 of the *Marine Vessel Rules*.

1 Shell Plating Thickness

Shell plating thickness is not to be less than is required for purposes of longitudinal hull girder strength in accordance with 3-2-1/3, nor is it to be less than required by the respective equations for minimum thickness of side and bottom plating in this Section. In general, after all corrections are made, the shell plating thickness is not to be less than required by Section 3-2-7 for tank bulkhead plating with h to the deck at side. Where hull girder shear values are abnormal, the thickness of the side shell plating may be required to be increased.

3 Shell Plating Amidships

3.1 Side Shell Plating Amidships

The thickness of the side shell plating within $0.4L$ amidships, as defined in 3-1-1/19, is not to be less than obtained from the following equations nor less than required by 3-2-2/5.1:

$$t = 0.07L + 0.007s \text{ mm} \quad \text{for } L \leq 150 \text{ meters}$$

$$t = 0.03L + 0.007s + 6.0 \text{ mm} \quad \text{for } L > 150 \text{ meters}$$

$$t = 0.00084L + 0.007s \text{ in.} \quad \text{for } L \leq 492 \text{ feet}$$

$$t = 0.00036L + 0.007s + 0.236 \text{ in.} \quad \text{for } L > 492 \text{ feet}$$

where

t = required thickness of plating, in mm (in.)

L = length of the barge, as defined in 3-1-1/3

s = frame spacing, in mm (in.)

3.1.1 Barges with Longitudinal Bulkheads

Where longitudinal bulkheads are fitted on each side of the centerline throughout the cargo space or extending not less than the midship $0.5L$, and located not more than $0.2B$ from the side of the barge, the side shell thickness, as obtained above, may be reduced by 0.5 mm (0.02 in.).

3.1.2 Transverse Framing

Where the side shell is transversely framed and the frame spacing adopted is greater than 760 mm (30 in.), calculations to show adequate provision against buckling are to be submitted.

3.3 Sheer Strake

In general, the thickness of the sheer strake is not to be less than the thickness of the side shell plating nor less than the required deck stringer strake thickness in the same section being considered.

3.5 Bottom Shell Plating

The thickness of the bottom shell plating within $0.4L$ amidships, as defined in 3-1-1/21, is not to be less than that obtained from the following equations nor less than required by 3-2-2/5.1:

3.5.1 Longitudinal Framing

$$t = 0.045L + 0.007s + 1.8 \text{ mm} \quad \text{for } L \leq 123 \text{ meters}$$

$$t = 0.08L + 0.007s - 2.5 \text{ mm} \quad \text{for } L > 123 \text{ meters}$$

$$t = 0.00054L + 0.007s + 0.07 \text{ in.} \quad \text{for } L \leq 405 \text{ feet}$$

$$t = 0.00096L + 0.007s - 0.1 \text{ in.} \quad \text{for } L > 405 \text{ feet}$$

where

t = required thickness of plating, in mm (in.)

L = length of the barge, as defined in 3-1-1/3, but need not be greater than 225 m (738 ft)

s = frame spacing, in mm (in.)

3.5.2 Transverse Framing (2020)

In general, the thickness is to be 0.75 mm (0.03 in.) greater than obtained from the above equations.

5 Shell Plating at Ends

5.1 Minimum Shell Plating Thickness

The minimum shell plating thickness for $0.1L$ at ends is to be obtained from the following equations. Between the midship $0.4L$ and the end $0.1L$, the thickness of the plating may be gradually tapered.

$$t = 0.055L + 0.007s + 1.0 \text{ mm} \quad \text{for } L \leq 76 \text{ meters}$$

$$t = 0.015L + 0.01s + 2.2 \text{ mm} \quad \text{for } L > 76 \text{ meters}$$

$$t = 0.00066L + 0.007s + 0.04 \text{ in.} \quad \text{for } L \leq 250 \text{ feet}$$

$$t = 0.00018L + 0.01s + 0.087 \text{ in.} \quad \text{for } L > 250 \text{ feet}$$

where

t = required thickness of plating, in mm (in.)

L = length of the barge, as defined in 3-1-1/3, but need not be greater than 225 m (738 ft)

s = frame spacing, in mm (in.)

5.3 Bottom Forward Plating

The thickness of the bottom forward plating, as defined in 3-1-1/33, is not to be less than that obtained from the following equations. However, it need not exceed 25.4 mm (1 in.).

$$t = 0.055L + 0.01s + 1.0 \text{ mm} \quad \text{for } L \leq 110 \text{ meters}$$

$$t = 0.085L + 0.01s - 2.3 \text{ mm} \quad \text{for } L > 110 \text{ meters}$$

$$t = 0.00066L + 0.01s + 0.04 \text{ in.} \quad \text{for } L \leq 360 \text{ feet}$$

$$t = 0.00102L + 0.01s - 0.09 \text{ in.} \quad \text{for } L > 360 \text{ feet}$$

where

t = required thickness of plating, in mm (in.)

L = length of the barge, as defined in 3-1-1/3, but need not be greater than 225 m (738 ft)

s = frame spacing, in mm (in.)

5.5 Immersed Bow Plating

Where the bow is of ship-shape form, the thickness of the plating below the waterline for the forward $0.16L$ is not to be less than obtained from the following equations, but need not be greater than the thickness of the side shell plating amidships.

$$t = 0.05L + 0.009s + 1.0 \text{ mm}$$

$$t = 0.0006L + 0.009s + 0.04 \text{ (in.)}$$

where

t = required thickness of plating, in mm (in.)

L = length of the barge, as defined in 3-1-1/3

s = frame spacing, in mm (in.)

7 Shell Recesses

Recesses in shell plating to serve as ladders are to have well rounded corners and in general are to be staggered vertically with the recessed plating specially reinforced where forming pockets. The side shell longitudinals in way of shell recesses are to remain intact or the strength of the longitudinals is to be developed.

9 Bow and Stern Thruster Tunnels

The thickness of the tunnel plating is to be not less than required by 3-2-2/5.1, nor is the thickness to be less than obtained from the following equation:

$$t = 0.008d + 3.0 \text{ mm}$$

$$t = 0.008d + 0.12 \text{ in.}$$

where

d = inside diameter of the tunnel, in mm (in.), but is to be taken not less than 970 mm (38 in.)

Where the outboard ends of the tunnel are provided with bars or grids, the bars or grids are to be effectively secured.

10 Skeg and other Appendages (2021)

Vessels fitted with skegs and other permanent appendages are to comply with the following:

- i) The thickness of the skeg plating is to be in accordance with 3-2-2/3 or 3-2-2/5 depending on its location, and 3-2-7/3.1 for deep tanks. The thickness of the shell plating in way of an appendage is to be increased by 25%. However, this increase need not exceed 6.5 mm (0.25 in.).
- ii) The stiffener section modulus is to be in accordance with Part 5, Chapter 1 (for dry cargo barges) or Part 5, Chapter 2 (for tank barges), and 3-2-7/3.3 for deep tanks.
- iii) Where a closing plate prohibits the inspection of a void space or joint that is integral to the shell plating, access ports or drain plugs are to be provided in way of this space. Access arrangements with manholes are to be provided for skegs used as deep tanks.
- iv) All appendages are to be attached to shell plating using double continuous fillet welds in accordance with Section 3-2-12. Where access is not feasible, one side full penetration weld with backing is to be provided.
- v) Appendage structures are to be reinforced and aligned with the internal hull structural members.

11 Bilge Keels

Bilge keels, where fitted, are to be attached to the shell by a doubler. In general, both the bilge keel and the doubler are to be continuous. The connection of the bilge keel to the doubler and the doubler to the shell are to be by double continuous fillet welds.

Butt welds in the bilge keel and doubler are to be full penetration and are to be kept clear of master erection butts. In general, shell butts are to be flush in way of the doubler; doubler butts are to be flush in way of the bilge keel, and, in general, scallops and cutouts are not to be used. Where desired, a drilled crack arresting hole at least 25 mm (1 in.) in diameter may be provided in the bilge keel butt weld as close as practical to the doubler.

The ends of the bilge keel are to be suitably tapered and are to terminate on an internal stiffening member. The material tensile properties for bilge keels and doublers are to be as required for the bottom shell plating.

12 Bilge Plating (2016)

In general, the bilge plate is to be longitudinally stiffened. The thickness of the bilge plate is to be not less than required in 3-2-2/3 and 3-2-2/5, adjusted for spacing of the bilge longitudinals or frames and the material factors. Where girth spacing of bilge longitudinals is greater than that of the adjacent bottom plating, the spacing may be modified by the following equation in calculations of minimum required thickness.

$$s = k_{r1} s_g \text{ mm (in.), but not to be taken less than the spacing of the longitudinals of the adjacent bottom plating}$$

where

$$s_g = \text{girth spacing of bilge longitudinals, in mm (in.)}$$

$$k_{r1} = (1 - 0.5s_g/R)^2 \text{ but not less than } 0.55$$

$$R = \text{radius of bilge, in mm (in.)}$$

Longitudinals around the bilge are to be graduated in size from that required for the lowest side longitudinal to the required for the most outboard bottom longitudinals. A bilge keel is not considered as an effective longitudinal stiffening member.

In no case is the thickness of the bilge plate to be less than that of the adjacent bottom plating.

13 Higher-strength Materials

13.1 General

In general, applications of higher-strength materials for shell plating are to take into consideration the suitable extension of the higher-strength material above and below the bottom and deck, respectively (for longitudinal extent, see 3-2-1/11.1). Calculations to show adequate provision against buckling are to be submitted. Care is to be exercised against the adoption of reduced thicknesses of material that might be subjected to damage during normal operation. The thicknesses of bottom and side-shell plating, where constructed of higher-strength materials, are to be not less than required for purposes of longitudinal hull girder strength. The actual bottom/side plate thicknesses are also not to be less than those required in the previous paragraph, corrected using the Q factor, as specified below.

13.3 Bottom Plating of Higher-strength Material

Bottom shell plating, where constructed of higher-strength material, is to be not less in thickness than obtained from the following equation:

$$t_{hts} = (t_{ms} - C)Q + C$$

where

t_{hts} = thickness of higher-strength material, in mm (in.)

t_{ms} = thickness, in mm (in.), of ordinary-strength steel, as required by 3-2-2/3.5

C = $0.3t_{ms}$, but need not be greater than 4.3 mm (0.17 in.)

Q = as defined in 3-2-1/11.3

The thickness of bottom shell plating, where transversely framed, will be specially considered.

13.5 Side Plating of Higher-strength Material

Side shell plating, where constructed of higher-strength material, is to be not less in thickness than obtained from the following equations:

$$t_{hts} = [t_{ms} - C][(Q + 2\sqrt{Q})/3] + C$$

where t_{hts} , t_{ms} , C and Q are as defined in 3-2-2/13.3.

The thickness of side shell plating, where transversely framed, will be specially considered.

13.7 End Plating

End plating thicknesses, including immersed bow plating and plating on the flat of bottom forward, where constructed of higher-strength materials, will be subject to special consideration.

1 Deck Plating

1.1 Deck Plating Thickness

The strength deck plating is to be of the thickness necessary to obtain the required hull girder section modulus. The thickness outside the longitudinal line of the openings, or completely across the barge where there are no centerline openings, is not to be less than obtained from the equations in 3-2-3/1.1.1 or 3-2-3/1.1.2 below, except within steel deckhouses, where the plating may be 1 mm (0.04 in.) less. The requirements of equations 3-2-3/1.1.1(b) and 3-2-3/1.1.2(b) are to extend over 0.4L amidships, beyond which they may be gradually reduced in the manner permitted for strength deck area in 3-2-1/3.3. The thickness requirements of 3-2-3/1.1.1(a) and 3-2-3/1.1.2(a) are to extend over the 0.8L amidships.

1.1.1 Thickness of Strength Decks with Transverse Beams in Barges Over 91.5 m (300 ft) up to 183 m (600 ft) in Length

Thickness of strength decks with transverse beams in barges over 91.5 m (300 ft) up to 183 m (600 ft) in length is to be not less than 3-2-3/1.1.1(a) and 3-2-3/1.1.1(b) below:

1.1.1(a)

$$t = 0.01s + 2.3 \text{ mm} \quad \text{for } s \leq 760 \text{ mm}$$

$$t = 0.0066s + 4.9 \text{ mm} \quad \text{for } s > 760 \text{ mm}$$

$$t = 0.01s + 0.09 \text{ in.} \quad \text{for } s \leq 30 \text{ in.}$$

$$t = 0.0066s + 0.192 \text{ in.} \quad \text{for } s > 30 \text{ in.}$$

1.1.1(b)

$$t = \frac{s(L + 45.73)}{25L + 6082} \text{ mm}$$

$$t = \frac{s(L + 150)}{25L + 19950} \text{ in.}$$

1.1.2 Thickness of Strength Decks with Longitudinal Beams, Strength Decks with Transverse Beams in Barges 91.5 m (300 ft) or Less and Forecastle Decks in Barges over 122 m (400 ft)

Thickness of strength decks with longitudinal beams is to be not less than 3-2-3/1.1.2(a) and 3-2-3/1.1.2(b), below. Thickness of strength decks with transverse beams in barges 91.5 m (300 ft) or less is to be not less than 3-2-3/1.1.2(a) and 3-2-3/1.1.1(b). Thickness of forecastle decks in barges over 122 m (400 ft) is to be not less than 3-2-3/1.1.2(a), below.

1.1.2(a)

$$t = 0.009s + 2.4 \text{ mm} \quad \text{for } s \leq 760 \text{ mm}$$

$$t = 0.006s + 4.7 \text{ mm} \quad \text{for } s > 760 \text{ mm}$$

$$t = 0.009s + 0.095 \text{ in.} \quad \text{for } s \leq 30 \text{ in.}$$

$$t = 0.006s + 0.185 \text{ in.} \quad \text{for } s > 30 \text{ in.}$$

1.1.2(b)

$$t = \frac{s(L + 48.76)}{26L + 8681} \text{ mm} \quad \text{for } L \leq 183 \text{ m}$$

$$t = \frac{24.38s}{1615.4 - 1.1L} \text{ mm} \quad \text{for } L > 183 \text{ m}$$

$$t = \frac{s(L + 160)}{26L + 28482} \text{ in.} \quad \text{for } L \leq 600 \text{ ft}$$

$$t = \frac{80s}{5300 - 1.1L} \text{ in.} \quad \text{for } L > 600 \text{ ft}$$

1.1.3 Thickness of Exposed Strength Decks within Line of Openings, Forecastle Decks in Barges of 122 m (400 ft) in Length or Less

$$t = 0.01s + 0.9 \text{ mm} \quad \text{for } s \leq 760 \text{ mm}$$

$$t = 0.0067s + 3.4 \text{ mm} \quad \text{for } s > 760 \text{ mm}$$

$$t = 0.01s + 0.035 \text{ in.} \quad \text{for } s \leq 30 \text{ in.}$$

$$t = 0.0067s + 0.134 \text{ in.} \quad \text{for } s > 30 \text{ in.}$$

1.1.4 Thickness of Platform Decks in Enclosed Cargo Spaces

$$t = 0.00395s\sqrt{h} + 1.5 \text{ mm} \quad \text{but not less than } 5.0 \text{ mm}$$

$$t = 0.00218s\sqrt{h} + 0.06 \text{ in.} \quad \text{but not less than } 0.20 \text{ in.}$$

where

h = tween deck height, in meters (feet). When a design load is specified, h is to be taken as $p/7.070 \text{ m}$ ($p/0.721 \text{ m}$, $p/45 \text{ ft}$.)

p = uniformly distributed deck loading, in kN/m^2 (tf/m^2 , lbf/ft^2)

1.1.5 Thickness of Enclosed Platform Decks not Intended for Cargo

$$t = 0.0058s + 1.0 \text{ mm}$$

$$t = 0.0058s + 0.04 \text{ in.}$$

but not less than 4.5 mm (0.18 in.)

where

- L = length of the barge, as defined in 3-1-1/3, in m (ft)
 s = spacing of deck beams, in mm (in.)

1.3 Plating within Line of Openings

Within the longitudinal line of openings, the thickness of exposed strength deck plating is to be not less than obtained from the equation in 3-2-3/1.1.3 amidships. At the forward and after ends it is to be as required by 3-2-3/1.7. Within steel deckhouses, the plating may be of the thickness obtained from the equation in 3-2-3/1.1.4.

1.5 Plating In Way of Deck Cargo

Where cargo is to be carried on deck, the deck thickness is not to be less than obtained from the appropriate equations in 3-2-3/1.1.1, 3-2-3/1.1.2 or 3-2-3/1.1.3, nor is the deck thickness to be less than is required for platform decks in enclosed cargo spaces per 3-2-3/1.1.4.

1.7 Deck Plating at Ends

The thickness of the deck plating forward or aft of $0.1L$ from the ends is not to be less than 0.01 mm for each millimeter of frame spacing (0.01 in. for each inch of frame spacing). In way of deck cargo, the requirements of 3-2-3/1.5 also apply. Exposed freeboard deck plating forward of $0.05L$ from the forward perpendicular is also not to be less in thickness than given by the following equation:

$$t = 0.03L + 0.0036s + 2.8 \quad \text{mm}$$

$$t = 0.00036L + 0.0036s + 0.11 \quad \text{in.}$$

where

- L = length of the barge as defined in 3-1-1/3, in m (ft)
 s = spacing of the beams, in mm (in.)

3 Trunks

A trunk will be considered an effective part of the hull girder if it extends for not less than the midship $0.6L$ and has a width of not less than $0.6B$. The thickness of the trunk side is not to be less than 8.5 mm (0.34 inches) thick in barges not exceeding 30 meters (100 feet) in length and 11 mm (0.44 inches) thick in barges 225 meters (738 feet) in length and above. The thickness at intermediate lengths is obtained by interpolation. The thickness of the plating of the top of the trunk within the $0.4L$ is not to be less than required for purposes of longitudinal hull girder strength, nor is the thickness to be less than obtained from the equations given in 3-2-3/1.1.3. Plating of trunk top and side is to have adequate strength to resist buckling.

5 Watertight Decks

Watertight flats, decks or inner bottoms over tanks are not to be of less thickness than required for the plating of tank bulkheads at the same level, and those located over void compartments are not to be of less thickness than required for the plating of watertight bulkheads. Where cargo is to be carried, the thickness is not to be less than required by 3-2-3/1.1.4.

7 Superstructure Decks

The deck plating of superstructures is to be obtained from 3-1-1/3.

9 Mechanical Unloading

In barges regularly engaged in trades where cargo is handled by grabs or similar mechanical appliances, it is recommended that flush plating be used in way of the cargo spaces and that increased framing and thickness of plating be provided.

11 Reinforcement at Openings

At corners of hatchways or other openings in decks, generous radii are to be provided. In general, the radii are not to be less than one eighth of the breadth of the hatchway or other deck opening but the radii need not exceed 760 mm (30 in.). In general cargo, bulk cargo or container carrier barges etc., with wide hatchway openings, the forwardmost and aftermost outboard comers of hatchway openings are to have insert plates of a thickness 25% greater than the adjacent required deck plating thickness. The material grade of these inserts is not to be less than class III as defined in 3-1-2/3 TABLE 2. Compensation may be required for all deck openings.

13 Reinforcement at Superstructure or Deckhouse Ends

The deck plating at the outboard corners of superstructures or deckhouses having lengths greater than $0.14L$ are to have insert plates of a thickness 25% greater than the adjacent required deck plating thickness. The material grade of these inserts is to be not less than Class III as defined in 3-1-2/3 TABLE 2.

15 Retractable Tween Decks

The thickness of the deck plating is to be not less than required by 3-2-3/1.1.4 for platform decks in enclosed cargo spaces.

The edges of the deck panels are to be stiffened to provide the necessary rigidity.

The beams and girders, in association with the plating to which they are attached, are to have section modulus, SM , not less than obtained from the following equation:

$$SM = 7.8chs\ell^2 \quad \text{cm}^3$$

$$SM = 0.0041chs\ell^2 \quad \text{in}^3$$

where

c = 0.81 for the section modulus to the flange or face bar

= 1.00 for the section modulus to the deck plating

h = $p/7.07$ m ($p/0.721$ m, $p/45$ ft)

p = uniform loading, in kN/m^2 (tf/m^2 , lbf/ft^2)

s = spacing of the beam or girder, in m (ft)

ℓ = unsupported length of the beam or girder, in m (ft)

In general, the depth of the beam and girder is to be not less than 4% of the unsupported length.

When the retractable deck is intended for the operation or stowage of vehicles having rubber tires, the thickness of the deck plating is to be not less than required by 3-2-9/15.3. The retractable decks are to be secured against movement and effectively supported by the hull structure.

17 Vehicle Loading (2014)

Where provision is to be made for the operation or stowage of vehicles having rubber tires, and after all other requirements are met, the thickness of deck plating is to be not less than obtained from the following equation:

$$t = 25.2Kn\sqrt{CW} \text{ mm}$$

$$t = Kn\sqrt{CW} \text{ in.}$$

where

$$K = [21.99 + 0.316(a/s)^2 - 5.328(a/s) + 2.6(a/s)(b/s) - 0.895(b/s)^2 - 7.624(b/s)]10^{-2}$$

, derived from the curves indicated in 3-2-3/17 FIGURE 1

$n = 1.0$ where $\ell/s \geq 2.0$ and 0.85 where $\ell/s = 1.0$, for intermediate values of ℓ/s , n is to be obtained by interpolation.

$C = 1.5$ for wheel loads of vehicles stowed at sea and 1.1 for vehicles operating in port

W = static wheel load, in tonnes (tons)

a = wheel imprint dimension, in mm (in.), parallel to the longer edge, ℓ , of the plate panel

b = wheel imprint dimension, in mm (in.), perpendicular to the longer edge, ℓ , of the plate panel

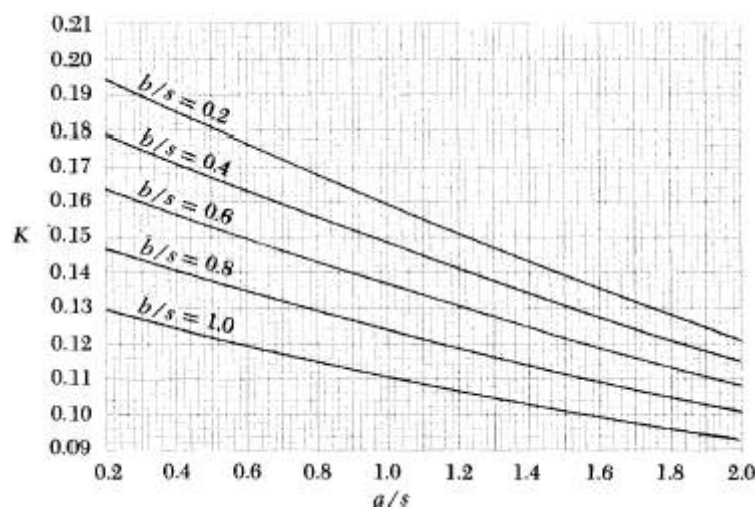
s = spacing of the deck beams or deck longitudinals, in mm (in)

ℓ = length of the plate panel, in mm (in.)

For wheel loading, the strength deck plating thickness is not to be less than 10% greater than required by the above equation and the platform deck plating thickness is to be not less than 90% of that required by the above equation.

Where the wheels are close together, special consideration will be given to the use of a combined imprint and load. Where the intended operation is such that only the larger dimension of the wheel imprint is perpendicular to the longer edge of the plate panel, b , above may be taken as the larger wheel imprint dimension, in which case, a is to be the lesser wheel imprint dimension.

FIGURE 1
Wheel Loading Curves of K



19 Decks of Higher-strength Material

19.1 Thickness

In general, proposed applications of higher-strength material for decks are to be accompanied by submission of calculations in support of adequate strength against buckling. Care is to be exercised to avoid the adoption of reduced thicknesses of material such as might be subject to damage during normal operation. The thickness of deck plating, etc., where constructed of higher-strength material, is to be not less than required for longitudinal strength, nor it is to be less than obtained from the following equation:

$$t_{hts} = (t_{ms} - C)Q + C$$

where

- t_{hts} = thickness of higher-strength material, in mm (in.)
- t_{ms} = thickness of ordinary-strength steel, in mm (in.), as required by the Rules
- C = $0.3t_{ms}$, but need not be greater than 4.3 mm (0.17 in.) for exposed deck plating
- Q = as defined in 3-2-1/11.3

The thickness t_{hts} , is also to be determined from the above equation using the t_{ms} as obtained from 3-2-3/1.1.2(b) with a factor of $0.92/\sqrt{Q}$ in lieu of Q . The factor $0.92/\sqrt{Q}$ is not to be less than 1.0.

Where the deck plating is transversely framed, or where the Rules do not provide a specific thickness for the deck plating, the thickness of the higher-strength material will be specially considered, taking into consideration the size of the barge, intended service and the foregoing Rule requirements.

19.3 Vehicle Loading

Where decks or flats are constructed of higher strength material and provision is made for the operation or stowage of vehicles having rubber tires, the thickness of plating is to be not less than obtained from the following equations.

$$t_{hts} = t_{ms}\sqrt{M/Y} \text{ mm(in.)}$$

where

- t_{hts} = thickness of higher-strength material, in mm (in.)
- t_{ms} = thickness of ordinary strength steel, as obtained from 3-2-3/17, in mm (in.)
- M = 235 (24, 34000)
- Y = as defined in 3-2-6/5.1

21 Deck Covering Compositions

Deck covering compositions are to be of material which is not destructive to steel, or they are to be effectively insulated from the steel by a non-corrosive protective covering. Samples may be taken by the Surveyor from the composition while it is being laid, in which case the samples are to be subject to independent analysis at the manufacturer's expense. The steel plating is to be thoroughly cleaned with alkaline solution before the composition is laid. Large areas of deck are to be divided by cabin sills, angles, etc., and unless otherwise approved, holdfasts are to be fitted not more than 915 mm (3 ft) apart. Deck covering within accommodation spaces on the decks forming the crown of machinery and cargo spaces are to be of a type which will not ignite readily.

PART 3

CHAPTER 2 Hull Structures and Arrangements

SECTION 4 Main Framing

1 Application

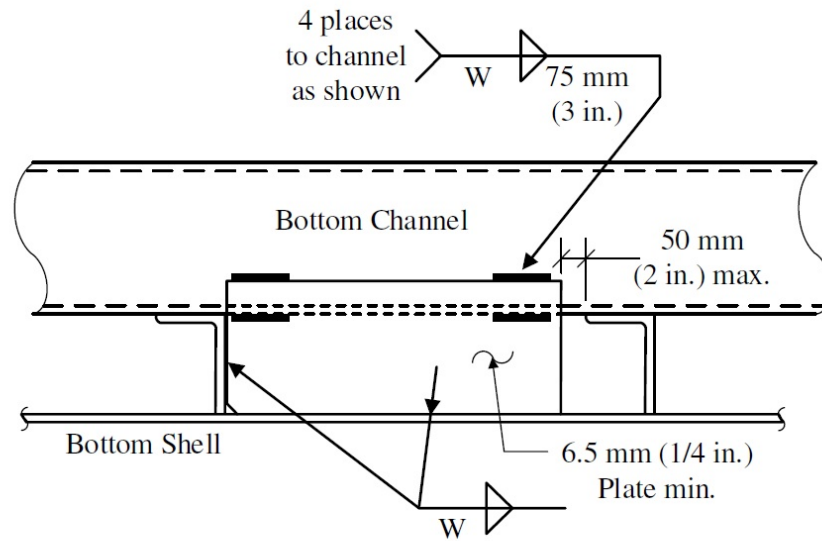
This Section applies to the framing of tank barges, deck cargo barges, double skin tank barges and barges intended for carriage of dry cargo below decks. Requirements for combination framing systems may be developed from the several illustrations.

3 General

3.1 Channel Construction (2022)

Channel construction may be used for barges up to 76 meters (250 feet) in length. In addition, channel construction is not to be used as deck beams/girders/transverses on barges with uniform deck rating greater than 2000 psf. Where bottom longitudinals are supported by channel members extending across the inner faces of the longitudinals, the attachment of the channels to the shell is to be augmented by fitting filler plates in alternate longitudinal frame spaces connected to the channel and the bottom shell plating. The minimum required weld area of the end connection of these channels is not to be less than 75% of the sectional area of the channel. In determining the weld area provided, the throat dimension of the fillet is to be used. See 3-2-4/3.1 FIGURE 1 below for illustration. Channel members that are utilized as main supporting members (transverses or girders) are to comply with the thickness requirements in 3-2-4/3.11 and the depth requirements in 3-2-4/3.9.

FIGURE 1
Typical Filler Plate Design Details (2017)



$W = 1.5 \text{ mm (1/16 in.) less than minimum thickness being joined}$

The vertical side channels are to extend to the deck and bottom plating (3-2-4/3.1 FIGURE 2A), or the bottom and deck channels are to extend to the side shell plating (3-2-4/3.1 FIGURE 2B). In either case, the ends of the channels are to be welded to the plating and the flanges of the channels are to be sniped.

FIGURE 2A
Side Channels Attached to Deck and Bottom Plating (2018)

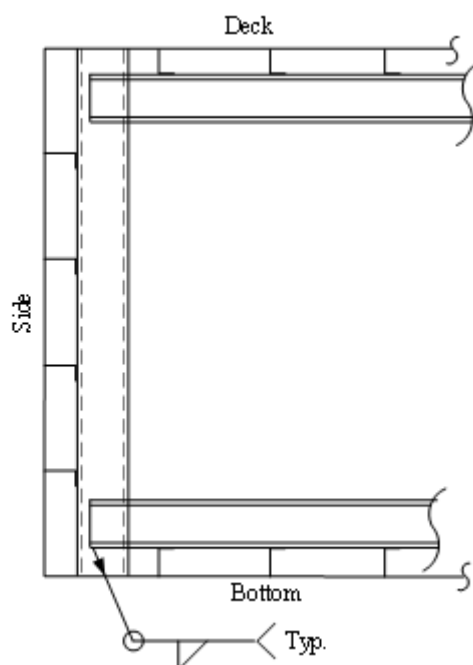
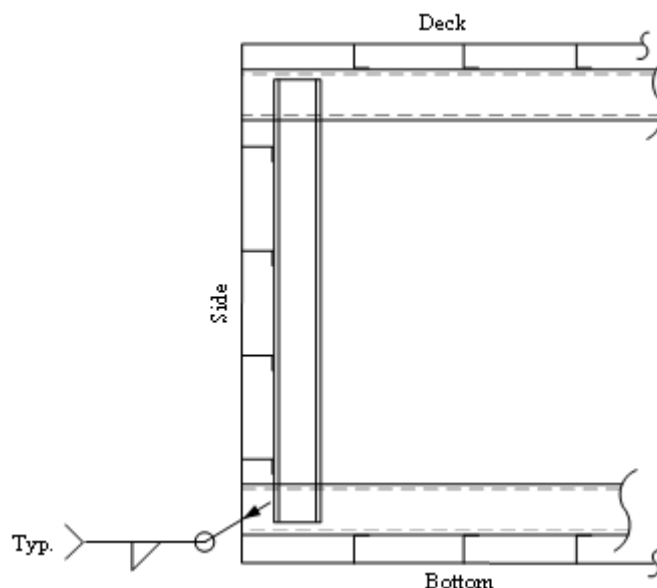


FIGURE 2B
Deck and Bottom Channels Attached to Side Plating (2018)



3.3 Longitudinals (2015)

Bottom, inner bottom, side, deck and bulkhead longitudinals are to be continuous or attached at their ends in such a manner as to effectively develop the sectional area and the resistance to bending as described below, based on the barge's length, L . Regardless of the barge's length, L , the longitudinals are to be continuous through any web frames, floors, deck transverse, or other supporting structures located between the transverse bulkheads.

3.3.1 $L < 76$ meters (250 feet)

Non-through bracketed end connections may be provided at the transverse bulkheads throughout the vessel's length if the cross sectional area of the longitudinals is not needed in order to meet the hull girder strength requirements. The end connections are to be designed such that the throat area of the bracket (taken at plane A-A in 3-2-4/3.3 FIGURE 3A) is at least equal to the cross sectional area of the longitudinal. The offered throat weld area at the connection of the bracket to the longitudinal and at the connection of the bracket to the bulkhead is to be at least equal to the cross sectional area of the longitudinal. If the area of the longitudinals must be included to pass the hull girder strength requirements, then through bracketed connections are to be provided at the transverse bulkheads located within the amidships $0.4L$ region (see the text below and 3-2-4/3.3 FIGURE 3B for through bracket design criteria). Outside of the amidships $0.4L$ region the connections may be made with non-through brackets as described in this paragraph.

3.3.2 L between 76 meters (250 feet) and 106.5 meters (350 feet) (2019)

End connections within the amidships $0.4L$ region are to be accomplished by providing either through brackets or continuous longitudinals at the transverse bulkheads. Outside of this region, the end connections may be non-through brackets as described above. In addition to meeting the requirement given in 5-1-1/3.1 TABLE 1 for thickness and flanges of brackets and knees, the design of through brackets is to be such that the section modulus of the bracket and its associated plating, if applicable, at the termination point of the longitudinal (at plane A-A in 3-2-4/3.3 FIGURE 3B) is to be at least equal to the section modulus of the longitudinal and its associated plating.

The throat area of the bracket (at plane B-B in 3-2-4/3.3 FIGURE 3B) is to be at least equal to the cross sectional area of the longitudinal. The face of the through bracket is not to have an angle of greater than 30 degrees with respect to the face of the longitudinal. Abrupt changes of section are to be avoided and the members are to be suitably tapered. The throat weld area of the connection of the through bracket to the longitudinal, as well as the connection of the through bracket to the bulkhead, is to be at least equal to the cross sectional area of the longitudinal. A flat bar or chock is to be fitted at the toe of a through bracket, welded to the bulkhead plating and extended to a location where it can be attached to adjacent stiffeners on the bulkhead. Where through brackets are aligned with (or lapped onto) bulkhead stiffeners, no additional flat bar or chock is necessary.

3.3.3 $L > 106.5$ meters (350 feet)

The longitudinals are to be continuous through any transverse bulkheads located within the amidships $0.4L$ region. Outside this region, through bracketed end connections are to be provided as described above.

FIGURE 3A
Example of Non-through Bracketed Connection at Transverse Bulkhead (2015)

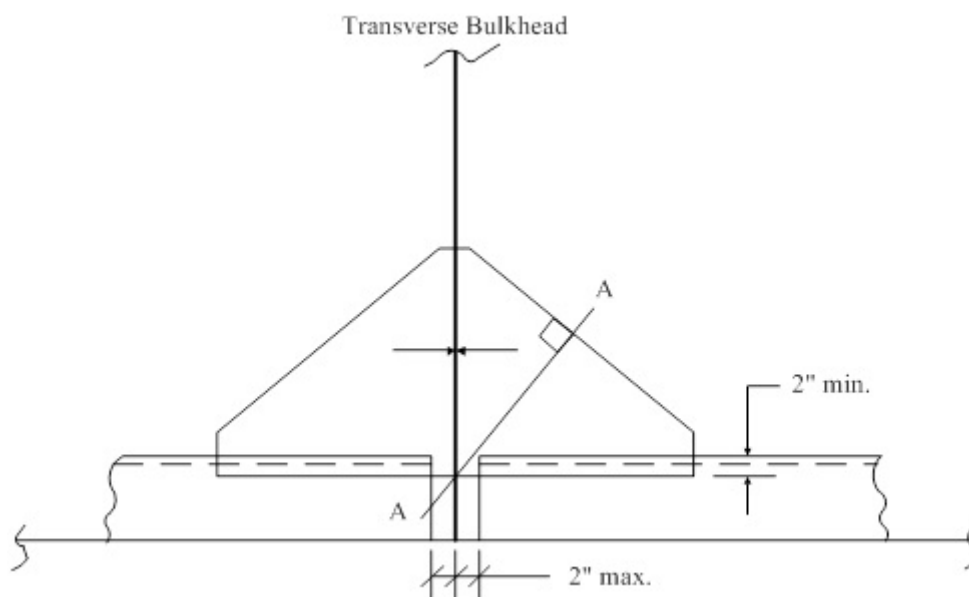
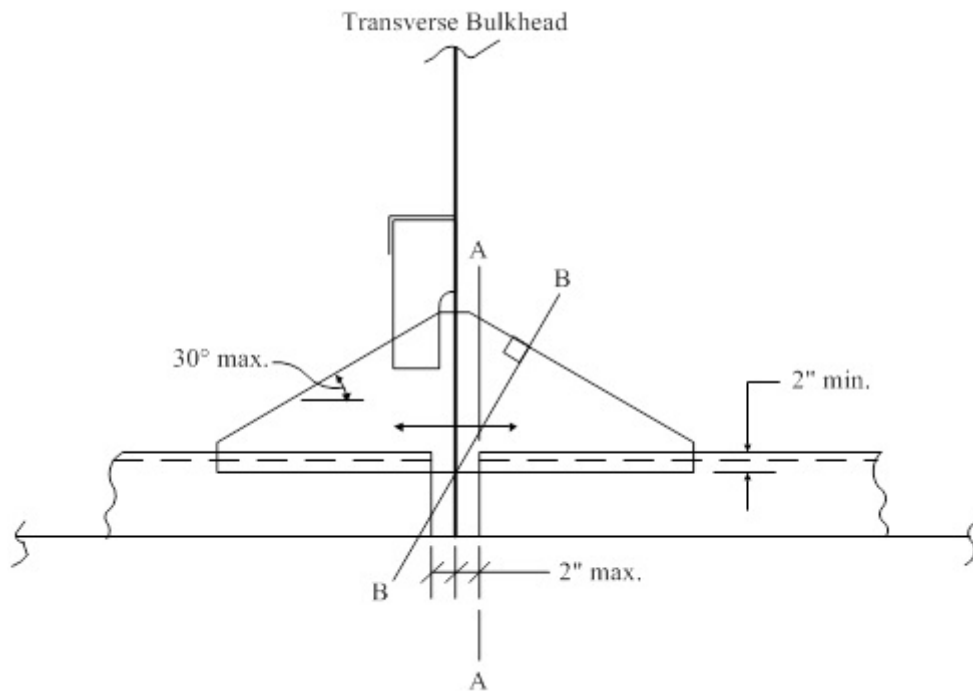


FIGURE 3B
Example of through Bracketed Connection at Transverse Bulkhead (2015)



3.5 Flanged Plate Members

Flanged plate main supporting members are to be fitted with brackets arranged so as to support the flange at intervals of about 3 meters (10 feet) and in close proximity to changes of sections. The width of the flange is not to exceed 14 times the thickness of the member. Unusually deep members may require additional stiffeners on the webs.

3.7 Drydocking Supporting Structures

Girders or other structures are to be provided to support the barge on dry-dock.

3.9 Proportions (2020)

Deck girders, chords and transverse and bottom/side girders, chords and transverses, including channel members, are to have proportions complying with the following:

- i)* Deck girders, chords and transverses are to have a depth of not less than 58.5 mm per meter of span ℓ (0.7 in. per foot of span ℓ).
- ii)* Deck girders, chords and transverses in tanks are to have depth of not less than 83.5 mm per meter of span ℓ (1 in. per foot of span ℓ).
- iii)* Bottom and side girders, chords and transverses are to have a depth of not less than 125 mm per meter of span ℓ (1.5 in. per foot of span ℓ).
- iv)* In general, the depth of the girders, chords and transverses is to be not less than twice the depth of the cut-outs for longitudinal or transverse frames, as appropriate, in way of non-tank spaces and not less than 2.5 times the depth of cut-outs in tanks. Where it can be shown by detailed calculation that the shear stress in way of the cut-outs, based on the net sectional area of the web material, is not greater than 8.65 kN/cm² (880 kgf/cm², 5.6 Ltf/in²), the above requirement for a depth of 2 or 2.5 times the depth of the cut-outs, as appropriate, may be waived provided *i)*, *ii)* and *iii)* are satisfied.

3.11 Minimum Thicknesses (2020)

Web portions of girders, chords and transverses, including channel members, are to have a thickness of not less than 1 mm per 100 mm (0.01 in. per in.) of depth plus 3 mm (0.12 in.) but need not exceed 11.5 mm (0.46 in.), nor is the thickness to be less than:

3.11.1 In Tanks

$$t = L_1/36 + 7.0 \text{ mm} \quad \text{for } L \geq 75 \text{ m}$$

$$= L_1/20 + 5.33 \text{ mm} \quad \text{for } L < 75 \text{ m}$$

$$t = L_1/3000 + 0.275 \text{ in.} \quad \text{for } L \geq 246 \text{ ft}$$

$$= L_1/1665 + 0.21 \text{ in.} \quad \text{for } L < 246 \text{ ft}$$

3.11.2 Clear of Tanks

$$t = L_1/36 + 5.5 \text{ mm} \quad \text{for } L \geq 75 \text{ m}$$

$$= L_1/60 + 6.35 \text{ mm} \quad \text{for } L < 75 \text{ m}$$

$$t = L_1/3000 + 0.217 \text{ in.} \quad \text{for } L \geq 246 \text{ ft}$$

$$= L_1/5000 + 0.25 \text{ in.} \quad \text{for } L < 246 \text{ ft}$$

where

t = minimum thickness of the web, in mm (in.)

L_1 = length of the barge as defined in 3-1-1/3, but is not to be taken less than 29 m (95 ft)

3.13 Tripping Brackets

Tripping brackets, arranged to support the flanges or face bars of girders, chords and transverses, are to be fitted at intervals of about 3 meters (10 feet), close to change of section and in line with, or as near as practicable, to the stanchions of transverse or longitudinal trusses.

3.15 Stiffeners

Where the depth/thickness ratio of the web portion of girders, chords and transverses exceeds 80, stiffeners are to be provided aligning with each longitudinal or transverse frame or horizontal or vertical bulkhead stiffener, as appropriate. In addition, where the depth/thickness ratio exceeds 200, a stiffener is to be fitted parallel to the flange at about 25% of the depth of the web from the flange.

5 Higher-strength Materials

In general, applications of higher-strength materials are to meet the requirements of this Section, but may be modified as permitted by the following paragraphs.

5-1-1/13 and 5-2-1/15 for beams, frames, girders, chords or transverses.

5-1-2/5.27 and 5-2-2/3.11 for double bottom structures.

Care is to be exercised to avoid the adoption of reduced thickness of material such as might be subject to damage during normal operations.

Calculations are to be submitted to show adequate provision against buckling.

7 Water Ballast Spaces (1992)

For coating of water ballast spaces, see 3-1-2/19.

1 General

1.1 Arrangement of Fore End Framing (2022)

3-2-5/1.7 FIGURE 1 illustrates an arrangement of framing members for a typical rake-ended barge. Fore end may be longitudinally or transversely framed. Deck and bottom longitudinal framing members are to be attached to the collision bulkhead by effective brackets and to the headlog by deep diaphragm plates or a system of vertical channels which in turn support horizontal stiffening on the headlog. The longitudinals in the rake are not to have spans greater than 2.44 meters (8 feet). The longitudinals may be supported by transverse trusses or by transverses which are supported by fore and aft trusses. See 3-1-2/25 for stanchion and truss general guidance.

The transverses, in general, are to be flanged plates or equivalent, notched over the longitudinals. Bottom transverses are to have flat bar stiffeners at each bottom longitudinal. Channels extending across the face of the longitudinals will be accepted in barges where the length L does not exceed 76 meters (250 feet). Where channels are used as bottom transverses, filler plates are to be fitted in each longitudinal frame bay connecting the channel to the bottom shell plating.

Where a system incorporating longitudinal trusses is adopted, one truss or its equivalent is to be located at the barge centerline and at least one between the centerline and the barge side, but in no case is the distance between trusses or their equivalent to exceed 4.6 meters (15 feet). The depth of the top and bottom chords of longitudinal trusses is to be not less than the depth of the deck or bottom transverses which they support nor is the depth of the bottom chord to be less than 380 mm (15 in.).

For fore end bottom strengthening, fillet welds of all transverse webs and girders to bottom shell in the fore rake end are to be double continuous welds.

1.3 Extent of Fore End Framing

Fore end framing requirements are to extend from the headlog to a vertical plane in line with the lower turn of the rake or to the collision bulkhead if located aft of the lower turn of the rake.

1.5 Ship-Shaped Bows

Barges with ship-shaped bow forms are to have scantlings in accordance with the requirements of the *ABS Rules for Building and Classing Marine Vessels (Marine Vessel Rules)*.

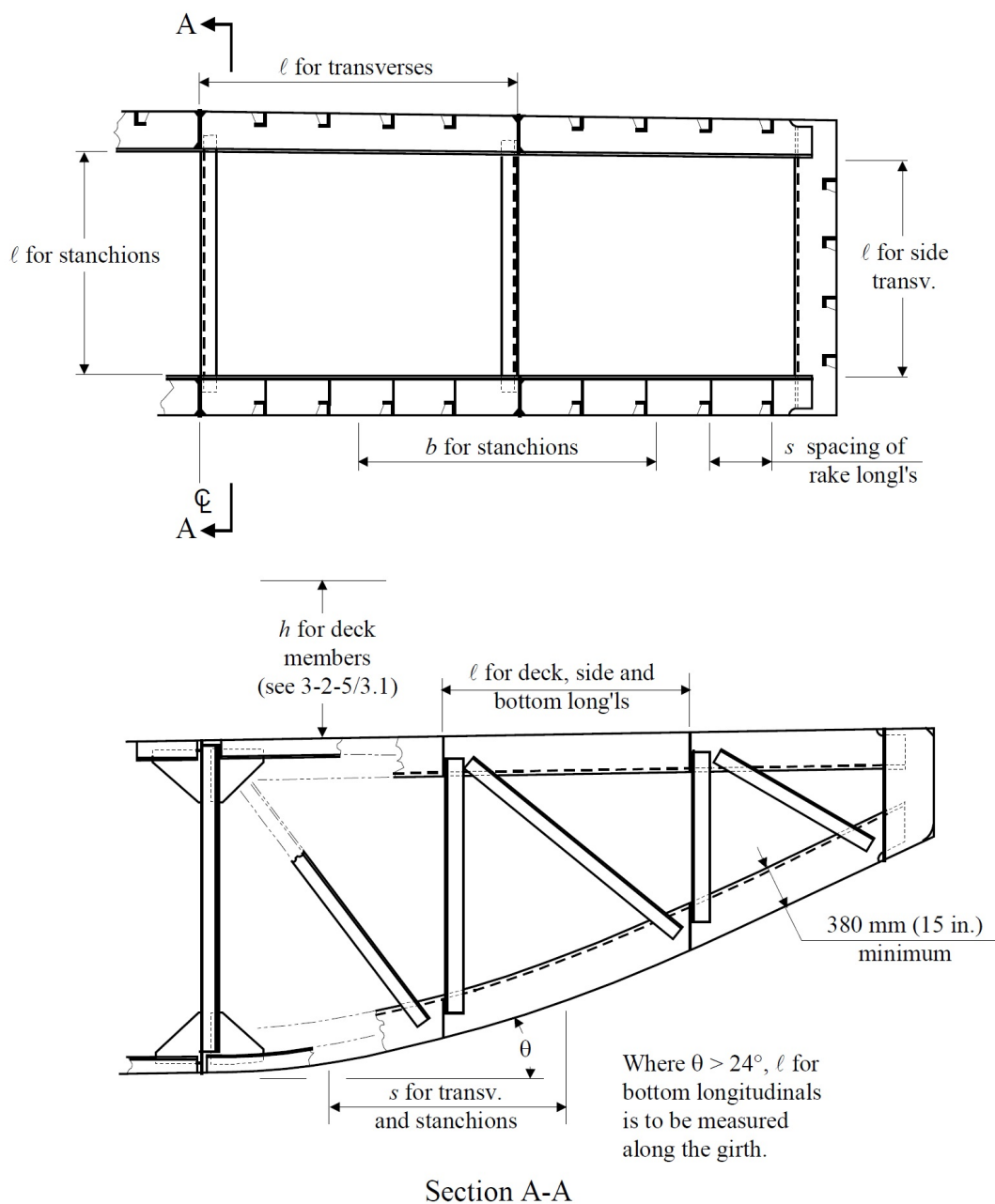
1.7 Carriage of Liquids in Forward Rake

The drawings are to indicate whether the forward rake compartment is to be used for the carriage of liquid or is a void space. If liquid is to be carried, the height and location of the overflow is to be clearly indicated on the drawings.

Tanks forward of the collision bulkhead, either above or below deck, are not to be arranged for the carriage of oil or other liquid substances that are flammable. Small independent fuel and lube oil tanks serving equipment necessary for the safe operation of the barge will be permitted forward of the collision bulkhead, provided that they are completely independent of the barge hull structure, that their size is limited to the requirements of the equipment they serve, and that they are located as far inboard of the shell and as far aft as is reasonable and practicable.

Liquids of the type referred to in 5-2-4/1.9 are not to be carried in tanks forward of the collision bulkhead.

FIGURE 1
Fore End Framing



1.9 Channel Construction End Connections

Where channel construction is employed, as permitted by 3-2-5/1.1, the minimum required weld area of the end connection of these channels is not to be less than 75% of the sectional area of the channel. In determining the weld area provided, the throat dimension of the fillet is to be used.

3 Framing

3.1 Deck Longitudinals

3.1.1

Each deck longitudinal, in association with the plating to which it is attached, is to have a section modulus SM not less than that obtained from the following equation:

$$SM = 7.8chs\ell^2 \quad \text{cm}^3$$

$$SM = 0.0041chs\ell^2 \quad \text{in}^3$$

where

$$c = 1.0$$

$$h = 0.02L + 0.76 \text{ meters } (0.02L + 2.5 \text{ feet})$$

$$L = \text{length of barge, as defined in 3-1-1/3}$$

$$s = \text{spacing of longitudinals, in meters (feet)}$$

$$\ell = \text{unsupported span, in meters (feet), of the longitudinals, see 3-2-5/1.7 FIGURE 1.}$$

3.1.2

Where cargo is to be carried on deck, the longitudinals, in addition to complying with 3-2-5/3.1.1, are also to comply with 5-1-1/3.3.

3.3 Deck Transverses

Each deck transverse, in association with the plating to which it is attached, is to have a section modulus SM not less than that obtained from the following equation:

$$SM = 4.74chs\ell^2 \quad \text{cm}^3$$

$$SM = 0.0025chs\ell^2 \quad \text{in}^3$$

where

$$c = 1.0 \text{ (1.1 for channel construction)}$$

$$h = \text{head as required by 3-2-5/3.1.1, for the deck longitudinals supported. Where deck cargo is to be carried, } h \text{ is also to be not less than required by 5-1-1/3.3.}$$

$$s = \text{spacing of the deck transverses, in meters (feet)}$$

$$\ell = \text{unsupported span, in meters (feet). For deck transverses fitted with end brackets having a slope of approximately 45 degrees and a thickness given in 5-1-1/3.1 TABLE 1, the length } \ell \text{ may be measured to a point on the bracket equal to 25\% of the length of the bracket.}$$

3.5 Bottom and Side Frames (2024)

Each bottom and side frames, in association with the plating to which it is attached, is to have a section modulus SM not less than that obtained from the following equation:

$$SM = 7.8chs\ell^2 \quad \text{cm}^3$$

$$SM = 0.0041chs\ell^2 \quad \text{in}^3$$

where

- c = 1.34 for bottom frames
 = 1.25 for side frames **and frames on plate stem**
- h = vertical distance, in meters (feet), from the middle of ℓ to a point located 1.0 m (3.28 ft), or if greater $0.02L$ m (ft), above the deck at side amidships. Where the forward rake is a tank, the height above the deck is not to be less than two-thirds the height of the overflow.
- s = spacing of frames, in meters (feet)
- ℓ = unsupported span, in meters (feet), as shown in 3-2-5/1.7 FIGURE 1.
- L = length of barge, as defined in 3-1-1/3.

3.7 Bottom and Side Transverses (2024)

Each bottom and side transverse, in association with the plating to which it is attached, is to have a section modulus SM not less than that obtained from the following equation:

$$SM = 4.74chs\ell^2 \quad \text{cm}^3$$

$$SM = 0.0025chs\ell^2 \quad \text{in}^3$$

where

- c = 1.75 for bottom transverses
 = 1.75 for side transverses **and vertical webs on plate stem** (1.95 for channel construction)
- h = head as required by 3-2-5/3.5 for bottom and side longitudinals supported
- s = spacing of the transverses, in meters (feet), see 3-2-5/1.7 FIGURE 1
- ℓ = unsupported horizontal span, in meters (feet), as shown in 3-2-5/1.7 FIGURE 1. Where brackets are fitted with a slope of approximately 45 degrees and a thickness given in 5-1-1/3.1 TABLE 1, the length ℓ may be measured to a point on the bracket equal to 25% of the length of the bracket.

3.9 Proportions

Deck and bottom chords and transverses and side transverses are to have proportions complying with the following:

- i)* Deck chords and transverses are to have a depth of not less than 83.5 mm per meter of span ℓ (1 in. per foot of span ℓ).
- ii)* Side transverses are to have a depth of not less than 125 mm per meter of span ℓ (1.5 in. per foot of span ℓ).
- iii)* Bottom transverses and chords are to have a depth of not less than 156 mm per meter of span ℓ (1.875 in. per foot of span ℓ).
- iv)* In general, the depth of transverses is not to be less than 2.5 times the depth of cut-outs for the longitudinals. [See also 3-2-4/3.9.iv].

3.11 Minimum Thickness

Web portions of transverses and chords are to have a thickness not less than required by 3-2-4/3.11.

3.13 Tripping Brackets

Tripping brackets are to be fitted in accordance with 3-2-4/3.13. (See also 3-2-5/1.1).

3.15 Trusses

3.15.1 Trusses Arrangement (2020)

Trusses are to be arranged as necessary for the support of frames and may extend either fore and aft or athwartship. See 5-1-1/Figures 1 through 3. See 3-1-2/25.

3.15.2 Stanchions (2019)

The permissible load W_a of a stanchion, pillar or strut is to be obtained from the following equation which will, in all cases, be equal to or greater than the calculated load W defined in 3-2-5/3.15.3 and 5-1-1/15.5 as appropriate.

$$W_a = (m - n\ell/r)A \quad \text{kN(tf,Ltf)}$$

where

- ℓ = unsupported span of the strut, stanchion or pillar, in m (ft)
- r = least radius of gyration, in cm (in.)
- A = area of the strut, stanchion or pillar, in cm² (in²)
- m = 12.09 (1.232, 7.83) ordinary strength steel
 = 16.11 (1.643, 10.43) HT32 strength steel
 = 18.12 (1.848, 11.73) HT36 strength steel
 = 19.13 (1.951, 12.38) HT40 strength steel
- n = 4.44 (0.452, 0.345) ordinary strength steel
 = 7.47 (0.762, 0.581) HT32 strength steel
 = 9.00 (0.918, 0.699) HT36 strength steel
 = 9.76 (0.996, 0.758) HT40 strength steel

The foregoing equation applies where ℓ/r , with ℓ and r in the same units, is less than 130.

3.15.3 Calculated Load

The calculated load W for a specific stanchion, pillar or strut is to be obtained from the following equation:

$$W = 1.025bhs \quad \text{tonnes}$$

$$W = 0.0286bhs \quad \text{tons}$$

where

- b = mean breadth of the area supported, in m (ft)
- h = vertical distance, in m (ft), from the bottom shell in way of the stanchion to a point located above the deck, as defined in 3-2-5/3.5
- s = length of the area supported, in m (ft). See 3-2-5/1.7 FIGURE 1.

3.15.4 Diagonals (2020)

Diagonals in trusses are:

- to be arranged to have angles of inclination of about 45°
- to have a sectional area of approximately 75% of that of the adjacent stanchion
- to be of the same material strength as the adjacent stanchion

- the ℓ/r ratio of the diagonal, with ℓ and r in the same units, is to be less than 130 where ℓ is the unsupported span of the diagonal and r is the least radius of gyration

For deck cargo barges, refer to Section 5-1-1. The size of the stanchions for deck cargo barges will be based on the higher calculated W due to the hydrostatic load or the deck cargo load. The area of the diagonals should be based on the greater of: 75% of the stanchion area based on the hydrostatic W or 50% of the stanchion area based on the deck cargo W .

3.15.5 Trusses in Tanks

Solid sections are to be used in tanks. The strut, stanchion or pillar, in addition to satisfying 3-2-5/3.15.2, is to have a cross-sectional area not less than $1.016W \text{ cm}^2$ ($0.16W \text{ in}^2$), where W is the calculated load as defined in 3-2-5/3.15.3.

3.15.6 End Connections

The required welding area of end connections of stanchions and diagonals is not to be less than the following:

Stanchions: 75% of the area of the stanchions

Diagonals: 50% of the area of the diagonal

In determining the weld area provided, the throat dimension of the fillet is to be used.



PART 3

CHAPTER 2 Hull Structures and Arrangements

SECTION 6 Watertight Bulkheads

1 General (2020)

All barges are to be provided with watertight bulkheads in accordance with this Section. In all cases, clearly show the location and extent of the bulkheads in the plans submitted.

Watertight bulkheads are those which have void/dry spaces on both sides and are not normally subject to hydrostatic loading.

The plating of non-watertight bulkheads should be in accordance with 3-2-6/5.1. The *SM* of non-watertight bulkhead stiffeners, stringers and webs may be half of that obtained from the equations in 3-2-6/5.3 and 3-2-6/5.5.

3 Arrangement of Watertight Bulkheads

3.1 Collision Bulkhead

All barges are to be fitted with a collision bulkhead extending intact to the freeboard deck in one plane.

The collision bulkhead is to be located at a distance aft of the forward perpendicular (See 3-1-1/27) not less than given by the following:

0.05L meters	where $L < 200$ meters
10 meters	where $L \geq 200$ meters
0.05L feet	where $L < 656$ feet
32.8 feet	where $L \geq 656$ feet

and

The collision bulkhead is to be located at a distance aft of the forward perpendicular (See 3-1-1/27), except as specially permitted, not more than given by the following:

0.05L + 3.66 meters	where $L < 122$ meters
0.08L meters	where $L \geq 122$ meters

$$0.05L + 12 \text{ feet} \quad \text{where } L < 400 \text{ feet}$$

$$0.08L \text{ feet} \quad \text{where } L \geq 400 \text{ feet}$$

where

$$L = \text{length of the barge, as defined in 3-1-1/3}$$

3.3 Other Watertight Bulkheads

Watertight bulkheads are to be arranged to provide a reasonable standard of subdivision.

The following is recommended as a guide to determine the maximum spacing between transverse watertight bulkheads in single bottom deck cargo barges, but is not required as a condition of classification:

$$S = 0.153L + 3.81 \text{ m} \quad \text{for } L < 122 \text{ m}$$

$$= 0.048L + 16.61 \text{ m} \quad \text{for } L \geq 122 \text{ m}$$

$$S = 0.153L + 12.5 \text{ ft} \quad \text{for } L < 400 \text{ ft}$$

$$= 0.048L + 54.5 \text{ ft} \quad \text{for } L \geq 400 \text{ ft}$$

where

$$S = \text{distance between transverse bulkheads, in meters (feet)}$$

$$L = \text{length of the barge, as defined in 3-1-1/3}$$

3.5 Chain Lockers (2020)

Chain lockers located abaft the collision bulkhead or those which extend into a forepeak deep tank are to be made watertight. The arrangements are to be such that accidental flooding of the chain locker cannot result in damage to auxiliaries or equipment necessary for the proper operation of the barge. Chain lockers are to have a means of drainage.

5 Construction of Watertight Bulkheads

5.1 Plating

Plating of watertight bulkheads is to be of the thickness obtained from the following equation:

$$t = sk\sqrt{qh}/c + 1.5 \text{ mm}$$

$$t = sk\sqrt{qh}/c + 0.06 \text{ in.}$$

but not less than 6 mm (0.24 in.) or $s/200 + 2.5 \text{ mm}$ ($s/200 + 0.10 \text{ in.}$), whichever is greater.

where

$$t = \text{thickness, in mm (in.)}$$

$$s = \text{spacing of stiffeners, in mm (in.)}$$

$$k = (3.075\sqrt{a} - 2.077)/(a + 0.272) \quad \text{where } (1 \leq a \leq 2)$$

$$= 1.0 \quad \text{where } a > 2$$

- a = aspect ratio of the panel (longer edge/shorter edge)
 q = $235/Y$ ($24/Y$, $34000/Y$)
 Y = yield point or yield strength as defined in 3-1-1/35 or 3-1-1/37 or 72% of the specified minimum tensile strength, whichever is less, in N/mm^2 (kgf/mm^2 , lbf/in^2)
 h = distance from the lower edge of the plate to the freeboard deck at center, in m (ft)
 c = 254 (460) for collision bulkhead
 = 290 (525) for other watertight bulkheads

5.3 Stiffeners

Each stiffener, in association with the watertight bulkhead plating to which it is attached, is to have a section modulus SM not less than obtained from the following equations:

$$SM = 7.8chs\ell^2Q \quad \text{cm}^3$$

$$SM = 0.0041chs\ell^2Q \quad \text{in}^3$$

where

- c = 0.56 for stiffeners having both ends attached
 = 0.60 for other stiffeners having no end attachments and for stiffeners between horizontal girders
 = 0.70 for horizontal stiffeners on longitudinal bulkheads
 s = spacing of the stiffeners, in m (ft)
 h = distance, in m (ft), from the middle of ℓ to the freeboard deck at center. Where that distance is less than 6.10 m (20 ft), h is to be taken as 0.8 times the distance plus 1.22 m (4 ft)
 ℓ = unsupported length, in meters (feet), between supports. Where brackets are fitted which have a slope of about 45° and a thickness indicated in 5-1-1/3.1 TABLE 1, the length ℓ may be measured to a point on the bracket equal to 25% of the length of the bracket, as shown in 3-2-6/7 FIGURE 3.
 Q = 1.0 for ordinary strength steel
 = as defined in 3-2-1/11.3 for higher strength steel

The value of SM for stiffeners on the collision bulkhead is to be at least 25% greater than required above for stiffeners on other watertight bulkheads.

5.5 Stringers and Webs

5.5.1 Strength Requirements

Each stringer or web which supports watertight bulkhead stiffeners is to have a section modulus SM not less than obtained from the following equation:

$$SM = 4.74chs\ell^2Q \quad \text{cm}^3$$

$$SM = 0.0025chs\ell^2Q \quad \text{in}^3$$

where

- c = 1.0 (1.1 for channel construction, see 5-1-1/3.1 TABLE 1)
- h = vertical distance, in m (ft), to the freeboard deck at center from the middle of s in the case of stringers, and from the middle of ℓ in the case of webs. Where that distance is less than 6.10 m (20 ft), the value of h is to be 0.8 times the distance, in m (ft), plus 1.22 m (4 ft)
- s = sum of half lengths (on each side of stringer or web) of the stiffeners supported, in m (ft)
- ℓ = unsupported span, in meters (feet). Where end brackets are fitted having a slope of approximately 45 degrees and a thickness given in 5-1-1/3.1 TABLE 1, the length ℓ may be measured to a point on the bracket equal to 25% of the length of the bracket, as shown in 3-2-6/7 FIGURE 3.
- Q = 1.0 for ordinary strength steel
 = as defined in 3-2-1/11.3 for higher strength steel

The section modulus SM of each stringer or web on the collision bulkhead is to be at least 25% greater than required for similar supporting members on other watertight bulkheads.

5.5.2 Proportions

Stringers and webs are to have depths not less than 83.5 mm per meter of span ℓ (1 in. per foot of span ℓ). See also 3-2-4/3.9.iv).

5.5.3 Tripping Brackets

Tripping brackets are to be fitted at intervals of about 3 m (10 ft), and are to be arranged to support the flange.

5.7 Corrugated Bulkheads

5.7.1 Plating

The plating of corrugated bulkheads is to be of the thickness required by 3-2-6/5.1 with the following modification. The spacing to be used is the greater of dimensions a or c as indicated in 3-2-6/7 FIGURE 1. The angle ϕ is to be 45° or more.

5.7.2 Stiffeners

The section modulus SM for a corrugated bulkhead is to be not less than obtained from the following equation:

$$SM = 7.8chs\ell^2Q \quad \text{cm}^3$$

$$SM = 0.0041chs\ell^2Q \quad \text{in}^3$$

where

- ℓ = distance between supporting members, in m (ft)
- s = $a + b$ (3-2-6/7 FIGURE 1) meters (feet)
- c = 0.56
- h = as defined in 3-2-6/5.3
- Q = 1.0 for ordinary strength steel
 = as defined in 3-2-1/11.3 for higher strength steel

The developed section modulus SM may be obtained from the following equation, where a , t and d are as defined in 3-2-6/7 FIGURE 1.

$$SM = (td^2/6) + (adt/2) \quad \text{cm}^3 \text{ (in}^3\text{)}$$

The values of SM for stiffeners on collision bulkheads is to be at least 25% greater than required above for stiffeners on other watertight bulkheads.

5.7.3 End Connection (2017)

The structural arrangements and size of welding at the ends of corrugations are to be designed to develop the required strength of corrugated stiffeners. Joints within 10% of the depth of corrugation from the outer surface of corrugation, d_1 , are to have double continuous welds with fillet size w not less than 0.7 times the thickness of bulkhead plating or penetration welds of equal strength. See 3-2-6/7 FIGURE 2.

Where no stools are fitted for the vertically corrugated bulkhead, the following requirements are to be complied with:

- i) The corrugation webs are to be supported by brackets, beams, diaphragms or girders.
- ii) The corrugation flanges are to be in line with the supporting floors. Scallops and cut-outs in the supporting members aligned with corrugation flanges and webs are to be closed by insert collar plates. Alternatives to closing the scallops and cut-outs may be accepted provided that adequate strength to the supporting members is verified by special review.
- iii) The thickness and material properties of the floors in line with the corrugation flanges are to be at least equal to those provided for the corrugation flanges.
- iv) Reinforcement may be required for access openings in supporting floors, girders, beams, and transverses.
- v) Calculations or Finite Element analysis may be submitted for review to justify the design of the supporting structure in way of the connection. Finite Element Analysis shall comply with the ABS *Guidance Notes on SafeHull Finite Element Analysis of Hull Structures*.

7 Testing

Requirements for testing are contained in Section 3-4-1.

FIGURE 1
Corrugated Bulkhead

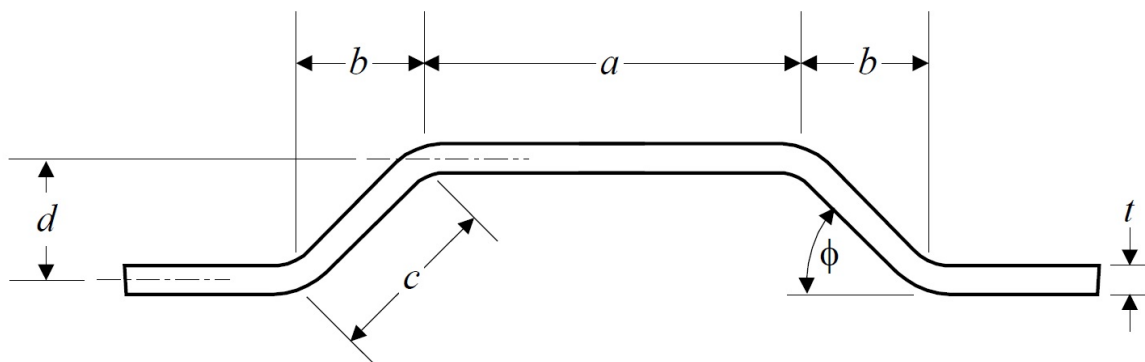


FIGURE 2
Corrugated Bulkhead End Connections

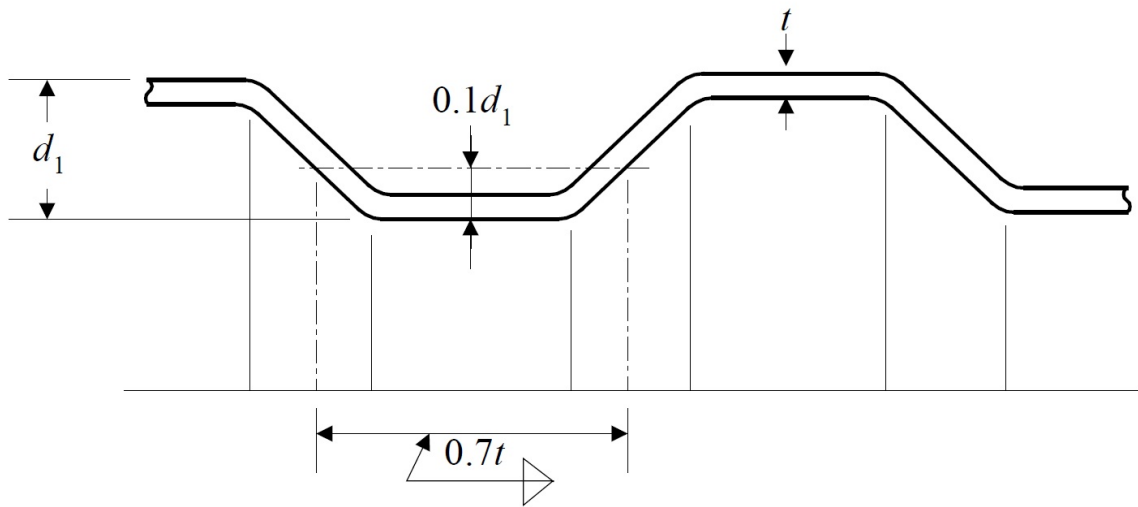
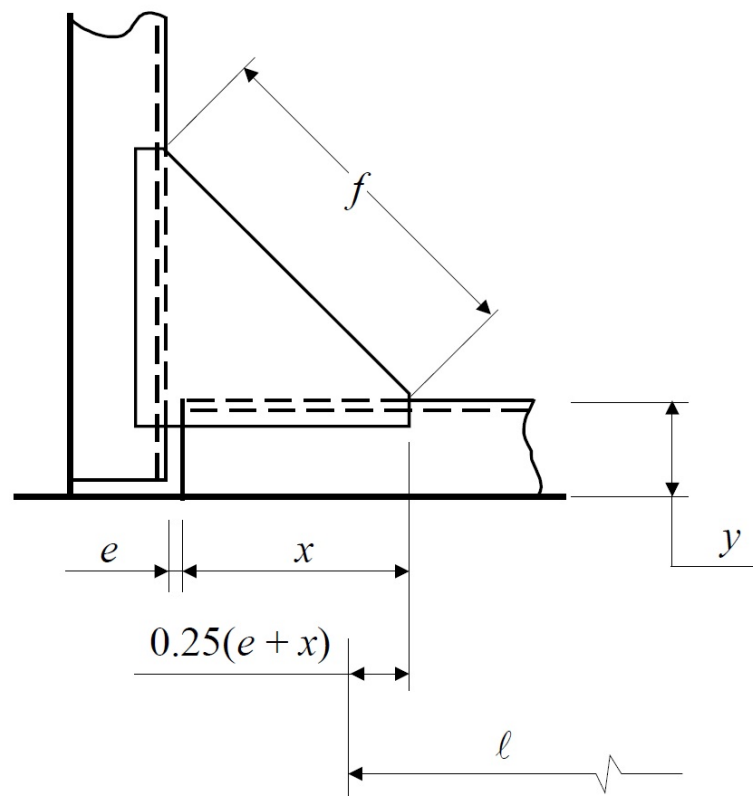


FIGURE 3
Brackets



1 General (2020)

The length of the tanks and the positions of longitudinal bulkheads are to be such as to avoid excessive dynamic stresses in the hull structure. For subdivision and stability, see Section 3-6-1.

For coating of water ballast spaces, see 3-1-2/19.

3 Cargo Tank Bulkhead Scantlings (1993)
3.1 Plating

Plating of cargo tank bulkheads is to be of thickness obtained from the following equation:

$$t = [sk\sqrt{qh}/254] + 2.5 \quad \text{mm}$$

$$t = [sk\sqrt{qh}/460] + 0.10 \quad \text{in.}$$

but not less than 6.5 mm (0.25 in.) or $s/150 + 2.5$ mm ($s/150 + 0.10$ in.), whichever is greater,

where

t = thickness, in mm (in.)

s = stiffener spacing, in mm (in.)

k = $(3.075\sqrt{a} - 2.077)/(a + 0.272)$ where $(1 \leq a \leq 2)$
 = 1.0 where $a > 2$

a = aspect ratio of the panel (longer edge/shorter edge)

q = $235/Y$ ($24/Y$, $34000/Y$)

Y = as defined in 3-2-6/5.1

h = as defined in 5-2-1/3

In addition to the above, the top strake of effective longitudinal bulkheads is not to be less in thickness than given by the following:

$$t = 0.0521L + 4.8 \quad \text{mm}$$

$$t = 0.000625L + 0.19 \quad \text{in.}$$

and the second top strake is not to be less in thickness than given by the following:

$$t = 0.0347L + 5.3 \quad \text{mm}$$

$$t = 0.000417L + 0.21 \quad \text{in.}$$

where

$$L = \text{length of the barge as defined in 3-1-1/3}$$

3.3 Stiffeners (2020)

Bulkhead stiffeners are to have their ends attached by providing brackets or clips as necessary to avoid creating stress concentrations. Each stiffener, in association with the plating to which it is attached, is to have a section modulus SM not less than that obtained from the following equation:

$$SM = 7.8chs\ell^2Q \quad \text{cm}^3$$

$$SM = 0.0041chs\ell^2Q \quad \text{in}^3$$

where

$$c = 1.00 \quad \text{for horizontal or vertical stiffeners on transverse bulkheads and vertical stiffeners on longitudinal bulkheads}$$

$$= 0.90 \quad \text{for horizontal stiffeners on longitudinal bulkheads}$$

$$h = \text{as defined in 5-2-1/3}$$

$$s = \text{spacing of the stiffeners, in meters (feet)}$$

$$\ell = \text{unsupported length, in meters (feet), between supports afforded by the shell, deck, webs, girders or other members. Where brackets are fitted which have a slope of about } 45^\circ \text{ and a thickness indicated in 5-1-1/3.1 TABLE 1, the length } \ell \text{ may be measured to a point on the bracket equal to 25\% of the length of the bracket.}$$

$$Q = 1.0 \text{ for ordinary-strength steel}$$

$$= \text{as defined in 3-2-1/11.3 for higher strength steel}$$

In cases where construction access is restricted and the unsupported length of the stiffener is 1 meter (3.28 feet) or less, the stiffener ends may be sniped and the required SM increased by 50%. This will be considered on a case-by-case basis.

3.5 Stringers and Webs

3.5.1 Strength Requirements

Stringers and webs which support bulkhead stiffeners are to have section moduli SM as obtained from the following equation. Where the expanse of the bulkhead is relatively large, consideration is to be given to fitting of deep girders in line with webs and stringers so as to obtain complete planes of stiffness.

$$SM = 4.74chs\ell^2Q \quad \text{cm}^3$$

$$SM = 0.0025chs\ell^2Q \quad \text{in}^3$$

where

- c = 1.50 (1.65 for channel construction, see 5-2-1/17 FIGURE 1)
- h = as defined in 5-2-1/3
- s = sum of half lengths, in meters (feet) (on each side of girder or web), of the stiffeners supported
- ℓ = unsupported length, in meters (feet), between supports. Where brackets are fitted which have a slope of about 45° and a thickness indicated in 5-1-1/3.1 TABLE 1, the length ℓ may be measured to a point on the bracket equal to 25% of the length of the bracket.
- Q = 1.0 for ordinary-strength steel
= as defined in 3-2-1/11.3 for higher strength steel.

3.5.2 Tripping Brackets

Tripping brackets are to be fitted at intervals of about 3 meters (10 feet) and are to be arranged to support the flange. See also 3-2-4/3.15.

3.5.3 Proportions (2018)

The stringers and webs are to have a depth of 125 mm per meter (1.5 in. per foot) of unsupported length; the thickness is not to be less than 1 mm per 100 mm (0.01 in. per inch) of depth plus 3 mm (0.12 in.) but need not exceed 11.5 mm (0.46 in.). See also 3-2-4/3.11. In general, the depth of the girder is to be not less than 2.5 times the depth of the cutouts. See also 3-2-4/3.9.iv.

5 Ballast and Deep Tank Bulkheads (2020)

The scantlings of ballast and deep tanks in deck or hopper barges are to be determined by the preceding paragraphs, except that the design head h may be taken to a point located at two-thirds of the distance from the top of the tank to the top of the overflow, or 0.91 meters (3 feet), whichever is greater. Where the compartments are filled through open manholes on the deck, the design head may be taken to the deck at side.

7 Corrugated Bulkheads

Where corrugated bulkheads are used as tank boundaries, the scantlings may be developed from 3-2-6/5.7. The plating thickness t and the value of h are to be as required by 3-2-7/3.1 and 3-2-7/3.3, respectively, and $c = 0.9$.

9 Testing

Requirements for testing are contained in Section 3-4-1.

1 General (2020)

The scantlings of decks and bulkheads of superstructures and deckhouses are to be in accordance with the following paragraphs. Superstructures or deckhouses having lengths greater than $0.14L$ and located within the amidships $0.4L$ are to have effective longitudinal scantlings such that the hull girder section modulus and inertia required by 3-2-1/3 is obtained through the top of the superstructures or deckhouses.

Special consideration may be given to the bulkhead scantlings and sills of access openings of deckhouses which do not protect openings in the freeboard deck, superstructure deck or in the top of a lowest tier deckhouse, provided they do not contain accommodation, or do not protect equipment essential to the operation of the barge.

Portable accommodation modules, where provided, are to meet the requirements of the *ABS Guide for Portable Accommodation Modules*.

3 Side and End Bulkheads**3.1 Design Head (2015)**

The design head for side and end bulkhead plating and stiffeners is to be obtained from the following:

$$h = ch_b k \quad \text{but } h \text{ is not to be taken less than } h_m$$

where

h	=	design head, in m (ft)	
h_b	=	$0.16L_1 - 4.0$ m	for $L_1 \leq 150$ m
	=	$0.08L_1 + 8.0$ m	for $L_1 > 150$ m
	=	$0.16L_1 - 13$ ft	for $L_1 \leq 487.5$ ft
	=	$0.08L_1 + 26$ ft	for $L_1 > 487.5$ ft

for lowest tier unprotected front bulkheads

$$\begin{aligned}
 c &= 1.0 && \text{where } fbd \leq 0.02L_1 \text{ m (ft)} \\
 &= 0.5 && \text{where } fbd = 0.02L_1 + 0.01L_2 + 1.05 \text{ m} \\
 &&& = 0.02L_1 + 0.01L_2 + 3.445 \text{ ft} \\
 &= 0.14 && \text{where } fbd \geq 0.02L_1 + 0.02L_2 + 2.1 \text{ m} \\
 &&& \geq 0.02L_1 + 0.02L_2 + 6.89 \text{ ft} \\
 h_m &= 2.8 \text{ m (9.2 ft)} && \text{where } fbd \leq 0.02L_1 \text{ m (ft)} \\
 &= 1.4 \text{ m (4.6 ft)} && \text{where } fbd \geq 0.02L_1 + 0.01L_2 + 1.05 \text{ m} \\
 &&& \geq 0.02L_1 + 0.01L_2 + 3.445 \text{ ft}
 \end{aligned}$$

for the lowest tier side and aft bulkheads

$$\begin{aligned}
 c &= 0.6 && \text{where } fbd \leq 0.02L_1 \text{ m (ft)} \\
 &= 0.3 && \text{where } fbd = 0.02L_1 + 0.01L_2 + 1.05 \text{ m} \\
 &&& = 0.02L_1 + 0.01L_2 + 3.445 \text{ ft} \\
 &= 0.14 && \text{where } fbd \geq 0.02L_1 + 0.02L_2 + 2.1 \text{ m} \\
 &&& \geq 0.02L_1 + 0.02L_2 + 6.89 \text{ ft} \\
 h_m &= 1.4 \text{ m (4.6 ft)}
 \end{aligned}$$

for second tier unprotected front bulkheads

$$\begin{aligned}
 c &= 0.5 && \text{where } fbd \leq 0.02L_1 \text{ m (ft)} \\
 &= 0.14 && \text{where } fbd \geq 0.02L_1 + 0.01L_2 + 1.05 \text{ m} \\
 &&& \geq 0.02L_1 + 0.01L_2 + 3.445 \text{ ft} \\
 h_m &= 1.4 \text{ m (4.6 ft)}
 \end{aligned}$$

for second tier side and aft bulkheads

$$\begin{aligned}
 c &= 0.3 && \text{where } fbd \leq 0.02L_1 \text{ m (ft)} \\
 &= 0.14 && \text{where } fbd \geq 0.02L_1 + 0.01L_2 + 1.05 \text{ m} \\
 &&& \geq 0.02L_1 + 0.01L_2 + 3.445 \text{ ft} \\
 h_m &= 1.4 \text{ m (4.6 ft)}
 \end{aligned}$$

for all other bulkheads

$$\begin{aligned}
 c &= 0.14 \\
 h_m &= 1.4 \text{ m (4.6 ft)}
 \end{aligned}$$

Intermediate values of fbd , c and h_m may be obtained by linear interpolation.

- L_1 = length of barge, as defined in 3-1-1/3, but need not be taken greater than 230 m (755 ft)
- L_2 = length of barge, as defined in 3-1-1/3, but is not to be taken less than 75 m (246 ft) and need not be taken greater than 125 m (410 ft)
- fb = the assigned freeboard, in m (ft)
- k = $0.3 + 0.7b_1/B$ but k is not to be taken less than 0.5
- b_1 = breadth of the superstructure or deckhouse, in m (ft), at the location being considered. See 3-2-8/3.1 FIGURE 1 and 3-2-8/3.1 FIGURE 2 below. The distance between vessel's centerline to the deckhouse bulkhead, at that location being considered is taken as $b_1/2$.
- B = breadth of the barge, in m (ft), as defined in 3-1-1/5

FIGURE 1 (2015)

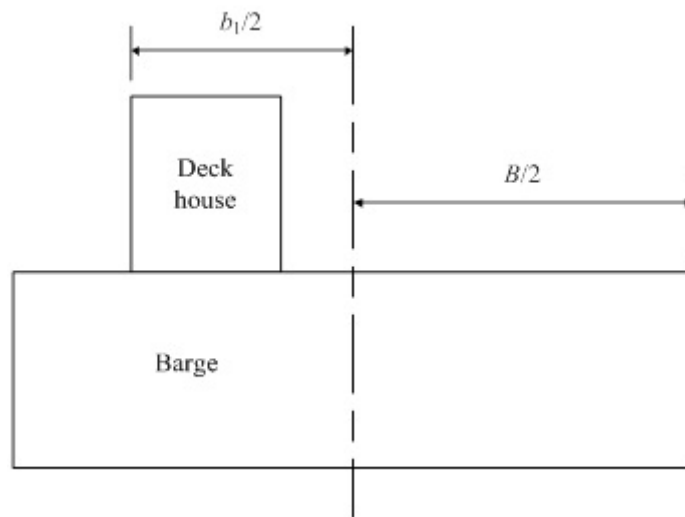
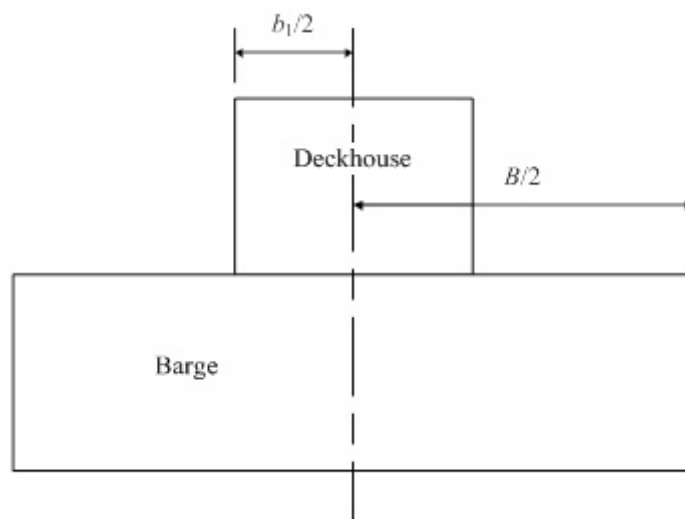


FIGURE 2 (2015)



3.3 Plating

The plating thickness is not to be less than obtained from the following equation:

$$t = 3s\sqrt{h} \quad \text{mm}$$

$$t = s\sqrt{h}/50 \quad \text{in.}$$

but t is not to be less than t_m

where

s = spacing of the stiffeners, in m (ft)

h = design head defined in 3-2-8/3.1

t_m = for lowest tier bulkheads

$$5.0 + 0.01L \quad \text{mm}$$

$$0.2 + 0.00012L \quad \text{in.}$$

= for other tiers

$$4.0 + 0.01L_1 \quad \text{mm}$$

$$0.16 + 0.00012L_1 \quad \text{in.}$$

L = length of barge, as defined in 3-1-1/3, but need not be taken greater than 300 m (984 ft)

L_1 = length of barge, as defined in 3-1-1/3, but is not to be taken less than 100 m (328 ft) nor need not be taken greater than 300 m (984 ft)

3.5 Stiffeners

Each stiffener, in association with the plating to which it is attached, is to have a section modulus SM not less than obtained from the following equation:

$$SM = 3.5sh\ell^2 \quad \text{cm}^3$$

$$SM = 0.00185sh\ell^2 \quad \text{in}^3$$

where

s = spacing of the stiffeners, in m (ft)

h = design head defined in 3-2-8/3.1

ℓ = tween deck height, in m (ft), or in the case of horizontal stiffeners, web spacing, in m (ft)

3.6 Swage Bulkheads (1 July 2020)

Exposed bulkheads in steel superstructures and deckhouses shorter than $0.14L$ in length and whose sides are not in line with the barges's sides may be constructed of swage panels.

Swages are triangular shaped recesses pressed into plates to form stiffeners (see 3-2-8/Figure 3).

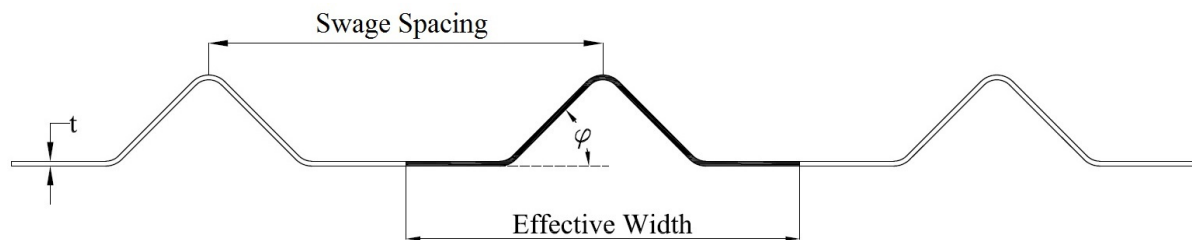
The scantlings of the exposed swage panel bulkheads of superstructures and deckhouses are to be in accordance with the following paragraphs.

The swage panel plating thickness is to satisfy the requirements in 3-2-8/3.3, where s is to be taken as the spacing of swages.

The effective width of the swage (see 3-2-8/Figure 3) is to be taken as the sum of one-half of the spacing on either side of the swage centerline. The section modulus of the swage, including the flat portion of the plates on either side of the swage within the effective width, is to satisfy the requirements in 3-2-8/3.5, where s is to be taken as the effective width of the swage. If the flat plate thickness varies, mean flat plate thickness over the effective width is to be used.

Swages are to be oriented vertically. The swage angle, ϕ , is to be between 40 and 70 degrees.

FIGURE 3
Swage Panel



3.7 End Attachment (1 July 2020)

The upper and lower ends of all lowest tier bulkhead stiffener webs and the 2nd tier unprotected front bulkhead stiffener webs are to be efficiently welded. The end attachments of stiffener webs are to be supported by the deck/beams and clipped or bracketed to adjacent structure as necessary in order to prevent stress concentrations.

The upper and lower edges of swage panels are to be continuously welded to the deck plating. The flat plating of swage panels is to be aligned with deck girders, deck transverses, or bulkheads. The bottom ends of swages of all lowest tier bulkheads and the 2nd tier unprotected front bulkhead are to be adequately supported by underdeck stiffeners, brackets, or carlings to prevent stress concentrations.

Special attention is to be paid to connections between horizontal deck stiffeners, deck girders, or deck transverses and swage panels in order to enable effective load transfer and to minimize stress concentrations.

Large cutouts for doors, windows, pipes, and ventilation ducts are not to be positioned directly across the swages. Appropriate carlings are to be fitted at the edges of such cutouts in order to enable effective load transfer to the adjacent structure of the bulkhead.

The scantlings of swage panels having other types of end connections are to be specially considered.

3.9 Openings in Bulkheads (2013)

All openings in the bulkheads of enclosed superstructures and deckhouses are to be provided with efficient means of closing so that water will not penetrate in any sea conditions. Opening and closing appliances are to be framed and stiffened so that the whole structure is equivalent to the unpierced bulkhead when closed.

3.11 Doors for Access Openings (1 July 2020)

Doors for access openings into enclosed superstructures and deckhouses are to be of steel or other equivalent material, permanently and strongly attached to the bulkhead. Scantlings for door panels and stiffeners or swages are to be obtained from 3-2-8/3.3, 3-2-8/3.5, or 3-2-8/3.6 based on the design head of the bulkhead where the door is located. Minimum thickness requirements in 3-2-8/3.3 or 3-2-8/3.6 for

exposed bulkheads are to be applied to panels of doors located on exposed bulkheads of superstructure and deckhouses at and below Position 2 and to doors located on the exposed front bulkhead at all levels. The doors are to be provided with gaskets and clamping devices, or other equivalent arrangements, permanently attached to the bulkhead or to the doors themselves, and the doors are to be so arranged that they can be operated from both sides of the bulkhead. Doors located above Position 2 (refer to 3-2-9/3) of superstructure and deckhouses are to have strength compatible to adjacent bulkheads and may be of joiner-type construction (e.g., thin gauge steel sheeting surrounding a mineral wool core), provided they are verified to be weathertight to the satisfaction of the attending Surveyor.

Marine doors rated for the same design head as the bulkhead where they are located and which are designed and built to industry standards (the current versions of ASTM F1069, JIS F 2318, and BSI Standards BSMA 39) are considered acceptable as meeting requirements in this Section.

3.13 Sills of Access Openings (2022)

The height of the sills of access openings in bulkheads of enclosed superstructures and deckhouses located on and below Position 2 is to be at least 380 mm (15 in.) above the deck. See also 3-2-9/23.7.

5 Portlights

5.1 Construction (2013)

Portlights to spaces below the freeboard deck or to spaces within enclosed superstructures and deckhouses are to be fitted with efficient hinged inside deadlights arranged so that they can be effectively closed and secured watertight. The portlights, together with their glasses and deadlights, are to comply with a recognized standard. They are to have strong frames (other than cast iron) and opening-type portlights are to have non-corrosive hinge pins.

5.3 Location

No portlight is to be fitted in a position with its sill below a line drawn parallel to the freeboard deck at side and having its lowest point 2.5% of the breadth of the barge above the load waterline, or 500 mm (19.5 in.), whichever is the greater distance.

7 Deck Plating of Superstructures and Deckhouses

7.1 General (2017)

Decks of superstructures and deckhouses having lengths greater than $0.14L$ and located within the amidship $0.4L$ are to comply with the requirements of 3-2-3/1.

7.3 Exposed Deck Plating of Decks on the First and Second Tiers above the Freeboard Deck (2002)

The deck plating thickness is not to be less than obtained from the following equations. The required thickness is not to be less than 5.0 mm (0.20 in.).

$$t = 0.009s + 0.8 \text{ mm} \quad \text{for } s \leq 685 \text{ mm}$$

$$t = 0.0039s + 4.3 \text{ mm} \quad \text{for } s > 685 \text{ mm}$$

$$t = 0.009s + 0.032 \text{ in.} \quad \text{for } s \leq 27 \text{ in.}$$

$$t = 0.0039s + 0.17 \text{ in.} \quad \text{for } s > 27 \text{ in.}$$

where

t = deck thickness, in mm (in.)

s = spacing of deck beams, in mm (in.)

7.5 Exposed Deck Plating on Third and Higher Tiers above the Freeboard Deck and Enclosed Decks within Deckhouses at all Levels (2002)

The deck plating thickness is not to be less than obtained from the following equation. The required thickness is not to be less than 4.5 mm (0.18 in.).

$$t = 0.0058s + 1.0 \text{ mm}$$

$$t = 0.0058s + 0.04 \text{ in.}$$

where

t = the deck thickness, in mm (in.)

s = the spacing of deck beams, in mm (in.)

7.7 Forecastle Deck

Forecastle decks are to comply with the requirements in 3-2-3/1.1.

9 Deck Beams and Girders of Superstructures and Deckhouses

9.1 General

Where longitudinal beams are adopted on decks considered to be strength decks, as defined in 3-2-8/7.1, they are to comply with 5-1-1/3 in association with a design head h obtained from 3-2-8/9.3 corresponding to the appropriate location.

9.3 Deck Beams and Girders

Each deck beam or girder, in association with the plating to which it is attached, is to have section modulus SM not less than obtained from the following equation:

$$SM = 7.8chs\ell^2 \text{ cm}^3$$

$$SM = 0.0041chs\ell^2 \text{ in}^3$$

where

c = 0.585

s = spacing of beams, in m (ft), or in the case of girders, spacing between girders, in m (ft)

ℓ = unsupported span of beams or girders, in m (ft)

h = the value of h to be used in the above equation is to be obtained from the following:

- i)** on the first tier level above the freeboard deck and located forward of $0.05L$ from the forward perpendicular FP:
 $h = (L/75) + 0.61$ meters
 $h = (L/75) + 2.0$ feet
where L is the length of barge, in m (ft)
- ii)** on the first tier located aft of $0.16L$ from the FP:
 $h = (L/70) + 0.305$ meters
 $h = (L/70) + 1.0$ feet
where L is the length of the barge, in m (ft), but need not be taken greater than 117 meters (385 feet).
- iii)** on the first tier located between $0.05L$ and $0.16L$ from the FP, h is obtained by linear interpolation between i) and ii):
- iv)** on the second tier located forward of $0.05L$ from the FP:
 $h = (L/180) + 0.57$ meters
 $h = (L/180) + 1.87$ feet
where L is the length of the barge, in m (ft).
- v)** on the second tier located aft of $0.16L$ from the FP:
 $h = (L/115) + 0.23$ meters
 $h = (L/115) + 0.75$ feet
where L is the length of the barge, in m (ft), but need not be taken greater than 109 m (357.6 ft).
- vi)** on the second tier located between $0.05L$ and $0.16L$ from the FP, h is obtained by linear interpolation between iv) and v).
- vii)** on exposed third and higher tiers and on decks within deckhouses at all levels:
 $h = 0.46$ meters
 $h = 1.5$ feet

PART 3

CHAPTER 2 Hull Structures and Arrangements

SECTION 9 Protection of Deck Openings

1 General (2020)

All openings in decks are to be so framed as to provide efficient support with beams reinforced as necessary. Beams which are cut for hatchways are to be properly supported. Openings in the deck are to be located as far as practicable from the gunwale, but in no case are they to be less than 150 mm (6 in.) from the side shell. Circular single central bolt manhole covers are allowed in the deck in way of void spaces or ballast tanks only. Their diameter should not exceed 500 mm (19.7 in.).

For barges receiving a load line assignment, the design pressures, allowable deflections and minimum thicknesses for cargo hold hatch covers are to be as given in Regulations 15 and 16 of the International Convention on Load Lines, 1966 and Protocol of 1988, as amended in 2003, where those requirements are more stringent than those given below. Also see IACS Unified Interpretations LL6 and LL66.

3 Position of Deck Openings

For the purpose of these Rules, two positions of deck openings are defined as follows:

- Position 1* Upon exposed freeboard deck; and upon superstructure decks situated forward of a point located a quarter of the barge's length from the forward perpendicular.
- Position 2* Upon exposed superstructure decks situated abaft $0.25L$ from the forward perpendicular.

5 Hatchway Coamings

5.1 Height of Coamings (2020)

The height of coamings of hatchways secured weathertight by tarpaulins and battening devices is to be at least as follows:

600 mm (23.5 in.) if in Position 1

450 mm (17.5 in.) if in Position 2

Where hatch covers are made of steel or other equivalent material and made tight by means of gaskets and clamping devices, these heights may be reduced, or the coamings omitted entirely, provided that the safety of the barge is not thereby impaired in any sea condition or if the hatches are only opened while in port.

5.3 Coaming Plates

Coaming plates are not to be less than 8 mm (0.32 in.) thick in barges not exceeding 30.5 meters (100 feet) length and 11 mm (0.44 in.) thick in barges of 76 meters (250 feet) length and above. The thickness at intermediate lengths are obtained by linear interpolation.

5.5 Cargo Hold Hatch Coaming Stiffening (2020)

Except as noted below, coaming stiffening is to comply with the following:

- i) Horizontal stiffeners are to be fitted on coamings in Position 1. They are to be not more than 254 mm (10 in.) below the upper edge of the coaming. *
- ii) The breadth of the stiffeners is not to be less than 100 mm (4 in.) in barges not exceeding 30.5 meters (100 feet) in length, nor less than 175 mm (7 in.) in barges of 76 meters (250 feet) length and above. The minimum breadths for barges of intermediate lengths are to be obtained by linear interpolation. *
- iii) Efficient brackets or stays are to be fitted from the stiffeners to the deck at intervals of not more than 3 meters (10 feet). *
- iv) All exposed coamings in Position 2 which are 760 mm (30 in.) or more in height are to be similarly supported. *
- v) Where the height of any exposed coaming exceeds 915 mm (36 in.), the arrangement of the stiffeners and brackets or stays is to be such as to provide equivalent support. *
- vi) Where end coamings are protected, the arrangement of the stiffeners and brackets or stays may be modified.

Note:

* Small hatches as specified in 3-2-9/18 need not comply with these requirements. (See the strength requirements for small hatches in 3-2-9/18.3).

Where chocks are provided on the coaming to limit the horizontal movement of hatch covers, the strength of the coaming and deck structure is to be adequate to withstand the load on these chocks. Similar consideration is to be given to pads supporting the weight from hatch covers.

5.7 Protection of Coamings

Heavy convex moldings are to be fitted at the upper edges of all exposed coamings, and the lower edges are to be flanged or provided with other suitable protection against damage.

5.9 Continuous Longitudinal Hatch Coamings

Strength deck longitudinal hatch coamings of length greater than $0.14L$ are to be effectively supported by underdeck longitudinal bulkheads or deep girders and they are, in general, to be longitudinally stiffened. The coaming thickness is to be not less than required by 3-2-3/1.1.2(b), and the longitudinal stiffeners are not to be less than required by 5-1-1/3.1 for strength deck longitudinal beams; where s is the spacing of the stiffeners in m (ft), ℓ is the distance between coaming brackets in m (ft) and h is as follows:

$$\begin{aligned}
 h &= 0.02L + 0.46 \text{ meters} && \text{for } L < 91.5 \text{ m} \\
 &= 2.29 \text{ meters} && \text{for } L \geq 91.5 \text{ m} \\
 h &= 0.02L + 1.5 \text{ feet} && \text{for } L < 300 \text{ ft} \\
 &= 7.5 \text{ feet} && \text{for } L \geq 300 \text{ ft}
 \end{aligned}$$

Special consideration will be given to the coaming scantlings where adequate buckling strength is shown to be otherwise provided.

7 Cargo Hold Steel Hatch Covers (2020)

7.1 Strength of Covers

7.1.1 Plating

The thickness of the plating of steel hatch covers is not to be less than 0.01s or 6 mm (0.24 in.), if that be greater.

7.1.2 Webs and Stiffeners

The scantlings of steel cover primary and secondary webs or stiffeners are to have a section modulus, SM , and a moment of inertia, I , in association with the plating to which they are attached, not less than obtained from the following equations:

$$SM = 530ps\ell^2/U \text{ cm}^3 \quad \text{SI and MKS Units}$$

$$= 6.375ps\ell^2/U \text{ in}^3 \quad \text{US Units}$$

$$I = 2.25ps\ell^3 \text{ cm}^4 \quad \text{SI Units}$$

$$= 22ps\ell^3 \text{ cm}^4 \quad \text{MKS Units}$$

$$= 22.32ps\ell^3 \cdot 10^{-6} \text{ in}^4 \quad \text{US Units}$$

where

s = spacing of the webs or stiffeners, in meters (feet)

ℓ = span of the webs or stiffeners, in meters (feet)

U = minimum tensile strength of the steel, in N/mm² (kgf/mm², psi), as defined in 3-2-1/11.3

p = uniformly distributed loading on the hatch cover, in kN/m² (tf/m², lbf/ft²)

i) for Position 1 covers, p is not to be less than:

$$p = 0.09676L + 7.484 \quad \text{for } L < 100 \text{ m}$$

$$= 0.00986L + 0.764$$

$$p = 17.16 \text{ kN/m}^2 \quad \text{for } L \geq 100 \text{ m}$$

$$= (1.75 \text{ tf/m}^2)$$

$$p = 0.6143L + 156.5 \text{ lbf/ft}^2 \quad \text{for } L < 328 \text{ ft}$$

$$p = 358 \text{ lbf/ft}^2 \quad \text{for } L \geq 328 \text{ ft}$$

ii) for Position 2 covers, p is not to be less than:

$$p = 0.071L + 5.65 \text{ kN/m}^2 \quad \text{for } L < 100 \text{ m}$$

$$= (0.00724L + 0.576 \text{ tf/m}^2)$$

$$p = 12.75 \text{ kN/m}^2 \quad \text{for } L \geq 100 \text{ m}$$

$$= (1.3 \text{ tf/m}^2)$$

$$p = 0.45L + 118.4 \text{ lbf/ft}^2 \quad \text{for } L < 328 \text{ ft}$$

$$p = 266 \text{ lbf/ft}^2 \quad \text{for } L \geq 328 \text{ ft}$$

L = length of the barge as defined in 3-1-1/3, but is not to be taken less than 24 m (79 ft)

Where the webs or stiffeners do not maintain a constant cross-section over their span ℓ , refer to 3-2-9/11.

7.1.3 Container Loading

Where it is intended to carry containers on the covers, the exact locations of the container pads and the maximum total static load on the pads are to be indicated on the plans. Where the pads are not in line with the supporting structures, headers are to be provided to transmit the loads to these members.

In addition to complying with 3-2-9/7.1.2 or 3-2-9/15.3, as appropriate, each member intended to support containers is to have a section modulus SM not less than obtained from the following equation:

$$SM = MQ/f \text{ cm}^3(\text{in}^3)$$

where

- M = maximum bending moment due to maximum static container loading, in kN-cm (tf-cm, Ltf-in)
- f = permissible maximum bending stress, not to exceed 10.81 kN/cm² (1.1 tf/cm², 7 Ltf/in²)
- Q = 1.0 for ordinary-strength steel
 = as defined in 3-2-1/11.3 for higher-strength steel

In determining the maximum bending moments, members are to be considered simply supported.

The net sectional area, A , of the web of the member is to be not less than obtained from the following equation:

$$A = F/q \text{ cm}^2(\text{in}^2)$$

where

- F = shearing force at the point under consideration, in kN (tf, Ltf)
- q = allowable average shear stress in the web, not to exceed 8 kN/cm² (0.816 tf/cm², 5.18 Ltf/in²)

7.1.4 Flush Hatch Covers

Where flush hatch covers are fitted on the freeboard deck within the forward one-fourth length, and the barge is assigned a freeboard less than Type-B under the International Convention of Load Lines 1966, the assumed loads are to be increased 15% over those indicated in 3-2-9/7.1.2.

7.1.5 Other Materials

The strength and stiffness of covers made of materials other than steel is to be equivalent to those of steel and is to be subject to special consideration.

9 Cargo Hold Hatch Beams and Wood or Pontoon Covers (2020)

9.1 Portable Hatch Beams

9.1.1 Strength

The section modulus, SM , and moment of inertia, I , of portable web plate beams, stiffened at their upper and lower edges by continuous flat bars, is to be not less than obtained from the following equations:

$$\begin{aligned}
 SM &= 625ps\ell^2/U \text{ cm}^3 && \text{SI and MKS Units} \\
 &= 7.5ps\ell^2/U \text{ in}^3 && \text{US Units} \\
 I &= 2.86ps\ell^3 \text{ cm}^4 && \text{SI Units} \\
 &= 28ps\ell^3 \text{ cm}^4 && \text{MKS Units} \\
 &= 28.41ps\ell^3 \cdot 10^{-6} \text{ in}^4 && \text{US Units}
 \end{aligned}$$

where

- s = spacing of the beams, in meters (feet)
- ℓ = span of the beams, in meters (feet)
- U = minimum tensile strength of the steel, in N/mm² (kgf/mm², lbf/in²)
- p = as defined in 3-2-9/7.1.2

Where the portable beams do not maintain constant cross-section over their span ℓ , refer to 3-2-9/11.

9.1.2

The ends of the web plates are to be doubled for a distance of at least 180 mm (7 in.) from the end.

9.1.3

Beams which support the ends of wood or steel pontoon covers are to have a vertical flat bar at least 50 mm (2 in) in depth on the upper flat bar of the beam. The bearing surface for hatch covers is not to be less than 65 mm (2.5 in.) in width.

9.1.4

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 in position when the hatchway is closed. The bearing surface is not to be less than 75 mm (3 in.) in width measured along the axis of the beam unless the carriers be of an interlocking type with the beam ends. Carriers for beams are to overlap the hatchway coaming angles or the coamings are to be fitted with stiffeners or external brackets in way of each beam.

9.3 Wood Hatch Covers

Wood hatch covers are to have a finished thickness of not less than 60 mm (2.375 in.) in association with an unsupported span of 1.5 meters (5 feet) and not less than 82 mm (3.25 in.) with an unsupported span of 2 meters (6.5 feet). The thickness for intermediate spans is to be obtained by linear interpolation. Where the uniformly distributed loading on the cover exceeds 18.39 kN/m² (1.875 tf/m², 384 lbf/ft²), the thickness of the wood covers, as obtained above, is to be increased by the factor:

$$1 + 0.165(p - 18.39)/7.07 \quad \text{SI units}$$

$$1 + 0.165(p - 1.875)/0.721 \quad \text{MKS units}$$

$$1 + 0.05(p - 384)/45 \quad \text{US units}$$

where

$$p = \text{uniformly distributed loading on the cover, in kN/m}^2 \text{ (tf/m}^2 \text{, lbf/ft}^2\text{)}$$

9.5 Pontoon Covers

Where steel pontoon covers are employed in lieu of portable hatch beams and wood covers, the steel pontoon covers are to satisfy the strength requirements of portable beams as given in 3-2-9/9.1.1.

The plating forming the top of the covers is to be not less in thickness than required by 3-2-9/7.1.1.

The strength and stiffness of pontoon covers made of materials other than steel are to be equivalent to those of steel and will be subject to special consideration.

11 Cargo Hold Hatch Beams of Variable Cross-Section (2020)

11.1

Where hatch beams are of the type shown by 3-2-9/11.1 FIGURE 1 with non-uniform cross-section over the span ℓ of the member, the required section modulus SM at mid-span is obtained by increasing the SM required by 3-2-9/7.1.2 or 3-2-9/9.1.1, as appropriate, by a factor K expressed by:

$$K = 1 + \frac{3.2\alpha - \gamma - 0.8}{7\gamma + 0.4} \quad \text{but not } < 1.0$$

And the required moment of inertia (I) at mid-span is obtained by increasing the I required by 3-2-9/7.1.2 or 3-2-9/9.1.1 as appropriate, by a factor C expressed by:

$$C = 1 + 8\alpha^3 \frac{1 - \beta}{0.2 + 3\sqrt{\beta}} \quad \text{but not } < 1.0$$

where

$$\alpha = \ell_1 / \ell$$

$$\gamma = SM_1 / SM_o$$

$$\beta = I_1 / I_o$$

$$\ell_1 = \text{as indicated in 3-2-9/11.1 FIGURE 1}$$

$$\ell = \text{span of beam between supports, see 3-2-9/11.1 FIGURE 1}$$

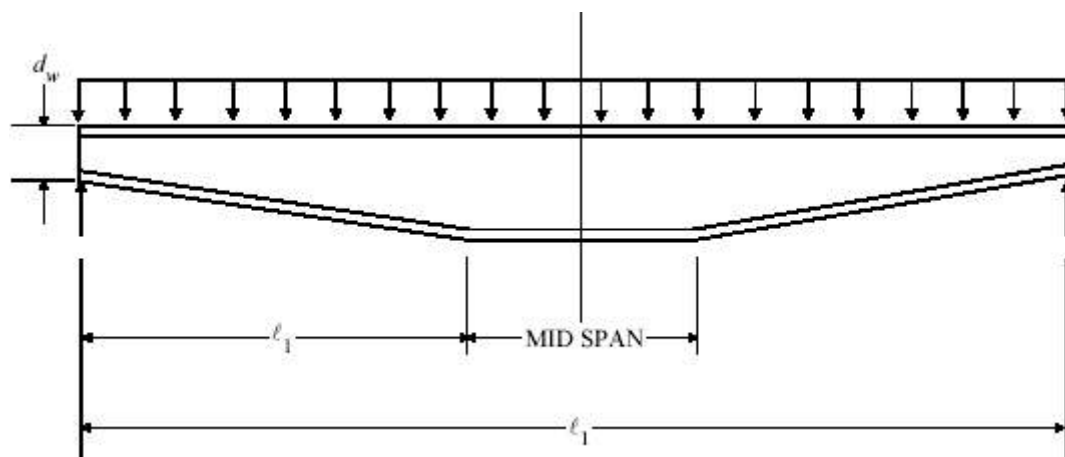
$$SM_1 = \text{section modulus of beam at supports}$$

$$SM_o = \text{section modulus of beam at mid-span}$$

$$I_1 = \text{moment of inertia of beam at supports}$$

$$I_o = \text{moment of inertia of beam at mid-span}$$

FIGURE 1



11.3

The overall depth d_w of the beam at the supports, measured as shown in 3-2-9/11.1 FIGURE 1, is not to be less than 150 mm (6 in.), and the net sectional area A of the web of the beam, at the supports, is not to be less than:

$$\begin{aligned}
 A &= 0.058ps\ell \text{ cm}^2 && \text{SI units} \\
 &= 0.5688ps\ell \text{ cm}^2 && \text{MKS units} \\
 &= 0.00004ps\ell \text{ in}^2 && \text{US units}
 \end{aligned}$$

where

$$\begin{aligned}
 p &= \text{as defined in 3-2-9/7.1.2, in kN/m}^2 \text{ (tf/m}^2 \text{, lbf/ft}^2\text{)} \\
 s &= \text{spacing of the beams, in meters (feet)} \\
 \ell &= \text{as defined in 3-2-9/11.1, in meters (feet)}
 \end{aligned}$$

13 Hatch Cover Securing Arrangements

13.1 Steel Covers - Clamped and Gasketed

The means for securing and maintaining weathertightness are to be such 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 bar (2.1 kgf/cm², 30 lbf/in²) at the time of construction and, if considered necessary, at subsequent surveys.

Special consideration will be given to the omission of gaskets on covers on hatchways in decks located above Position 2 where it can be shown that the closing arrangements are weathertight.

13.3 Portable Covers –Tarpaulins and Battening Devices

13.3.1 Tarpaulins

At least two tarpaulins, thoroughly waterproofed and of ample strength, are to be provided for each exposed hatchway in Positions 1 and 2. The material is to be guaranteed free from jute and is to be of an approved type. Synthetic fabrics which have been demonstrated to be equivalent will be specially approved.

13.3.2 Cleats

Cleats are to be set to fit the taper of the wedges. They are to be at least 65 mm (2.5 in.) wide and spaced not more than 600 mm (23.5 in.) center to center. The cleats along each side or end are to be not more than 150 mm (6 in.) from the hatch corners.

13.3.3 Wedges

Wedges are to be of tough wood. They are to have a taper of not more than 1 in 6 and not less than 13 mm (0.50 in.) thick at the toes.

13.3.4 Battening Bars

Battening bars are to be provided for properly securing the tarpaulins. They are to have a width of 64 mm (2.5 in.) and a thickness of not less than 9.5 mm (0.375 in.).

13.3.5 Security of Hatchway Covers

For all hatchways in Positions 1 and 2, steel bars or other equivalent means are to be provided in order to efficiently and independently secure each section of hatchway covers after the tarpaulins are battened down. Hatchway covers of more than 1.5 m (5 ft) in length are to be secured by at least two such securing appliances.

15 Hatch Covers in Lower Decks or Within Fully Enclosed Superstructures

15.1 General

The following scantlings are intended for barges with conventional type covers. Covers of special type are to be specially considered.

15.3 Steel Covers

Where steel covers are fitted, the thickness of the plating is to be not less than required for platform decks in enclosed cargo spaces as obtained from 3-2-3/1.1.4. A stiffening bar is to be fitted around the edges as required to provide the necessary rigidity to permit the covers being handled without deformation. The effective depth of the framework is normally to be not less than 4% of its unsupported length. Each stiffener in association with the plating to which it is attached is to have a section modulus SM not less than that obtained from the following equation:

$$\begin{aligned}
 SM &= 441ps\ell^2/U \text{ cm}^3 && \text{SI units} \\
 &= 444ps\ell^2/U \text{ cm}^3 && \text{MKS units} \\
 &= 5.285ps\ell^2/U \text{ in}^3 && \text{US units}
 \end{aligned}$$

where

$$\begin{aligned}
 p &= \text{uniformly distributed loading on the hatch cover, in kN/m}^2 \text{ (tf/m}^2, \text{ lbf/ft}^2\text{), but is to be not less than the tween deck height, in meters (feet), multiplied by 7.07 (0.721, 45).} \\
 s &= \text{spacing of the stiffeners, in meters (feet)} \\
 \ell &= \text{length of the stiffeners, in meters (feet)} \\
 U &= \text{minimum tensile strength of the steel, in N/mm}^2 \text{ (kgf/mm}^2, \text{ lbf/in}^2\text{)}
 \end{aligned}$$

Where provision is to be made for the operation or stowage of vehicles having rubber tires, the thickness of the hatch cover plating is to be not less than obtained from 3-2-3/17, except that the thickness of plate panels adjacent to the edges of the covers is to be at least 15% greater than obtained from 3-2-3/17.

Where it is intended to carry containers on the covers, the requirements of 3-2-9/7.1.3 are to be satisfied.

15.5 Portable Beams and Wood or Pontoon Covers

The section modulus SM of portable beams or steel pontoon covers is not to be less than that obtained from the following equation:

$$\begin{aligned}
 SM &= 521ps\ell^2/U \quad \text{cm}^3 && \text{SI units} \\
 &= 524ps\ell^2/U \quad \text{cm}^3 && \text{MKS units} \\
 &= 6.25ps\ell^2/U \quad \text{in}^3 && \text{US units}
 \end{aligned}$$

where

- p = uniformly distributed loading on the hatch cover, in kN/m² (tf/m², lbf/ft²), but is to be not less than the tween deck height, in meters (feet), multiplied by 7.07 (0.721, 45).
- s = spacing of the beams, in meters (feet)
- ℓ = length of the beams, in meters (feet)
- U = minimum tensile strength of the steel, in N/mm² (kgf/mm², lbf/in²)

Wood covers are to be in compliance with 3-2-9/9.3.

Where steel pontoon covers are employed in lieu of wood covers, the plating forming the top of the covers is not be less in thickness than required by 3-2-3/1.1.4.

17 Tank Barge Access Hatchways (2020)

Exposed hatchways in Position 1 or 2 are to be of sufficient size to provide access and ventilation. They are to be fitted to each tank and are to have substantial watertight metal covers. The thicknesses of the covers are not to be less than that required by 3-2-3/1.1.3.

18 Small Hatches on the Exposed Fore Deck (2011)

18.1 Application (2016)

This subsection is applicable to barges with length, L , (as defined in 3-1-1/3) of 80 meters (263 feet) or more.

The requirements of this subsection apply to all small hatches [opening normally 2.5 m² (27 ft²) or less] located on the exposed fore deck within the forward $0.25L$, where the deck in way of the hatch is less than $0.1L$ or 22 m (72.2 ft) above the summer load line, whichever is less.

Hatches designed for emergency escape need not comply with 3-2-9/18.5.i, 3-2-9/18.5.ii, the third paragraph of 3-2-9/18.7 and 3-2-9/18.9.

18.3 Strength

For small rectangular steel hatch covers, the plate thickness, stiffener arrangement and scantlings are to be in accordance with 3-2-9/18 TABLE 1 and 3-2-9/18 FIGURE 2. Stiffeners, where fitted, are to be aligned with the metal-to-metal contact points required in 3-2-9/18.7 (see also 3-2-9/18 FIGURE 2). Primary stiffeners are to be continuous. All stiffeners are to be welded to the inner edge stiffener (see 3-2-9/18 FIGURE 3).

The upper edge of the hatchway coaming is to be suitably reinforced by a horizontal section, normally not more than 170 to 190 mm (6.9 to 7.5 in.) from the upper edge of the coaming.

For small hatch covers of circular or similar shape, the cover plate thickness and reinforcement is to provide strength and stiffness equivalent to the requirements for small rectangular hatches.

For small hatch covers constructed of materials other than steel, the required scantlings are to provide strength and stiffness equivalent to 235 N/mm² (24 kgf/mm², 34,000 psi) yield strength steel.

18.5 Primary Securing Devices

The primary securing devices are to be such that their hatch covers can be secured in place and made weathertight by means of a mechanism employing any one of the following methods:

- i) Butterfly nuts tightening onto forks (clamps), or
- ii) Quick acting cleats, or
- iii) A central locking device.

Dogs (twist tightening handles) with wedges are not acceptable.

18.7 Requirements for Primary Securing

The hatch cover is to be fitted with a gasket of elastic material. This is to be designed to allow a metal-to-metal contact at a designed compression and to prevent over compression of the gasket by green sea forces that may cause the securing devices to be loosened or dislodged. The metal-to-metal contacts are to be arranged close to each securing device, in accordance with 3-2-9/18 FIGURE 2, and of sufficient capacity to withstand the bearing force.

The primary securing method is to be designed and manufactured such that the designed compression pressure is achieved by one person without the need of any tools.

For a primary securing method using butterfly nuts, the forks (clamps) are to be of robust design. They are to be designed to minimize the risk of butterfly nuts being dislodged while in use, by means of curving the forks upward and a raised surface on the free end, or a similar method. The plate thickness of unstiffened steel forks is not to be less than 16 mm ($\frac{5}{8}$ in.). An example arrangement is shown in 3-2-9/18 FIGURE 3.

For small hatch covers located on the exposed deck forward of the fore-most cargo hatch, the hinges are to be fitted such that the predominant direction of green sea will cause the cover to close, which means that the hinges are normally to be located on the fore edge.

On small hatches located between the main hatches, for example, between Nos. 1 and 2, the hinges are to be placed on the fore edge or outboard edge, whichever is practicable for protection from green water in beam sea and bow quartering conditions.

18.9 Secondary Devices

Small hatches on the fore deck are to be fitted with an independent secondary securing device, e.g., by means of a sliding bolt, a hasp or a backing bar of slack fit, which is capable of keeping the hatch cover in place even in the event that the primary securing device became loosened or dislodged. It is to be fitted on the side opposite to the hatch cover hinges.

TABLE 1
Scantlings for Small Steel Hatch Covers on the Fore Deck (2011)

<i>Nominal Size (mm x mm)</i>	<i>Cover Plate Thickness (mm)</i>	<i>Primary Stiffeners</i>	<i>Secondary Stiffeners</i>
		<i>Flat Bar (mm x mm); number</i>	
630 x 630	8	---	---
630 x 830	8	100 x 8; 1	---
830 x 630	8	100 x 8; 1	---
830 x 830	8	100 x 10; 1	---
1030 x 1030	8	120 x 12; 1	80 x 8; 2
1330 x 1330	8	150 x 12; 2	100 x 10; 2

FIGURE 2
Arrangement of Stiffeners (2011)

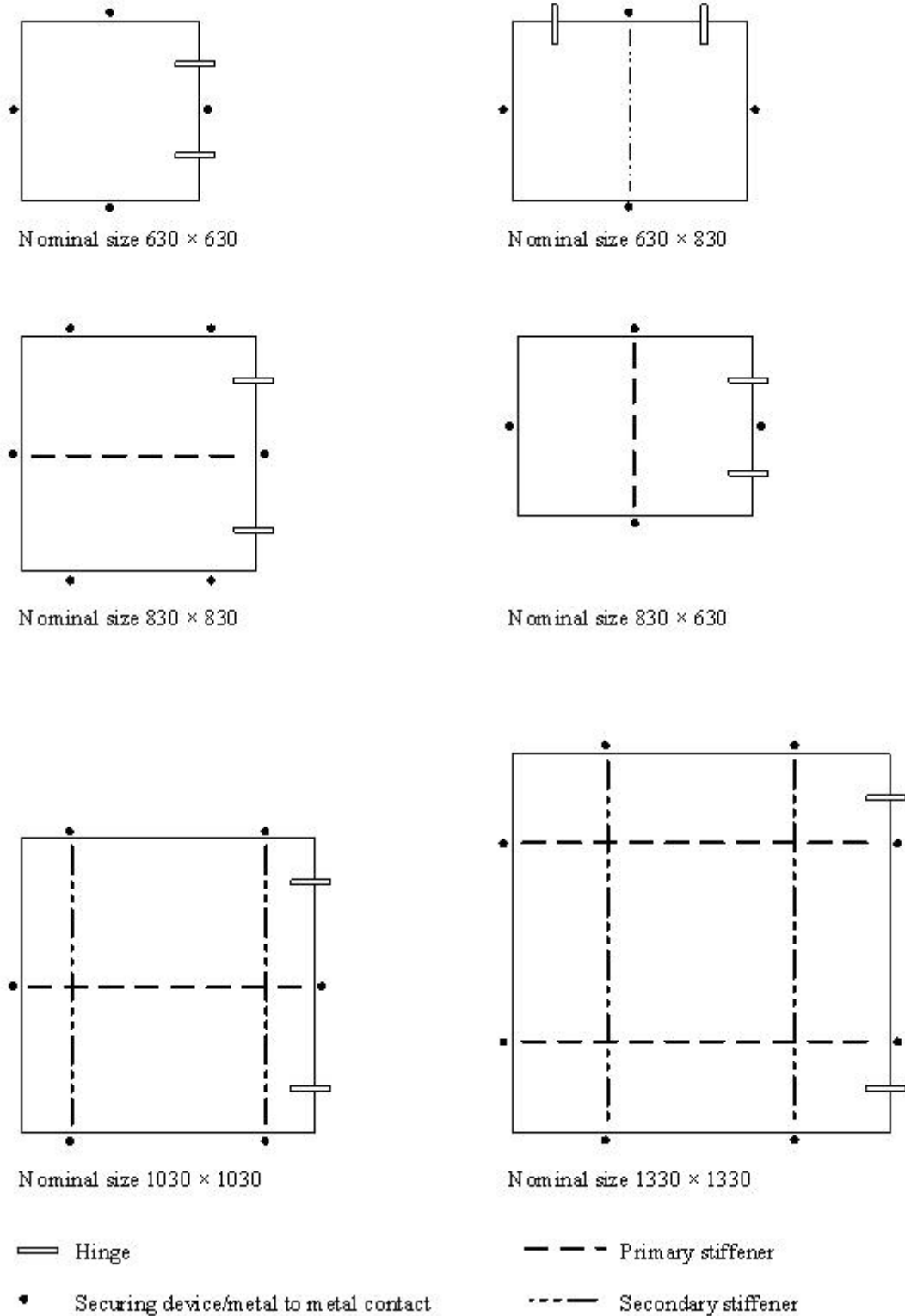
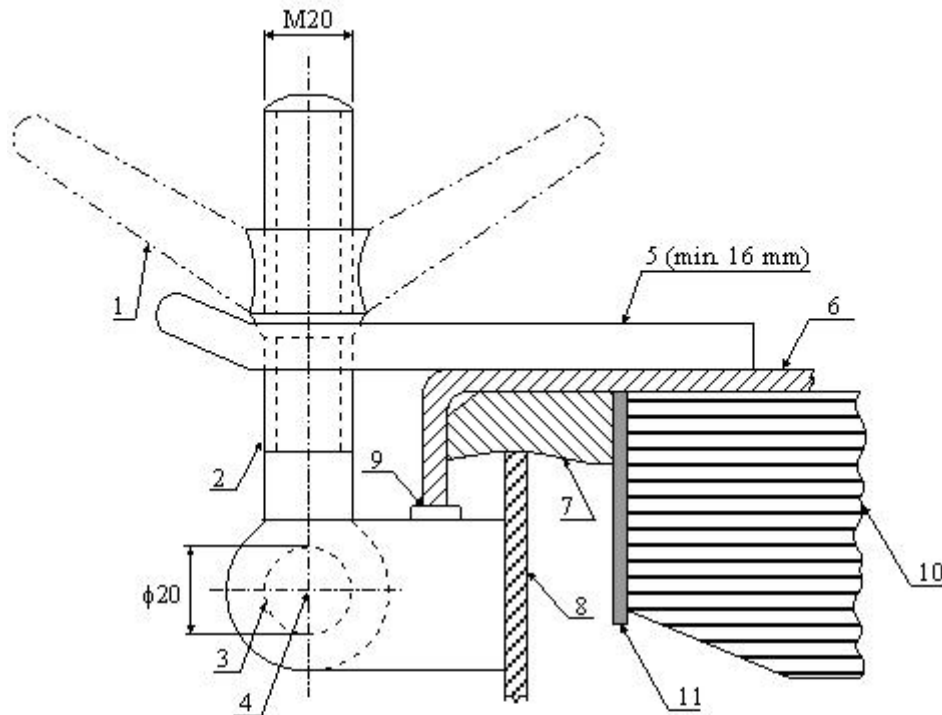


FIGURE 3
Example of Primary Securing Method (2011)



- (Note: Dimensions in millimeters)
- 1: butterfly nut
 - 2: bolt
 - 3: pin
 - 4: center of pin
 - 5: fork (clamp) plate
 - 6: hatch cover
 - 7: gasket
 - 8: hatch coaming
 - 9: bearing pad welded on the bracket of a toggle bolt for metal to metal contact
 - 10: stiffener
 - 11: inner edge stiffener

19 Hatchways within Open Superstructures

Hatchways within open superstructures are to be considered as exposed.

21 Hatchways within Deckhouses

Hatchways within deckhouses are to have coamings and closing arrangements as required in relation to the protection afforded by the deckhouse from the standpoint of its construction and the means provided for the closing of all openings into the house.

23 Miscellaneous Openings in Freeboard and Superstructure Deck

23.1 Manholes and Scuttles

Manholes and flush scuttles in Position 1 or 2 within superstructures other than enclosed superstructures are to be closed by substantial covers capable of being made watertight. Unless secured by closely spaced bolts, the covers are to be permanently attached.

23.3 Other Openings

Openings in freeboard decks other than hatchways, manholes and flush scuttles are to be protected by an enclosed superstructure, or by a deckhouse or companionway of equivalent strength and weathertightness. Any such opening in an exposed superstructure deck or in the top of a deckhouse on the freeboard deck which gives access to a space below the freeboard deck or a space within an enclosed superstructure is to be protected by an efficient deckhouse or companionway. Doorways in such deckhouses or companionways are to be fitted with substantial steel weathertight doors.

23.5 Escape Opening

The closing appliances of escape openings are to be readily operable from each side.

23.7 Companionway Sills

In Position 1, the height above the deck of sills to the doorways in companionways is to be at least 600 mm (23.5 in.). In Position 2, they are to be at least 380 mm (15 in.).



PART 3

CHAPTER 2

Hull Structures and Arrangements

SECTION 10

Bulwarks, Rails and Ventilators

1 Bulwarks and Guard Rails

1.1 Unmanned Barges

Bulwarks or guard rails are not required as a condition of classification on barges intended to be unmanned while at sea.

1.3 Height (2017)

The height of bulwarks and guard rails on exposed parts of freeboard and superstructure decks, at the boundary of first tier deckhouses and at the ends of superstructures is to be at least 1 m (39.5 in.) from the deck. Where this height would interfere with the normal operation of the barge, a lesser height may be approved if adequate protection is provided. Where approval of a lower height is requested, justifying information is to be submitted.

1.5 Strength of Bulwarks

Bulwarks are to be of ample strength in proportion to their height and efficiently stiffened at the upper edge. Bulwark plating on freeboard decks is not to be less than 6.5 mm (0.25 in.) in thickness. The bulwark plating is to be kept clear of the sheer strake and the lower edge effectively stiffened. Bulwarks are to be supported by efficient stays. Those on freeboard decks are to have stays spaced not more than 1.8 m (6 ft) apart. The stays are to be formed of plate and angle or built-up tee sections and are to be efficiently attached to the bulwark and deck plating. Where it is intended to carry timber deck cargoes, the bulwark stays are to be not over 1.5 m (5 ft) apart and have increased attachment to deck and bulwark. Gangways and other openings in bulwarks are to be kept well away from breaks of superstructures, and heavy plates are to be fitted in way of fairleads.

1.7 Spacing of Guard Rails

The opening below the lowest course of the guard rails is not to exceed 230 mm (9 in.). The other courses are to be not more than 380 mm (15 in.) apart.

1.9 Guard Rail Construction

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.

1.11 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. In the case of barges with rounded gunwales, the guard rail stanchions are to be placed on the flat of the deck.

1.13 Portable Rails and Stanchions (2020)

Wire ropes or chains 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.

Refer to 3-2-17/2.5 FIGURE 2 and 3-2-17/2.5 FIGURE 3 of the *Marine Vessel Rules*.

3 Freeing Ports

3.1 Basic Area

Where bulwarks on the weather portions of freeboard or superstructure decks form wells, ample provision is to be made for rapidly freeing the decks of water and for draining them. Except as provided in 3-2-10/3.3 and 3-2-10/3.5, the minimum freeing-port area A on each side of the barge for each well on the freeboard deck is to be obtained from the following equations in cases where the sheer in way of the well is standard or greater than standard*. The minimum area for each well on superstructure decks is to be one-half of the area obtained from the following equation:

Where the length of bulwark ℓ in the well is 20 meters (66 feet) or less:

$$A = 0.7 + 0.035\ell \text{ m}^2$$

$$A = 7.6 + 0.115\ell \text{ ft}^2$$

Where ℓ exceeds 20 meters (66 feet):

$$A = 0.07\ell \text{ m}^2$$

$$A = 0.23\ell \text{ ft}^2$$

In no case need ℓ be taken as greater than $0.7L$, where L is the length of the barge as defined in 3-1-1/3. If the bulwark is more than 1.2 meters (3.9 feet) in average height, the required area is to be increased by 0.004 square meters per meter (0.04 sq. foot per foot) of length of well for each 0.1 meter (1 foot) difference in height. If the bulwark is less than 0.9 meters (3 feet) in average height, the required area may be decreased by 0.004 square meters per meter (0.04 sq. foot per foot) of length of well for each 0.1 meter (1 foot) difference in height.

Note:

* Standard sheer as defined in the International Convention on Load Lines, 1966.

3.3 Barges with Less than Standard Sheer

In barges with no sheer, the calculated area is to be increased by 50%. Where the sheer is less than the standard, the percentage is to be obtained by interpolation.

3.5 Trunks

Where a barge is fitted with a trunk, and open rails are not fitted on weather parts of the freeboard deck in way of the trunk for at least half their length, or where continuous or substantially continuous hatchway side coamings are fitted between detached superstructures, the minimum area of the freeing port openings is to be calculated from the following table:

<i>Breadth of hatchway or trunk in relation to the breadth of barge</i>	<i>Area of freeing ports in relation to the total area or the bulwarks</i>
40% or less	20%
75% or more	10%

Note:

The area of freeing ports at intermediate breadths is to be obtained by linear interpolation.

3.7 Open Superstructures

In barges having superstructures which are open at one or both ends, adequate provision for freeing the space within such superstructures is to be provided, and the arrangements will be subject to special consideration.

3.9 Details of Freeing Ports

The lower edges of the freeing ports are to be as near the deck as practicable. Two-thirds of the freeing-port area required is to be provided in the half of the well nearest the lowest point of the sheer curve. All such openings in the bulwarks are to be protected by rails or bars spaced approximately 230 mm (9 in.) apart. If shutters are fitted to freeing ports, ample clearance is to be provided to prevent jamming. Hinges are to have pins or bearings of noncorrodible material. If shutters are fitted with securing appliances, these are to be of approved construction.

5 Miscellaneous Cargo Retaining Structures

5.1 General

Cargo bins, flash boards, coamings or other structures for retaining deck cargo are to be sufficiently strong for their height and efficiently stiffened at their upper edge. The coamings are to be supported by efficient stays spaced usually not more than 1.8 meters (6 feet) apart and effectively attached to the deck and coaming plate. Where it is intended to carry timber deck cargo, the stays are to be spaced not more than 1.5 meters (5 feet) apart and have increased attachment to deck and coamings. Where steel cargo bins or coamings have a length greater than $0.14L$, the hull girder section modulus and inertia as required by Section 3-2-1 are to be satisfied through the top of the coaming. Cargo bin sides are to be located not less than $0.04B$ inboard from the barge side where B is the breadth of the barge, as defined in 3-1-1/5 and L is the length of the barge, as defined in 3-1-1/3.

5.3 Freeing Arrangements for Cargo Bins

5.3.1 Basic Area (2016)

The basic freeing port area is to be in accordance with 3-2-10/3.1, including a height correction if applicable, but a sheer correction (see 3-2-10/3.3) need not be applied.

5.3.2 Beam Correction

The freeing port area as determined by 3-2-10/5.3.1, above, may then be reduced by the factor f_b expressed by:

$$f_b = 1.18(b/B)^2$$

where

- b = transverse distance between the bin sides, in meters (feet)
- B = breadth of the barge, as defined in 3-1-1/5

5.3.3 Height Correction.

Where the height, h_b , of the bin sides is greater than standard height h_s , the freeing port area as determined by 3-2-10/5.3.2, above, may be reduced by the factor f_h , given in 3-2-10/5.3.3 TABLE 1.

where

- h_b = height of the bin sides, in meters (feet)
- h_s = $0.01L + 1.05$ meters
 = $0.01L + 3.445$ feet
- L = length of the barge, as defined in 3-1-1/3, but is not to be taken less than 75 m (246 ft) and need not be taken more than 125 m (410 ft)

TABLE 1

h_b/h_s	f_h
1.0	1.00
2.0	0.66
3.0	0.44
4.0	0.33
5.0	0.26
6.0	0.22

Note:

Values of f_h for intermediate values of h_b/h_s are to be obtained by linear interpolation.

7 Ventilators

7.1 Construction of Coamings

Ventilators in Position 1 and 2 leading to spaces below the freeboard deck or decks of enclosed superstructure are to have coamings of steel or other equivalent material.

Coaming plate thicknesses are not to be less than obtained from 3-2-10/7.1 TABLE 2.

Coamings are to be effectively and properly secured to properly stiffened deck plating of sufficient thickness. Coamings which are more than 900 mm (35.5 in.) high and which are not supported by adjacent structures are to have additional strength and attachment. Ventilators passing through superstructures other than enclosed superstructures are to have substantially constructed coamings of steel at the freeboard deck.

TABLE 2

<i>Internal Cross Sectional Area of Coaming</i>	<i>Minimum Plate Thickness</i>	
	<i>Exposed</i>	<i>Partially Protected</i>
$\leq 320 \text{ cm}^2$	7.5 mm	7.0 mm
$\geq 1645 \text{ cm}^2$	10.0 mm	7.5 mm
$\leq 50 \text{ in}^2$	0.3 in.	0.27 in.
$\geq 255 \text{ in}^2$	0.4 in.	0.3 in.

Note:

The thickness of coamings having intermediate internal cross-sectional areas is to be obtained by linear interpolation.

7.3 Height of Coamings

Ventilators in Position 1 are to have coamings at least 900 mm (35.5 in.) above the deck. Ventilators in Position 2 are to have coamings at least 760 mm (30 in.) above the deck. (See 3-2-9/3 for definition of Positions 1 and 2.). In exposed positions, the height of coamings may be required to be increased.

7.5 Closing Appliances for Ventilators

Except as provided below, ventilator openings are to be provided with efficient weathertight closing appliances. In barges less than 100 meters (328 feet) in length L , the closing appliances are to be permanently attached. In other barges, they may be permanently attached or are to be conveniently stowed near the ventilators to which they are to be fitted. Ventilators in Position 1, the coamings of which extend to more than 4.5 meters (14.8 feet) above the deck, and in Position 2, the coamings of which extend to more than 2.3 meters (7.5 feet) above the deck, need not be fitted with closing arrangements.

9 Ventilators, Tank Vents and Overflows on the Fore Deck (2011)

9.1 Application (1 July 2012)

The requirements of this paragraph apply to all ventilators, tank vents and overflows located on the exposed fore deck within the forward $0.25L$ on barges with length, L , (as defined in 3-1-1/3) of 80 meters (263 feet) or more and where the height of the exposed deck in way of the item is less than $0.1L$ or 22 meters (72 ft) above the summer load waterline, whichever is the lesser.

9.3 Applied Loading to the Air Pipes and Ventilators

9.3.1 Pressure

The pressures p , in kN/m^2 (tf/m^2 , Ltf/ft^2), acting on air pipes, ventilator pipes and their closing devices, may be calculated from:

$$p = f\rho V^2 C_d C_s C_p \quad \text{kN/m}^2 (\text{tf/m}^2, \text{Ltf/ft}^2)$$

where

$$f = 0.5 \text{ (0.05, 0.0156)}$$

$$\rho = \text{density of sea water, } 1.025 \text{ t/m}^3 \text{ (1.025 t/m}^3, 0.0286 \text{ Lt/ft}^3)$$

$$V = \text{velocity of water over the fore deck, } 13.5 \text{ m/sec (44.3 ft/sec)}$$

$$C_d = \text{shape coefficient}$$

$$= 0.5 \text{ for pipes}$$

- = 1.3 for pipes or ventilator heads in general
- = 0.8 for pipes or ventilator heads of cylindrical form with their axis in the vertical direction
- C_s = slamming coefficient, 3.2
- C_p = protection coefficient:
 - = 0.7 for pipes and ventilator heads located immediately behind a breakwater or forecastle
 - = 1.0 elsewhere, including immediately behind a bulwark

9.3.2 Force

Forces acting in the horizontal direction on the pipe and its closing device may be calculated from the above pressure using the largest projected area of each component.

9.5 Strength Requirements for Ventilators, Tank Vents and Overflows and their Closing Devices

9.5.1 Bending Moment and Stress

Bending moments and stresses in air pipes and ventilator pipes are to be calculated at critical positions: at penetration pieces, at weld or flange connections, at toes of supporting brackets. Bending stresses in the net section are not to exceed $0.8Y$, where Y is the specified minimum yield stress or 0.2% proof stress of the steel at room temperature. Irrespective of corrosion protection, a corrosion addition to the net section of 2.0 mm (0.08 in.) is then to be applied.

9.5.2 Tank Vents and Overflows

- i)* For standard tank vents and overflows of 760 mm (30 in.) height closed by heads of not more than the tabulated projected area, pipe thicknesses and bracket heights are specified in 3-2-10/9.5.5 TABLE 3. Where brackets are required, three or more radial brackets are to be fitted.
- ii)* Brackets are to be of gross thickness of 8 mm (0.32 in.) or more, of minimum length of 100 mm (4.0 in.), and height according to 3-2-10/9.5.5 TABLE 3, but need not extend over the joint flange for the head. Bracket toes at the deck are to be suitably supported.
- iii)* For other configurations, loads according to 3-2-10/9.3 are to be applied, and means of support determined in order to comply with the requirements above. Brackets, where fitted, are to be of suitable thickness and length according to their height.
- iv)* Final (gross) pipe thickness is not to be taken less than as indicated in 3-2-10/9.5.5 TABLE 3. The strength and wall thickness requirements are also to comply with 3-2-10/9.5.1.
- v)* The minimum internal diameter of the air pipe or overflow is not to be less than 65 mm.

9.5.3 Ventilators

- i)* For standard ventilators of 900 mm (35.4 in.) height closed by heads of not more than the tabulated projected area, pipe thicknesses and bracket heights are specified in 3-2-10/9.5.5 TABLE 4. Brackets, where required, are to be as specified in 3-2-10/9.5.2.iii.
- ii)* For ventilators of height greater than 900 mm (35.4 in.), brackets or alternative means of support are to be provided. Pipe thicknesses are not to be taken less than as indicated in 3-2-10/9.5.5 TABLE 4.

9.5.4 Components and Connections

All component parts and connections of the tank vents and overflows or ventilators are to be capable of withstanding the loads defined in 3-2-10/9.3.

9.5.5 Rotary Heads

Rotating type mushroom ventilator heads are not to be used for applications in this location.

TABLE 3
760 mm (30 in.) High Tank Vents and Overflows
Thickness and Bracket Standards (2011)

Nominal Pipe Size		Minimum Fitted Gross Thickness		Maximum Projected Area of Head		Height ⁽¹⁾ of Brackets	
A	B						
mm	in.	mm	in.	cm ²	in ²	mm	in.
65	2 1/2	6.0	---	---	---	480	18.9
80	3	6.3	0.25	---	---	460	18.1
100	4	7.0	0.28	---	---	380	15.0
125	5	7.8	0.31	---	---	300	11.8
150	6	8.5	0.33	---	---	300	11.8
175	7	8.5	0.33	---	---	300	11.8
200	8	8.5 ⁽²⁾	0.33 ⁽²⁾	1900	295	300	11.8
250	10	8.5 ⁽²⁾	0.33 ⁽²⁾	2500	388	300 ⁽²⁾	11.8 ⁽²⁾
300	12	8.5 ⁽²⁾	0.33 ⁽²⁾	3200	496	300 ⁽²⁾	11.8 ⁽²⁾
350	14	8.5 ⁽²⁾	0.33 ⁽²⁾	3800	589	300 ⁽²⁾	11.8 ⁽²⁾
400	16	8.5 ⁽²⁾	0.33 ⁽²⁾	4500	698	300 ⁽²⁾	11.8 ⁽²⁾

Notes:

- 1 Brackets [see 3-2-10/9.5.2.ii] need not extend over the joint flange for the head.
- 2 Brackets are required where the as fitted (gross) thickness is less than 10.5 mm (0.41 in.) or where the tabulated projected head area is exceeded.

Note: For other air pipe heights, the relevant requirements of 3-2-10/9.3 are to be applied.

TABLE 4
900 mm (35.4 in.) High Ventilator Thickness and Bracket Standards
(2011)

Nominal Pipe Size		Minimum Fitted Gross Thickness		Maximum Projected Area of Head		Height ⁽¹⁾ of Brackets	
A	B						
mm	in.	mm	in.	cm ²	in ²	mm	in.
80	3	6.3	0.25	-	-	460	18.1
100	4	7.0	0.28	-	-	380	15.0
150	6	8.5	0.33	-	-	300	11.8
200	8	8.5	0.33	550	85	-	-
250	10	8.5	0.33	880	136	-	-
300	12	8.5	0.33	1200	186	-	-

<i>Nominal Pipe Size</i>		<i>Minimum Fitted Gross Thickness</i>		<i>Maximum Projected Area of Head</i>		<i>Height⁽¹⁾ of Brackets</i>	
<i>A</i>	<i>B</i>						
<i>mm</i>	<i>in.</i>	<i>mm</i>	<i>in.</i>	<i>cm²</i>	<i>in²</i>	<i>mm</i>	<i>in.</i>
350	14	8.5	0.33	2000	310	-	-
400	16	8.5	0.33	2700	419	-	-
450	18	8.5	0.33	3300	511	-	-
500	20	8.5	0.33	4000	620	-	-

Note: For other ventilator heights, the relevant requirements of 3-2-10/9.3 are to be applied.

1 General (1 July 2012)

Helicopter decks, where provided, are to be of steel or equivalent fire resistant construction and are to meet the following structural and safety requirements. The attention of Owners, builders and designers is directed to various international and governmental regulations and guides regarding the operational and other design requirements for helicopters landing on barges.

Plans showing the arrangement, scantlings, and details of the helicopter deck are to be submitted. The arrangement plan is to show in both plan view and elevation the overall size of the helicopter deck and the designated landing area. The arrangement should provide for the securing of a helicopter or helicopters to the deck and the predetermined position(s) selected to accommodate the secured helicopter, in addition to the locations of deck fittings for securing the helicopter. The type of helicopter to be considered is to be specified and calculations for appropriate loading conditions are to be submitted

3 Aluminum Decks (1992)

Aluminum decks may be used for helicopter decks above deckhouses provided the following conditions are complied with:

- i)* An air gap of at least 1 m (3.3 ft) is provided between the deckhouse top and the underside of the helicopter deck
- ii)* There are no openings in the deckhouse top directly below the helicopter deck.
- iii)* Unless the installation fully complies with another recognized standard such as the IMO Code for the Construction and Equipment of Mobile Offshore Drilling Units, the following additional requirements will apply:
 - There are to be no openings in the exterior bulkheads directly below the helicopter decks.
 - All windows in the lower exterior bulkheads are to be fitted with steel shutters.

5 Construction (1 July 2012)**5.1 Structure**

Scantlings of helicopter decks and supporting structures are to be such that the resulting stress in members does not exceed:

$$Y/F_s$$

where

Y = specified minimum yield point or yield strength of the material

F_s = factor of safety, as given in 3-2-11/5.1 TABLE 1

TABLE 1
Allowable Factors of Safety F_s for Helicopter Decks (1 July 2012)

<i>Loading</i>	<i>Plating</i> (See Note 1)	<i>Beams</i>	<i>Girders, Stanchions, Truss Support, etc.</i> (See Note 3)
Overall Distributed Loading	1.67	1.67	1.67
Helicopter Landing Impact Loading	(See Note 1) 1.00 ⁽²⁾	1.00	1.10
Stowed Helicopter Loading	1.00	1.10	1.25

Notes:

- 1 The minimum plate thickness t is generally not to be less than obtained from the following:

<i>beam spacing</i>	<i>t</i>	<i>beam spacing</i>	<i>t</i>
460 mm	4.0 mm	18 in.	0.16 in.
610 mm	5.0 mm	24 in.	0.20 in.
760 mm	6.0 mm	30 in.	0.24 in.

- 2 Alternatively, ultimate state limit methods may be considered.
- 3 For members subjected to axial compression, the factor of safety is to be based on the yield stress or critical buckling stress, whichever is less.
- 4 (1 July 2012) The minimum plate thickness for materials other than steel will be specially considered.
- 5 Helicopters fitted with landing gear other than wheels will be specially considered.
- 6 Calculations are to consider anticipated wind and wave and impact loadings on helicopter decks and their supporting structures.

In determining the resulting stress in members, the following loading conditions are to be considered:

5.1.1 Overall Distributed Loading

A minimum distributed loading of 2.01 kN/m² (205 kgf/m², 42 lbf/ft²) is to be taken over the entire helicopter deck.

5.1.2 Helicopter Landing Impact Loading

A load of not less than 75% of the helicopter maximum take-off weight is to be taken on each of two square areas, 0.305 m × 0.305 m (1 ft × 1 ft). Alternatively, the manufacturer's recommended wheel impact loading will be considered. The deck is to be considered for helicopter landings at any location within the designated landing area. The structural weight of the helicopter deck is to be added to the helicopter impact loading when considering girders, stanchions, truss supports, etc. Where the upper deck of a superstructure or deckhouse is used as a helicopter deck and the spaces below are normally manned, the impact loading is to be multiplied by a factor of 1.15.

5.1.3 Stowed Helicopter Loading

If provisions are made to accommodate helicopters secured to the deck in a predetermined position, the structure is to be considered for a local loading equal to the manufacturer's recommended wheel loadings at maximum take-off weight, multiplied by a dynamic amplification factor based on the predicted motions of the barge for this condition, as may be applicable for the barge under consideration.

In addition to the helicopter load, a uniformly distributed loading of 0.49 kN/m² (50 kgf/m², 10.24 lbf/ft²), representing wet snow or ice, is to be considered, if applicable. For the girders, stanchions, truss supports, etc., the structural weight of the helicopter deck is also to be considered.

5.1.4 Loading due to Motions of Barge

The structure supporting helicopter decks is to withstand the loads resulting from the motions of the barge.

5.3 Size

Each helicopter deck is to be of sufficient size, and located so as to provide a clear approach and take off sector in order to enable the largest helicopter using the deck to operate under the most severe conditions. Helicopter deck size is to comply with ABS *Guide for Helicopter Decks and Facilities (HELIDK and HELIDK(SRF))*.

5.5 Surface

The helicopter deck is to have a non-skid surface.

5.7 Drainage

The helicopter deck is to have drainage facilities to prevent the collection of liquids and prevent liquids from spreading to or falling on other parts of the barge having regard to the use of fire-fighting equipment and the possible spillage of fuel.

5.9 Bolted Connections (2018)

Where bolted connections are used, calculations are to be carried out in accordance with a recognized standard and submitted for review. Metallic isolation arrangement is to be provided where galvanic potential exists between different materials. The degree of fixity of structural components incorporating bolted connections is to be properly considered in the helideck structural assessment. Where fully fixed connection is considered, the bolted connection is to be designed with enough stiffness to account for the full transfer of moment and prevent relative rotation of the structural components.

7 Arrangements

7.1 Projections

The helicopter deck is to be free of projections except that landing lights or other essential projections may be installed on or around the periphery of the deck provided they do not rise more than 25 mm (1 in.) above the level of the helicopter deck.

7.3 Tie Downs

The helicopter deck is to have recessed tie-down points for securing a helicopter.

7.5 Safety Net

For personnel protection, a safety net as least 1.5 m (5 ft) wide is to be provided around the periphery of the helicopter deck, except where structural protection exists. The outer edge of the safety net or structural protection is not to rise more than 150 mm (6 in.) above the edge of the deck.

7.7 Access Routes (2018)

The helicopter deck is to be provided with both a main and an emergency means of escape and access for fire fighting and rescue personnel. These means are to be located as far apart from each other as is practicable and preferably on opposite sides of the helicopter deck.

Aluminum access/egress platforms and stairways leading to and from the aluminum helideck are acceptable, provided the following conditions are satisfied:

- i) Conditions in Ch. II-2/ Reg. 18.3.2 of IMO SOLAS, as applicable are complied with.
- ii) Acceptance from the flag Administration.
- iii) The firefighting equipment, which includes the hose reel, portable fire extinguishers, fixed foam system, is to provide coverage for the access/egress platforms and stairways. The capacity of the fixed foam system is to be increased to include the additional areas of protection for the aluminum access/egress platforms and stairways.
- iv) Where the helideck is also used as a firefighting station, the aluminum access/egress platforms and stairways are to meet the L3 fire integrity test, or equivalent as per 3-4-A1/9 TABLE 1 of *Marine Vessel Rules*.
- v) Where alternative means of fire protection (such as deluge system) are provided (typically along stairways or access under the helideck), and the arrangement and locations of the firefighting equipment, required in (i) above are also available at or cover the access/egress route, the L3 performance test will not be necessary.
- vi) Where the helideck is fitted with a refueling station, there is to be sufficient distance from the refueling station to at least one of the stairs, such that the aluminum stairs are not impacted by the fire at the refueling station.

In case of a fire outside the helideck area, access platforms and stairways are not to be considered part of an escape route.

9 Visual Aids (1 July 2012)

9.1 General

Coastal States may have specific requirements that must be incorporated into the design. Where the Coastal State has no requirements, wind indicator, marking, and lights (in line with the latest International Code) are to comply with ABS *Guide for Helicopter Decks and Facilities (HELIDK and HELIDK(SRF))*.

11 Fire Fighting for Helicopter Landing Areas with No Refueling Capabilities and Facilities for Winching Only

11.1 Hoses and Nozzles

At least two approved combination solid stream and water spray nozzles and detachable applicators and hoses sufficient in length to reach any part of the helicopter landing or winching area are to be provided.

11.3 Portable Extinguishers

The helicopter landing or winching area is to be protected by approved dry powder extinguishers of a total capacity of not less than 45 kg (100 lb).

11.5 Back-up System

A back-up fire-fighting system is to be provided, consisting of CO₂ extinguishers of a total capacity of not less than 18 kg (40 lb) or equivalent, one of these extinguishers being equipped so as to enable it to reach the engine area of any helicopter using the landing or winching area. The back-up system is to be located

so that the equipment would not be vulnerable to the same damage as the dry powder extinguishers required by 3-2-11/11.3.

13 Fire Fighting for Helicopter Landing Areas with Refueling Capabilities

13.1 Fire-Fighting Systems

A fire-fighting system, as required by 3-2-11/11, is to be provided and arranged so as to adequately protect both the helicopter landing area and helicopter fuel storage areas.

13.3 Fixed-Foam System

A fixed-foam fire-extinguishing system, consisting of monitors or hose streams or both, is to be installed to protect the helicopter landing area and fuel storage areas. The helicopter landing area is the area contained within a circle of diameter D where D is the distance, in m (ft), across the main rotor and tail rotor in the fore and aft line of a helicopter with a single main rotor and across both rotors for a tandem rotor helicopter or the full area of the deck, whichever is less. The system is to be capable of delivering foam solution at a rate of 6.0 liters per square meter per minute (0.15 gpm per square foot) for protein foam or 4.1 liters per square meter per minute (0.10 gpm per square foot) for aqueous film forming foam (AFFF) of the areas protected for at least five minutes. The operation of the foam system is not to interfere with the simultaneous operation of the fire main.

15 Helicopter Fuel Oil Storage And Transfer Facilities

15.1

A designated area is to be provided for the storage of fuel tanks and transfer facilities which are to be as remote as is practicable from accommodation spaces, escape routes and embarkation stations, and suitably isolated from areas containing a source of vapor ignition.

The storage and transfer area is to be permanently marked as an area where smoking and open flames are not permitted.

15.3

Fixed fuel storage tanks are to be of metal construction. Special attention is to be given to the design, mounting, securing arrangement and electrical bonding of the storage tank and the fuel transfer system.

15.5

Tank vents are to be sized in accordance with 4-1-2/13 of these Rules, API Standard 2000, "Venting Atmospheric and Low-Pressure Storage Tanks," or other approved criteria. Vent outlets are to be fitted with corrosion resistant flame screens and are to be located such that vapors will disperse freely.

15.7

Storage tank outlet valves are to be provided with a means of remote closure in the event of fire. Means are also to be provided for remote shutdown of the fuel transfer unit.

15.9 (2013)

To contain spillage and retain fire extinguishing agents, a coaming at least 150 mm (6 in.) in height is to be provided. The coaming is to surround the fuel storage area, which consists of the fuel tank, associated piping and any pumping unit adjacent to the storage tank. Where the pumping unit is remote from the tank, a separate coaming around the unit is to be provided. A coaming will be required only around the fuel pumping unit where the installation is such that the fuel storage tank is cantilevered from the barge and arranged to be jettisoned.

Drainage is to be provided for the area enclosed by the coaming and complying with the following:

- i)* The area within the coaming is to be sloped toward the drain line.
- ii)* Drainage from the area within the coaming is to be led through a valve designed for selective output (e.g., 3-way valve) either to a holding tank complying with 3-2-11/15.3 and 3-2-11/15.5 or directly overboard. No other valves may be fitted in the drain line.
- iii)* The cross-sectional area of the drain line from the fuel tank coaming is to be at least twice that of the fuel storage tank outlet connection.

Fuel tank coamings not provided with drainage arrangements, in accordance with the above, are to be sized to contain the full volume of the fuel storage tank plus 150 mm (6 in.) of foam.

15.11

Tanks and associated equipment are to be protected against physical damage and from a fire in an adjacent space or area.

15.13

The fuel pumping unit is to be connected to one tank at a time and the piping between the tank and the pumping unit is to be of steel or equivalent material, as short as possible and protected against damage.

15.15

Fire-extinguishing arrangements for protection of the designated area are to be submitted for review.

17 Helicopter Fuel Oil Pumping Arrangements

17.1

Electrical fuel pumping units and associated control equipment are to be of a type suitable for the location and potential hazard.

17.3

Fuel pumping units are to incorporate a device which will prevent over-pressurization of the delivery or filling hose.

17.5

The procedures and precautions during refueling operations are to be in accordance with good recognized practice.

17.7

Attention is to be paid to the electrical bonding of all equipment used in refueling operations.

17.9

“NO SMOKING” signs are to be displayed at appropriate locations.

1 General**1.1 Hull Welding**

Welding in hull construction is to comply with the requirements of this Section, unless specially approved otherwise. It is recommended that appropriate permanent markings be applied to the side shell of barges to indicate the location of bulkheads for reference. In all instances, welding procedures and filler metals are to be applied which will produce sound welds that have strength and toughness comparable to that of the base material.

1.3 Plans and Specifications

The plans submitted are to indicate clearly the extent to which welding is proposed to be used in the principal parts of the structure. The welding process, filler metal and joint design are to be shown on the detail drawings or in separate specifications submitted for approval which should distinguish between manual and automatic welding. The builders are to prepare and file with the Surveyors a planned procedure to be followed in the erection and welding of the important structural members.

1.5 Workmanship and Supervision

The Surveyors are to satisfy themselves that all welders and welding operators to be employed in the construction of barges to be classed are properly qualified and are experienced in the type of work proposed and in the proper use of welding processes and procedures to be followed. The Surveyors are to be satisfied as to the employment of a sufficient number of skilled supervisors to ensure a thorough supervision and control of all welding operations.

1.7 Welding Procedures**1.7.1 General**

Procedures for the welding of all joints are to be established before construction for the welding processes, types of electrodes, edge preparations, welding techniques and positions proposed. See 2-4-3/5 of the *ABS Rules for Materials and Welding (Part 2)*. Details of proposed welding procedures and sequences may be required to be submitted for review depending on the intended application.

1.7.2 Weld Metal Toughness-Criteria for ABS Grades of Steel

For ABS grades of steel, approved filler metals appropriate to the grades shown in the listing of Approved Welding Consumables (available from www.eagle.org), may be used.

1.7.3 Weld Metal Toughness Criteria for Other Steels

Weld metal is to exhibit Charpy V-notch toughness values at least equivalent to transverse base metal requirements ($2/3$ of the longitudinal base metal requirements).

3 Preparation for Welding

3.1 Edge Preparation and Fitting

The edge preparation is to be accurate and uniform and the parts to be welded are to be fitted in accordance with the approved joint details. All means adopted for correcting improper fitting are to be to the satisfaction of the Surveyor. The Surveyor may accept a welding procedure for build-up of each edge that does not exceed one half the thickness of the member or 12.5 mm (0.5 in), whichever is the lesser. The Surveyor may accept edge build-up in excess of the above up to the full thickness of the member on a case-by-case basis provided notification is given of such cases before the members are welded together. Where plates to be joined differ in thickness and have an offset on either side of more than 3 mm ($1/8$ in.), a suitable transition taper is to be provided. For the transverse butts in bottom shell, sheerstrake, and strength deck plating within the midship portion of the hull, and other joints which may be subject to comparatively high stresses, the transition taper length is to be not less than three times the offset. The transition may be formed by tapering the thicker member or by specifying a weld joint design which will provide the required transition.

3.3 Alignment

Means are to be provided for maintaining the parts to be welded in correct position and alignment during the welding operation. In general, strong backs or other appliances used for this purpose are to be so arranged as to allow for expansion and contraction during production welding. The removal of such items is to be carried out to the satisfaction of the Surveyor.

3.5 Cleanliness

All surfaces to be welded are to be free from moisture, grease, loose mill scale, excessive rust or paint. Primer coatings of ordinary thicknesses, thin coatings of linseed oil or equivalent coatings may be used provided it is demonstrated that their use has no adverse effect in the production of satisfactory welds. Slag and scale are to be removed not only from the edges to be welded but also from each pass or layer before the deposition of subsequent passes or layers. Weld joints prepared by arc-air gouging may require additional preparation by grinding or chipping and wire brushing prior to welding to minimize the possibility of excessive carbon on the scarfed surfaces. Compliance with these cleanliness requirements is of prime importance in the welding of higher-strength steels, especially those which are quenched and tempered.

3.7 Tack Welds

Tack welds of consistently good quality, made with the same grade of filler metal as intended for production welding and deposited in such a manner as not to interfere with the completion of the final weld, need not be removed, provided they are found upon examination to be thoroughly clean and free from cracks or other defects. Preheat may be necessary prior to tack welding when the materials to be joined are highly restrained. Special consideration is to be given to the use of the same preheat as specified in the welding procedure when tack welding higher-strength steels, particularly those materials which are quenched and tempered. These precautions are to be followed when making any permanent welded markings.

3.9 Run-on and Run-off Tabs

When used, run-on and run-off tabs are to be designed to minimize the possibility of high-stress concentrations and base-metal and weld-metal cracking.

3.11 Stud Welding

The attachment of pins, hangers, studs and other related items to ordinary and higher-strength hull structural steels or equivalent by stud welding may be approved at the discretion of the Surveyor. Stud welded attachment to quenched and tempered steel is to be specially approved. At the Surveyor's discretion, trial stud welds may be tested to demonstrate that the base material in way of the stud welds is free from cracking and excessively high hardness. The use of stud welding for structural attachments is subject to special approval and may require special procedure tests appropriate to each application.

5 Production Welding

5.1 Environment

Proper precautions are to be taken to ensure that all welding is done under conditions where the welding site is protected against the deleterious effects of moisture, wind and severe cold.

5.3 Sequence

Welding is to be planned to progress symmetrically so that shrinkage on both sides of the structure will be equalized. The ends of frames and stiffeners should be left unattached to the plating at the subassembly stage until connecting welds are made in the intersecting systems of plating, framing and stiffeners at the erection stage. Welds are not to be carried across an unwelded joint or beyond an unwelded joint which terminates at the joint being welded unless specially approved.

5.5 Preheat

The use of preheat and interpass temperature control is to be considered when welding higher-strength steels, material of thick cross-section or materials subject to high restraint. When welding is performed under high humidity conditions or when the temperature of steel is below 0°C (32°F), the base metal is to be preheated to at least 16°C (60°F) or a temperature appropriate to the alloy and the thickness, whichever is higher. The control of interpass temperature is to be specially considered when welding quenched and tempered higher-strength steels. When preheat is used, the preheat and interpass temperatures are to be in accordance with the accepted welding procedure and to the satisfaction of the Surveyor. In all cases, preheat and interpass temperature control are to be sufficient to maintain dry surfaces and minimize the possibility of the formation of fractures.

5.7 Low-hydrogen Electrodes or Welding Processes

5.7.1 Welding of Ordinary and Higher Strength Steel

The use of low-hydrogen electrodes or welding processes is recommended for welding all higher-strength steel and may also be considered for ordinary-strength steel weldments subject to high restraint. When using low-hydrogen electrodes or processes, proper precautions are to be taken to ensure that the electrodes, fluxes and gases used for welding are clean and dry.

5.7.2 Welding of Quenched and Tempered Steels

Unless approved otherwise, matching strength, low-hydrogen electrodes or welding processes are to be used for welding quenched and tempered steels, and overmatching should be generally avoided. When welding quenched and tempered steels to other steels, the weld filler metal selection is to be based on the lower-strength base material being joined. In all cases, filler metal strength is to be no less than that of the lowest strength member of the joint unless approved otherwise. The Surveyor is to be satisfied that the procedures for handling and baking filler metals and fluxes are commensurate with the low-hydrogen practices appropriate to the highest-strength steel.

5.9 Back Gouging

Chipping, grinding, arc-air gouging or other suitable methods are to be employed at the root or underside of the weld to obtain sound metal before applying subsequent beads for all full-penetration welds. When arc-air gouging is employed, a selected technique is to be used so that carbon buildup and burning of the weld or base metal is minimized. Quenched and tempered steels are not to be flame gouged.

5.11 Peening

The use of peening is not recommended for single-pass welds or the root or cover passes on multipass welds. Peening, when used to correct distortion or to reduce residual stresses, is to be effected immediately after depositing and cleaning each weld pass.

5.13 Fairing and Flame Shrinking

Fairing by heating or flame shrinking and other methods of correcting distortion or defective workmanship in fabrication of main-strength members within the midships portion of the vessel and other plating which may be subject to high stresses is to be carried out only with the express approval of the Surveyor. These corrective measures are to be kept to an absolute minimum when the higher-strength steels are involved, due to high local stresses and the possible degradation of the mechanical properties of the base material.

5.15 Surface Appearance and Weld Soundness

5.15.1 Surface Appearance

The surfaces of welds are to be visually inspected and are to be regular and uniform with a minimum amount of reinforcement and reasonably free from undercut and overlap. Welds and adjacent base metal are to be free from injurious arc strikes.

5.15.2 Weld Soundness

Welds are to be sound, crack-free throughout the weld cross section, and fused to the base material to the satisfaction of the attending Surveyor and should generally be considered on the basis of 3-2-12/1.5 "Workmanship and Supervision", 3-2-12/1.7 "Welding Procedure Qualification" and 3-2-12/5.17 "Nondestructive Inspection of Welds".

5.17 Nondestructive Inspection of Welds

Inspection of welded joints in important locations is to be carried out by an approved nondestructive test method such as radiographic, ultrasonic, magnetic-particle or dye-penetrant inspection. ABS's separately issued *Guide for Nondestructive Inspection* or an approved equivalent standard is to be used in evaluating radiographs and ultrasonic indications. Evaluation of radiographs and ultrasonic indications is one of the factors in assessing shipyard weld quality control. Radiographic or ultrasonic inspection, or both, is to be used when the overall soundness of the weld cross section is to be evaluated. Magnetic-particle or dye-penetrant inspection or other approved methods are to be used when investigating the outer surface of welds or may be used as a check of intermediate weld passes, such as root passes, and also to check back-gouged joints prior to depositing subsequent passes. Surface inspection of important tee or corner joints in critical locations, using an approved magnetic particle or dye penetrant method, is to be conducted to the satisfaction of the Surveyor. Extra high-strength steels [415-690 N/mm², (42-70 kgf/mm², 60,000-100,000 psi) minimum yield strength] may be susceptible to delayed cracking. When welding these materials, the final nondestructive testing is to be delayed sufficiently to permit detection of such defects. Weld run-on or run-off tabs may be used where practical, and be sectioned for examination. Where a method (such as radiographic or ultrasonic) is selected as the primary nondestructive method of inspection, the acceptance standards of such a method govern. However, if additional inspection by any method should indicate the presence of defects that could jeopardize the integrity of the structure, removal and repair of such defects are to be to the satisfaction of the attending Surveyor.

5.19 Repair Welding

Defective welds and other injurious defects, as determined by visual inspection, nondestructive test methods or leakage are to be excavated in way of the defects to sound metal and corrected by re-welding

using a suitable repair welding procedure to be consistent with the material being welded. Removal by grinding of minor surface imperfections such as scars, tack welds and arc strikes may be permitted at the discretion of the attending Surveyor. Special precautions, such as the use of preheat, interpass temperature control and low-hydrogen electrodes, are to be considered when repairing welds in all higher-strength steel, ordinary strength steel of thick cross-section or steel subject to high restraint. Materials thicker than approximately 19 mm ($\frac{3}{4}$ in.) are considered to be of thick cross-section. In all cases, preheat and interpass temperature control are to be sufficient to maintain dry surfaces and minimize the possibility of the formation of fractures.

7 Butt Welds

7.1 Manual Welding Using Covered Electrodes

Manual welding using covered electrodes may be ordinarily employed for butt welds in plating not exceeding 6.5 mm ($\frac{1}{4}$ in.) in thickness without beveling the abutting plate edges. Plates exceeding 6.5 mm ($\frac{1}{4}$ in.) are to be prepared for welding by similarly beveling the edges of both plates from one or both sides to form a single-Vee or double-Vee butt joint with an included angle of 60°. The root face or land is not to exceed 3 mm ($\frac{1}{8}$ in.) in depth and the root opening or gap between the plates is not to be less than 1.5 mm ($\frac{1}{16}$ in.) nor more than 5 mm ($\frac{3}{16}$ in.) except in the case of single-Vee joints welded in the flat position where tight fits may be used. In all cases, unsound weld metal at the root on the reverse side of the weld is to be removed to sound metal by an approved method before applying subsequent weld passes. Where welding is to be deposited from one side only, using ordinary welding techniques, backing is to be provided and the plates are to be beveled to an included angle of 45° and spaced so as to leave a gap at the root of 6.5 mm ($\frac{1}{4}$ in.). Other included angles and root gaps or combinations thereof will be specially considered. The backing bar is to be fitted so that a minimum spacing exists between the backing bar and the plates to be joined. Splices in back-up bars are to be welded with full-penetration welds prior to making the primary weld.

7.3 Submerged-arc Welding

Submerged-arc welding, using wire-flux combinations for butt welds in members not exceeding 16 mm ($\frac{5}{8}$ in.) in thickness, may be ordinarily employed without beveling the abutting edges. Members exceeding 16 mm ($\frac{5}{8}$ in.) are normally to be prepared for welding in a manner acceptable to the Surveyor by using an appropriate edge preparation, root opening and root face (land) to provide for welding from one or both sides. When it is determined that sound welds can be made without back gouging, the provisions of 3-2-12/5.9 are not applicable. Where the metal is to be deposited from one side only, using ordinary welding techniques, backing (either permanent or temporary) is to be provided and the members are to be beveled and fitted in accordance with established procedures.

7.5 Gas metal-arc and Flux Cored-arc Welding

Manual semiautomatic or machine automatic gas metal-arc welding and flux cored-arc welding using wire-gas combinations and associated processes, may be ordinarily employed utilizing the conditions as specified in 3-2-12/7.1, except that specific joint designs may differ between processes.

Gas metal-arc welding utilizing short circuiting-arc transfer technique (the consumable electrode is deposited during repeated short circuits) is to be restricted to welding thickness up to 6.3 mm (0.25 in.) unless specially approved otherwise (see 3-2-12/15 for special requirement for welder qualification).

7.7 Electroslag and Electrogas Welding

The use of electroslag and electrogas welding processes will be subject to special consideration, depending upon the specific application and the mechanical properties of the resulting welds and heat-affected zones.

7.9 Special Welding Techniques

Special welding techniques employing any of the basic welding processes mentioned in 3-2-12/7.1 through 3-2-12/7.7 will be specially considered, depending upon the extent of the variation from the generally

accepted technique. Such special techniques include one-side welding, narrow-gap welding, tandem-arc welding, open-arc welding and consumable-nozzle electroslag welding. The use of gas tungsten-arc welding will also be subject to special consideration, depending upon the application and whether the process is used manually or automatically.

9 Fillet Welds

9.1 General (1 July 2015)

The actual sizes of fillet welds are subject to approval in each individual case, and are to be indicated on detail drawings or on a separate welding schedule. Frames, beams, bulkhead stiffeners, floors and intercostals, etc. are to have at least the disposition and sizes of intermittent or continuous fillet welds as required by 3-2-12/15 TABLE 1A. Where it is desirable to substitute continuous welding for intermittent welding as given in 3-2-12/15 TABLE 1A, a reduction from the required size of fillet may be allowed if equivalent strength is provided. It may be required that special precautions such as the use of preheat or low-hydrogen-type electrodes or processes be employed where small fillets are used for attachment to heavy plates. Fillet welds may be made by an approved manual or automatic process. Where the gap between the faying surfaces of members exceeds 2.0 mm ($1/16$ in.) and is not greater than 5 mm ($3/16$ in.), the weld leg size is to be increased by the amount of the opening. Where the gap between members is greater than 5 mm ($3/16$ in.), fillet weld sizes and weld procedures are to be specially approved by the Surveyor. Completed welds are to be to the Surveyor's satisfaction.

For all welds in ballast tanks required to be in compliance with the IMO PSPC and/or IMO PSPC-COT Regulations, continuous welding is to be adopted.

9.3 Tee Joints

Tee joints are to be formed by either continuous or intermittent fillet welds on each side, as required by 3-2-12/9.5 and 3-2-12/9.7, except where full-penetration welds may be required to develop the effectiveness of continuous longitudinal members. In general, the required size and spacing of the fillets is to be determined by the thickness of the stem of the tee or the plate to which it is joined, whichever is the lesser. Where the opening between members exceeds 1.5 mm ($1/16$ in.) and is not greater than 5 mm ($3/16$ in.), the size of the fillets is to be increased by the amount of the opening. Spacing between plates forming tee joints is not to exceed 5 mm ($3/16$ in.).

9.5 Tee-type End Connections

Tee type end connections where fillet welds are used are to have continuous welds on each side. In general the sizes of the welds, w , are not to be less than $3/4$ times the thickness of the member being attached, but in special cases where heavy members are attached to relatively light plating, the sizes may be modified. In certain cases, only the webs of girders, beams and stiffeners need be attached. In such cases the unattached face plates or flanges are to cut back.

9.7 Tee joints at Boundary Connections

Tee joints at boundary connections of bulkheads, decks, inner bottoms, etc. are to have continuous welding on both sides where the thinner of the plates is 12.5 mm ($1/2$ in.) thick or greater. In general, the size of the welds, w , is to be such that the two together are not less than the thickness of the thinner plate plus 1.5 mm ($1/16$ in.). Where the thickness of the thinner plate is less than 12.5 mm ($1/2$ in.), the attachment may be made by a continuous weld on one side 1.5 mm ($1/16$ in.) less than the thickness of the thinner plate with intermittent welding on the opposite side of the size required by 3-2-12/15 TABLE 1B for stiffeners to deep tank bulkheads, except in way of tanks where equivalent continuous welds are to be used.

9.9 Lapped Joints

Lapped joints are generally to have overlaps of not less width than twice the thinner plate thickness plus 25 mm (1 in.). Both edges of an overlap joint are to have fillet welds, which may be continuous or intermittent and of the sizes, w , as required by 3-2-12/9.11 and 3-2-12/9.13.

9.11 Overlapped End Connections

Overlapped end connections of longitudinal strength members within the midship $0.4L$ are to have continuous fillet welds on both edges each equal in size, w , to the thickness of the thinner of the two plates joined. All other overlapped end connections are to have continuous welds on each edge of sizes, w , such that the sum of the two is not less than 1.5 times the thickness of the thinner plate.

9.13 Overlapped Seams in Barges Up to 76.2 Meters (250 Feet) in Length (2017)

The following requirements with regard to overlapped seams are to be complied with:

- i)* Overlapped seams are not to be used in way of tanks carrying flammable liquids, or in barges with a length (L) of more than 76.2 m (250 ft).
- ii)* Overlapped seams of deck plating and shell plating are to have continuous fillet welds along both their exterior and interior edges (see 3-2-12/9.13 FIGURE 1).
- iii)* The fillet welds are to be of the size specified in 3-2-12/15 TABLE 1 based on the thinner plate being joined.
- iv)* Overlapped seams at deck or bottom plating are to comply with the following (see 3-2-12/9.13 FIGURE 1):

$$d_2 \geq 75 \text{ mm (3 in.)}$$

$$d_1 \geq 2t_{\min} + 25 \text{ mm (1 in.)}$$

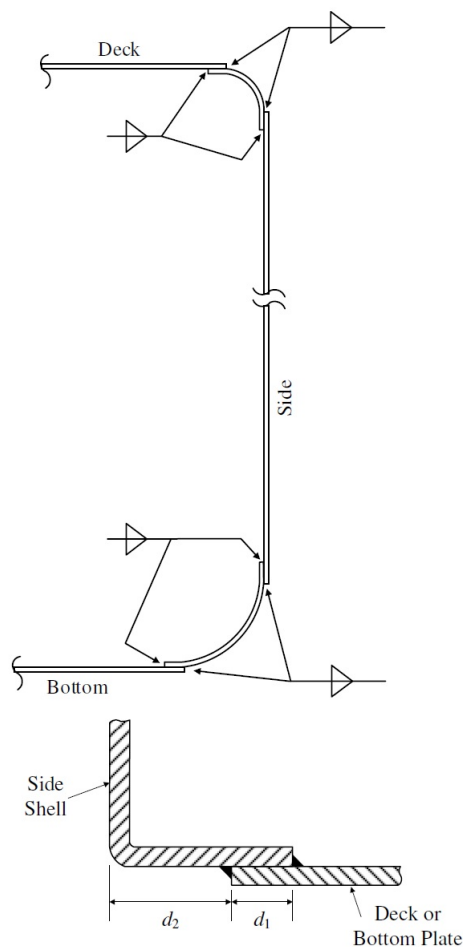
where

d_2 = distance away from the gunwale corner or bilge corner

d_1 = overlap distance

t_{\min} = the thinner of the two plates being joined

FIGURE 1
Overlapped Seams of Deck and Shell Plating (2017)



9.15 Plug Welds or Slot Welds (2021)

Plug welds or slot welds may be approved only for particular applications where access for welding from inside the hull or shell is impracticable such as: very narrow recesses at ends, one side of skag plating, fairleads or one side of box keel. Where used in the body of doublers and similar locations, such welds may be spaced about 300 mm (12 in.) between centers in both directions. Doubler plates are not acceptable in tanks carrying flammable liquids. Where doubler plates are proposed in way of equipment foundations when large tensile forces normal to the doubler plates could exist, the doubler plate and welds are to be assessed for yielding and buckling, as applicable.

Where plug or slot welds are used, the weld details are to comply with a recognized standard (IACS CSR, AWS D1.1, AISC, etc.).

Suitable torch angles are to be applied to minimize lack of fusion in the root corner during slot welding. Welders are to be suitably trained and qualified to perform slot welds.

9.16 Overlaps for Lugs (2021)

The overlaps for lugs and collars in way of cutouts for the passage of stiffeners through webs and bulkhead plating are not to be less than three times the thickness of the lug, but need not be greater than 50 mm (2.0 in.).

9.17 Widely Spaced Floors (2017)

Wide spaced floors are those which typically support longitudinally framed bottom/inner bottom structure. Wide spaced floors are also those solid floors fitted at spacing up to 3.66 meters (12 feet) apart in association with transverse open floors of the type mentioned in 5-1-2/5.7.2 and 5-1-2/5.9 (see 5-1-2/5.9 FIGURE 2 also). Closely spaced floors which function as the stiffeners for bottom/inner bottom plating are not considered wide spaced floors.

11 Alternatives

The foregoing are considered minimum requirements for electric-arc welding in hull construction, but alternative methods, arrangements and details will be considered for approval. The *Marine Vessel Rules* will be an acceptable alternative.

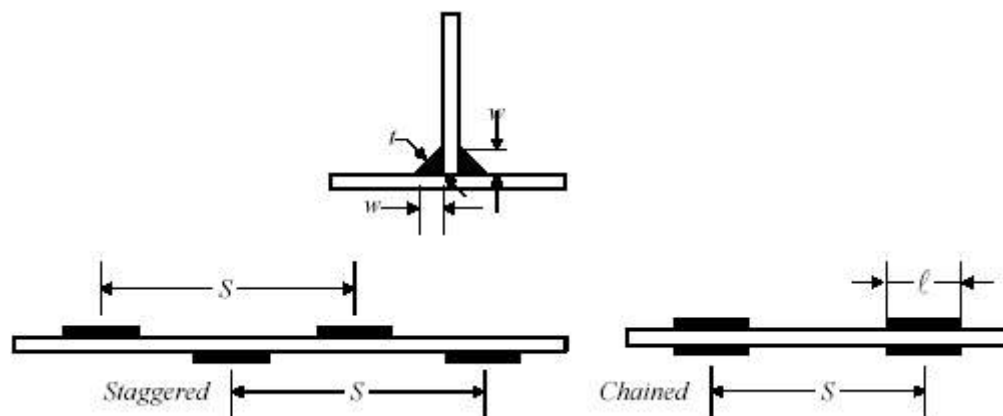
13 Welding for Machinery Components

For welding details of machinery components, see Section 2-4-2 of the *ABS Rules for Materials and Welding (Part 2)*.

15 Weld Tests

For welding procedures, workmanship tests, radiographic or ultrasonic inspection and welder qualification, see Section 2-4-3 of the *ABS Rules for Materials and Welding (Part 2)*.

TABLE 1A
Weld Sizes and Spacing - Millimeters



	<i>Weld size for lesser thickness of members joined, mm</i>							
	5	6.5	8	9.5	11	12.5	14.5	16
Nominal leg size of fillet <i>w</i>	3	5	6.5	6.5	8	8	8	8
Nominal throat size of fillet <i>t</i>	2	3.5	4.5	4.5	5.5	5.5	5.5	5.5
Length of fillet weld	40	65	75	75	75	75	75	75
Structural Items	Spacing of Welds <i>S</i>, mm							
Single-Bottom Floors								
To center keelson <i>Note</i> : Connections elsewhere to take same weld as floors in double bottom	In accordance with 3-2-12/9.7							
Double-Bottom Floors								

<i>Structural Items</i>	<i>Spacing of Welds S , mm</i>							
To bottom shell forward (fore-end strengthening) in rake end barges	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.
To shell flat of bottom forward (fore-end strengthening) in barges having ship-shaped bows	—	—	250	225	250	250	225	200
To shell elsewhere	*300	*300	300	275	300	275	250	250
Wide spaced solid floors to center vertical keel plate with longitudinal frames and in barges where length exceed 152.5 meters	In accordance with 3-2-12/9.7							
Solid floors to center vertical keel plate elsewhere, and open-floor brackets to center vertical keel	*250	*250	250	225	250	225	200	175
Solid floors and open-floor brackets to margin plate	In accordance with 3-2-12/9.7							
To inner bottom at forward end (fore-end strengthening)	*275	*275	275	250	275	250	225	200
To inner bottom elsewhere	*300	*300	300	275	300	275	250	250
Wide spaced with longitudinal framing to shell and inner bottom	In accordance with 3-2-12/9.7							
Solid floor stiffeners at watertight or oiltight boundaries	—	300	300	275	300	275	250	250
Watertight and oiltight periphery connections of floors throughout double bottom	In accordance with 3-2-12/9.7							
Center Girder								
Nontight to shell	In accordance with 3-2-12/9.7							
Nontight to inner-bottom or center strake	150	150	150	125	150	125	125	125
Watertight or oiltight to inner bottom, rider plate or shell	In accordance with 3-2-12/9.7							
Intercostals								
Intercostals and continuous longitudinal girders to bottom shell forward (fore-end strengthening) in rake end barges	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.
Intercostals and continuous longitudinal girders to shell on flat bottom forward (fore-end strengthening) in barges having ship-shaped bows	—	150	150	125	150	125	125	‡Dbl. Cont.
Intercostals and continuous longitudinal girders to shell and inner bottom elsewhere and to floors	*275	*275	275	250	275	250	225	225
Watertight and oiltight periphery connections of longitudinal girders in double bottom	In accordance with 3-2-12/9.7							
Frames								
To shell for 0.125L forward	—	—	250	225	250	250	225	225
To shell on flat of bottom forward (fore-end strengthening)	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	‡Dbl. Cont.	‡Dbl. Cont.	Dbl. Cont.	Dbl. Cont.
To shell and inner bottom elsewhere—See Note 1	*300	*300	300	275	300	275	250	250

<i>Structural Items</i>	<i>Spacing of Welds S, mm</i>							
Frame brackets to frames, decks and inner bottom	Dbl. Cont.	Dbl. Cont.	‡Dbl. Cont.	Dbl. Cont.	‡Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	†Dbl. Cont.
Girders and Webs								
To shell and to bulkheads or decks in tanks	—	200	225	200	225	200	175	150
To bulkheads or decks elsewhere	—	—	250	225	250	225	200	175
Webs to face plate where area of face plate is 64.5 sq. cm. or less	*250	*250	300	275	300	275	250	250
Webs to face plate area of face plate exceeds 64.5 sq. cm	—	—	250	225	250	225	200	175
Bulkheads								
Peripheries of swash bulkheads	—	200	225	200	225	200	175	150
Peripheries of nontight structural bulkheads	—	225	250	225	250	225	200	175
Peripheries of oiltight or watertight bulkheads	In accordance with 3-2-12/9.7							
Stiffeners to deep tank bulkheads—See Note 1	—	*300	300	275	300	275	250	250
Stiffeners to ordinary watertight bulkheads and deckhouse fronts—See Note 1	—	*300	300	275	300	275	250	250
Stiffeners to nontight structural bulkheads; stiffeners on deckhouse sides and after ends—See Note 2	*300	*300	‡300	300	‡300	300	300	250
Stiffener brackets to beams, decks, etc.	Dbl. Cont.	Dbl. Cont.	‡Dbl. Cont.	Dbl. Cont.	‡Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	†Dbl. Cont.
Decks	Peripheries of platform decks and nontight flats							
Peripheries of platform decks and nontight flats								
Upper Weld	Cont.	Cont.	Cont.	‡Cont.	Cont.	‡Cont.	Cont.	†Cont.
Lower Weld	300	300	300	‡300	300	‡300	300	250
Peripheries of strength decks, exposed decks, and all watertight or oiltight decks, tunnels and flats	In accordance with 3-2-12/9.7							
Beams (transverse or longitudinal) to decks—See Note 3	*300	*300	300	275	300	275	250	250
Beams knees to beams and frames	Dbl. Cont.	Dbl. Cont.	‡Dbl. Cont.	Dbl. Cont.	‡Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	†Dbl. Cont.
Hatch coamings to exposed decks	—	—	—	In accordance with 3-2-12/9.7				
Foundations								
To top plates, shell or inner bottom for major auxiliaries	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	†Dbl. Cont.	†Dbl. Cont.
To top plates, shell or inner bottom for other auxiliaries	In accordance with 3-2-12/9.7							
Additional Welding for Oil Tank Barges (See Note 4)								
Girders and Webs								
Centerline girder to shell	—	In accordance with 3-2-12/9.7					†Dbl. Cont.	†Dbl. Cont.

<i>Structural Items</i>	<i>Spacing of Welds S, mm</i>								
Centerline girder to deck	—	In accordance with 3-2-12/9.7						†Dbl. Cont.	Dbl. Cont.
Bulkhead webs to plating	—	In accordance with 3-2-12/9.7						Dbl. Cont.	Dbl. Cont.
To face plates	—	150	150	150	150	125	125	‡Dbl. Cont.	
Transverses									
Bottom transverses to shell	—	In accordance with 3-2-12/9.7						†Dbl. Cont.	†Dbl. Cont.
Side, deck and bulkhead transverses to plating	—	In accordance with 3-2-12/9.7						Dbl. Cont.	Dbl. Cont.
To face plates	—	150	150	150	150	125	125	‡Dbl. Cont.	

Where beams, stiffeners, frames, etc., are intermittently welded and pass through slotted girders, shelves or stringers, there is to be a pair of matched intermittent welds on each side of each such intersection, and the beams, stiffeners and frames are to be efficiently attached to the girders, shelves and stringers.

* Fillet welds are to be staggered.

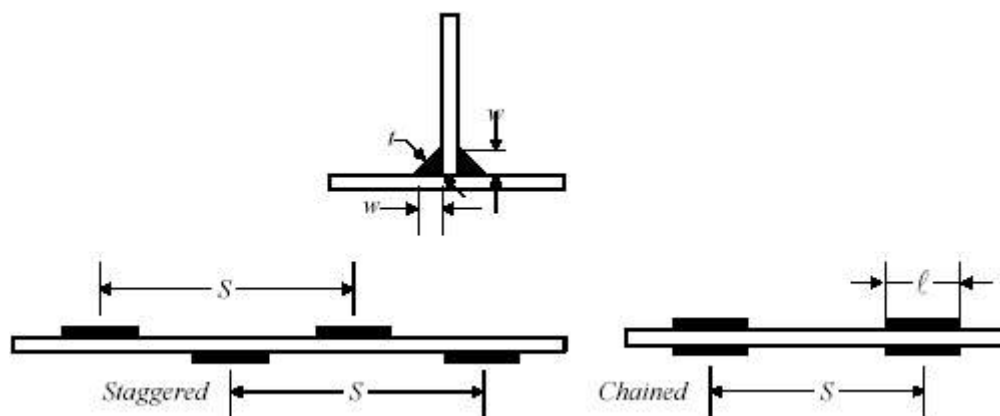
‡ Nominal size of fillet w may be reduced 1.5 mm.

† Nominal size of fillet w is to be increased 1.5 mm.

Notes

- 1 Unbracketed stiffeners of shell, watertight and oiltight bulkheads and house fronts are to have double continuous welds for one-tenth of their length at each end.
- 2 Unbracketed stiffeners of nontight structural bulkheads, deckhouse sides and after ends are to have a pair of matched intermittent welds at each end.
- 3 For slab longitudinals, the attachment is to be made by double continuous fillet welds of a size w which is 0.3 times the thickness of the thinner plate but need not be greater than 8.0 mm.
- 4 The welding of longitudinals may be as required under frames or decks above. In addition, they are to have double continuous welds at the ends and in way of transverses equal in length to the depth of the longitudinal. For deck longitudinals, only a matched pair of welds is required at the transverses.
- 5 Where the symbol "—" (dash), is shown in place of the spacing of intermittent fillet welds, it is to indicate that the corresponding thickness is not anticipated for that particular structural member.

TABLE 1B
Weld Sizes and Spacing - Inches



	<i>Leg size for lesser thickness of members joined, in.</i>							
	0.19	0.25	0.32	0.38	0.44	0.50	0.57	0.63
Nominal leg size of fillet <i>w</i>	1/8	3/16	1/4	1/4	5/16	5/16	5/16	5/16
Length of fillet weld	1½	2½	3	3	3	3	3	3

<i>Structural Items</i>	<i>Spacing of Welds S, in.</i>							
Single-Bottom Floors								
To center keelson <i>Note:</i> Connections elsewhere to take same weld as floors in double bottom	In accordance with 3-2-12/9.7							
Double-Bottom Floors								
To bottom shell forward (fore-end strengthening) in rake end barges	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.
To shell flat of bottom forward (fore-end strengthening) in barges having ship-shaped bows	—	—	10	9	10	10	9	8
To shell elsewhere	*12	*12	12	11	12	11	10	10
Wide spaced solid floors to center vertical keel plate with longitudinal frames and in barges where length exceed 500 feet	In accordance with 3-2-12/9.7							
Solid floors to center vertical keel plate elsewhere, and open-floor brackets to center vertical keel	*10	*10	10	9	10	9	8	7
Solid floors and open-floor brackets to margin plate	In accordance with 3-2-12/9.7							
To inner bottom at forward end (fore-end strengthening)	*11	*11	11	10	11	10	9	8
To inner bottom elsewhere	*12	*12	12	11	12	11	10	10
Wide spaced with longitudinal framing to shell and inner bottom	In accordance with 3-2-12/9.7							
Solid floor stiffeners at watertight or oiltight boundaries	—	12	12	11	12	11	10	10

<i>Structural Items</i>	<i>Spacing of Welds S, in.</i>							
Watertight and oiltight periphery connections of floors throughout double bottom	In accordance with 3-2-12/9.7							
Center Girder								
Nontight to shell	In accordance with 3-2-12/9.7							
Nontight to inner-bottom or center strake	6	6	6	5	6	5	5	5
Watertight or oiltight to inner bottom, rider plate or shell	In accordance with 3-2-12/9.7							
Intercostals								
Intercostals and continuous longitudinal girders to bottom shell forward (fore-end strengthening) in rake end barges	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.
Intercostals and continuous longitudinal girders to shell on flat bottom forward (fore-end strengthening) in barges having ship-shaped bows	—	6	6	5	6	5	5	‡Dbl. Cont.
Intercostals and continuous longitudinal girders to shell and inner bottom elsewhere and to floors	*11	*11	11	10	11	10	9	9
Watertight and oiltight periphery connections of longitudinal girders in double bottom	In accordance with 3-2-12/9.7							
Frames								
To shell for 0.125L forward	—	—	10	9	10	10	9	9
To shell on flat of bottom forward (fore-end strengthening)	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	‡Dbl. Cont.	‡Dbl. Cont.	Dbl. Cont.	Dbl. Cont.
To shell and inner bottom elsewhere—See Note 1	*12	*12	12	11	12	11	10	10
Frame brackets to frames, decks and inner bottom	Dbl. Cont.	Dbl. Cont.	‡Dbl. Cont.	Dbl. Cont.	‡Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	†Dbl. Cont.
Girders and Webs								
To shell and to bulkheads or decks in tanks	—	8	9	8	9	8	7	6
To bulkheads or decks elsewhere	—	—	10	9	10	9	8	7
Webs to face plate where area of face plate is 10 sq. in. or less	*10	*10	12	11	12	11	10	10
Webs to face plate area of face plate exceeds 10 sq. in.	—	—	10	9	10	9	8	7
Bulkheads								
Peripheries of swash bulkheads	—	8	9	8	9	8	7	6
Peripheries of nontight structural bulkheads	—	9	10	9	10	9	8	7
Peripheries of oiltight or watertight bulkheads	In accordance with 3-2-12/9.7							
Stiffeners to deep tank bulkheads—See Note 1	—	*12	12	11	12	11	10	10
Stiffeners to ordinary watertight bulkheads and deckhouse fronts—See Note 1	—	*12	12	11	12	11	10	10

<i>Structural Items</i>	<i>Spacing of Welds S, in.</i>							
Stiffeners to nontight structural bulkheads; stiffeners on deckhouse sides and after ends—See Note 2	*12	*12	**‡12	12	12	12	12	10
Stiffener brackets to beams, decks, etc.	Dbl. Cont.	Dbl. Cont.	‡Dbl. Cont.	Dbl. Cont.	‡Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	†Dbl. Cont.
Decks								
Peripheries of platform decks and nontight flats								
Upper Weld	Cont.	Cont.	‡Cont.	Cont.	‡Cont.	Cont.	Cont.	†Cont.
Lower Weld	12	12	‡12	12	‡12	12	12	10
Peripheries of strength decks, exposed decks, and all watertight or oiltight decks, tunnels and flats	In accordance with 3-2-12/9.7							
Beams (transverse or longitudinal) to decks—See Note 3	*12	*12	12	11	12	11	10	10
Beams knees to beams and frames	Dbl. Cont.	Dbl. Cont.	‡Dbl. Cont.	Dbl. Cont.	‡Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	†Dbl. Cont.
Hatch coamings to exposed decks	—	—	—	In accordance with 3-2-12/9.7				
Foundations								
To top plates, shell or inner bottom for major auxiliaries	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	Dbl. Cont.	†Dbl. Cont.	†Dbl. Cont.
To top plates, shell or inner bottom for other auxiliaries	In accordance with 3-2-12/9.7							
Additional Welding for Oil Tank Barges (See Note 4)								
Girders and Webs								
Centerline girder to shell	—	In accordance with 3-2-12/9.7					†Dbl. Cont.	†Dbl. Cont.
Centerline girder to deck	—	In accordance with 3-2-12/9.7					†Dbl. Cont.	Dbl. Cont.
Bulkhead webs to plating	—	In accordance with 3-2-12/9.7					Dbl. Cont.	Dbl. Cont.
To face plates	—	6	6	6	6	5	5	‡Dbl. Cont.
Transverses								
Bottom transverses to shell	—	In accordance with 3-2-12/9.7					†Dbl. Cont.	†Dbl. Cont.
Side, deck and bulkhead transverses to plating	—	In accordance with 3-2-12/9.7					Dbl. Cont.	Dbl. Cont.
To face plates	—	6	6	6	6	6	6	‡Dbl. Cont.

Where beams, stiffeners, frames, etc., are intermittently welded and pass through slotted girders, shelves or stringers, there is to be a pair of matched intermittent welds on each side of each such intersection, and the beams, stiffeners and frames are to be efficiently attached to the girders, shelves and stringers.

* Fillet welds are to be staggered.

‡ Nominal size of fillet w may be reduced $\frac{1}{16}$ in.

† Nominal size of fillet w is increased $\frac{1}{16}$ in.

Notes

- 1 Unbracketed stiffeners of shell, watertight and oiltight bulkheads and house fronts are to have double continuous welds for one-tenth of their length at each end.
- 2 Unbracketed stiffeners of nontight structural bulkheads, deckhouse sides and after ends are to have a pair of matched intermittent welds at each end.
- 3 For slab longitudinals, the attachment is to be made by double continuous fillet welds of a size w which is 0.3 times the thickness of the thinner plate but need not be greater than $\frac{1}{16}$ in.
- 4 The welding of longitudinals may be as required under frames or decks above. In addition, they are to have double continuous welds at the ends and in way of transverses equal in length to the depth of the longitudinal. For deck longitudinals, only a matched pair of welds is required at the transverses.
- 5 Where the symbol "—" (dash), is shown in place of the spacing of intermittent fillet welds, it is to indicate that the corresponding thickness is not anticipated for that particular structural member.

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1 General (1 July 2022)

Barges are to have equipment of anchors and cables in accordance with the requirements of this section. The symbol **Ⓢ** placed after the symbols of classification in the *Record*, thus: **ⓈA1Ⓢ** will signify that the equipment of the barge is in compliance with the requirements of 3-3-1/21 TABLE 1. The weight per anchor of bower anchors, given in 3-3-1/21 TABLE 1, is for anchors of equal weight. The weight of individual anchors may vary 7% plus or minus from the tabular weight provided that the combined weight of anchors is not less than that required for anchors of equal weight. The total length of chain required to be carried on board, as given in 3-3-1/21 TABLE 1, is to be reasonably divided between the two bower anchors.

Cables which are intended to form part of the equipment are not to be used as check chains when the barge is launched. The inboard ends of the cables of the bower anchors are to be secured by efficient means. Anchors and their cables are to be connected and positioned, ready for use. Means are to be provided for stopping each cable as it is paid out, and the windlass should be capable of heaving in either cable. Suitable arrangements are to be provided for securing the anchors and stowing the cables.

Equipment Number calculations for unconventional vessels with unique topside arrangements or operational profiles may be specially considered. Such consideration may include accounting for additional wind areas of widely separated deckhouses or superstructures in the equipment number calculations or equipment sizing based on direct calculations. However, in no case may direct calculations be used to reduce the equipment size to be less than that required by 3-3-1/9.

Commentary:

If ABS is acting on behalf of the flag Administration in the issuance of the IMO MODU Code Safety Certificate, compliance with the requirements as per 4.12 or 4.13 of the 2009 IMO MODU Code for offshore barges are to be verified. If the unit has the mooring arrangement as the sole means of position keeping (i.e., DP system is not installed or does not have the required redundancy), then compliance with 4.12 is to be demonstrated through the submission of a mooring analysis for both intact and one-line broken conditions indicating that, for the limiting operating conditions specified by the Owners for the mooring system, the safety factors of the mooring line loads and the holding capacity of the anchors comply with a recognized standard. Reference is made to the IMO Guidelines on Anchoring Systems for MODUs (MSC/Circ. 737).

End of Commentary

3 Equipment With E (2016)

The equipment weight and size for all barges, where the symbol E is requested, are to be in accordance with 3-3-1/21 TABLE 1. Anchor windlass or winch is to be in accordance with 3-3-1/19 of this section.

5 Equipment for Manned Barges (1 July 2022)

Manned barges for which the symbol E is not requested in the classification designation are to have equipment in accordance with 3-3-1/21 Table 2. Wire rope of equal breaking strength to the required tabular normal strength steel (Grade 1) stud-link bower chain will be approved in lieu of the required anchor chain, but the length of the wire rope is to be not less than 1.5 times the tabular chain length. Anchor windlass or winch is to be in accordance with 3-3-1/19 of this section. For accommodation barges, refer to 5-3-6/19.5.

7 Equipment for Unmanned Barges

Equipment will not be required as condition of classification on unmanned barges unless the symbol E is requested.

9 Equipment Weight and Size (2012)

Anchors and chains are to be in accordance with 3-3-1/21 TABLE 1 or 3-3-1/21 TABLE 2, as appropriate, and the numbers, weights and sizes of these are to be regulated by the equipment number EN obtained from the following equation:

SI and MKS Units

$$\text{Equipment Number (EN)} = \Delta^{2/3} + 2(Ba + bh) + 0.1A$$

US Units

$$\text{Equipment Number (EN)} = 1.012 \Delta^{2/3} + 0.186(Ba + bh) + 9.29A \cdot 10^{-3}$$

where

- Δ = molded displacement, in tonnes (tons), to the summer load waterline
- B = molded breadth, in meters (feet), as defined in 3-1-1/5
- a = freeboard, in meters (feet), amidships from the summer load waterline
- b = maximum breadth, in meters (feet), of the superstructure or deckhouse
- h = $h_1 + h_2 + h_3 + \dots$, as shown in 3-3-1/9 FIGURE 1. In the calculation of h , sheer, camber and trim may be neglected.
- h_1, h_2, h_3, \dots = height, in m (ft), on the centerline of each tier of houses having a breadth greater than $B/4$
- A = profile area, in m^2 (ft^2), of the hull, superstructure and houses above the summer load waterline which are within the Rule length L . Superstructures or deckhouses having a breadth less than $0.25B$ may be excluded. Screens and bulwarks more than 1.5 m (4.9 ft) in height are to be regarded as parts of houses when calculating h and A . The height of the hatch coamings and that of any deck cargo, such as containers, may be disregarded when determining h and A . With regard to determining A , when a bulwark is more than 1.5 m (4.9 ft) high, the area shown below as A_2 should be included in A .

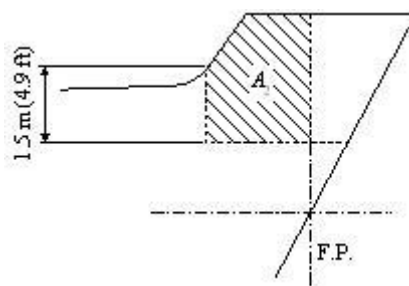
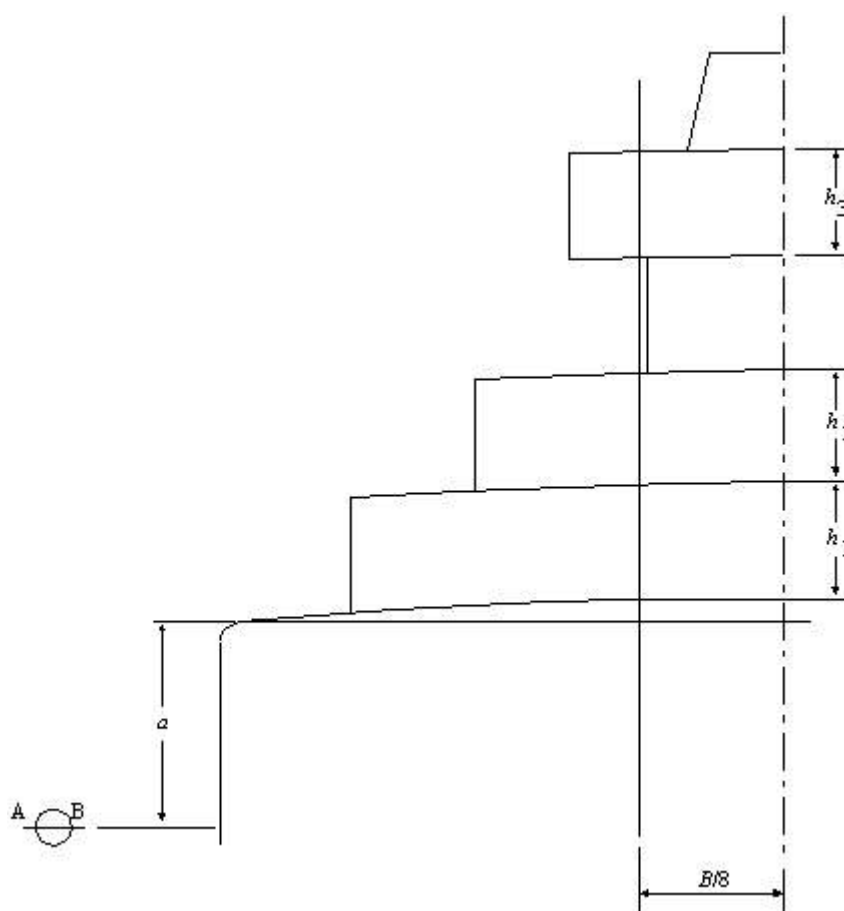


FIGURE 1
Effective Heights of Deckhouses



11 Tests

Tests are to be in accordance with the requirements of Chapter 2 of the ABS *Rules for Materials and Welding (Part 2)*.

13 Anchor Types

Anchors may be either of the ordinary or stockless type. The weight of the head of a stockless anchor, including pins and fittings, is not to be less than three-fifths of the total weight of the anchor. Where specifically requested by the Owners, ABS is prepared to give consideration to the use of special types of

anchors and where these are of proven superior holding ability, consideration may also be given to some reduction in the weight, up to a maximum of 25% from the weight specified in 3-3-1/21 TABLE 1 and 3-1-1/21 Table 2. In such cases, an appropriate notation will be made in the *Record*.

15 Anchor Chain

Where the equipment number *EN* is less than 110, unstudded short-link chain may be employed in lieu of stud-link chain. The unstudded short-link chain is to have a breaking strength not less than the required tabular normal strength steel (Grade 1) stud-link bower chain. The unstudded short-link chain is to comply with the requirements of 2-2-2/25 of the *ABS Rules for Materials and Welding (Part 2)*.

17 Hawsers and Towlines

Hawser and towline sizes are listed in 3-3-1/21 TABLE 3 as a guide, but this equipment is not required as a condition of classification.

Where the tabular breaking strength exceeds 490 kN (50,000 kgf, 110,200 lbf), the breaking strength and the number of individual hawsers given in 3-3-1/21 TABLE 3 may be modified, provided that their product is not less than that of the breaking strength and the number of hawsers given in 3-3-1/21 TABLE 3. For barges having an *A/EN* ratio greater than 0.9 for SI/MKS units (9.7 for US units), the number of hawsers given in 3-3-1/21 TABLE 3 is to be increased by the number given below:

<i>A/EN</i>		<i>Increase number of hawsers by</i>
<i>SI or MKS Units</i>	<i>US Units</i>	
above 0.9 up to 1.1	above 9.7 up to 11.8	1
above 1.1 up to 1.2	above 11.8 up to 12.9	2
above 1.2	above 12.9	3

A = defined in 3-3-1/9

EN = determined by the equation in 3-3-1/9

19 Windlass or Winch

19.1 General (2011)

Construction and installation of all windlasses and winches used for anchoring are to be carried out in accordance with the following requirements, and to the satisfaction of the Surveyor. In general, the design is to conform to an applicable standard or code of practice. As a minimum, standards or practices are to indicate strength, performance and testing criteria.

The manufacturer or builder is to submit the following, as applicable. Plans or data should generally be submitted electronically to ABS. However, hard copies will also be accepted.

19.1.1 Plans

- i)* Arrangement and details of the windlass or winch, drums, brakes, shaft, gears, coupling bolts, wildcat, sheaves, pulleys and foundation.
- ii)* Electric one line diagram
- iii)* Piping system diagrams
- iv)* Control arrangements

Plans or data are to show complete details, including power ratings, working pressures, welding details, material specifications, pipe and electric cable specifications, etc.

19.1.2 Calculations

Detailed stress calculations for the applicable system components listed in 3-3-1/19.1.1.i above. The calculations are to be based on the breaking strength of the chain or wire rope, are to indicate maximum torque or load to which the unit will be subjected and also show compliance with either applicable sections of the *ABS Marine Vessel Rules*, such as Sections 4-3-1 and 4-3-2 for the gears and shafts, or to other recognized standard or code of practice.

21 Hawse Pipes

Hawse pipes are to be of ample size and strength. They are to have full rounded flanges and the least possible lead in order to minimize the nip on the cables. They are to be securely attached to thick doubling or insert plates by continuous welds the size of which are to be in accordance with 3-2-12 for the plating thickness and type of joint selected. When in position, they are to be thoroughly tested for watertightness by means of a hose in which the water pressure is not to be less than 2 bar (2.1 kgf/cm², 30 lbf/in²). Hawse pipes for stockless anchors are to provide ample clearances. The anchors are to be shipped and unshipped so that the Surveyor may be satisfied that there is no risk of the anchor jamming in the hawse pipe. Care is to be taken to ensure a fair lead for the chain from the windlass to the hawse pipes and to the chain pipes.

TABLE 1A
Equipment for Barges with ⓔ (SI, MKS Units)

<i>SI, MKS Units</i>							
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Stockless Bower Anchors</i>		<i>Chain Cable Stud Link Bower Chain</i>			
		<i>Number</i>	<i>Mass per Anchor,kg</i>	<i>Length, m</i>	<i>Diameter</i>		
					<i>Normal-Strength Steel (Grade 1), mm</i>	<i>High-Strength Steel (Grade 2), mm</i>	<i>Extra High-Strength Steel (Grade 3), mm</i>
UA1	30	2	80	165	11	—	—
UA2	40	2	100	192.5	11	—	—
UA3	50	2	120	192.5	12.5	—	—
UA4	60	2	140	192.5	12.5	—	—
UA5	70	2	160	220	14	12.5	—
UA6	80	2	180	220	14	12.5	—
UA7	90	2	210	220	16	14	—
UA8	100	2	240	220	16	14	—
UA9	110	2	270	247.5	17.5	16	—
UA10	120	2	300	247.5	17.5	16	—
UA11	130	2	340	275	19	17.5	—
UA12	140	2	390	275	19	17.5	—
U6	150	2	480	275	22	19	—
U7	175	2	570	302.5	24	20.5	—
U8	205	2	660	302.5	26	22	20.5

<i>SI, MKS Units</i>							
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Stockless Bower Anchors</i>		<i>Chain Cable Stud Link Bower Chain</i>			
		<i>Number</i>	<i>Mass per Anchor,kg</i>	<i>Length, m</i>	<i>Diameter</i>		
					<i>Normal-Strength Steel (Grade 1), mm</i>	<i>High-Strength Steel (Grade 2), mm</i>	<i>Extra High-Strength Steel (Grade 3), mm</i>
U9	240	2	780	330	28	24	22
U10	280	2	900	357.5	30	26	24
U11	320	2	1020	357.5	32	28	24
U12	360	2	1140	385	34	30	26
U13	400	2	1290	385	36	32	28
U14	450	2	1440	412.5	38	34	30
U15	500	2	1590	412.5	40	34	30
U16	550	2	1740	440	42	36	32
U17	600	2	1920	440	44	38	34
U18	660	2	2100	440	46	40	36
U19	720	2	2280	467.5	48	42	36
U20	780	2	2460	467.5	50	44	38
U21	840	2	2640	467.5	52	46	40
U22	910	2	2850	495	54	48	42
U23	980	2	3060	495	56	50	44
U24	1060	2	3300	495	58	50	46
U25	1140	2	3540	522.5	60	52	46
U26	1220	2	3780	522.5	62	54	48
U27	1300	2	4050	522.5	64	56	50
U28	1390	2	4320	550	66	58	50
U29	1480	2	4590	550	68	60	52
U30	1570	2	4890	550	70	62	54
U31	1670	2	5250	577.5	73	64	56
U32	1790	2	5610	577.5	76	66	58
U33	1930	2	6000	577.5	78	68	60

<i>SI, MKS Units</i>							
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Stockless Bower Anchors</i>		<i>Chain Cable Stud Link Bower Chain</i>			
		<i>Number</i>	<i>Mass per Anchor,kg</i>	<i>Length, m</i>	<i>Diameter</i>		
					<i>Normal-Strength Steel (Grade 1), mm</i>	<i>High-Strength Steel (Grade 2), mm</i>	<i>Extra High-Strength Steel (Grade 3), mm</i>
U34	2080	2	6450	605	81	70	62
U35	2230	2	6900	605	84	73	64
U36	2380	2	7350	605	87	76	66
U37	2530	2	7800	632.5	90	78	68
U38	2700	2	8300	632.5	92	81	70
U39	2870	2	8700	632.5	95	84	73
U40	3040	2	9300	660	97	84	76
U41	3210	2	9900	660	100	87	78
U42	3400	2	10500	660	102	90	78
U43	3600	2	11100	687.5	105	92	81
U44	3800	2	11700	687.5	107	95	84
U45	4000	2	12300	687.5	111	97	87
U46	4200	2	12900	715	114	100	87
U47	4400	2	13500	715	117	102	90
U48	4600	2	14100	715	120	105	92
U49	4800	2	14700	742.5	122	107	95
U50	5000	2	15400	742.5	124	111	97
U51	5200	2	16100	742.5	127	111	97
U52	5500	2	16900	742.5	130	114	100
U53	5800	2	17800	742.5	132	117	102
U54	6100	2	18800	742.5	—	120	107
U55	6500	2	20000	770	—	124	111
U56	6900	2	21500	770	—	127	114
U57	7400	2	23000	770	—	132	117
U58	7900	2	24500	770	—	137	122

<i>SI, MKS Units</i>							
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Stockless Bower Anchors</i>		<i>Chain Cable Stud Link Bower Chain</i>			
		<i>Number</i>	<i>Mass per Anchor,kg</i>	<i>Length, m</i>	<i>Diameter</i>		
					<i>Normal-Strength Steel (Grade 1), mm</i>	<i>High-Strength Steel (Grade 2), mm</i>	<i>Extra High-Strength Steel (Grade 3), mm</i>
U59	8400	2	26000	770	—	142	127
U60	8900	2	27500	770	—	147	132
U61	9400	2	29000	770	—	152	132
U62	10000	2	31000	770	—	—	137
U63	10700	2	33000	770	—	—	142
U64	11500	2	35500	770	—	—	147
U65	12400	2	38500	770	—	—	152
U66	13400	2	42000	770	—	—	157
U67	14600	2	46000	770	—	—	162

* For intermediate values of equipment number, use equipment complement in sizes and weights given for the lower equipment number in the table.

TABLE 1B
Equipment for Barges with ⓔ (US Units)

<i>US Units</i>							
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Stockless Bower Anchors</i>		<i>Chain Cable Stud Link Bower Chain</i>			
		<i>Number</i>	<i>Mass per Anchor, pounds</i>	<i>Length, fathoms</i>	<i>Diameter</i>		
					<i>Normal-Strength Steel (Grade 1), inches</i>	<i>High-Strength Steel (Grade 2), inches</i>	<i>Extra High-Strength Steel (Grade 3), inches</i>
UA1	30	2	176	90	$\frac{7}{16}$	—	—
UA2	40	2	220	105	$\frac{7}{16}$	—	—
UA3	50	2	265	105	$\frac{1}{2}$	—	—
UA4	60	2	310	105	$\frac{1}{2}$	—	—
UA5	70	2	350	120	$\frac{9}{16}$	$\frac{1}{2}$	—
UA6	80	2	395	120	$\frac{9}{16}$	$\frac{1}{2}$	—
UA7	90	2	460	120	$\frac{5}{8}$	$\frac{9}{16}$	—
UA8	100	2	530	120	$\frac{5}{8}$	$\frac{9}{16}$	—
UA9	110	2	595	135	$\frac{11}{16}$	$\frac{5}{8}$	—

<i>US Units</i>							
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Stockless Bower Anchors</i>		<i>Chain Cable Stud Link Bower Chain</i>			
		<i>Number</i>	<i>Mass per Anchor, pounds</i>	<i>Length, fathoms</i>	<i>Diameter</i>		
					<i>Normal-Strength Steel (Grade 1), inches</i>	<i>High-Strength Steel (Grade 2), inches</i>	<i>Extra High-Strength Steel (Grade 3), inches</i>
UA10	120	2	660	135	11/16	5/8	—
UA11	130	2	750	150	3/4	11/16	—
UA12	140	2	860	150	3/4	11/16	—
U6	150	2	1060	150	7/8	3/4	—
U7	175	2	1255	165	15/16	13/16	—
U8	205	2	1455	165	1	7/8	13/16
U9	240	2	1720	180	1 1/8	15/16	7/8
U10	280	2	1985	195	1 3/16	1	15/16
U11	320	2	2250	195	1 1/4	1 1/8	15/16
U12	360	2	2510	210	1 5/16	1 3/16	1
U13	400	2	2840	210	1 7/16	1 1/4	1 1/8
U14	450	2	3170	225	1 1/2	1 5/16	1 3/16
U15	500	2	3500	225	1 9/16	1 5/16	1 3/16
U16	550	2	3830	240	1 5/8	1 7/16	1 1/4
U17	600	2	4230	240	1 3/4	1 1/2	1 5/16
U18	660	2	4630	240	1 13/16	1 9/16	1 7/16
U19	720	2	5020	255	1 7/8	1 5/8	1 7/16
U20	780	2	5420	255	2	1 3/4	1 1/2
U21	840	2	5820	255	2 1/16	1 13/16	1 9/16
U22	910	2	6280	270	2 1/8	1 7/8	1 5/8
U23	980	2	6740	270	2 3/16	1 15/16	1 3/4
U24	1060	2	7270	270	2 5/16	2	1 13/16
U25	1140	2	7800	285	2 3/8	2 1/16	1 13/16
U26	1220	2	8330	285	2 7/16	2 1/8	1 7/8
U27	1300	2	8930	285	2 1/2	2 3/16	2

<i>US Units</i>							
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Stockless Bower Anchors</i>		<i>Chain Cable Stud Link Bower Chain</i>			
		<i>Number</i>	<i>Mass per Anchor, pounds</i>	<i>Length, fathoms</i>	<i>Diameter</i>		
					<i>Normal-Strength Steel (Grade 1), inches</i>	<i>High-Strength Steel (Grade 2), inches</i>	<i>Extra High-Strength Steel (Grade 3), inches</i>
U28	1390	2	9520	300	2 ⁵ / ₈	2 ⁵ / ₁₆	2
U29	1480	2	10220	300	2 ¹¹ / ₁₆	2 ³ / ₈	2 ¹ / ₁₆
U30	1570	2	10800	300	2 ³ / ₄	2 ⁷ / ₁₆	2 ¹ / ₈
U31	1670	2	11600	315	2 ⁷ / ₈	2 ¹ / ₂	2 ³ / ₁₆
U32	1790	2	12400	315	3	2 ⁵ / ₈	2 ⁵ / ₁₆
U33	1930	2	13200	315	3 ¹ / ₁₆	2 ¹¹ / ₁₆	2 ³ / ₈
U34	2080	2	14200	330	3 ³ / ₁₆	2 ³ / ₄	2 ⁷ / ₁₆
U35	2230	2	15200	330	3 ⁵ / ₁₆	2 ⁷ / ₈	2 ¹ / ₂
U36	2380	2	16200	330	3 ⁷ / ₁₆	3	2 ⁵ / ₈
U37	2530	2	17200	345	3 ⁹ / ₁₆	3 ¹ / ₁₆	2 ¹¹ / ₁₆
U38	2700	2	18300	345	3 ⁵ / ₈	3 ³ / ₁₆	2 ³ / ₄
U39	2870	2	19200	345	3 ³ / ₄	3 ⁵ / ₁₆	2 ⁷ / ₈
U40	3040	2	20500	360	3 ⁷ / ₈	3 ⁵ / ₁₆	3
U41	3210	2	21800	360	3 ¹⁵ / ₁₆	3 ⁷ / ₁₆	3 ¹ / ₁₆
U42	3400	2	23100	360	4	3 ⁹ / ₁₆	3 ¹ / ₁₆
U43	3600	2	24500	375	4 ¹ / ₈	3 ⁵ / ₈	3 ³ / ₁₆
U44	3800	2	25800	375	4 ¹ / ₄	3 ³ / ₄	3 ⁵ / ₁₆
U45	4000	2	27100	375	4 ³ / ₈	3 ⁷ / ₈	3 ⁷ / ₁₆
U46	4200	2	28400	390	4 ¹ / ₂	3 ¹⁵ / ₁₆	3 ⁷ / ₁₆
U47	4400	2	29800	390	4 ⁵ / ₈	4	3 ⁹ / ₁₆
U48	4600	2	31100	390	4 ³ / ₄	4 ¹ / ₈	3 ⁵ / ₈
U49	4800	2	32400	405	4 ³ / ₄	4 ¹ / ₄	3 ³ / ₄
U50	5000	2	33900	405	4 ⁷ / ₈	4 ³ / ₈	3 ⁷ / ₈
U51	5200	2	35500	405	5	4 ³ / ₈	3 ⁷ / ₈
U52	5500	2	37200	405	5 ¹ / ₈	4 ¹ / ₂	3 ¹⁵ / ₁₆

<i>US Units</i>							
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Stockless Bower Anchors</i>		<i>Chain Cable Stud Link Bower Chain</i>			
		<i>Number</i>	<i>Mass per Anchor, pounds</i>	<i>Length, fathoms</i>	<i>Diameter</i>		
					<i>Normal-Strength Steel (Grade 1), inches</i>	<i>High-Strength Steel (Grade 2), inches</i>	<i>Extra High-Strength Steel (Grade 3), inches</i>
U53	5800	2	39200	405	5 1/8	4 5/8	4
U54	6100	2	41400	405	—	4 3/4	4 1/4
U55	6500	2	44000	420	—	4 7/8	4 3/8
U56	6900	2	47400	420	—	5	4 1/2
U57	7400	2	50700	420	—	5 1/8	4 5/8
U58	7900	2	54000	420	—	5 3/8	4 3/4
U59	8400	2	57300	420	—	5 5/8	5
U60	8900	2	60600	420	—	5 3/4	5 1/8
U61	9400	2	63900	420	—	6	5 1/8
U62	10000	2	68000	420	—	—	5 3/8
U63	10700	2	72500	420	—	—	5 5/8
U64	11500	2	78000	420	—	—	5 3/4
U65	12400	2	85000	420	—	—	6
U66	13400	2	92500	420	—	—	6 1/8
U67	14600	2	101500	420	—	—	6 3/8

* For intermediate values of equipment number, use equipment complement in sizes and weights given for the lower equipment number in the table.

TABLE 2A
Equipment for Manned Barges without ⓔ (SI, MKS Units)

<i>SI, MKS Units</i>							
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Stockless Bower Anchors</i>		<i>Chain Cable Stud Link Bower Chain</i>			
		<i>Number</i>	<i>Mass per Anchor, kg</i>	<i>Length, m</i>	<i>Diameter</i>		
					<i>Normal-Strength Steel (Grade 1), mm</i>	<i>High-Strength Steel (Grade 2), mm</i>	<i>Extra High-Strength Steel (Grade 3), mm</i>
MA1	30	1	80	82	11	—	—
MA2	40	1	100	97	11	—	—
MA3	50	1	120	97	12.5	—	—

<i>SI, MKS Units</i>							
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Stockless Bower Anchors</i>		<i>Chain Cable Stud Link Bower Chain</i>			
		<i>Number</i>	<i>Mass per Anchor, kg</i>	<i>Length, m</i>	<i>Diameter</i>		
					<i>Normal-Strength Steel (Grade 1), mm</i>	<i>High-Strength Steel (Grade 2), mm</i>	<i>Extra High-Strength Steel (Grade 3), mm</i>
MA4	60	1	140	97	12.5	—	—
MA5	70	1	160	110	14	12.5	—
MA6	80	1	180	110	14	12.5	—
MA7	90	1	210	110	16	14	—
MA8	100	1	240	110	16	14	—
MA9	110	1	270	124	17.5	16	—
MA10	120	1	300	124	17.5	16	—
MA11	130	1	340	137	19	17.5	—
MA12	140	1	390	137	19	17.5	—
M6	150	1	480	137	22	19	—
M7	175	1	570	151	24	20.5	—
M8	205	1	660	151	26	22	20.5
M9	240	1	780	165	28	24	22
M10	280	1	900	179	30	26	24
M11	320	1	1020	179	32	28	24
M12	360	1	1140	192	34	30	26
M13	400	1	1290	192	36	32	28
M14	450	1	1440	206	38	34	30
M15	500	1	1590	206	40	34	30
M16	550	1	1740	220	42	36	32
M17	600	1	1920	220	44	38	34
M18	660	1	2100	220	46	40	36
M19	720	1	2280	234	48	42	36
M20	780	1	2460	234	50	44	38
M21	840	1	2640	234	52	46	40

<i>SI, MKS Units</i>							
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Stockless Bower Anchors</i>		<i>Chain Cable Stud Link Bower Chain</i>			
		<i>Number</i>	<i>Mass per Anchor, kg</i>	<i>Length, m</i>	<i>Diameter</i>		
					<i>Normal-Strength Steel (Grade 1), mm</i>	<i>High-Strength Steel (Grade 2), mm</i>	<i>Extra High-Strength Steel (Grade 3), mm</i>
M22	910	1	2850	247	54	48	42
M23	980	1	3060	247	56	50	44
M24	1060	1	3300	247	58	50	46
M25	1140	1	3540	261	60	52	46
M26	1220	1	3780	261	62	54	48
M27	1300	1	4050	261	64	56	50
M28	1390	1	4320	275	66	58	50
M29	1480	1	4590	275	68	60	52
M30	1570	1	4890	275	70	62	54
M31	1670	1	5250	289	73	64	56
M32	1790	1	5610	289	76	66	58
M33	1930	1	6000	289	78	68	60
M34	2080	1	6450	302	81	70	62
M35	2230	1	6900	302	84	73	64
M36	2380	1	7350	302	87	76	66
M37	2530	1	7800	316	90	78	68
M38	2700	1	8300	316	92	81	70
M39	2870	1	8700	316	95	84	73
M40	3040	1	9300	330	97	84	76
M41	3210	1	9900	330	100	87	78
M42	3400	1	10500	330	102	90	78
M43	3600	1	11100	344	105	92	81
M44	3800	1	11700	344	107	95	84
M45	4000	1	12300	344	111	97	87
M46	4200	1	12900	357	114	100	87

<i>SI, MKS Units</i>							
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Stockless Bower Anchors</i>		<i>Chain Cable Stud Link Bower Chain</i>			
		<i>Number</i>	<i>Mass per Anchor, kg</i>	<i>Length, m</i>	<i>Diameter</i>		
					<i>Normal-Strength Steel (Grade 1), mm</i>	<i>High-Strength Steel (Grade 2), mm</i>	<i>Extra High-Strength Steel (Grade 3), mm</i>
M47	4400	1	13500	357	117	102	90
M48	4600	1	14100	357	120	105	92
M49	4800	1	14700	371	122	107	95
M50	5000	1	15400	371	124	111	97
M51	5200	1	16100	371	127	111	97
M52	5500	1	16900	371	130	114	100
M53	5800	1	17800	371	132	117	102
M54	6100	1	18800	371	—	120	107
M55	6500	1	20000	385	—	124	111
M56	6900	1	21500	385	—	127	114
M57	7400	1	23000	385	—	132	117
M58	7900	1	24500	385	—	137	122
M59	8400	1	26000	385	—	142	127
M60	8900	1	27500	385	—	147	132
M61	9400	1	29000	385	—	152	132
M62	10000	1	31000	385	—	—	137
M63	10700	1	33000	385	—	—	142
M64	11500	1	35500	385	—	—	147
M65	12400	1	38500	385	—	—	152
M66	13400	1	42000	385	—	—	157
M67	14600	1	46000	385	—	—	162

* For intermediate values of equipment number, use equipment complement in sizes and weights given for the lower equipment number in the table.

TABLE 2B
Equipment for Manned Barges without ⓔ (US Units)

<i>US Units</i>							
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Stockless Bower Anchors</i>		<i>Chain Cable Stud Link Bower Chain</i>			
		<i>Number</i>	<i>Mass per Anchor, pounds</i>	<i>Length, fathoms</i>	<i>Diameter</i>		
					<i>Normal-Strength Steel (Grade 1), inches</i>	<i>High-Strength Steel (Grade 2), inches</i>	<i>Extra High-Strength Steel (Grade 3), inches</i>
MA1	30	1	176	45	7/16	—	—
MA2	40	1	220	53	7/16	—	—
MA3	50	1	265	53	1/2	—	—
MA4	60	1	310	53	1/2	—	—
MA5	70	1	350	60	9/16	1/2	—
MA6	80	1	395	60	9/16	1/2	—
MA7	90	1	460	60	5/8	9/16	—
MA8	100	1	530	60	5/8	9/16	—
MA9	110	1	595	68	11/16	5/8	—
MA10	120	1	660	68	11/16	5/8	—
MA11	130	1	750	75	3/4	11/16	—
MA12	140	1	860	75	3/4	11/16	—
M6	150	1	1060	75	7/8	3/4	—
M7	175	1	1255	83	15/16	13/16	—
M8	205	1	1455	83	1	7/8	13/16
M9	240	1	1720	90	1 1/8	15/16	7/8
M10	280	1	1985	98	1 3/16	1	15/16
M11	320	1	2250	98	1 1/4	1 1/8	15/16
M12	360	1	2510	105	1 5/16	1 3/16	1
M13	400	1	2840	105	1 7/16	1 1/4	1 1/8
M14	450	1	3170	113	1 1/2	1 5/16	1 3/16
M15	500	1	3500	113	1 9/16	1 5/16	1 3/16
M16	550	1	3830	120	1 5/8	1 7/16	1 1/4
M17	600	1	4230	120	1 3/4	1 1/2	1 5/16

<i>US Units</i>							
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Stockless Bower Anchors</i>		<i>Chain Cable Stud Link Bower Chain</i>			
		<i>Number</i>	<i>Mass per Anchor, pounds</i>	<i>Length, fathoms</i>	<i>Diameter</i>		
					<i>Normal-Strength Steel (Grade 1), inches</i>	<i>High-Strength Steel (Grade 2), inches</i>	<i>Extra High-Strength Steel (Grade 3), inches</i>
M18	660	1	4630	120	1 ¹³ / ₁₆	1 ⁹ / ₁₆	1 ⁷ / ₁₆
M19	720	1	5020	128	1 ⁷ / ₈	1 ⁵ / ₈	1 ⁷ / ₁₆
M20	780	1	5420	128	2	1 ³ / ₄	1 ¹ / ₂
M21	840	1	5820	128	2 ¹ / ₁₆	1 ¹³ / ₁₆	1 ⁹ / ₁₆
M22	910	1	6230	135	2 ¹ / ₈	1 ⁷ / ₈	1 ⁵ / ₈
M23	980	1	6740	135	2 ³ / ₁₆	1 ¹⁵ / ₁₆	1 ³ / ₄
M24	1060	1	7270	135	2 ⁵ / ₁₆	2	1 ¹³ / ₁₆
M25	1140	1	7800	143	2 ³ / ₈	2 ¹ / ₁₆	1 ¹³ / ₁₆
M26	1220	1	8330	143	2 ⁷ / ₁₆	2 ¹ / ₈	1 ⁷ / ₈
M27	1300	1	8930	143	2 ¹ / ₂	2 ³ / ₁₆	2
M28	1390	1	9520	150	2 ⁵ / ₈	2 ⁵ / ₁₆	2
M29	1480	1	10120	150	2 ¹¹ / ₁₆	2 ³ / ₈	2 ¹ / ₁₆
M30	1570	1	10800	150	2 ³ / ₄	2 ⁷ / ₁₆	2 ¹ / ₈
M31	1670	1	11600	158	2 ⁷ / ₈	2 ¹ / ₂	2 ³ / ₁₆
M32	1790	1	12400	158	3	2 ⁵ / ₈	2 ⁵ / ₁₆
M33	1930	1	13200	158	3 ¹ / ₁₆	2 ¹¹ / ₁₆	2 ³ / ₈
M34	2080	1	14200	165	3 ³ / ₁₆	2 ³ / ₄	2 ⁷ / ₁₆
M35	2230	1	15200	165	3 ⁵ / ₁₆	2 ⁷ / ₈	2 ¹ / ₂
M36	2380	1	16200	165	3 ⁷ / ₁₆	3	2 ⁵ / ₈
M37	2530	1	17200	173	3 ⁹ / ₁₆	3 ¹ / ₁₆	2 ¹¹ / ₁₆
M38	2700	1	18300	173	3 ⁵ / ₈	3 ³ / ₁₆	2 ³ / ₄
M39	2870	1	19200	173	3 ³ / ₄	3 ⁵ / ₁₆	2 ⁷ / ₈
M40	3040	1	20500	180	3 ⁷ / ₈	3 ⁵ / ₁₆	3
M41	3210	1	21800	180	3 ¹⁵ / ₁₆	3 ⁷ / ₁₆	3 ¹ / ₁₆
M42	3400	1	23100	180	4	3 ⁹ / ₁₆	3 ¹ / ₁₆

<i>US Units</i>							
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Stockless Bower Anchors</i>		<i>Chain Cable Stud Link Bower Chain</i>			
		<i>Number</i>	<i>Mass per Anchor, pounds</i>	<i>Length, fathoms</i>	<i>Diameter</i>		
					<i>Normal-Strength Steel (Grade 1), inches</i>	<i>High-Strength Steel (Grade 2), inches</i>	<i>Extra High-Strength Steel (Grade 3), inches</i>
M43	3600	1	24500	188	4 1/8	3 5/8	3 3/16
M44	3800	1	25800	188	4 1/4	3 3/4	3 5/16
M45	4000	1	27100	188	4 3/8	3 7/8	3 7/16
M46	4200	1	28400	195	4 1/2	3 15/16	3 7/16
M47	4400	1	29800	195	4 5/8	4	3 9/16
M48	4600	1	31100	195	4 3/4	4 1/8	3 5/8
M49	4800	1	32400	203	4 3/4	4 1/4	3 3/4
M50	5000	1	33900	203	4 7/8	4 3/8	3 7/8
M51	5200	1	35500	203	5	4 3/8	3 7/8
M52	5500	1	37200	203	5 1/8	4 1/2	3 15/16
M53	5800	1	39200	203	5 1/8	4 5/8	4
M54	6100	1	41400	203	—	4 3/4	4 1/4
M55	6500	1	44000	210	—	4 7/8	4 3/8
M56	6900	1	47400	210	—	5	4 1/2
M57	7400	1	50700	210	—	5 1/8	4 5/8
M58	7900	1	54000	210	—	5 3/8	4 3/4
M59	8400	1	57300	210	—	5 5/8	5
M60	8900	1	60600	210	—	5 3/4	5 1/8
M61	9400	1	63900	210	—	6	5 1/8
M62	10000	1	68000	210	—	—	5 3/8
M63	10700	1	72500	210	—	—	5 5/8
M64	11500	1	78000	210	—	—	5 3/4
M65	12400	1	85000	210	—	—	6
M66	13400	1	92500	210	—	—	6 1/8
M67	14600	1	101500	210	—	—	6 3/8

* For intermediate values of equipment number, use equipment complement in sizes and weights given for the lower equipment number in the table.

TABLE 3A
Towline and Hawsers (SI, MKS Units)

<i>SI, MKS Units</i>								
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Towline Wire or Rope</i>			<i>Hawsers</i>			
		<i>Length, m</i>	<i>Breaking Strength,</i>		<i>Number</i>	<i>Length of Each, m</i>	<i>Breaking Strength,</i>	
			<i>KN</i>	<i>kgf</i>			<i>kN</i>	<i>kgf</i>
UA1	30	—	—	—	—	—	—	—
UA2	40	—	—	—	—	—	—	—
UA3	50	180	98.0	10000	3	80	34.0	3475
UA4	60	180	98.0	10000	3	80	34.0	3475
UA5	70	180	98.0	10000	3	100	37.0	3775
UA6	80	180	98.0	10000	3	100	37.0	3775
UA7	90	180	98.0	10000	3	110	39.0	3975
UA8	100	180	98.0	10000	3	110	39.0	3975
UA9	110	180	98.0	10000	3	110	44.0	4475
UA10	120	180	98.0	10000	3	110	44.0	4475
UA11	130	180	98.0	10000	3	120	49.0	5000
UA12	140	180	98.0	10000	3	120	49.0	5000
U6	150	180	98.0	10000	3	120	54.0	5500
U7	175	180	112.0	11400	3	120	59.0	6000
U8	205	180	129.0	13150	4	120	64.0	6500
U9	240	180	150.0	15300	4	120	71.0	7250
U10	280	180	174.0	17750	4	140	78.0	7950
U11	320	180	207.0	21100	4	140	86.0	8770
U12	360	180	224.0	22850	4	140	93.0	9500
U13	400	180	250.0	25500	4	140	101.0	10300
U14	450	180	277.0	28250	4	140	108.0	11000
U15	500	190	306.0	31200	4	160	123.0	12500
U16	550	190	338.0	34450	4	160	132.0	13500

<i>SI, MKS Units</i>								
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Towline Wire or Rope</i>			<i>Hawsers</i>			
		<i>Length, m</i>	<i>Breaking Strength,</i>		<i>Number</i>	<i>Length of Each, m</i>	<i>Breaking Strength,</i>	
			<i>KN</i>	<i>kgf</i>			<i>kN</i>	<i>kgf</i>
U17	600	190	370.0	37700	4	160	147.0	15000
U18	660	190	406.0	41400	4	160	157.0	16000
U19	720	190	441.0	44950	4	170	172.0	17500
U20	780	190	479.0	48850	4	170	186.0	19000
U21	840	190	518.0	52800	4	170	201.0	20500
U22	910	190	559.0	57000	4	170	216.0	22000
U23	980	200	603.0	61500	4	180	230.0	23500
U24	1060	200	647.0	66000	4	180	250.0	25500
U25	1140	200	691.0	70450	4	180	270.0	27500
U26	1220	200	738.0	75250	4	180	284.0	29000
U27	1300	200	786.0	80150	4	180	309.0	31500
U28	1390	200	836.0	85250	4	180	324.0	33000
U29	1480	220	888.0	90550	5	190	324.0	33000
U30	1570	220	941.0	95950	5	190	333.0	34000
U31	1670	220	1024.0	104400	5	190	353.0	36000
U32	1790	220	1109.0	113100	5	190	378.0	38500
U33	1930	220	1168.0	119100	5	190	402.0	41000
U34	2080	240	1259.0	128400	5	200	422.0	43000
U35	2230	240	1356.0	138250	5	200	451.0	46000
U36	2380	240	1453.0	148150	5	200	480.0	49000
U37	2530	260	1471.0	150000	6	200	480.0	49000
U38	2700	260	1471.0	150000	6	200	490.0	50000
U39	2870	260	1471.0	150000	6	200	500.0	51000
U40	3040	280	1471.0	150000	6	200	520.0	53000
U41	3210	280	1471.0	150000	6	200	554.0	56500
U42	3400	280	1471.0	150000	6	200	588.0	60000

<i>SI, MKS Units</i>								
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Towline Wire or Rope</i>			<i>Hawsers</i>			
		<i>Length, m</i>	<i>Breaking Strength,</i>		<i>Number</i>	<i>Length of Each, m</i>	<i>Breaking Strength,</i>	
			<i>KN</i>	<i>kgf</i>			<i>kN</i>	<i>kgf</i>
U43	3600	300	1471.0	150000	6	200	618.0	63000
U44	3800	300	1471.0	150000	6	200	647.0	66000
U45	4000	300	1471.0	150000	7	200	647.0	66000
U46	4200	300	1471.0	150000	7	200	657.0	67000
U47	4400	300	1471.0	150000	7	200	667.0	68000
U48	4600	300	1471.0	150000	7	200	677.0	69000
U49	4800	300	1471.0	150000	7	200	686.0	70000
U50	5000	300	1471.0	150000	8	200	686.0	70000
U51	5200	300	1471.0	150000	8	200	696.0	71000
U52	5500	300	1471.0	150000	8	200	706.0	72000
U53	5800	300	1471.0	150000	9	200	706.0	72000
U54	6100	300	1471.0	150000	9	200	716.0	73000
U55	6500	300	1471.0	150000	9	200	726.0	74000
U56	6900	300	1471.0	150000	10	200	726.0	74000
U57	7400	300	1471.0	150000	11	200	726.0	74000
U58	7900	—	—	—	11	200	736.0	75000
U59	8400	—	—	—	12	200	736.0	75000
U60	8900	—	—	—	13	200	736.0	75000
U61	9400	—	—	—	14	200	736.0	75000
U62	10000	—	—	—	15	200	736.0	75000
U63	10700	—	—	—	16	200	736.0	75000
U64	11500	—	—	—	17	200	736.0	75000
U65	12400	—	—	—	18	200	736.0	75000
U66	13400	—	—	—	19	200	736.0	75000
U67	14600	—	—	—	21	200	736.0	75000

* For intermediate values of equipment number, use equipment complement in sizes and weights given for the lower equipment number in the table.

TABLE 3B
Towline and Hawsers (US Units)

<i>US Units</i>						
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Towline Wire or Rope</i>		<i>Hawsers</i>		
		<i>Length, Fathoms</i>	<i>Breaking Strength, Pounds</i>	<i>Number</i>	<i>Length of Each Fathoms</i>	<i>Breaking Strength, Pounds</i>
UA1	30	—	—	—	—	—
UA2	40	—	—	—	—	—
UA3	50	98	22000	3	44	7650
UA4	60	98	22000	3	44	7650
UA5	70	98	22000	3	55	8300
UA6	80	98	22000	3	55	8300
UA7	90	98	22000	3	60	8750
UA8	100	98	22000	3	60	8750
UA9	110	98	22000	3	60	9900
UA10	120	98	22000	3	60	9900
UA11	130	98	22000	3	66	11000
UA12	140	98	22000	3	66	11000
U6	150	98	22000	3	66	12100
U7	175	98	25200	3	66	13300
U8	205	98	29000	4	66	14400
U9	240	98	33700	4	66	16000
U10	280	98	39100	4	77	17500
U11	320	98	46300	4	77	19300
U12	360	98	50300	4	77	20900
U13	400	98	56200	4	77	22700
U14	450	98	62300	4	77	24300
U15	500	104	68800	4	88	27600
U16	550	104	76000	4	88	29700
U17	600	104	83200	4	88	33000
U18	660	104	91300	4	88	35300
U19	720	104	99100	4	93	38700

<i>US Units</i>						
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Towline Wire or Rope</i>		<i>Hawsers</i>		
		<i>Length, Fathoms</i>	<i>Breaking Strength, Pounds</i>	<i>Number</i>	<i>Length of Each Fathoms</i>	<i>Breaking Strength, Pounds</i>
U20	780	104	107700	4	93	41800
U21	840	104	116500	4	93	45200
U22	910	104	125700	4	93	48500
U23	980	109	135600	4	98	51700
U24	1060	109	145500	4	98	56200
U25	1140	109	155300	4	98	60700
U26	1220	109	166000	4	98	63800
U27	1300	109	176700	4	98	69500
U28	1390	109	187900	4	98	72800
U29	1480	120	199600	5	104	72800
U30	1570	120	211500	5	104	74900
U31	1670	120	230200	5	104	79400
U32	1790	120	249300	5	104	85000
U33	1930	120	262600	5	104	90400
U34	2080	131	283000	5	109	94900
U35	2230	131	304800	5	109	101400
U36	2380	131	326500	5	109	107900
U37	2530	142	330700	6	109	107900
U38	2700	142	330700	6	109	110200
U39	2870	142	330700	6	109	112400
U40	3040	153	330700	6	109	116900
U41	3210	153	330700	6	109	124500
U42	3400	153	330700	6	109	132200
U43	3600	164	330700	6	109	138900
U44	3800	164	330700	6	109	145500
U45	4000	164	330700	7	109	145500

<i>US Units</i>						
<i>Equipment Numeral</i>	<i>Equipment Number*</i>	<i>Towline Wire or Rope</i>		<i>Hawsers</i>		
		<i>Length, Fathoms</i>	<i>Breaking Strength, Pounds</i>	<i>Number</i>	<i>Length of Each Fathoms</i>	<i>Breaking Strength, Pounds</i>
U46	4200	164	330700	7	109	147700
U47	4400	164	330700	7	109	149900
U48	4600	164	330700	7	109	152200
U49	4800	164	330700	7	109	154200
U50	5000	164	330700	8	109	154200
U51	5200	164	330700	8	109	156500
U52	5500	164	330700	8	109	158700
U53	5800	164	330700	9	109	158700
U54	6100	164	330700	9	109	161000
U55	6500	164	330700	9	109	163200
U56	6900	164	330700	10	109	163200
U57	7400	164	330700	11	109	163200
U58	7900	—	—	11	109	165500
U59	8400	—	—	12	109	165500
U60	8900	—	—	13	109	165300
U61	9400	—	—	14	109	165500
U62	10000	—	—	15	109	165500
U63	10700	—	—	16	109	165500
U64	11500	—	—	17	109	165500
U65	12400	—	—	18	109	165500
U66	13400	—	—	19	109	165500
U67	14600	—	—	21	109	165500

* For intermediate values of equipment number, use equipment complement in sizes and weights given for the lower equipment number in the table.

Testing, Trials and Surveys During Construction - Hull

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1 General

Testing to confirm the watertightness of tanks and watertight boundaries and the structural adequacy of tanks which form the watertight subdivisions⁽¹⁾ of barges is to be completed. Verification of the weathertightness of structures and shipboard outfitting is to be carried out. The tightness of all tanks and tight boundaries of new barges and those tanks and boundaries whose structural integrity is affected by major conversions or major repairs⁽²⁾ is to be confirmed prior to the delivery of the barge or prior to the completion of the modification or repair as relevant.

Testing procedures of watertight compartments for barges built in compliance with SOLAS 1974 as amended are to be carried out in accordance with 3-4-1/3, unless:

- i)* The shipyard provides documentary evidence of the Owner's agreement to a request to the Flag Administration for an exemption from the application of Chapter II-1, Regulation 11 of SOLAS 1974 as amended, or for an equivalency agreeing that the content of 3-4-1/5 is equivalent to Chapter II-1, Regulation 11 of SOLAS 1974 as amended; and
- ii)* The above-mentioned exemption/equivalency has been granted by the responsible Flag Administration.

Testing procedures of watertight compartments are to be carried out in accordance with 3-4-1/5 for barges not built in compliance with SOLAS 1974 as amended and those barges built in compliance with SOLAS 1974 as amended for which:

- i)* The shipyard provides documentary evidence of the Owner's agreement to a request to the Flag Administration for an exemption from the application of Chapter II-1, Regulation 11 of SOLAS 1974 as amended, or for an equivalency agreeing that the content of 3-4-1/5 is equivalent to Chapter II-1, Regulation 11 of SOLAS 1974 as amended; and
- ii)* The above-mentioned exemption/equivalency has been granted by the responsible Flag Administration.

Notes:

- 1** Watertight subdivision means the transverse and longitudinal subdivisions of the barge required to satisfy the subdivision requirements of SOLAS Chapter II-1.
- 2** Major repair means a repair affecting structural integrity.

3 Testing Requirements for Barges Built in Compliance with SOLAS 1974 as Amended

3.1 Application

All gravity tanks which are subjected to vapor pressure not greater than 0.7 bars (0.7 kgf/cm², 10 psi) and other boundaries required to be watertight or weathertight are to be tested in accordance with this Subsection and proven to be tight or structurally adequate as follows:

3.1.1

Gravity Tanks for their structural adequacy and tightness,

3.1.2

Watertight Boundaries Other Than Tank Boundaries for their watertightness, and

3.1.3

Weathertight Boundaries for their weathertightness.

For the testing of cargo containment systems of liquefied gas carriers, the requirements in 5C-8-4/20 of the *Marine Vessel Rules* will apply.

Testing of structures not listed in 3-4-1/3 TABLE 1 and 3-4-1/3 TABLE 2 is to be specially considered.

3.3 Test Types and Definitions

3.3.1

The following two types of test are specified in this requirement.

3.3.1(a) Structural Test. A test to verify the structural adequacy of tank construction. This may be a hydrostatic test or, where the situation warrants, a hydropneumatic test.

3.3.1(b) Leak Test. A test to verify the tightness of a boundary. Unless a specific test is indicated, this may be a hydrostatic/hydropneumatic test or an air test. A hose test may be considered an acceptable form of leak test for certain boundaries, as indicated by Note 3 of 3-4-1/3 TABLE 1.

3.3.2

The definition of each test type is as follows:

<i>Hydrostatic Test: (Leak and Structural)</i>	A test wherein a space is filled with a liquid to a specified head.
<i>Hydropneumatic Test: (Leak and Structural)</i>	A test combining a hydrostatic test and an air test, wherein a space is partially filled with a liquid and pressurized with air.
<i>Hose Test: (Leak)</i>	A test to verify the tightness of a joint by a jet of water with the joint visible from the opposite side.
<i>Air Test: (Leak)</i>	A test to verify tightness by means of air pressure differential and leak indicating solution. It includes tank air test and joint air tests, such as <i>compressed air fillet weld tests</i> and <i>vacuum box tests</i> .
<i>Compressed Air Fillet Weld Test: (Leak)</i>	An air test of fillet welded tee joints wherein leak indicating solution is applied on fillet welds.
<i>Vacuum Box Test: (Leak)</i>	A box over a joint with leak indicating solution applied on the welds. A vacuum is created inside the box to detect any leaks.

<i>Ultrasonic Test: (Leak)</i>	A test to verify the tightness of the sealing of closing devices such as hatch covers by means of ultrasonic detection techniques.
<i>Penetration Test: (Leak)</i>	A test to verify that no visual dye penetrant indications of potential continuous leakages exist in the boundaries of a compartment by means of low surface tension liquids (i.e. dye penetrant test).

3.5 Test Procedures

3.5.1 General

Tests are to be carried out in the presence of a Surveyor at a stage sufficiently close to the completion of work with all hatches, doors, windows, etc., installed and all penetrations including pipe connections fitted, and before any ceiling and cement work is applied over the joints. Specific test requirements are given in 3-4-1/3.5.4 and 3-4-1/3 TABLE 1. For the timing of the application of coating and the provision of safe access to joints, see 3-4-1/3.5.5, 3-4-1/3.5.6, and 3-4-1/3 TABLE 3.

3.5.2 Structural Test Procedures

Type and Time of Test. Where a structural test is specified in 3-4-1/3 TABLE 1 or 3-4-1/3 TABLE 13, a hydrostatic test in accordance with 3-4-1/3.5.4(a) will be acceptable. Where practical limitations (strength of building berth, light density of liquid, etc.) prevent the performance of a hydrostatic test, a hydropneumatic test in accordance with 3-4-1/3.5.4(b) may be accepted instead.

A hydrostatic test or hydropneumatic test for the confirmation of structural adequacy may be carried out while the barge is afloat, provided the results of a leak test are confirmed to be satisfactory before the barge is afloat.

3.5.2(b) Testing Schedule for New Construction or Major Structural Conversion.

- i)* Tanks which are intended to hold liquids, and which form part of the watertight subdivision of the barge⁽¹⁾, shall be tested for tightness and structural strength as indicated in 3-4-1/3 TABLE 1 and 3-4-1/3 TABLE 2.
- ii)* The tank boundaries are to be tested from at least one side. The tanks for structural test are to be selected so that all representative structural members are tested for the expected tension and compression.
- iii)* The watertight boundaries of spaces other than tanks for structural testing may be exempted, provided that the watertightness of boundaries of exempted spaces is verified by leak tests and inspections. Structural testing may not be exempted and the requirements for structural testing of tanks in 3-4-1/3.5.2(b).i. to 3-4-1/3.5.2(b).ii. shall apply, for ballast holds, chain lockers and a representative cargo hold if intended for in-port ballasting.
- iv)* Tanks which do not form part of the watertight subdivision of the barge⁽¹⁾, may be exempted from structural testing provided that the water-tightness of boundaries of exempted spaces is verified by leak tests and inspections.

Note:

* Watertight subdivision means the main transverse and longitudinal subdivisions of the barge required to satisfy the subdivision requirements of SOLAS Chapter II-1.

3.5.3 Leak Test Procedures

For the leak tests specified in 3-4-1/3 TABLE 1, tank air tests, compressed air fillet weld tests, vacuum box tests in accordance with 3-4-1/3.5.4(d) through 3-4-1/3.5.4(f), or their combination, will be acceptable. Hydrostatic or hydropneumatic tests may also be accepted as leak tests provided that 3-4-1/3.5.5, 3-4-1/3.5.6, and 3-4-1/3.5.7 are complied with. Hose tests will also be

acceptable for such locations as specified in 3-4-1/3 TABLE 1, note 3, in accordance with 3-4-1/3.5.4(c).

The application of the leak test for each type of welded joint is specified in 3-4-1/3 TABLE 3.

Air tests of joints may be carried out in the block stage provided that all work on the block that may affect the tightness of a joint is completed before the test. See also 3-4-1/3.5.5(a) for the application of final coatings and 3-4-1/3.5.6 for the safe access to joints and the summary in 3-4-1/3 TABLE 1.

3.5.4 Test Methods

3.5.4(a) Hydrostatic Test. Unless another liquid is approved, hydrostatic tests are to consist of filling the space with fresh water or sea water, whichever is appropriate for testing, to the level specified in 3-4-1/3 TABLE 1 or 3-4-1/3 TABLE 2. See also 3-4-1/3.5.7.

In cases where a tank is designed for cargo densities greater than sea water and testing is with fresh water or sea water, the testing pressure height is to simulate the actual loading for those greater cargo densities as far as practicable.

All external surfaces of the tested space are to be examined for structural distortion, bulging and buckling, other related damage and leaks.

3.5.4(b) Hydropneumatic Test. Hydropneumatic tests, where approved, are to be such that the test condition, in conjunction with the approved liquid level and supplemental air pressure, will simulate the actual loading as far as practicable. The requirements and recommendations for tank air tests in 3-4-1/3.5.4(d) will also apply to hydropneumatic tests. See also 3-4-1/3.5.7.

All external surfaces of the tested space are to be examined for structural distortion, bulging and buckling, other related damage and leaks.

3.5.4(c) Hose Test. Hose tests are to be carried out with the pressure in the hose nozzle maintained at least at 2 bar (2 kgf/cm², 30 psi) during the test. The nozzle is to have a minimum inside diameter of 12 mm (0.5 in.) and be at a perpendicular distance from the joint not exceeding 1.5 m (5 ft). The water jet is to impinge directly upon the weld.

Where a hose test is not practical because of possible damage to machinery, electrical equipment insulation or outfitting items, it may be replaced by a careful visual examination of welded connections, supported where necessary by means such as a dye penetrant test or ultrasonic leak test or the equivalent.

3.5.4(d) Tank Air test. All boundary welds, erection joints and penetrations, including pipe connections, are to be examined in accordance with approved procedure and under a stabilized pressure differential above atmospheric pressure not less than 0.15 bar (0.15 kgf/cm², 2.2 psi), with a leak indicating solution such as soapy water/detergent or a proprietary brand applied.

A U-tube with a height sufficient to hold a head of water corresponding to the required test pressure is to be arranged. The cross sectional area of the U-tube is not to be less than that of the pipe supplying air to the tank. Arrangements involving the use of two calibrated pressure gauges to verify the required test pressure may be accepted taking into account the provisions in F5.1 and F7.4 of IACS Recommendation 140, "Recommendation for Safe Precautions during Survey and Testing of Pressurized Systems".

Other effective methods of air testing, including compressed air fillet weld testing or vacuum testing, may be considered in accordance with 3-4-1/3.5.4(i).

A double inspection is to be made of tested welds. The first is to be immediately upon applying the leak indication solution; the second is to be after approximately four or five minutes, without further application of leak indication solution, in order to detect those smaller leaks which may take time to appear.

3.5.4(e) Compressed Air Fillet Weld Test. In this air test, compressed air is injected from one end of a fillet welded joint and the pressure verified at the other end of the joint by a pressure gauge. Pressure gauges are to be arranged so that an air pressure of at least 0.15 bar (0.15 kgf/cm², 2.2 psi) can be verified at each end of all passages within the portion being tested.

For limited portions of the partial penetration or fillet welded joints forming tank boundaries, such as corners and section of the weld adjacent to the testing apparatus, the attending Surveyor may accept the use of Magnetic Particle Inspection or Dye Penetration examination as an alternative to fillet air testing.

Where a leaking test of partial penetration welding is required and the root face is sufficiently large such as 6-8 mm (0.24-0.32 inch), the compressed air test is to be applied in the same manner as for a fillet weld.

3.5.4(f) Vacuum Box Test. A box (vacuum testing box) with air connections, gauges and an inspection window is placed over the joint with a leak indicating solution applied to the weld cap vicinity. The air within the box is removed by an ejector to create a vacuum of 0.20 bar (0.20 kgf/cm², 2.9 psi) – 0.26 bar (0.27 kgf/cm², 3.8 psi) inside the box.

3.5.4(g) Ultrasonic Test. An ultrasonic echo transmitter is to be arranged inside of a compartment and a receiver is to be arranged on the outside. The watertight/weathertight boundaries of the compartment are scanned with the receiver in order to detect an ultrasonic leak indication. A location where sound is detectable by the receiver indicates a leakage in the sealing of the compartment.

3.5.4(h) Penetration Test. A test of butt welds or other weld joints uses the application of a low surface tension liquid at one side of a compartment boundary or structural arrangement. If no liquid is detected on the opposite sides of the boundaries after the expiration of a defined period of time, this indicates tightness of the boundaries. In certain cases, a developer solution may be painted or sprayed on the other side of the weld to aid leak detection.

3.5.4(i) Other Test. Other methods of testing, except as provided in 3-4-1/5, may be considered upon submission of full particulars prior to the commencement of testing.

3.5.5 Application of Coating

3.5.5(a) Final Coating. For butt joints welded by an automatic process, the final coating may be applied any time before the completion of a leak test of spaces bounded by the joints, provided that the welds have been carefully inspected visually to the satisfaction of the Surveyor.

Surveyors reserve the right to require a leak test prior to the application of final coating over automatic erection butt welds.

For all other joints, the final coating is to be applied after the completion of the leak test of the joint. See also 3-4-1/3 TABLE 1.

3.5.5(b) Temporary Coating. Any temporary coating which may conceal defects or leaks is to be applied at the time as specified for the final coating [see 3-4-1/3.5.5(a)]. This requirement does not apply to shop primer.

3.5.6 Safe Access to Joints

For leak tests, safe access to all joints under examination is to be provided. See also 3-4-1/3 TABLE 3.

3.5.7 Hydrostatic or Hydropneumatic Tightness Test

In cases where the hydrostatic or hydropneumatic tests are applied instead of a specific leak test, examined boundaries must be dew-free, otherwise small leaks are not visible.

**TABLE 1
 Testing Requirements for Tanks and Boundaries (2018)**

	<i>Tank or Boundary to be Tested</i>	<i>Test Type</i>	<i>Test Head or Pressure</i>	<i>Remarks</i>
1	Double bottom tanks ⁽⁴⁾	Leak & Structural ⁽¹⁾	The greater of <ul style="list-style-type: none"> • top of the overflow, • to 1.2 m (4 ft) above top of tank ⁽²⁾ for $L < 61$ m (200 ft), • to 0.02L above top of tank ⁽²⁾ for 61 m (200 ft) $\leq L \leq 122$ m (400 ft), • to 2.4 m (8 ft) above top of tank ⁽²⁾ for $L > 122$ m (400 ft), or • to bulkhead deck 	
2	Double bottom voids ⁽⁵⁾	Leak	See 3-4-1/3.5.4(d) , as applicable	Including pump room double bottom and bunker tank protection double hull required by MARPOL Annex I
3	Double side tanks	Leak & Structural ⁽¹⁾	The greater of <ul style="list-style-type: none"> • top of the overflow, • to 1.2 m (4 ft) above top of tank ⁽²⁾ for $L < 61$ m (200 ft), • - to 2.4 m (8 ft) above top of tank ⁽²⁾, or • to 2.4 m (8 ft) above top of tank ⁽²⁾ for $L > 122$ m (400 ft), or • to bulkhead deck 	
4	Double side voids	Leak	See 3-4-1/3.5.4(d) through 3-4-1/3.5.4(f) , as applicable	

	<i>Tank or Boundary to be Tested</i>	<i>Test Type</i>	<i>Test Head or Pressure</i>	<i>Remarks</i>
5	Deep tanks other than those listed elsewhere in this table	Leak & Structural ⁽¹⁾	The greater of <ul style="list-style-type: none"> • top of the overflow, • to 1.2 m (4 ft) above top of tank ⁽²⁾ for $L < 61$ m (200 ft), • to $0.02L$ above top of tank ⁽²⁾ for 61 m (200 ft) $\leq L \leq 122$ m (400 ft), or • to 2.4 m (8 ft) above top of tank ⁽²⁾ for $L > 122$ m (400 ft) 	
6	Cargo oil tanks	Leak & Structural ⁽¹⁾	The greater of <ul style="list-style-type: none"> • top of the overflow, • to 1.2 m (4 ft) above top of tank ⁽²⁾ for $L < 61$ m (200 ft), • to $0.02L$ above top of tank ⁽²⁾ for 61 m (200 ft) $\leq L \leq 122$ m (400 ft), • to 2.4 m (8 ft) above top of tank ⁽²⁾ for $L > 122$ m (400 ft), or • top of tank ⁽²⁾ plus setting of any pressure relief valve 	
7	Ballast holds of bulk carriers	Leak & Structural ⁽¹⁾	top of cargo hatch coaming	See item 16 for hatch covers.
8	Peak tanks	Leak & Structural ⁽¹⁾	The greater of <ul style="list-style-type: none"> • top of the overflow, or • to 1.2 m (4 ft) above top of tank ⁽²⁾ for $L < 61$ m (200 ft), • to $0.02L$ above top of tank ⁽²⁾ for 61 m (200 ft) $\leq L \leq 122$ m (400 ft), or • to 2.4 m (8 ft) above top of tank ⁽²⁾ for $L > 122$ m (400 ft) 	After peak to be tested after installation of stern tube.

	<i>Tank or Boundary to be Tested</i>	<i>Test Type</i>	<i>Test Head or Pressure</i>	<i>Remarks</i>
9	1. Fore peak spaces with equipment	Leak	See 3-4-1/3.5.4(c) through 3-4-1/3.5.4(f), as applicable	
	2. Fore peak voids	Leak	See 3-4-1/3.5.4(d) through 3-4-1/3.5.4(f), as applicable	
	3. Aft peak spaces with equipment	Leak	See 3-4-1/3.5.4(c) through 3-4-1/3.5.4(f), as applicable	
	4. Aft peak voids	Leak	See 3-4-1/3.5.4(d) through 3-4-1/3.5.4(f), as applicable	After peak to be tested after installation of stern tube
10	Cofferdams	Leak	See 3-4-1/3.5.4(d) through 3-4-1/3.5.4(f), as applicable	
11	1. Watertight bulkheads	Leak ⁽⁸⁾	See 3-4-1/3.5.4(c) through 3-4-1/3.5.4(f), as applicable	
	2. Superstructure end bulkheads	Leak	See 3-4-1/3.5.4(c) through 3-4-1/3.5.4(f), as applicable	
	3. Cable penetrations in watertight bulkheads	Hose	See 3-4-1/3.5.4(c)	
12	Watertight doors below freeboard or bulkhead deck	Leak ^(6, 7)	See 3-4-1/3.5.4(c) through 3-4-1/3.5.4(f), as applicable	See 3-2-9/9.11 of the <i>Marine Vessel Rules</i> for additional test at the manufacturer.
13	Double plate rudder blades	Leak	See 3-4-1/3.5.4(d) through 3-4-1/3.5.4(f), as applicable	
14	Shaft tunnels clear of deep tanks	Leak ⁽³⁾	See 3-4-1/3.5.4(c) through 3-4-1/3.5.4(f), as applicable	
15	Shell doors	Leak ⁽³⁾	See 3-4-1/3.5.4(c) through 3-4-1/3.5.4(f), as applicable	
16	Watertight hatch covers and closing appliances	Leak ^(3, 7)	See 3-4-1/3.5.4(c) through 3-1-4/3.5.4(f), as applicable	Hatch covers closed by tarpaulins and battens excluded.
17	Dual purpose tanks/dry cargo hatch cover	Leak ^(3, 7)	See 3-4-1/3.5.4(c) through 3-4-1/3.5.4(f), as applicable	In addition to structural test in item 6 or 7
18	Chain lockers	Leak & Structural ⁽¹⁾	Top of chain pipe	
19	Ballast ducts	Leak & Structural ⁽¹⁾	The greater of <ul style="list-style-type: none"> • ballast pump maximum pressure, or • setting of any pressure relief valve 	

Notes:

- 1 (2018) Refer to 3-4-1/3.5.2(b).
- 2 Top of tank is the deck forming the top of the tank, excluding any hatchways.

- 3 (2018) *Hose Testing* may also be considered as a medium of the test. See 3-4-1/3.3.2.
- 4 Including tanks arranged in accordance with the provisions of SOLAS regulation II-1/9.4.
- 5 (2016) Including duct keels and dry compartments arranged in accordance with the provisions of SOLAS regulation II-1/11.2 and II-1/9.4 respectively, and/or oil fuel tank protection and pump room bottom protection arranged in accordance with the provisions of MARPOL Annex I, Chapter 3, Part A regulation 12A and Chapter 4, Part A, regulation 22, respectively.
- 6 Where water tightness of a watertight door has not confirmed by prototype test, testing by filling watertight spaces with water is to be carried out. See SOLAS regulation II-1/16.2 and MSC/Circ.1176.
- 7 (2018) As an alternative to the hose testing, other testing methods listed in 3-4-1/3.5.4(g) through 3-4-1/3.5.4(i) may be applicable subject to adequacy of such testing methods being verified. See SOLAS regulation II-1/11.1. For watertight bulkheads (item 11.1) alternatives to the hose testing may only be used where a hose test is not practicable.
- 8 (2018) A "leak test and structural test", see 3-4-1/3.5.2(b) is to be carried out for a representative cargo hold if intended for in-port ballasting. The filling level requirement for testing cargo holds intended for in-port ballasting is to be the maximum loading that will occur in-port as indicated in the loading manual.

TABLE 2
Additional Testing Requirements for Barges or Tanks of Special Service (2018)

	<i>Type of Barges or Tanks</i>	<i>Structures to be Tested</i>	<i>Type of Testing</i>	<i>Hydrostatic Testing Head</i>	<i>Remarks</i>
1	Liquefied Gas Carriers	Ballast or Fuel Oil Tanks adjacent to or between Cargo Tank Hold Spaces	Leak & Structural	The greater of <ul style="list-style-type: none"> • the top of overflow, or • to 2.4 m (8 ft) above top of tank ⁽²⁾ 	See 5C-8-4/20 of the Marine Vessel Rules for testing requirements applicable to integral cargo tanks, independent cargo tanks and hull structure supporting membrane or semi-membrane cargo tanks.
2	Edible Liquid Tanks	Independent Tanks	Leak & Structural ⁽¹⁾	The greater of water head <ul style="list-style-type: none"> • the top of overflow, or • to 0.9 m (3 ft) above top of tank ⁽²⁾ 	
3	Chemical Carriers	Integral or Independent Tanks	Leak & Structural ⁽¹⁾	The greater of <ul style="list-style-type: none"> • to 2.4 m (8 ft) above top of tank ⁽²⁾, or • to top of tank ⁽²⁾ plus setting of any pressure relief valve 	Where a cargo tank is designed for the carriage of cargoes with specific gravities larger than 1.0, an appropriate additional head is to be considered.

Notes:

- 1 (2018) See 3-4-1/3.5.2(b).
- 2 (1 July 2013) Top of tank is the deck forming the top of the tank, excluding any hatchways.

TABLE 3
Application of Leak Testing, Coating and Provision of Safe Access
for Type of Welded Joints (2016)

Type of Welded Joints		Leak Testing	Coating ⁽¹⁾		Safe Access ⁽²⁾	
			Before Leak Testing	After Leak Testing & Before Structural Test	Leak Test	Structural Test
Butt	Automatic	Not required	Allowed ⁽³⁾	N/A	Not required	Not required
	Manual or Semi-automatic ⁽⁴⁾	Required	Not allowed	Allowed	Required	Not required
Fillet	Boundary including penetrations	Required	Not allowed	Allowed	Required	Not required

Notes:

- 1 Coating refers to internal (tank/hold coating), where applied, and external (shell/deck) painting. It does not refer to shop primer.
- 2 Temporary means of access for verification of the leak testing.
- 3 The condition applies provided that the welds have been carefully inspected visually to the satisfaction of the Surveyor.
- 4 (2016) Flux Core Arc Welding (FCAW) semiautomatic butt welds need not be tested provided that careful visual inspections show continuous uniform weld profile shape, free from repairs, and the results of the Rule and Surveyor required NDE testing show no significant defects.

5 Testing Requirements for Barges Not Built in Compliance with SOLAS 1974 as Amended

5.1

Testing procedures are to be carried out in accordance with the requirements of 3-4-1/3 in association with the following alternative procedures for 3-4-1/3.5.2(b) "Testing Schedule for New Construction or Major Structural Conversion" and alternative test requirements for 3-4-1/3 TABLE 1.

5.3

The tank boundaries are to be tested from at least one side. The tanks for structural test are to be selected so that all representative structural members are tested for the expected tension and compression.

5.5

Structural tests are to be carried out for at least one tank of a group of tanks having structural similarity (i.e., same design conditions, alike structural configurations with only minor localized differences determined to be acceptable by the attending Surveyor) on each barge provided all other tanks are tested for leaks by an air test. The acceptance of leak testing using an air test instead of a structural test does not apply to cargo space boundaries adjacent to other compartments in tankers and combination carriers or to the boundaries of tanks for segregated cargoes or pollutant cargoes in other types of ships.

5.7

Additional tanks may require structural testing if found necessary after the structural testing of the first tank.

5.9

Where the structural adequacy of the tanks of a barge were verified by the structural testing required in 3-4-1/3 TABLE 1, subsequent barges in the series (i.e. sister ships built from the same plans at the same shipyard) may be exempted from structural testing of tanks, provided that:

- i)* Watertightness of boundaries of all tanks is verified by leak tests and thorough inspections are carried out.
- ii)* Structural testing is carried out for at least one tank of each type among all tanks of each sister barge.
- iii)* Additional tanks may require structural testing if found necessary after the structural testing of the first tank or if deemed necessary by the attending Surveyor

For cargo space boundaries adjacent to other compartments in tankers and combination carriers or boundaries of tanks for segregated cargoes or pollutant cargoes in other types of ships, the provisions of paragraph of 3-4-1/5.3 shall apply in lieu of paragraph of 3-4-1/5.5.

5.11

Sister barges built (i.e., keel laid) two years or more after the delivery of the last barge of the series, may be tested in accordance with 3-4-1/5.5 at the discretion of the Surveyor, provided that:

- i)* General workmanship has been maintained (i.e., there has been no discontinuity of shipbuilding or significant changes in the construction methodology or technology at the yard, and shipyard personnel are appropriately qualified and demonstrate an adequate level of workmanship as determined by the Surveyor).
- ii)* An NDT plan is implemented and evaluated by the Surveyor for the tanks not subject to structural tests. Shipbuilding quality standards for the hull structure during new construction are to be reviewed and agreed during the kick-off meeting. Structural fabrication is to be carried out in accordance with IACS Recommendation 47, "Shipbuilding and Repair Quality Standard", or a recognized fabrication standard to the satisfaction of the attending Surveyor prior to the commencement of fabrication/construction. The work is to be carried out in accordance with the Rules and under survey of the Surveyor.

1 Anchor Windlass Trials (1 July 2012)

Where fitted, each windlass is to be tested under working conditions after installation onboard to demonstrate satisfactory operation. Each unit is to be independently tested for braking, clutch functioning, lowering and hoisting of chain cable and anchor, proper riding of the chain over the chain lifter, proper transit of the chain through the hawsepipe and the chain pipe, and effecting proper stowage of the chain and the anchor. It is to be confirmed that anchors properly seat in the stored position and that chain stoppers function as designed if fitted. Also, it is to be demonstrated that the windlass is capable of lifting each anchor with 82.5 m (45 fathoms) length of chain submerged and hanging free. The braking capacity is to be tested by intermittently paying out and holding the chain cable by means of the application of the brake. Where the available water depth is insufficient, the proposed test method will be specially considered.

3 Bilge System Trials

Where fitted, all elements of the bilge system are to be tested to demonstrate satisfactory pumping operation, including emergency suction and all controls. Upon completion of the trials, the bilge strainers are to be opened, cleaned and closed up in good order.



PART 3

CHAPTER 4

Testing, Trials and Surveys During Construction - Hull

SECTION 3

Surveys

1 Construction Welding and Fabrication (1 July 2012)

For surveys of hull construction welding and fabrication, refer to Chapter 4 of the *ABS Rules for Materials and Welding (Part 2)*, Section 3-2-12 of these Rules, and the *ABS Guide for Nondestructive Inspection*.

3 Hull Castings and Forgings

For surveys in connection with the manufacture and testing of hull castings and forgings, refer to Chapter 1 of the *ABS Rules for Materials and Welding (Part 2)*.

5 Hull Piping (1 July 2012)

For surveys in connection with the manufacture and testing of hull piping, refer to Section 4-1-2.

PART 3

CHAPTER 5

Safety Requirements for Barges with Personnel

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1 General (2020)

Barges which are intended to be manned at sea, whether on a voyage or on-site offshore by crew or special personnel, are to comply with this Chapter. Manning is established by the flag Administration.

1.1 Application (2020)

Where a manned barge is to carry less than 6 persons, it is to comply with the requirements contained in this Chapter or published requirements of the flag Administration. Where a manned barge is to carry 6 persons or more, excluding members of the crew, it is to comply with all the requirements contained in this Chapter. For a manned barge carrying more than 36 persons on board, excluding members of the crew, it is to comply with Section 5-3-6.

Where a review of all or part of the requirements covered in this Chapter has been conducted by the Administration of the State whose flag the barge is entitled to fly and found acceptable, the same will be acceptable to ABS. The designer or builder is to submit evidence that the Administration has reviewed the arrangements and that the details are acceptable to that Administration.

Each reference to a regulation in this Chapter means a regulation of the International Convention for The Safety of Life at Sea, 1974 (1974 SOLAS) as amended.

Accommodation spaces and control stations are not to be located forward of the collision bulkhead.

Flag Administrations may have specific safety requirements for allowing minimal personnel onboard unmanned barges while at sea.



PART 3

CHAPTER 5

Safety Requirements for Barges with Personnel

SECTION 2

Safety Construction

1 Bilge System (2023)

Manned barges carrying more than 36 persons, excluding members of the crew, are to be provided with a fixed power operated bilge system capable of pumping from and draining any compartment below the freeboard or bulkhead deck. At least two power driven bilge pumps are to be provided and each pump is to have a capacity of not less than 11.0 m³/hour (50 gpm). Bilge main and branch section sizes are to comply with 4-6-4/5.3.1 of the *Marine Vessel Rules*.

For manned barges carrying 36 persons or less, excluding members of the crew, the bilge system is to comply with the published requirements of the flag Administration. In the absence of specific bilge system requirements from the flag Administration, at least two (2) portable pumps of suitable capacity may be substituted for the power pumps in the bilge main. Alternate piping arrangements for the bilge system may be specially considered.

3 Fire Safety Measures (2020)

In the absence of specific safety requirements from the flag Administration, a manned barge carrying 36 persons or less is to comply with the cargo ship fire safety requirements of Chapter II-2, 1974 SOLAS, as amended, and of the International Code for Fire Safety Systems (FSS Code) as applicable to the barge under Section 3-5-1, except that 3-2-11 of the *Barge Rules* will apply in lieu of Regulation II-2/18 of SOLAS with regard to helicopter facilities. See also 5-2-3/1.5.2(c). Other Non Convention standards recognized by the flag Administration may also be accepted by ABS.

5 Extinguishers

Portable and semi-portable extinguishers are to be provided in the quantities and locations indicated in 3-5-2/9.9 TABLE 1 and 3-5-2/9.9 TABLE 2. The fire extinguishers are to be visible and readily accessible.

7 Power Supply

At least two main generator sets are to be provided with combined capacity sufficient to maintain the barge in normal operational conditions, including any special purpose equipment. Additionally, the capacity of these sets is to be sufficient to maintain the barge in normal operational conditions, excluding any special purpose equipment, with any one main generator in reserve. Special purpose equipment is the equipment aboard used to perform the intended specific industrial work function by special purpose barges such as dredges, crane barges, pipe-laying barges, etc.

9 Emergency Source of Power

9.1 General

A self-contained emergency source of power and its associated equipment, located on or above the freeboard deck, is to be provided if a fire or other casualty in any one space will make inoperative any combination of the independent sources of normal electrical power required by 3-5-2/7.

When an emergency source of power is not fitted, the two independent sources of electrical power required by 3-5-2/7 are to have their own systems, including power distribution and control systems, completely independent of the system in the other space, such that a fire or other casualty in any one space will not affect the power distribution in the other. In addition, the two independent sources of electrical power are to comply with 3-5-2/9.3 through 3-5-2/9.9 .

9.3 Power Supply

The power available is to be sufficient to supply for at least 18 hours all services necessary for safety in an emergency, particular attention being given to the following:

- i)* Navigation and special purpose lights and warning systems including helicopter landing lights
- ii)* Emergency lighting for machinery spaces, control stations, alleyways, stairways, exits and elevators
- iii)* Emergency lighting for embarkation stations on decks and over sides
- iv)* General alarm and communications systems
- v)* Emergency lighting for stowage position(s) for firemen's outfits
- vi)* Fire detection and alarm systems
- vii)* Fire extinguishing systems
- viii)* Emergency lighting for helicopter landing decks
- ix)* Abandonment systems dependent on electrical power

9.5 Emergency Generator

If the emergency source of electrical power is a generator, the generator is to have an independent supply of fuel in order to start automatically upon failure of the electrical supply from the main source of electrical power, and to be connected automatically to the emergency switchboard.

The automatic starting system and the characteristic of the prime mover shall be such as to permit the emergency generator to carry its full rated load as quickly as is safe and practicable.

When the arrangements are such that more than 45 seconds are needed for the generator to supply the required load, a transitional source of emergency power is to be provided in accordance with 3-5-2/9.7.

9.7 Transitional Source of Emergency Power

When a transitional source of emergency power is required in accordance with 3-5-2/9.5, it is to be installed consisting of storage batteries of sufficient capacity to supply the rated voltage and amperage for at least 30 minutes to the following:

- Emergency lighting
- Fire detection and alarm systems
- General alarm and communications systems

Arrangements are to be such that the transitional source of emergency power will come into operation automatically in the event of failure of the main electrical supply.

9.9 Testing

Means are to be provided for periodic testing of the emergency source of power and the transitional source of power, if provided, and is to include the testing of automatic arrangements.

TABLE 1
Classification of Portable and Semiportable Extinguishers (1 July 2009)

Fire extinguishers are designated by type as follows: A, for fires in combustible materials such as wood; B, for fires in flammable liquids and greases; C, for fires in electrical equipment.

Fire extinguishers are designated by size where II is the smallest and size V is the largest. Size II are hand portable extinguishers, and sizes III and V are semi-portable extinguishers.

Classification		Water liters (US gallons)	Foam liters (US gallons)	Carbon Dioxide kg (lb)	Dry Chemical kg (lb)
Type	Size				
A	II	9 (2.5)	9 (2.5)	—	5 (11) ⁽¹⁾
B	II	—	9 (2.5)	5 (11)	5 (11)
B	III	—	45 (12)	15.8 (35)	9.0 (20)
B	V	—	152 (40)	45 (100) ⁽²⁾	22.5 (50) ⁽²⁾
C	II	—	—	5 (11)	5 (11)
C	III	—	—	15.8 (35)	9.0 (20)

Notes:

- 1 Must be specifically approved as Type A, B, C extinguisher.
- 2 For outside use, double the amount to be carried.

TABLE 2
Hand Portable Fire Extinguishers and Semiportable Fire-Extinguishing Systems (1 July 2009)

Space	Classification*	Quantity and Location
Wheelhouse and control room	C-II	2 near the exit. (See Note 1)
Stairway and elevator enclosure	—	None required.
Corridors	A-II	1 in each corridor not more than 45 m (150 ft) apart, (May be located in stairways.)
Lifeboat embarkation and lowering stations	—	None required.
Radio room	C-II	2 near the exit. (See Note 1)
Accommodations		
Staterooms, toilet spaces, public spaces, offices, and pantries, open decks, and similar spaces.	—	None required
Service spaces		

<i>Space</i>	<i>Classification*</i>	<i>Quantity and Location</i>
Galleys	B-II or C-II	1 for each 232 m ² (2,500 ft ²) or fraction thereof suitable for hazards involved.
Paint and lamp rooms	B-II	1 outside each room in vicinity of exit. (See Note 2)
Storerooms	A-II	1 for each 232 m ² (2,500 ft ²) or fraction thereof located in vicinity of exits, either inside or outside the spaces (See Note 2)
Workshop and similar spaces	C-II	1 outside each space in vicinity of an exit. (See Note 2)
Machinery spaces		
Oil-fired boilers: Spaces containing oil-fired boilers, or their fuel oil units.	B-II B-V	2 required in each space. 1 required in each space.
Internal combustion or gas turbine machinery spaces.	B-II B-III	1 for each 1,000 brake horsepower, but not less than 2 nor more than 6 in each space. 1 required in each space. (See Note 3)
Electric generators, and large motors vital for station keeping that do not have an enclosed ventilating system	C-II	1 for each motor or generator
Electric generators, and large motors vital for station keeping that have an enclosed ventilating system	–	None required
Electric emergency motors or generators	C-II	1 outside the space containing motors or generators in vicinity of exit (See Note 2)
Steam driven auxiliary machinery	–	None required
Trunks to machinery spaces	–	None required
Fuel tanks	–	None required
Cranes with internal combustion engines	B-II	1 required

Notes:

- 1 One of which must be placed inside.
- 2 Vicinity is intended to mean within 1 meter.
- 3 Not required when a fixed gas extinguishing system is installed.
- * See 3-5-2/9.9 TABLE 1

1 General

All barges with personnel are to comply with Part A and Section I of Part B of Chapter III of 1974 SOLAS as amended and with the applicable provisions of the International Life-Saving Appliance (LSA) Code.

3 Survival Craft (2020)

In the absence of specific safety requirements from the flag Administration, a manned barge is to be provided with survival craft of such capacity as will accommodate twice the total number of persons on the barge, as follows:

- i)* One or more lifeboats on each side of the barge complying with the requirements of sections 4.6, 4.7, 4.8 and 4.9 of the LSA Code, as appropriate, of such aggregate capacity as will accommodate at least 50% of all persons onboard.
- ii)* In addition, one or more life rafts as necessary complying with the requirements of sections 4.2 and 4.3 of the LSA Code, capable of floating and breaking free in case the barge becomes submerged, of such aggregate capacity so that there will be survival craft on each side of the barge to accommodate all persons on board.
- iii)* In lieu of compliance with *i)* and *ii)* above, where a review of all or part of the requirements covered in this paragraph has been conducted by the Administration of the State whose flag the barge is entitled to fly and found acceptable, the same will be acceptable to ABS. The designer or builder is to submit evidence that the Administration has reviewed the arrangements and that the details are acceptable to that Administration.
- iv)* Exemptions granted by or instructions received from the flag Administration based on the operation distance from shore and number of persons on board and other emergency procedures will be accepted by ABS.

5 Small Barges

In lieu of meeting the requirements of 3-5-3/3, barges of less than 85 m (279 ft) in length may carry on each side of the barge one or more life rafts complying with the requirements of sections 4.2 and 4.3 of the LSA Code of such aggregate capacity as will accommodate all persons on board.

7 Rescue Boats (2020)

A manned barge is to carry at least one rescue boat complying with the requirements of Chapter V of the LSA Code. A lifeboat may be accepted as a rescue boat, provided that it also complies with the requirements for a rescue boat. Exemptions granted by or instructions received from the Flag Administration based on the operation distance from shore and number of persons on board and other evacuation measures will be accepted by ABS.

9 Personal Life-Saving Appliances

Personal life-saving appliances are to comply with Regulation III/32.

11 Survival Craft Stowage, Embarkation and Launching Arrangements

All survival craft stowage, embarkation and launching arrangements are to comply with Regulation III/13 and III/33.

1 Application

The purpose of this Section is to provide minimum requirements for distress and safety radio communications between barges and coast stations, ships and supporting aircraft in the Maritime Mobile Service.

3 Radiotelephone Installation

Each barge is to be provided with:

- i)* A radiotelephone station complying with the provisions of Chapter IV of the 1974 SOLAS Convention, as amended
- ii)* An efficient means of communication between the radiotelephone station and the rest of the barge
- iii)* At least one emergency position-indicating radio beacon (EPIRB)

5 Accommodation for Radio Personnel

The accommodation for at least one of the radiotelephone operators is to be situated as near as practicable to the radiotelephone operating position.

7 Survey of the Radio Station

The radio station is to be subject to survey as specified below:

- i)* By the Administration which issues the license or its authorized representative before the radio station is put into service
- ii)* Once every 12 months, carried out by an officer of the Administration or its authorized representative, or by a qualified radio service technician recognized by ABS.



PART 3

CHAPTER 6 Subdivision and Stability

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PART 3

CHAPTER 6 Subdivision and Stability

SECTION 1 General Requirements (2020)

1 General

Barges are to have subdivision and stability in accordance with the criteria as shown.

3 Criteria

3.1 Intact Stability

All barges which have a length of 24 m (79 ft) or over, as defined in the International Convention on Load Lines, are to have intact stability guidance as required by Regulation 10 of the International Convention on Load Lines. The following criteria may be used for classification purposes:

- Cargo barges of 24 m (79 ft) in length and over with or without deck cargo: Part B, Chapter 2.2 of IMO Code on Intact Stability

In case the above criteria are not applicable to a particular barge, the intact stability will be reviewed by ABS in accordance with other recognized criteria appropriate to the barge's type, size and intended service.

Tank barges for which the request for class for new construction is received on or after 1 July 1997 are to meet the requirements in Appendix 3-3-A1 of the *Marine Vessel Rules*, "Intact Stability of Tankers During Liquid Transfer Operations".

In addition to the stability criteria required by the barge's flag Administration, each barge that is equipped to lift is to satisfy the intact stability requirements in 5-3-3/9.

3.3 Subdivision and Damage Stability

Barges of applicable size, type and service are to have subdivision and damage stability as required by the applicable International Conventions as follows:

- Oil Tank Barge - Annex I to MARPOL 73/78
- Liquefied Gas Tank Barge - IGC Code (Section 5C-8-2 of the *Marine Vessel Rules*)
- Chemical Tank Barge - IBC Code (Section 5C-9-2 of the *Marine Vessel Rules*)

5 Review Procedures

5.1 Administration Review

When the barge is issued an International Load Line Certificate, International Certificate for Fitness for the Carriage of Liquefied Gas in Bulk, International Certificate for Fitness for the Carriage of Dangerous Chemicals in Bulk or International Oil Pollution Prevention Certificate by the flag Administration or its agent other than ABS, such Certificate will be accepted as evidence that the vessel has subdivision and stability in accordance with the criteria in the respective Convention. Where the Administration undertakes the review of subdivision and stability and ABS is issuing the above certificate, the acceptance of subdivision and stability by the Administration will be required before the certificate is issued.

5.3 ABS Review

In all other cases, the information and calculations for subdivision and stability are to be submitted to ABS for review. Where the intact stability criteria are not applicable to a particular barge, the review will be in accordance with other recognized criteria acceptable to ABS.

7 Onboard Computers for Stability Calculations

Except for the barge types indicated below, the use of onboard computers for stability calculations is not a requirement of class. However, if stability software is installed onboard barges or associated vessels contracted on or after 1 July 2005, it shall cover all stability requirements applicable to the barge and is to be approved by ABS for compliance with the requirements of Appendix 3-3-A7, "Computer Software for Onboard Stability Calculations" of the *Marine Vessel Rules*.

Tank barges, including oil tank barges, liquefied gas tank barges, and chemical tank barges, are to be fitted with a stability instrument which uses approved stability software capable of verifying compliance with the applicable intact and damage stability requirements. This requirement may be waived for the following tank barges if loaded in accordance with the approved conditions in the trim and stability booklet:

- Tank barges on a dedicated service, with a limited number of permutations of loading
- Tank barges where stability verifications is made remotely by a means approved by the Administration
- Tank barges loaded within an approved range of loading conditions

See also 5C-8-2/2.6, 5C-8-2/2.7, 5C-9-2/2.6, and 5C-9-2/2.7 of the *Marine Vessel Rules*.



PART 4

Barge Systems and Machinery

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PART 4

CHAPTER 1

Machinery, Piping and Electrical Systems

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PART 4

CHAPTER 1

Machinery, Piping and Electrical Systems

SECTION 1

Machinery

1 General

1.1 Machinery and Equipment (2020)

In general, machinery, boilers, pressure vessels, pumps, piping, materials, electrical systems and fire extinguishing systems are to be in accordance with the applicable requirements of the ABS *Rules for Building and Classing Marine Vessels (Marine Vessel Rules)*. Design review of machinery and electrical equipment is to be in accordance with 4-1-1/9 TABLE 1 through TABLE 6 of the *Marine Vessel Rules* except as modified herein.

Mechanical and electrical machinery not related to additional optional notations, need not be inspected at the plant of the manufacturer, but will be accepted subject to satisfactory performance witnessed by the Surveyor after installation.

1.3 Machinery Associated with Liquefied Gas Systems

Machinery and equipment associated with liquefied gas systems are to be certified in accordance with the requirements as referenced by 4-1-2/19 and Section 5-2-5, including Survey at the plant of the manufacturer, as applicable.

3 Application

These sections are applicable to barges which are unattended at sea. For additional requirements for barges with personnel onboard at sea, see Part 3, Chapter 5.

5 Governmental and Other Regulations

While these Rules cover the requirements for the classification of new barges, the attention of owners, designers and builders is directed to the regulations of governmental and other authorities. See 1A-1-5/1 of the *ABS Rules for Conditions of Classification (Part 1A)*.

7 Internal Combustion Engines

7.1 Operation

Engines and gears are to be designed such that under the environmental conditions specified by the Owner for normal operation they will function properly, including their lubrication and cooling arrangements. See also 4-1-1/1.

7.3 Housings (2020)

Internal combustion engines located on the weather deck are to be provided with ventilated metal hoods or with a well-ventilated metal housing of sufficient size to allow for proper operation and maintenance. See 4-1-2/13.9.

7.5 Exhausts (2020)

Exhaust manifolds and piping are to be insulated with non-combustible material or are to be water-cooled such that the temperature of exposed parts does not exceed 220°C (428°F). Exhaust manifold connections are to be constructed of pipe or pipe fittings with screwed or welded connections or bolted connections with fireproof gaskets.

7.5.1 Emission Abatement Systems (2023)

For vessels with an Emission Abatement System fitted onboard, and requesting the optional notation **EGC**, the requirements of Part 6, Chapter 3 of the *Marine Vessel Rules* are applicable.

For vessels with an Emission Abatement System fitted onboard, and not requesting the optional notation **EGC**, the minimum requirements of Part 6, Chapter 3 of the *Marine Vessel Rules* are applicable.

7.7 Diesel Engines (2020)

Diesel engines having a rated power of 100kW (135 HP) and over that are intended for services considered not essential for maneuvering and safety need not be of an ABS approved design. This would include engines driving cargo pumps. Industrial engines constructed and equipped in accordance with good commercial practice are acceptable provided they meet the criteria specified in 4-1-1/7.1; namely, they can function properly under the environmental conditions as specified by the owner. Further, the engines are to comply with the safety features, such as crankcase explosion relief valve, overspeed protection, etc., as provided in 4-2-1/7 of the *Marine Vessel Rules*. After installation, the engines are subject to a satisfactory performance test conducted in the presence of the Surveyor. Crankcase explosion valves are not required for Engines with less than 200mm bore.

Diesel engines having a rated power of 100kW (135 HP) and over are to be of an approved design if they are intended for services considered essential for maneuvering or safety of the barge.

Diesel engines having a rated power of less than 100kW (135 HP), regardless of service, need not be of an ABS approved design. Industrial engines constructed and equipped in accordance with good commercial practice are acceptable provided they meet the criteria specified in 4-1-1/7.1. The same may be accepted based on manufacturer's affidavit, verification of engine nameplate data and satisfactory performance witnessed by the Surveyor after installation.

9 Electrical Machinery (2020)

Generators and motors of 100kW (135 HP) and over that are intended for services considered not essential need not be of an approved design. Generators and motors constructed and equipped in accordance with good commercial practice are acceptable provided they meet the criteria specified in 4-1-3/7. The same may be accepted based on manufacturer's affidavit, verification of nameplate data and satisfactory performance witnessed by the Surveyor after installation.

Generators and motors of 100kW (135 HP) and over are to be of an approved design if they are intended for essential services as per 4-8-3/3.1 and 4-8-1/7.3.3 of the *Marine Vessel Rules*.

Generators and motors of less than 100kW (135 HP) , regardless of service, need not be of an ABS approved design. Generators and motors constructed and equipped in accordance with good commercial practice are acceptable provided they meet the criteria specified in 4-1-3/7.

Design review of electrical machinery is to be in accordance with Section 4-1-1 of the *Marine Vessel Rules* intended for essential systems as per 4-8-3/3.1 and 4-8-1/7.3.3 of the *Marine Vessel Rules*.

11 Ventilation (2020)

Machinery spaces, including pump rooms, are to be provided with adequate ventilation for the operation of machinery and the safety of personnel. All air inlets to spaces where personnel may enter are to be located outside the hazardous locations in 4-1-3/11.

13 Fire Extinguishing

Portable fire extinguishers are to be provided for machinery space in accordance with 3-5-2/9.9 TABLE 2.

15 Plans to be Submitted (2020)

The following plans, as applicable, should generally be submitted electronically to ABS. However, hard copies will also be accepted. [See also 1A-5-4/3 of the *ABS Rules for Conditions of Classification (Part 1A)*]:

- i) Ship Equipment List (See 1A-1-7/3 of the *ABS Rules for Conditions of Classification (Part 1A)*)
- ii) Boilers, Pressure Vessels and Heat Exchangers (See Section 4-4-1 of the *Marine Vessel Rules*)
- iii) Windlass or Winch (See Section 3-3-1)
- iv) Fire Extinguisher Layout Plan
- v) Fixed Fire Extinguishing System, as applicable
- vi) Piping Systems (See 4-1-2/1)
- vii) Electrical Systems (See 4-1-3/3)

1 Plans and Data to be Submitted (2020)

The following plans, as applicable, should generally be submitted electronically to ABS. However, hard copies will also be accepted. [See also 1A-5-4/3 of the *ABS Rules for Conditions of Classification (Part 1A)*]:

- General arrangement of pumps and piping
- Sanitary System
- Cargo Piping System
- Bilge and Ballast Systems
- Compressed Air Systems
- Vents, sounding, and overflow pipes
- Fuel Oil Systems
- Lubricating Oil Systems
- Exhaust piping for internal combustion engines
- Hydraulic power piping systems
- Essential sea-water and fresh-water service Systems
- Fire-main and fire extinguishing Systems
- Inert Gas Systems (as applicable)
- Emission Abatement System (as applicable)
- Ballast Water Treatment System (as applicable)
- Other Piping Systems not mentioned above depending on type and service

The plans are to consist of a diagrammatic drawing of each system accompanied by lists of material giving size, wall thickness, maximum working pressure and material of all pipes and the type, size, pressure rating, and material of valves, pressure vessels and fittings.

3 Classes of Piping Systems (2020)

Classes of piping systems are to be in accordance with 4-6-1/5 of the *Marine Vessel Rules*.

5 Metallic Piping (2020)

Metallic piping systems are to be in accordance with Section 4-6-2 of the *Marine Vessel Rules*, as applicable.

7 Plastic Piping (2020)

Plastic piping systems are to be in accordance with Section 4-6-3 of the *Marine Vessel Rules*, as applicable.

9 Ballast System (2020)

9.1 General

Ballast systems are to meet the requirements, as applicable, of 4-6-4/7 of the *Marine Vessel Rules*.

9.3 Ballast Pumps

For barges of 20m (65ft) in length or greater all ballast tanks are to be connected to at least two power driven ballast pumps. Alternative means of deballasting, such as an eductor or a suitable liquid cargo pump with an appropriate temporary connection to the ballast system [see *Marine Vessel Rules* 5C-1-7/5.3.1(c)], may be accepted in lieu of a second ballast pump.

9.5 Ballast Water Treatment Systems

Where a ballast water treatment system is to be installed, it is to comply with the requirements in Sections 4 and 5 of the *ABS Guide for Ballast Water Treatment* and the same is to be verified by ABS.

11 Bilge System

Where the barges are fitted with below deck machinery spaces or where fixed piping systems are led through void spaces, a satisfactory means is to be provided capable of pumping from and draining such spaces. This means may be by use of suitable hand pumps through fixed bilge piping arrangements or by means of portable pumps stored onboard the barge. Alternate arrangements will be considered in case of barges where special conditions prevail.

13 Venting Arrangements

13.1 Vent Pipes (2010)

13.1.1 General (2011)

13.1.1(a) Basic Requirements.

The following tanks, void spaces and cofferdams are to be fitted with vent pipes:

- All tanks containing flammable liquids, combustible liquids or chemicals
- All tanks, cofferdams and voids adjacent to tanks containing flammable liquids, combustible liquids or chemicals
- All voids through which pressure piping passes
- All tanks that are filled or emptied through fixed pumping arrangements

13.1.1(b) Venting Arrangements.

The structural arrangement of those tanks, cofferdams and void spaces requiring a vent is to be such as to permit the free passage of air and gases from all parts of the spaces to the vent pipes. Each tank, cofferdam and void space requiring a vent is to be fitted with at least one vent pipe,

which is to be located at the highest part of the tank. Vent pipes are to be arranged to provide adequate self-drainage under normal conditions. No shutoff valve or closing device that can prevent the venting from a tank is to be installed in vent piping.

13.1.1(c) Termination of Outlet Ends.

Vent and overflow pipes on the open deck other than those covered by 4-1-2/13.7, are to terminate by way of return bends. All vent pipes terminating in the weather are to be fitted with automatic closing devices, i.e., close automatically upon submergence (e.g., ball float or equivalent), complying with 4-1-2/13.1.2. Vent pipes from fuel-oil tanks and cofferdams adjacent to cargo tanks containing low flashpoint liquid (at or below 60°C (140°F) closed cup test) are to be fitted with metallic corrosion resistant flame screens. Satisfactory means, permanently attached, are to be provided for closing the opening of the vent pipes.

13.1.2 Vent Closure Arrangements (2020)

The automatic closing devices for vent pipes terminating in the weather are to comply with the following requirements found in 4-6-4/9.3.7(b) thru 4-6-4/9.3.7(d) of the *Marine Vessel Rules*.

13.3 Vent Pipe Height and Wall Thickness (2020)

Vent pipe height and wall thickness is to meet requirements of 4-6-4/9.3.2 of the *Marine Vessel Rules*.

13.5 Vent Pipe Size (2020)

Vent pipe size is to meet requirements of 4-6-4/9.3.3 of the *Marine Vessel Rules*.

13.7 Cargo Venting Systems –Low-flashpoint Liquids (at or below 60°C (140°F) Closed Cup Test)

Each cargo tank is to be fitted with a pressure-vacuum type relief valve, or a suitably sized vent pipe is to be led from each tank into a common header. In the latter case, the header is to be led to a reasonable height but not less than 2 m (6.5 ft) above the deck and is to be fitted with an approved flame arrestor or pressure-vacuum type relief valve at the outlet to the atmosphere. Means are to be provided to prevent any tank from being subjected to excessive pressure during any phase of the cargo handling process. The diameter of the vent pipes is not to be less than 63 mm (2.5 in.) I.D. See also oil barge testing, Section 3-4-1. When it is intended that the tanks are to be loaded with closed ullage hatches, the vent pipes are to be sized for 125% of the maximum loading rate to prevent the pressure in any cargo tank from exceeding the design pressure. Vent outlets for cargo loading, discharging and ballasting shall be located not less than 3 m (10 ft) measured horizontally from deck machinery and equipment which may constitute an ignition hazard.

13.9 Vent Outlet Locations (1993)

Vent outlets from cargo spaces indicated in 4-1-3/11, above, and cofferdams in the cargo area are to be located more than 3 m (10 ft) from openings to spaces containing sources of vapor ignition, such as service spaces, machinery spaces and diesel engines on deck. See 4-1-3/11.

13.11 Cargo Venting Systems –High-flashpoint Liquids (above 60°C (140°F) Closed Cup Test)

When a barge is intended solely for carrying liquid cargo having a flash point above 60°C (140°F), closed cup test, a venting system consisting of individual return bend vents fitted with flame screens may be fitted in lieu of that described in 4-1-2/13.7. For vent piping arrangements see 4-1-2/13.1 and 4-1-2/13.3.

15 Sounding Arrangements

All tanks, except as noted below, are to be provided with separate sounding pipes or with approved tank-level indicating apparatus. Where a tank-level indicating system is used, a supplementary manual means of sounding is to be provided, where practicable, for tanks which are not always accessible.

Void compartments adjacent to the sea or to tanks containing liquids and void compartments through which piping carrying liquids pass are to be fitted with separate sounding pipes, approved tank liquid level indicating apparatus, or be fitted with other means such as bolted manholes to determine if the void tanks contain liquids.

17 Fuel-Oil Systems

17.1 General

The fuel-oil pumping arrangements are to be separate from other pumping systems as far as practicable, and the means provided for preventing dangerous interconnection in service are to be thoroughly effective.

No fuel-oil tank is to be situated where spillage or leakage can constitute a hazard by falling on heated surfaces. Precautions are to be taken to prevent any oil that may escape under pressure from any pump, filter or heater from coming into contact with heated surfaces.

Fuel-oil pipes, valves and fittings are to be of steel or other approved materials. All packing is to be of a composition not affected by fuel oil.

17.3 Pipes in Fuel-Oil Tanks

Oil pipes and other pipes where passing through fuel-oil tanks are to be of steel, except that other materials may be considered where it is demonstrated that the material is suitable for the intended service.

17.5 Valves on Fuel-Oil Tanks (2003)

Where pipe lines emanate from fuel oil tanks at such a level that they will be subjected to a static head of oil from the tank, they are to be fitted with positive closing valves located at the tank or where the pipe enters a machinery space. Where the fuel oil piping passes through adjacent tanks, the valve required above may be located where the pipe run exits the adjacent tank(s) provided the piping in the adjacent tanks is extra-heavy and has all welded connections. However, if the adjacent tank is a fuel oil tank, the pipe run within the fuel oil tank is to be at least Standard thickness. If the valves are installed on the outside of the tank, they are not to be of cast iron. The use of nodular iron, also known as ductile iron or spheroidal-graphite iron, will be accepted provided the material has an elongation not less than 12%. Arrangements are to be provided for closing them at the valve, and for tanks having a capacity of 500 liters (132 U.S. gal) or greater, from a readily accessible and safe location outside of the compartment in which the valve is located. If the valves are located inside of the tank, they may be of cast iron and arranged for remote control only, but additional valves for local control are to be located in the machinery space.

Where independent filling lines are fitted, they are to enter at or near the top of the tank. If this is impracticable, they are to be fitted with non-return valves at the tank.

17.7 Remote Shutdown of Pumps

Fuel-oil transfer pumps, fuel-oil unit pumps and other similar fuel pumps are to be fitted with remote controls so they may be stopped in the event of a fire. These controls are to be located outside of the spaces in which the pumps are located.

17.9 Independent Tanks

Tanks not forming part of the structure are to have suitable drip pans with drains to oil drain containment tanks.

19 Gas Fueled Auxiliary System (2015)

19.1 Not Interconnected to the Cargo System

Where a gas fueled auxiliary system is to be installed on the barge, and which is not interconnected to the cargo system, the system is to meet the applicable requirements of Part 5C, Chapter 13 of the *Marine Vessel Rules*.

19.3 Interconnected to the Cargo System (2021)

Where a gas fueled auxiliary system is to be installed on a Liquefied Gas Tank Barge, the system is to meet the applicable requirements of Section 5-2-5 of these Rules.

1 General – Electrical

Electrical installations are to be in accordance with the applicable requirements of Part 4, Chapter 8 of the *Marine Vessel Rules*, except as modified herein. These requirements may also be modified for barges classed for limited service and for barges having an aggregate generator capacity not exceeding 75 kW. The following detailed rules are minimum requirements for classification purposes. Consideration will be given, however, to arrangements or details of equipment and machinery which can be shown to comply with other recognized standards, provided they are not less effective.

3 Plans and Data to be Submitted (2021)

The following plans and data should generally be submitted electronically to ABS. However, hard copies will also be accepted. [See also 1A-5-4/3 of the *ABS Rules for Conditions of Classification (Part 1A)*].

- i)* Electrical Load Analysis
- ii)* Generators and motors including complete rating, class of insulation, rated ambient temperature, rated temperature rise, enclosure type and standard to which manufactured.
- iii)* Transformers including rating, class of insulation, rated ambient temperature, rated temperature rise, installation details including cooling, fire protection and vault details.
- iv)* Switchgear and switchboards showing arrangements and details below:
 - Front view
 - Schematic diagram
 - Protective device rating and setting
 - Emergency tripping and preferential tripping features
 - Internal power for control and instrumentation
 - Type and size of internal control and instrumentation wiring
 - Size, spacing, bracing arrangements, rated current carrying capacity and rated short-circuit current of bus bars and bus bar disconnecting device
 - Switchboard material and nameplate list
 - Written description of operation bus transfer switchgear of the electrical plan including but not limited to manual generator speed and voltage control, metering, load sharing, manual

changeover and paralleling of generators, and any remote controls or indication where provided.

- v) Motor-control equipment including terminal arrangements, degree of enclosure and wiring diagram including running over-current protection and contactor standard size or ratings.
- vi) Wiring including plans of all wiring, complete feeder list, giving for each feeder and branch circuit the load, wire size, type of wire or cable, rating or setting of circuit breakers, ratings of fuses and switches, interrupting capacity of circuit breakers and fuses and voltage drop.
- vii) Short-circuit data are to be submitted giving the maximum calculated short-circuit current at each point in the distribution system.
- viii) Cathodic protection where the plan is to give details of impressed-current-cathodic protection systems.
- ix) Batteries giving the details of the arrangement, cable overload and reverse power protection, ventilation and corrosion protection.
- x) Hazardous Area Plan. Hazardous area plan is to show the delineation of hazardous areas. The plan is to include general arrangement of the vessel with plan and section views of each deck, space, tanks and process equipment of interest, the recognized standard used for the development of hazardous area, Class or Group, Temperature Class and extent of associated hazardous area delineation (e.g. Division 1, 2 or Zone 0, 1 or 2). In addition, spaces held at over-pressure/under-pressure, sources of release, ventilation openings, airlocks, bulkheads, structures, etc. are to be indicated. Other conditions which may affect the extent of zones are also to be indicated.
- xi) Hazardous Area Electrical Equipment Booklet. When the selection of the equipment has been finalized, a booklet identifying all equipment in the hazardous areas and the particulars of the equipment is to be submitted for review and to be maintained on board for future reference. The booklet is to include a list of all electrical equipment/instruments in the hazardous areas along with evidence of certification. The list is also to include electrical equipment in spaces which may become hazardous upon loss of pressurization and any associated safe-area apparatus (such as zener safety barriers) required for the protection of the intrinsically safe type equipment. The hazardous area equipment list is to include the following particulars of the equipment:
 - a) Description of equipment,
 - b) Manufacturer's name and modl,
 - c) Location and hazardous area classification of the location,
 - d) Method of protection (flameproof, intrinsically safe, etc.),
 - e) Rating (flammable gas group and temperature class),
 - f) Name of testing laboratory and certificate number,
 - g) Design ambient temperature,
 - h) Ingress protection (IP rating), etc.

The booklet is also to include evidence of certification for each equipment indicated in the list of equipment in the hazardous area.

For intrinsically-safe systems, the booklet is also to include wiring plans, installation instructions with any restrictions imposed by the certification agency.

5 General Considerations

5.1 Equipment Location

Electrical equipment is to be so placed or protected as to minimize the probability of mechanical injury or damage from the accumulation of dust, oil vapors, steam or dripping liquids. Apparatus liable to arc is to be ventilated or placed in ventilated compartments in which flammable gases, acid fumes and oil vapors cannot accumulate. Electrical apparatus is to be located clear of skylights and ventilators so as to avoid damage to electrical apparatus.

5.3 Accessibility

The design and arrangement of electrical apparatus is to provide accessibility to parts requiring inspection or adjustment.

5.5 Watertight Equipment

All electrical equipment exposed to the weather or located in spaces where it would be exposed to the sea, splashing or other severe moisture condition is to be of a watertight type or be protected by means of watertight enclosures.

5.7 Materials

In general, all electrical equipment is to be constructed of durable, flame-retardant, moisture-resistant materials which are resistant to deterioration in the atmospheres and at the temperatures to which they are likely to be exposed.

5.9 Permanent Equipment Grounding Arrangements

Where not obtained through normal construction, arrangements are to be provided to effectively ground all machinery, armored cables, metal structures of derricks or cranes, masts and helicopter platforms.

In general, the frames or cases of all permanently installed generators, motors, controllers, instruments and similar equipment for which the arrangement and method of installation does not assure positive grounding are to be permanently grounded through separate conductors and protected against damage. Where outlets, switches and similar fittings are of non-metallic construction, grounding of all exposed metal parts is to be ensured. For switchboards, see 4-8-5/7.3 of the *Marine Vessel Rules*.

5.11 Protection from Bilge Water

All generators, motors and other electrical equipment are to be so arranged that they cannot be damaged by bilge water, and, if necessary, a watertight coaming is to be provided to form a well around the base of such equipment with provision for removing water from the well.

7 Rotating Electrical Machinery

Motors and generators are to be manufactured to a recognized standard such as NEMA, BSS, VDE or IEC. Where equipment has been rated on ambient temperatures less than those contemplated, the application of the equipment is to be such that the total temperature for which the equipment is rated will not be exceeded. See 4-1-1/1.

9 Cables and Wiring

9.1 Cable Construction

Electrical cables are to have conductors, insulation, and moisture-resistant jackets in accordance with IEC Publication 60092-353 or IEEE Std. 45. Other recognized marine standards will also be considered. Conductors are to be of copper not less than 1.0 mm² in cross section and stranded in all sizes. All electrical cables are to be at least of a flame-retardant type that complies with the requirements of IEC Publications 60332-3 category A or IEEE Std. 45. Flame-retardant marine cables which have not passed

the bunched cable flammability criteria of IEC 60332-3 category A or IEEE Std. 45 may be considered, provided that the cable is treated with approved flame-retardant material or the installation is provided with approved fire stop arrangements. Communications cables will be specially considered. When specifically approved, bus duct may be used in lieu of cable.

9.3 Splicing of Cables –Location (1995)

In general, electrical cables are to be installed in continuous lengths between terminations at equipment or in cable junction boxes. See 4-1-3/9.9. However, approved splices will be permitted at interfaces of new construction modules when it is deemed necessary to extend existing circuits for a barge undergoing repair or alteration, and in certain cases to provide for cables of exceptional length. The location of the splices is to be submitted for approval.

9.5 Splicing of Cables

9.5.1 Basis of Approval

Replacement of insulation on splices is to be fire-resistant and is to be at least equivalent in electrical and thermal properties to the original insulation. The replacement jacket is to be at least equivalent to the original impervious sheath and is to assure a watertight splice. Splices are to be made using an approved splice kit, which is to contain the following:

- Connector of correct size and number
- Replacement jacket
- Replacement insulation
- Instructions for use

In addition, prior to approval of a splicing kit, it will be required that completed splices be tested for fire resistance, water-tightness, dielectric strength, etc. to the satisfaction of the Surveyor. This requirement may be modified for splice kits which have had such tests conducted and reported on by an independent agency acceptable to ABS.

9.5.2 Installation

All splices are to be made after the cable is in place and are to be accessible for inspection. The conductor splice is to be made using a pressure type butt connector by use of a one-cycle compression tool.

9.5.3 Protection

Splices may be located in protected enclosures or in open wireways. Armored cables having splices will not be required to have the armor replaced provided that the remaining armor has been grounded to the metal hull at each end of the run, except that the final sub-circuits may be grounded at the supply end only or provided the armor is made electrically continuous. Splices are to be located such that stresses (as from the weight of the cable) are not carried by the splice.

9.5.4 Splices in Hazardous Areas

No splices are allowed in hazardous locations except in intrinsically safe circuits.

9.7 Protection

Cables, wiring, and equipment are to be provided with overcurrent, overload and short circuit protection in accordance with a recognized standard such as IEC standards or the NEC.

9.9 Cable Junction Box Construction and Installation (1995)

Except for propulsion cables, cable junction boxes may be used in the installation of electrical cables aboard vessels provided plans showing the intended application and location of the junction boxes are submitted for approval and the following requirements are complied with:

9.9.1

The design and construction of the junction boxes is to be in compliance with the recommendations of IEC Publication 60092-352 for "Joint Boxes" or other recognized standards as well as 4-1-3/9.9.2 below.

9.9.2

The junction boxes are to be suitable for the environment in which they are installed, i.e., explosion-proof in hazardous areas, watertight or weathertight on deck, etc.

9.9.3

Separate junction boxes are to be used for feeders and circuits of different rated voltage levels. Each junction box is to be appropriately identified as regards the rated voltage of the feeders and circuits it contains.

9.9.4

The junction boxes for emergency feeders and circuits are to be separate from those used for normal ship service feeders and circuits.

9.9.5

The junction boxes for control and alarm circuits are to be separate from those for power circuits. Also, where separate means of control is required (e.g., steering gear), the junction boxes for such circuits are to be separated.

9.9.6

Cables are to be supported, as necessary, within junction boxes so as not to put stress (as from the weight of the cable) on the cable contact mountings. The connections are to be provided with locking type connections.

11 Electrical Installations for Barges Carrying Low Flashpoint Liquids (at or below 60°C (140°F) Closed Cup Test) (2012)

11.1 Electrical Installations (2024)

Electrical Installations are to meet requirements of IEC 60092-502 except that the open deck over cargo tanks and ballast tanks within the cargo area is not required to be classified as hazardous. Areas near openings and cargo tank vents are to be classified as hazardous, as specified in IEC 60092-502.

11.3 Permanent Notice and Booklet of Certified Safe Equipment

A booklet containing the list of certified safe equipment, as installed, along with the particulars of the equipment (see 4-1-3/3), is to be maintained on board. Permanent notices are to be posted in the vicinity of hazardous areas in which such electrical equipment is installed to advise crew of the availability of the booklet so that it can be referenced during repair or maintenance.

11.5 Lighting Circuits in Hazardous Areas (2016)

All switches and protective devices for lighting fixtures in hazardous areas are to interrupt all poles or phases and are to be located in a non-hazardous area. However, a switch may be located in a hazardous area if the switch is of a certified safe type for the hazardous location in which it is to be installed. The switches and protective devices for lighting fixtures are to be suitably labeled for identification purposes.



PART 5

Specific Barge Types

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PART 5

CHAPTER 1 Dry Cargo Barges

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PART 5

CHAPTER 1 Dry Cargo Barges

SECTION 1 Deck Cargo Barges

1 General

The requirements of this Section are generally intended to apply to single deck cargo barges of the type illustrated by 5-1-1/15.11 FIGURE 1, 5-1-1/15.11 FIGURE 2 and 5-1-1/15.11 FIGURE 3.

Where structural arrangements are not provided for in these Rules, the *ABS Rules for Building and Classing Marine Vessels (Marine Vessel Rules)* are to apply.

3 Deck Beams

3.1

Each deck beam in association with the plating to which it is attached, is to have a section modulus SM not less than that obtained from the following equation:

$$SM = 7.8chs\ell^2 \quad \text{cm}^3$$

$$SM = 0.0041chs\ell^2 \quad \text{in}^3$$

where

c = 0.585 for transverse beams, for longitudinal beams of platform decks and between hatches at all decks

= $1/(1.709 - 0.651k)$ for longitudinal beams of strength decks and the effective lower decks

k = $SM_R Y / I_A$

SM_R = hull girder section modulus amidships required by 3-2-1/3.1, in $\text{cm}^2\text{-m}$ ($\text{in}^2\text{-ft}$)

Y = distance, in m (ft), from the neutral axis to the deck at side

I_A = hull girder moment of inertia of the barge amidships, in $\text{cm}^2\text{-m}^2$ ($\text{in}^2\text{-ft}^2$)

The values of I_A and Y are to be those obtained using the area of the longitudinal beams given by the above equation.

- s = spacing of beams, in m (ft)
- ℓ = unsupported span in meters (feet) as shown in 5-1-1/15.11 FIGURE 1, 5-1-1/15.11 FIGURE 2 and 5-1-1/15.11 FIGURE 3. Transverse beams fitted with end brackets having a slope of approximately 45° and a thickness given in 5-1-1/3.1 TABLE 1, the length ℓ may be measured to a point on the bracket equal to 25% of the length of the bracket.
- h = 0.02L + 0.76 meters where $L < 107$ meters
= 2.9 meters where $L \geq 107$ meters
= 0.02L + 2.5 feet where $L < 350$ feet
= 9.5 feet where $L \geq 350$ feet
- L = length of barge as defined in 3-1-1/3

TABLE 1
Thickness and Flanges of Brackets and Knees*

* The thickness of brackets is to be suitably increased in cases where the depth at throat is less than two-thirds that of the knee.

<i>Millimeters</i>				<i>Inches</i>			
<i>Depth of Longer Arm</i>	<i>Thickness</i>		<i>Width of Flange</i>	<i>Depth of Longer Arm</i>	<i>Thickness</i>		<i>Width of Flange</i>
	<i>Plain</i>	<i>Flanged</i>			<i>Plain</i>	<i>Flanged</i>	
150	6.5	---	---	6.0	0.26	---	---
175	7.0	---	---	7.5	0.28	---	---
200	7.0	6.5	30	9.0	0.30	0.26	1 ¹ / ₄
225	7.5	6.5	30	10.5	0.32	0.26	1 ¹ / ₄
250	8.0	6.5	30	12.0	0.34	0.28	1 ¹ / ₂
275	8.0	7.0	35	13.5	0.36	0.28	1 ¹ / ₂
300	8.5	7.0	35	15.0	0.38	0.30	1 ³ / ₄
325	9.0	7.0	40	16.5	0.40	0.30	1 ³ / ₄
350	9.0	7.5	40	18.0	0.42	0.32	2
375	9.5	7.5	45	19.5	0.44	0.32	2
400	10.0	7.5	45	21.0	0.46	0.34	2 ¹ / ₄
425	10.0	8.0	45	22.5	0.48	0.34	2 ¹ / ₄
450	10.5	8.0	50	24.0	0.50	0.36	2 ¹ / ₂
475	11.0	8.0	50	25.5	0.52	0.36	2 ¹ / ₂
500	11.0	8.5	55	27.0	0.54	0.38	2 ³ / ₄
525	11.5	8.5	55	28.5	0.56	0.38	2 ³ / ₄
550	12.0	8.5	55	30.0	0.58	0.40	3
600	12.5	9.0	60	33.0	---	0.42	3 ¹ / ₄

Millimeters				Inches			
Depth of Longer Arm	Thickness		Width of Flange	Depth of Longer Arm	Thickness		Width of Flange
	Plain	Flanged			Plain	Flanged	
650	13.0	9.5	65	36.0	---	0.44	3 ¹ / ₂
700	14.0	9.5	70	39.0	---	0.46	3 ³ / ₄
750	14.5	10.0	75	42.0	---	0.48	4
800	---	10.5	80	45.0	---	0.50	4 ¹ / ₄
850	---	10.5	85	---	---	---	---
900	---	11.0	90	---	---	---	---
950	---	11.5	90	---	---	---	---
1000	---	11.5	95	---	---	---	---
1050	---	12.0	100	---	---	---	---
1100	---	12.5	105	---	---	---	---
1150	---	12.5	110	---	---	---	---
1200	---	13.0	110	---	---	---	---

3.3

Where cargo is to be carried on deck, the uniformly distributed deck loading is to be indicated on the drawings and the transverse or longitudinal deck beams, in addition to complying with 5-1-1/3.1, are also to comply with the following:

$$SM = 7.8chs\ell^2 \quad \text{cm}^3$$

$$SM = 0.0041chs\ell^2 \quad \text{in}^3$$

where

$$c = 0.585$$

$$h = p / 7.07 \text{ m } (p / 0.721 \text{ m, } p / 45 \text{ ft})$$

$$p = \text{uniformly distributed deck loading in kN/m}^2 \text{ (tf/m}^2, \text{ lbf/ft}^2\text{)}$$

Where the uniformly distributed deck loading is not indicated on the drawings of flat top single deck cargo barges the following loading is to be assumed:

$$p = 10.05 \times d \times C_b \text{ kN/m}^2 \text{ (1.025} \times d \times C_b \text{ tf/m}^2, 64 \times d \times C_b \text{ lbf/ft}^2\text{)}$$

$$d = \text{draft as defined in 3-1-1/11, in m (ft)}$$

$$C_b = \text{block coefficient as defined in 3-1-1/31}$$

$$s = \text{as defined in 5-1-1/3.1, in m (ft)}$$

$$\ell = \text{as defined in 5-1-1/3.1, in m (ft)}$$

3.5

Where the space below the deck is a ballast or deep tank, the longitudinal or transverse deck beams, in addition to complying with the requirements of 5-1-1/3.1 and 5-1-1/3.3, are also to satisfy the requirements of 5-2-1/7, except that the head, h , may be taken to a point located at two-thirds of the distance from the top of the tank to the top of the overflow or 0.915 meters (3.0 feet), whichever is greater.

3.7 (2022)

The welded connections of the deck stiffeners to their deep supporting frame members are to be checked for the contributory area of the welds in the connection based on the loading attributed to uniform or isolated deck cargo loads of greater than or equal to 9.765 tf/m² (2000 lb/ft²).

For barges greater than 76 meters (250 feet), the deck stiffener webs are to be welded to the deep supporting frame. Effective welded connection is also to be provided for deck stiffeners to deep supporting frames for barges with $L \leq 76$ meters.

Allowable stresses shall be 2.5 (40% of yield strength of the material) factor of safety for shear stress and 1.67 (60% of yield strength of the material) factor of safety for axial or bending stress.

5 Container Loading

Where it is intended to carry containers, the exact locations of the container pads and the maximum total static load on the pads are to be indicated on the plans. Where the pads are not in line with the supporting structures, headers are to be provided to transmit the loads to these members.

Each deck member intended to support containers is to have a section modulus SM , in cm³ (in³), not less than obtained from the following equation:

$$SM = M/f$$

where

M = maximum bending moment due to maximum static container loading, in kN-cm (tf-cm, Ltf-in.)

f = permissible maximum bending stress as given in 5-1-1/5 TABLE 2

TABLE 2
Values of f (Ordinary-strength Steel)

	kN/cm^2	tf/cm^2	Ltf/in^2
Effective longitudinal members	12.36	1.26	8
Transverse members and longitudinal members inside the line of openings	13.90	1.42	9

In determining the maximum bending moment, members may be considered fixed-ended provided the member is continuous over the adjacent spans or is effectively attached to a bulkhead stiffener or frame. Where this is not the case, the member is to be considered simply-supported. Where weather deck containers are supported by pedestals, a section modulus is to be determined for the deck beam in accordance with 5-1-1/3.1, except that the head, h , is to be the distance between the deck and the underside of the container, but need not be greater than 50% of the appropriate h value in 5-1-1/3.1. This section modulus is to be added to the above required section modulus.

The net sectional area, A , of the web of the member, including effective brackets where applicable, is to be not less than obtained from the following equation:

$$A = F/q \text{ cm}^2(\text{in}^2)$$

where

F = shearing force at the point under consideration, in kN (tf, Ltf)

q = allowable average shear in the web, not to exceed 10.35 kN/cm² (1.055 tf/cm², 6.7 Ltf/in²)

7 Deck Girders, Chords and Transverses

Each deck girder, chord and transverse, in association with any plating to which it is attached, is to have a section modulus SM not less than that obtained from the following equation:

$$SM = 4.74chs\ell^2 \text{ cm}^3$$

$$SM = 0.0025chs\ell^2 \text{ in}^3$$

where

c = 1.0 (1.1 for channel construction. See 5-1-1/15.11 FIGURE 1.)

h = head as required by 5-1-1/3 or 5-1-1/3.3, whichever is greater, for the deck beams supported, in meters (feet)

s = mean breadth of the area of deck supported, in meters (feet)

ℓ = unsupported span, in meters (feet), as shown in 5-1-1/15.11 FIGURE 1, 5-1-1/15.11 FIGURE 2 and 5-1-1/15.11 FIGURE 3. Deck transverses fitted with end brackets having a slope of approximately 45° and a thickness given in 5-1-1/3.1 TABLE 1, the length ℓ may be measured to a point on the bracket equal to 25% of the length of the bracket.

9 Side and Bottom Frames

Each side and bottom frame in association with the plating to which it is attached is to have a section modulus SM not less than that obtained from the following equation:

$$SM = 7.8chs\ell^2 \text{ cm}^3$$

$$SM = 0.0041chs\ell^2 \text{ in}^3$$

where

c = 1.25 for transverse and longitudinal side frames

= 1.34 for bottom longitudinal frames

= 1.25 for bottom transverse frames

h = vertical distance, in meters (feet), from the midpoint of length ℓ to the deck at side, as shown in 5-1-1/15.11 FIGURE 1, 5-1-1/15.11 FIGURE 2 and 5-1-1/15.11 FIGURE 3

= where the space is a ballast or deep tank, vertical distance, in meters (feet), from the midpoint of length ℓ to a point located two-thirds of the distance from the top of the tank to the top of the overflow, or 0.915 meters (3.0 feet), whichever is greater

s = spacing of the frames, in meters (feet)

ℓ = unsupported span, in meters (feet), as shown in 5-1-1/15.11 FIGURE 1, 5-1-1/15.11 FIGURE 2 and 5-1-1/15.11 FIGURE 3. Transverse frames fitted with end brackets having a slope of approximately 45° and a thickness given in 5-1-1/15.11 FIGURE 3, the length ℓ may be measured to a point on the bracket equal to 25% of the length of the bracket.

11 Side Transverse and Bottom Girders, Chords and Transverses

Each side transverse and bottom girder, chord and transverse, in association with any plating to which it is attached, is to have a section modulus SM not less than that obtained from the following equation:

$$SM = 4.74chs\ell^2 \quad \text{cm}^3$$

$$SM = 0.0025chs\ell^2 \quad \text{in}^3$$

where

- c = 1.65 for bottom transverse, channel construction. See 5-1-1/15.11 FIGURE 1.
- = 1.5 for truss bottom cord and bottom transverse. See 5-1-1/15.11 FIGURE 2 and 5-1-1/15.11 FIGURE 3.
- = 1.95 for side transverse, channel construction. See 5-1-1/15.11 FIGURE 1.
- = 1.75 for side transverse. See 5-1-1/15.11 FIGURE 3.
- h = vertical distance, in meters (feet), from the midpoint of length ℓ to the deck at side, as shown in 5-1-1/15.11 FIGURE 1, 5-1-1/15.11 FIGURE 2 and 5-1-1/15.11 FIGURE 3.
- = where the space is a ballast or deep tank, is the vertical distance, in meters (feet), from the midpoint of length ℓ to a point located two thirds of the distance from the top of the tank to the top of the overflow, or 0.915 meters (3.0 feet), whichever is greater
- s = mean breadth of side/bottom area supported, in meters (feet)
- ℓ = unsupported span, in meters (feet), as shown in 5-1-1/15.11 FIGURE 1, 5-1-1/15.11 FIGURE 2 and 5-1-1/15.11 FIGURE 3. Side or bottom transverse fitted with end brackets having a slope of approximately 45° and a thickness given in 5-1-1/3.1 TABLE 1, the length ℓ may be measured to a point on the bracket equal to 25% of the length of the bracket.

13 Higher-strength Materials

Each beam, frame, girder, chord or transverse of higher-strength material, in association with the higher-strength plating to which it is attached, is to have a section modulus as required by the previous paragraphs reduced by the factor Q as defined in 3-2-1/11.3.

15 Trusses

15.1 Truss Arrangement (2020)

Trusses are to be arranged as necessary for the support of frames and may extend either fore and aft or athwartship. See 5-1-1/Figures 1 through 3.

See 3-2-1/15 and 3-1-2/25 for consideration of non-effective truss arrangement.

15.3 Stanchions (2019)

The permissible load W_a of a stanchion, pillar or strut is to be obtained from the following equation which will, in all cases, be equal to or greater than the calculated load W defined in 5-1-1/15.5:

$$W_a = [m - n(\ell/r)]A \quad \text{kN(tf, Ltf)}$$

where

- ℓ = unsupported span of the stanchion or pillar, in m (ft)
- r = least radius of gyration, in cm (in)

A	=	area of the strut, stanchion or pillar, in cm^2 (in^2)
m	=	12.09 (1.232, 7.83) ordinary strength steel
	=	16.11 (1.643, 10.43) HT32 strength steel
	=	18.12 (1.848, 11.73) HT36 strength steel
	=	19.13 (1.951, 12.38) HT40 strength steel
n	=	4.44 (0.452, 0.345) ordinary strength steel
	=	7.47 (0.762, 0.581) HT32 strength steel
	=	9.00 (0.918, 0.699) HT36 strength steel
	=	9.76 (0.996, 0.758) HT40 strength steel

The foregoing equation applies where ℓ/r , with ℓ and r in the same units, is less than 130.

15.5 Calculated Load (2019)

The calculated load W for a specific stanchion, pillar or strut is to be obtained from the following equation:

$$W = pbs \text{ kN (tf, Ltf)}$$

where

p	=	designed uniform load, in kN/m^2 , (tf/m^2 , Ltf/ft^2) p is not to be less than $1.07 D$ ($0.03 D$), meters (feet)
b	=	breadth of the area supported by the stanchion, pillar or strut, in meters (feet)
s	=	breadth of the area supported by the stanchion, pillar or strut, in meters (feet)
D	=	depth of the barge as defined in 3-1-1/7, in meters (feet)

See 5-1-1/15.11 FIGURE 1, 5-1-1/15.11 FIGURE 2 and 5-1-1/15.11 FIGURE 3.

15.7 Diagonals (2020)

Diagonals in trusses are:

- to be arranged to have angles of inclination of about 45°
- to have a sectional area of approximately 50% of that of the adjacent stanchion
- to be of the same material strength as the adjacent stanchion
- the ℓ/r ratio of the diagonal, with ℓ and r in the same units, is to be less than 130 where ℓ is the unsupported span of the diagonal and r is the least radius of gyration

The size of the stanchions for deck cargo barges will be based on the higher calculated W due to the hydrostatic load or the deck cargo load. The area of the diagonals should be based on the greater of: 75% of the stanchion area based on the hydrostatic W or 50% of the stanchion area based on the deck cargo W .

15.9 Trusses in Tanks

Solid sections are to be used in tanks. The strut, stanchion or pillar, in addition to satisfying 5-1-1/15.3, is to have a cross-sectional area not less than $0.1035W \text{ cm}^2$ ($1.015W \text{ cm}^2$, $0.16W \text{ in}^2$) where W is the calculated load as defined in 5-1-1/15.5.

15.11 End Connections (2020)

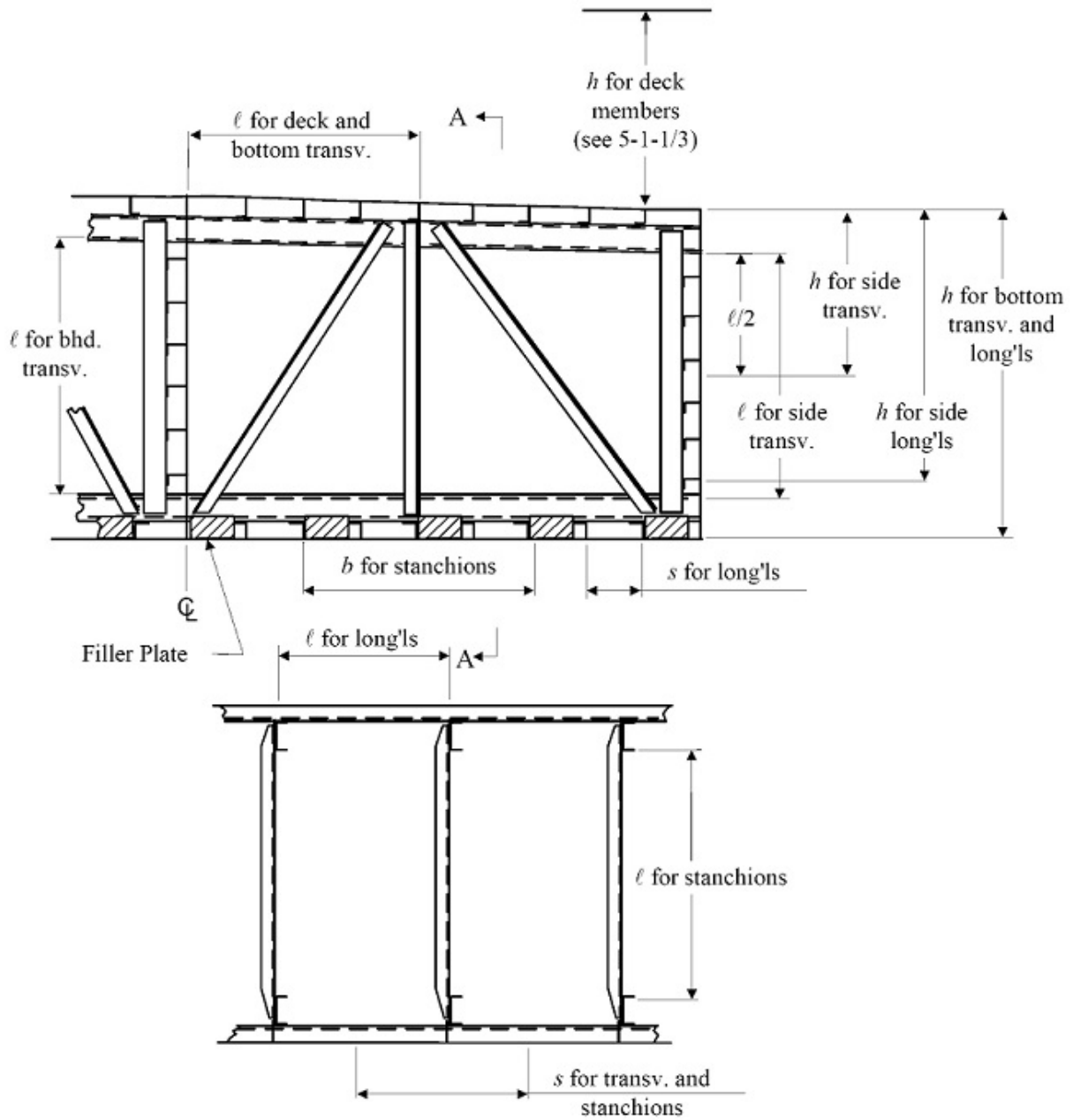
The required welding area of end connections of stanchions and diagonals is not to be less than the following:

- Stanchions: 75% of the area of the stanchions
- Diagonals: 50% of the area of the diagonal

In determining the weld area provided, the throat dimension of the fillet is to be used.

For designs where locally specified cargo load outweighs the hydrostatic pressure exerted on the bottom shell, due consideration shall be given to the welding area of end connections of diagonals.

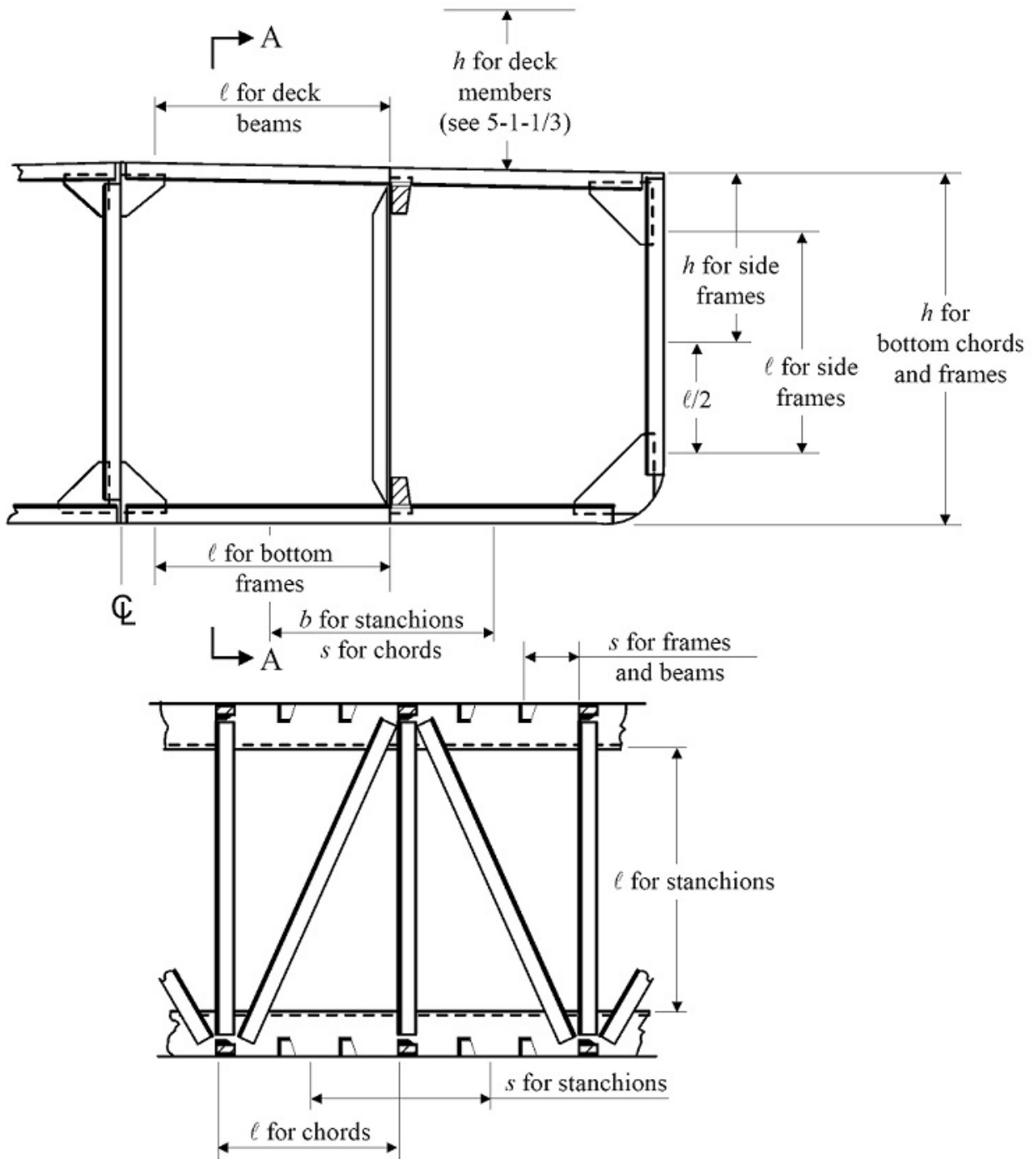
FIGURE 1
Deck Cargo Barge with $L \leq 76$ meters (250 feet) (2019)



Section A-A

Longitudinally Framed Barge with Channel Transverses and Transverse Trusses

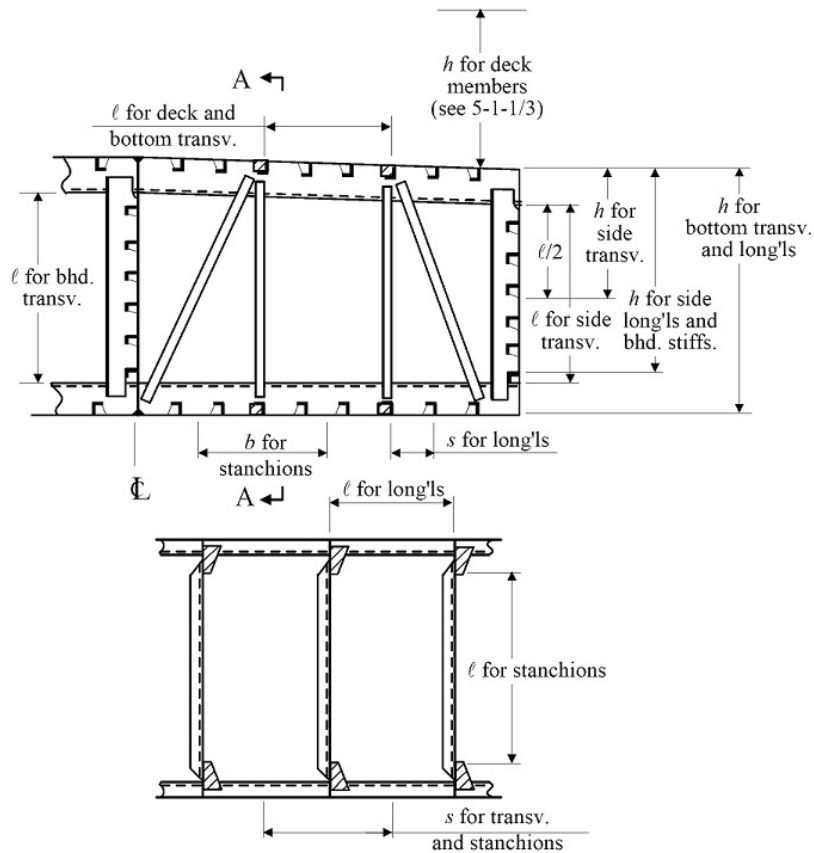
FIGURE 2
Deck Cargo Barge (2019)



Section A-A

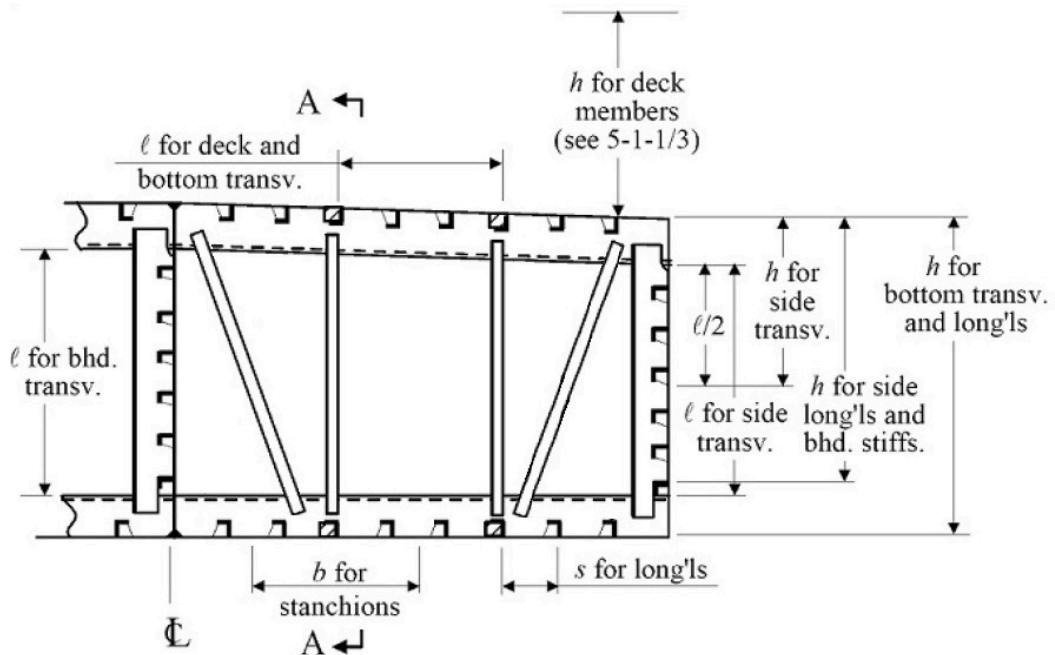
Transversely Framed Barge with Longitudinal Trusses

FIGURE 3
Deck Cargo Barge (2024)



Section A-A

Longitudinally Framed Barge with Flanged Plate Transverses and Transverse Trusses



Additional Illustration of Transverse Trusses

Barges Intended for the Carriage of Dry Cargo in Holds Below Deck**1 General (2020)**

The requirements of this Section are generally intended to apply to double bottom dry cargo barges of the type illustrated by 5-1-2/5.27 FIGURE 3 and 5-1-2/5.27 FIGURE 4. Barges of other structural configurations will be subject to special consideration, including split dump hopper barges.

3 Framing Arrangements in Holds

The structural requirements for frames, side shell stringers, etc., are to be in accordance with the requirements of the appropriate sections and paragraphs of the *Marine Vessel Rules*.

5 Double Bottom**5.1 Center Girder (2017)**

A center girder is to extend as far forward and aft as practicable. The plates are to be continuous within the midship three-quarters length. Elsewhere, they may be intercostal between the floors. Manholes may be cut in every frame space outside the midship three-quarters length. They may be cut in alternate frame spaces within the midship three-quarters length in barges under 90 m (295 ft) in length, provided the depth of the hole does not exceed one-third the depth of the center girder. Manholes within the midship three-quarters length in barges 90 m (295 ft) in length and above are to be compensated for and specially approved.

Center-girder plates are to be of the thickness and depths given by the following equations:

5.1.1 Thickness Amidships

$$t = 0.056L + 5.5 \quad \text{mm}$$

$$t = 0.000672L + 0.217 \quad \text{in.}$$

5.1.2 Thickness at Ends

85% of that given for amidships

5.1.3 Depth

$$d_{DB} = 32B + 190\sqrt{d} \quad \text{mm}$$

$$d_{DB} = 0.384B + 4.13\sqrt{d} \quad \text{in}$$

where

t = thickness of plating, in mm (in)

L = length of barge, as defined in 3-1-1/3

d_{DB} = depth of double bottom, in mm (in.) (See also 5-2-4/9.3.1.)

d = molded draft of barge, as defined in 3-1-1/11

B = breadth of barge, as defined in 3-1-1/5

Where longitudinal framing is adopted, the center-girder plate is to be suitably stiffened between floors, and docking brackets are to be provided where the spacing of floors exceeds 2.3 m (7.5 ft). Where special arrangements such as double skins or lower wing tanks effectively reduce the unsupported breadth of the double bottom in association with closely spaced transverse bulkheads, the depth of the center girder may be reduced by substituting for B the distance between sloping plating of the wing tanks at the inner-bottom plating level or between the inner skins. Where this distance is less than $0.9B$, an engineering analysis for the double bottom structure may be required. Where the length of the cargo hold is greater than $1.2B$ or where the barge is intended to carry heavy cargoes, particularly in alternate holds, the thickness and depth of center-girder plates are to be specially considered.

5.3 Pipe Tunnels

Pipe tunnels may be substituted for center girders provided the sides of the pipe tunnels have not less thickness than required for tank-end floors. The arrangement and details of construction of pipe tunnels are to be clearly shown on the plans submitted for approval.

5.5 Side Girders

Side girders are to be extended as far forward and aft as practicable. They are to be so arranged that the distance from the center girder to the first side girder, between the girders or from the outboard girder to the outboard abutment does not exceed 4.6 meters (15.0 feet). In barges specially reinforced for the carriage of heavy cargoes, the spacing between side girders is to be approximately 3.05 meters (10.0 feet). Additional full or half depth girders are to be fitted under wide spaced pillars.

In transversely framed double bottoms, the spacing between side girders forward of $0.3L$ from amidships is not to exceed 2.3 meters (7.5 feet)

Side girder plates are to have a thickness given by the following equation:

$$t = 0.036L + 4.5 \quad \text{mm}$$

$$t = 0.000432L + 0.18 \quad \text{in.}$$

where L is the length of the barge, as defined in 3-1-1/3.

Side girders forming the boundaries of tanks are also to satisfy the requirements for tank end floors.

5.7 Solid Floors

5.7.1 Longitudinally Framed Double Bottoms

Longitudinally framed double bottoms are to have solid floors of the type illustrated by 5-1-2/5.7.2 FIGURE 1, spaced not more than 3.66 meters (12.0 feet) apart, and are to have a thickness not less than given by the following equation:

$$t = 0.036L + 6.0 \quad \text{mm}$$

$$t = 0.000432L + 0.236 \quad \text{in.}$$

The floors are to have stiffeners fitted at every longitudinal.

Floors forming the boundaries of tanks are also to satisfy the requirements for tank end floors.

Forward of $0.3L$ from amidships, the floors are to be spaced not more than the spacing amidships nor more than the distance given by the following equation:

$$S = 0.00625L + 1.35 \text{ m}$$

$$S = 0.00625L + 4.43 \text{ ft}$$

where

S = spacing of the floors, in meters (feet)

L = length of the barge, as defined in 3-1-1/3, but is not be taken greater than 270 meters (886 feet)

5.7.2 Transversely Framed Double Bottoms.

Solid floors are to be fitted on every frame forward on $0.3L$ from amidships and are to have a thickness not less than given by the following equation:

$$t = 0.036L + 4.5 \text{ mm}$$

$$t = 0.000432L + 0.177 \text{ in.}$$

Aft of the above location, solid floors of the thickness given above are to be fitted on every frame, or, alternatively, a system of open floors may be fitted in association with solid floors spaced not more than 3.66 meters (12.0 feet) apart. With this alternative arrangement, the solid floors are to have a thickness not less than given by the following equation:

$$t = 0.036L + 6.0 \text{ mm}$$

$$t = 0.000432L + 0.236 \text{ in.}$$

where

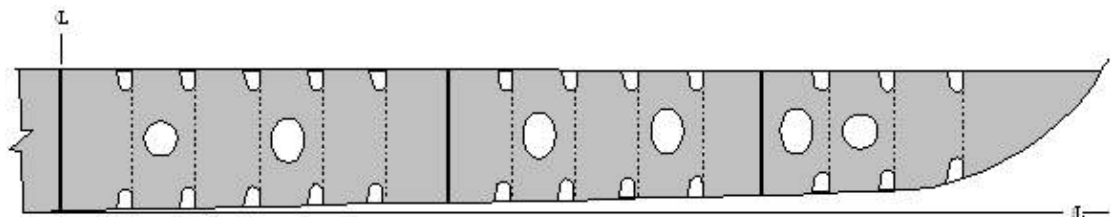
t = thickness of the solid floors, in mm (in.)

L = length of the barge, as defined in 3-1-1/3

Stiffeners may be omitted on non-tight floors with transverse framing provided the thickness of the floor plate is increased 10% above the thickness obtained from the above equations. Otherwise, stiffeners are to be spaced not more than 1.5 meters (5.0 feet) apart.

Floors forming the boundaries of tanks are also to satisfy the requirements for tank end floors.

FIGURE 1
Double-bottom Solid Floors



5.9 Open Floors

Open floors of the type illustrated by 5-1-2/5.9 FIGURE 2 are to be fitted at each frame between the solid floors and are to satisfy the following requirements.

5.9.1 Frames and Reverse Frames

Each frame and reverse frame similar to that shown in 5-1-1/15.11 FIGURE 2, in association with the plating to which they are attached, is to have a section modulus SM as obtained from the following equation:

$$SM = 7.8chs\ell^2 \quad \text{cm}^3$$

$$SM = 0.0041chs\ell^2 \quad \text{in}^3$$

where

s = spacing of frames, in m (ft)

c = 1.0 without struts

= 0.5 with struts in accordance with 5-1-2/5.9.3

h = distance, in m (ft), from the keel to the load line or two-thirds of the distance to the bulkhead or freeboard deck, whichever is greater. In the case of reverse frames without struts, the distance may be measured from the top of the double bottom.

ℓ = distance, in m (ft), between the connecting brackets on the centerline girder and the margin plate. Where side girders are fitted as specified by 5-1-2/5.5, it is the greatest distance between supports given by side girders and brackets. If effective struts are fitted and where the tank top is intended to be uniformly loaded with cargo, the length ℓ may be taken as 85% of the greatest distance between supports given by side girders and brackets, as determined above.

5.9.2 Center and Side Brackets

Center and side brackets are to overlap the frames and reverse frames for a distance equal to 0.05 B . They are to be of the thickness required for solid floors in the same location and are to be flanged on their outer edges.

5.9.3 Struts

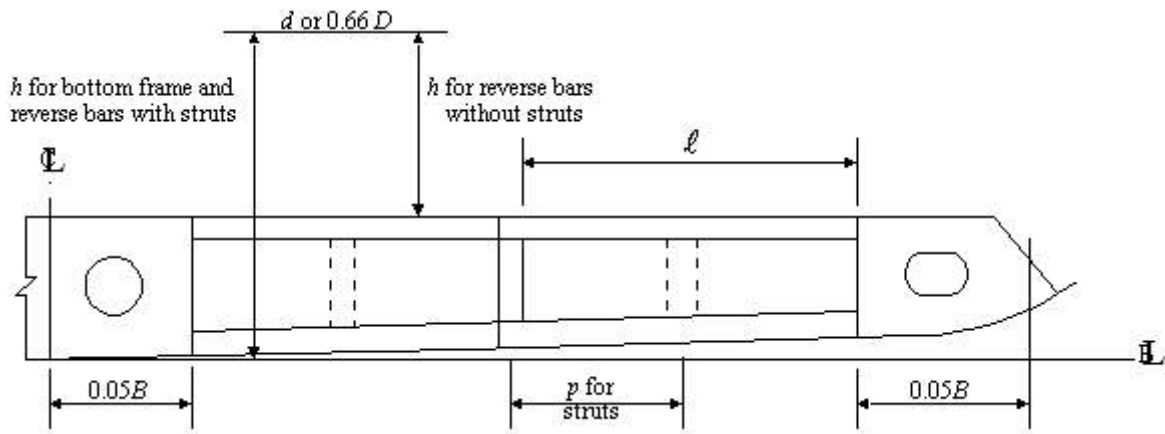
The permissible load W_a for struts is to be determined in accordance with 5-1-1/15.3. The calculated load W is to be determined by:

$$W = 1.025phs \quad \text{tf}$$

$$W = 0.0286phs \quad \text{Ltf}$$

where s and h have the values as defined in 5-1-2/5.9.1 and p is equal to distance, in m (ft), between the center of the struts. Struts are to be positioned so as to divide the distance ℓ in 5-1-2/5.9.1, into approximately equal intervals.

FIGURE 2
Double-bottom Open Floors



5.11 Tank End Floors

5.11.1 General

Tank end floors are to be so arranged that the subdivision of the double bottom generally corresponds with that of the barge.

5.11.2 Plating

Tank end floors are to have a thickness not less than given by the following equations:

$$t = 0.036L + 7.5 \quad \text{mm}$$

$$t = 0.000432L + 0.295 \quad \text{in.}$$

where

t = thickness of the tank end floor, in mm (in.)

L = length of the barge, as defined in 3-1-1/3

5.11.3 Stiffeners.

Stiffeners are to be of the sizes required for stiffeners on tank bulkheads and their spacing is not to exceed 915 mm (36 in.)

5.13 Bottom Longitudinal Frames

Each bottom longitudinal frame in association with the plating to which it is attached is to have a section modulus SM not less than obtained from the following equation:

$$SM = 7.8chs\ell^2 \quad \text{cm}^3$$

$$SM = 0.0041chs\ell^2 \quad \text{in}^3$$

where

c = 1.30 without struts

= 0.715 with effective struts

h = distance, in m (ft), from the keel to the load line, or two-thirds of the distance to the bulkhead or freeboard deck, whichever is greater

- s = spacing of longitudinals, in m (ft)
- ℓ = distance, in m (ft), between the floors. Where the barge length L is ≥ 61 meters (200 feet), the value of ℓ is not to be taken as less than 1.83 m (6.0 ft) without struts nor less than 2.44 m (8.0 ft) where effective struts are fitted. Where effective struts are fitted and the tank top is intended to be uniformly loaded with cargo, ℓ may be taken as 81% of the distance between the floors, subject to the preceding minimum.

For barges of 95 m (295 ft) or more in length where:

- i) The bottom hull girder section modulus SM_A is greater than required by 3-2-1/3.1, at least throughout $0.4L$ amidships
- ii) Still-water bending moment calculations are submitted, and
- iii) Adequate buckling strength maintained

the section modulus SM of the bottom longitudinals may be obtained from the above equations multiplied by R_ℓ . The bottom longitudinals with this modified section modulus are to meet all other Rule requirements.

$$R_\ell = 0.473(SM_R/SM_A)^4 + 0.528 \quad \text{but is not to be taken less than } 0.69.$$

where

$$SM_R = \text{hull girder section modulus required by 3-2-1/3.1, in cm}^2\text{-m (in}^2\text{-ft)}$$

$$SM_A = \text{bottom hull girder section modulus, in cm}^2\text{-m (in}^2\text{-ft), with the longitudinals modified as permitted above.}$$

Forward of $0.3L$ from amidships, the bottom longitudinals on the flat of bottom are to be not less than required by the above nor less than required by the following:

$$SM = 8.47(0.005L_1^2 - 1.3d_f^2)s\ell^2/d_f \quad \text{cm}^3$$

$$SM = 0.0044(0.005L_1^2 - 1.3d_f^2)s\ell^2/d_f \quad \text{in}^3$$

where

$$d_f = \text{draft at the forward perpendicular in the ballast loading condition to be used while the barge is in heavy weather, heavy ballast draft at the forward perpendicular, in m (ft)}$$

$$= d_f \times 214/L \text{ m (} d_f \times 702/L \text{ ft), where } L > 214 \text{ m (702 ft)}$$

$$L_1 = \text{length of barge as defined in 3-1-1/3, in mm (ft), but need not be taken as greater than 214 m (702 ft)}$$

$$L = \text{length of barge, as defined in 3-1-1/3, in m (ft)}$$

$$s = \text{spacing of longitudinals, in m (ft)}$$

$$\ell = \text{distance between floors, in m (ft)}$$

5.15 Inner-Bottom Longitudinals

5.15.1

The section modulus SM of inner-bottom longitudinals, in association with the plating to which they are attached, is not to be less than 85% of that required for bottom longitudinals.

5.15.2

Where bulk or ore cargoes are to be carried, each inner-bottom longitudinal, in association with the plating to which is attached, is to have a section modulus SM not less than required by the above nor less than that obtained from the following equation:

$$SM = 7.8chs n \ell^2 \quad \text{cm}^3$$

$$SM = 0.0041chs n \ell^2 \quad \text{in}^3$$

where

c	=	1.12	for barges intended for bulk cargo
	=	1.75	for barges specially reinforced for ore cargo or for loading in alternate holds
n	=	$0.40 (1 + V/1041)$	for barges intended for bulk cargo – SI or MKS units
	=	$V / 2403$	for barges specially reinforced for ore cargo or for loading in alternate holds – SI or MKS units
n	=	$0.40 (1 + V/65)$	for barges intended for bulk cargo – US units
	=	$V / 150$	for barges specially reinforced for ore cargo or for loading in alternate holds – US units

In no case is n to be less than 0.80.

V	=	cargo deadweight, in kg (lb), divided by the total volume of the holds, in m^3 (ft^3). Where the cargo is not uniformly distributed in all holds, the value of V is to be checked for each hold [cargo deadweight of each hold, in kg (lb), divided by the volume of the hold, in m^3 (ft^3)], and where in any one hold it exceeds the mean value calculated as directed above, the longitudinals of that hold are to be increased accordingly.
h	=	distance, in m (ft), from the inner bottom to the deck at centerline, or for inner bottom longitudinals located directly under upper wing tanks to the underside of the upper wing tank.
s	=	spacing of longitudinals, in m (ft)
ℓ	=	spacing of the floors, in m (ft)

5.17 Inner-Bottom Plating

Inner bottom plating is to be of not less thickness than obtained from the following equation:

$$t = 0.037L + 0.009s - 0.5 \quad \text{mm}$$

$$t = 0.000445L + 0.009s - 0.02 \quad \text{in.}$$

where

- t = thickness, in mm (in.)
 L = length of the barge, as defined in 3-1-1/3
 s = frame spacing, in mm (in.)

Where the inner-bottom is longitudinally framed, the minimum thickness of inner-bottom plating as obtained above may be reduced by 1 mm (0.04 in.).

Where there is no ceiling under hatchways, except for barges intended for the exclusive carriage of containers on the inner-bottom, the required thickness is to be increased by 2 mm (0.08 in.).

For barges regularly engaged in trades where the cargo is handled by grabs or similar mechanical appliances, or where heavy bulk cargoes are carried, it is recommended that flush inner-bottom plating be adopted throughout the cargo space and that the plating requirements be suitably increased, but the increase need not exceed 5 mm (0.20 in.). It is also recommended that the minimum thickness be not less than 12.5 mm with 610 mm (0.50 in. with 24 in.) frame spacing and 19 mm with 915 mm (0.75 in. with 36 in.) frame spacing with intermediate thicknesses obtained by interpolation.

It is recommended that for barges specially designed to carry ore, the minimum thickness of the inner bottom be 19 mm (0.75 in.) at 510 mm (20 in.) spacing of longitudinals.

Where provision is to be made for the operation or stowage of vehicles having rubber tires, and after all other requirements are met, the thickness of the inner bottom plating is to be not less than obtained from 3-2-3/17.

Where the inner-bottom is used as a tank boundary, the requirements of 3-2-7/5 apply also.

5.19 Drainage and Drain Wells

Efficient arrangements are to be provided for draining water which may gather on the inner bottom. Where wells are fitted for such purpose, it is recommended that such wells not extend for more than one-half the depth of the double bottom nor less than 460 mm (18 in.) from the outer shell. Thick steel plates or other approved arrangements are to be provided in way of sounding pipes to prevent damage by the sounding rods. Plating forming drain wells are to be of the thickness of tank end floors plus 2.5 mm (0.10 in.) greater than is otherwise required at that location. This requirement may be modified where corrosion-resistant material is used or special protective coatings are applied.

5.21 Structural Sea Chests (1 July 2019)

Where the inner bottom or the double bottom structure form part of a sea chest, the thickness of the plating is to be not less than that required in Section 3-2-2 as applicable for the shell plating in the same location, but need not exceed 25 mm (1.0 in.).

Where connections between shell and grating employ welding joints with lug plates instead of hinge joints, a partial or full penetration weld is required. Stiffeners attached to the shell in way of sea chest openings are to be connected at their ends.

5.23 Manholes and Lightening Holes

Manholes and lightening holes are to be cut in all non-tight members, except in way of widely spaced pillars, to ensure accessibility and ventilation. The proposed locations and sizes of holes are to be indicated on the plans submitted for approval. Manholes in tank tops are to be sufficient in number to ensure free ventilation and ready access to all parts of the double bottom. Care is to be taken in locating the manholes to avoid the possibility of interconnection of the main subdivision compartments through the double bottom insofar as practicable. Covers are to be of steel or other approved material and where no ceiling is fitted in the cargo holds, they are to be effectively protected against damage by the cargo.

5.25 Air and Drainage Holes

Air and drainage holes are to be cut in all parts of the structure to ensure the free escape of air to the vents and the free drainage to the suction pipes.

5.27 Higher-strength Materials

5.27.1 Inner-Bottom Plating

Inner-bottom plating, where constructed of higher-strength material and where longitudinally framed, is to be not less in thickness than required by 5-1-2/5.17, as modified by the following equation:

$$t_{hts} = [t_{ms} - C][(Q + 2\sqrt{Q})/3] + C$$

where

t_{hts} = thickness of higher-strength material, in mm (in.)

t_{ms} = thickness of ordinary strength steel, as required by 5-1-2/5.17, in mm (in.), increased where required for no ceiling

C = $0.3t_{ms}$, but need not be taken greater than 3 mm (0.12 in.)
 = $0.5t_{ms}$, but need not be taken greater than 5 mm (0.20 in.) where the plating is required to be increased for no ceiling.

Q = as defined in 3-2-1/11.3

The thickness of inner-bottom plating, where transversely framed, will be specially considered.

Where cargo is handled by grabs or similar mechanical appliances, the recommendations of 5-1-2/5.17, are applicable to t_{hts} .

5.27.2 Bottom and Inner-bottom Longitudinals

The section modulus of bottom and inner-bottom longitudinals where constructed of higher-strength material and in association with the higher-strength plating to which they are attached, is to be determined as indicated in 5-1-2/5.13 and 5-1-2/5.15, except the value may be reduced by the factor Q as defined in 3-2-1/11.3.

5.27.3 Center Girder, Side Girders, and Floors

Center girder, side girders and floors, where constructed of higher-strength materials, generally are to comply with the requirements of 5-1-2/5.1, 5-1-2/5.5 and 5-1-2/5.7 but may be modified as permitted by the following equation:

$$t_{hts} = [t_{ms} - C][(Q + 2\sqrt{Q})/3] + C$$

where

t_{hts} = thickness of higher-strength material, in mm (in.)

t_{ms} = thickness, in mm (in.), of ordinary strength steel, as required by preceding paragraphs of this section.

C = $0.3t_{ms}$, but need not be taken greater than 3 mm (0.12 in.)

Q = as defined in 3-2-1/11.3

FIGURE 3
Cargo Barge

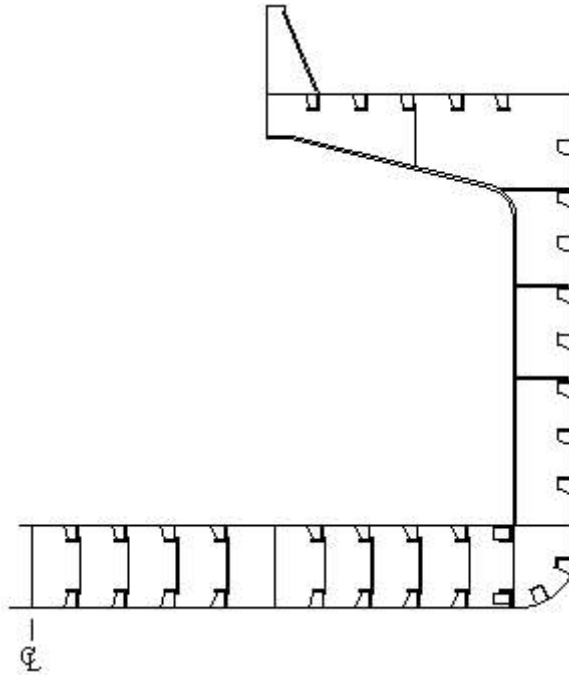
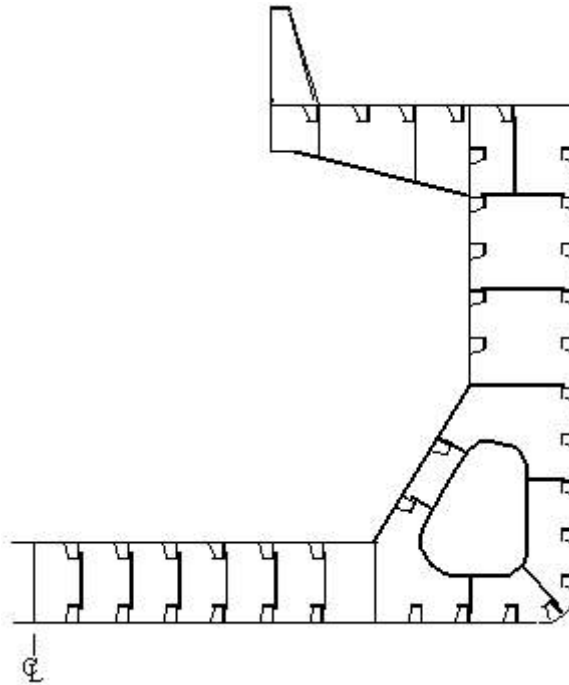


FIGURE 4
Cargo Barge



PART 5

CHAPTER 2 Tank Barges

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1 General (2015)

1.1 Application

The requirements of this Section are generally intended to apply to barges of the type illustrated by 5-2-1/17 FIGURE 1, 5-2-1/17 FIGURE 2 and 5-1-1/15.11 FIGURE 3 designed for the carriage of liquids in bulk.

Where structural arrangements are not provided for in these Rules, the *Marine Vessel Rules* are to apply.

1.3 Scantlings (2018)

Where heated cargoes are to be carried in integral tanks, a temperature distribution is to be submitted where the cargo heating source is adjacent to or integral with the structure of the cargo tank boundaries which are not in contact with the sea, or where heated cargoes are to be carried at temperatures greater than 80°C (176°F) in tanks not having common boundaries with the sea.

Where the steel temperature exceeds 80°C (176°F), calculations are to be submitted indicating the resultant hull structure stresses in association with an air temperature of 5°C (41°F) and a sea temperature of 0°C (32°F). Reduced permissible still water bending moment and/or reinforcement of the hull structure may be required for heated cargo conditions.

For the performance of Finite Element Analysis calculations including thermal stresses, see the *ABS Guide for SafeHull-Dynamic Loading Approach for Vessels*. The stress results including thermal stresses are to be checked against the allowable stresses in Section 15 of the aforementioned Guide. On plating panels where local elastic buckling occurs due to thermal loads, a reduced stiffness is to be employed on the FEA model in order to account for buckling and obtain an equivalent stiffness distribution on the modeled hull structure.

For cargo temperatures up to 140°C (284°F), vertical and transverse tank bulkheads are to be corrugated or of stiffened panel construction. Vertical or horizontal deep girders may produce high stress concentration when subject to thermal loads. Adequate back up and connection details are to be provided with due consideration for effect of thermal stresses.

For cargo temperatures up to 200°C (392°F), integral cargo tanks are to be arranged so that the vessel has full double skin structure including inner bottom, double side structure, and double deck. The double bottom, inner deck, and wing bulkheads, are to be stiffened transversely in order to counter act the loads

imposed by the heated cargo in the transverse direction of the vessel. The outer watertight envelope including bottom shell, side shell and strength deck are to be longitudinally stiffened to carry the full longitudinal hull girder loads. The longitudinal and transverse tank bulkheads are to be of corrugated type with vertical corrugations and without deep webs or bulkhead girders. For this type of vessel arrangement when calculating longitudinal strength, the inner hull envelope plate panels transversely stiffened may be allowed to reach elastic buckling. These plate panels are to be acceptable based on plate ultimate strength criteria as required by 5C-1-5/5 of the *Marine Vessel Rules*.

An alternative structural arrangement is acceptable provided it is proven adequate in terms of allowable stresses and buckling.

For cargo temperatures above 200°C (392°F), the cargo is to be carried in independent tanks. Appropriate arrangements are to be provided for independent tank foundations in order to allow for tank expansion and contraction due to heated cargo.

High stress concentration due to thermal loads at intersections between main bearing members should be avoided. Cut-outs and scallops between the transverse floors and the inner shell should be avoided at the turn of bilge area. Primary supporting members are to have adequate design in order to support thermal induced loads and present satisfactory behavior with respect to tripping, and shear stresses.

3 Tank Head for Scantlings (1993)

Except for stanchions (see 5-2-1/Figures 1 through 3), the scantling head of structural members in tanks is to be obtained as follows:

The scantling head h , in m (ft), is to be not less than h_1 , nor less than h_0 where spill valves or rupture discs are fitted in lieu of high level alarms.

$$h_1 = \rho h_t + h_a \text{ m(ft)}$$

h_1 is to be not less than the distance to the top of the hatch.

$$\begin{aligned} h_0 &= (2/3)(\rho h_s + 9.95P_s) \text{ m} \quad (P_s \text{ in bar}) \\ &= (2/3)(\rho h_s + 9.75P_s) \text{ m} \quad (P_s \text{ in kgf/cm}^2) \\ &= (2/3)(\rho h_s + 2.25P_s) \text{ ft} \quad (P_s \text{ in lbf/in}^2) \end{aligned}$$

where

$$\begin{aligned} \rho &= 1.0 \text{ where the specific gravity of liquid is 1.05 or less} \\ &= \text{specific gravity of liquid where it is in excess of 1.05} \end{aligned}$$

$$h_t = \text{head from the center of the supported area or lower edge of the plating to the deck at side or, where such is fitted, to the top of the trunk deck at side for tanks within trunk}$$

$$h_a = \text{the greater of } h_{a1} \text{ or } h_{a2}$$

$$\begin{aligned} h_{a1} &= 1.22 \text{ m (4 ft)} && \text{for } L \leq 61 \text{ m (200 ft)} \\ &= 0.02L && \text{for } 61 \text{ m (200 ft)} < L \leq 122 \text{ m (400 ft)} \\ &= 2.44 \text{ m (8 ft)} && \text{for } L > 122 \text{ m (400 ft)} \end{aligned}$$

$$L = \text{barge length, as defined in 3-1-1/3}$$

$$h_{a2} = 9.95p_v(9.75p_v, 2.25p_v)$$

$$p_v = \text{pressure/vacuum valve pressure setting, in bar (kgf/cm}^2, \text{ lbf/in}^2)$$

h_s = head to the spill valve or rupture disc, where fitted, in m (ft)

P_s = relieving pressure of spill valve or rupture disc, where fitted, in bar (kgf/cm², lbf/in²)

5 Deck Cargo

Where it is intended to carry cargo on the deck, this is to be clearly indicated on the drawings submitted for approval.

7 Deck Beams and Bottom and Side Shell Frames (1993)

Deck beams and bottom and side shell frames, in association with the plating to which they are attached, are to have a section modulus SM not less than obtained from the following equation:

$$SM = 7.8chs\ell^2 \quad \text{cm}^3$$

$$SM = 0.0041chs\ell^2 \quad \text{in}^3$$

where

c = 1.0 for transverse deck beams

= 1.25 for longitudinal deck beams

= 1.25 for transverse or longitudinal side frames

= 1.25 for bottom transverse frames

= 1.34 for bottom longitudinal frames

h = as defined in 5-2-1/3

s = spacing of beams/frames, in meters (feet)

ℓ = unsupported span, in meters (feet), as shown in 5-2-1/17 FIGURE 1, 5-2-1/17 FIGURE 2 and 5-2-1/17 FIGURE 3. Deck, bottom or side transverses fitted with end brackets having a slope of approximately 45° and thickness given in 5-1-1/3.1 TABLE 1, the length ℓ may be measured to a point on the bracket equal to 25% of the length of the bracket.

See 5-2-1/17 FIGURE 1, 5-1-1/15.11 FIGURE 2 and 5-1-1/15.11 FIGURE 3.

9 Deck Beams in Way of Deck Cargo

Where it is intended to carry deck cargo, the beams, in addition to complying with 5-2-1/7, are also to comply with 5-1-1/3.3.

11 Bottom, Side and Deck Girders, Chords and Transverses (1993)

Each bottom, side and deck girder, chord and transverse, in association with any plating to which it is attached, is to have a section modulus SM not less than that obtained from the following equation:

$$SM = 4.74chs\ell^2 \quad \text{cm}^3$$

$$SM = 0.0025chs\ell^2 \quad \text{in}^3$$

where

c = 1.95 bottom transverse channel construction, See 5-2-1/17 FIGURE 1

= 1.95 side transverse channel construction, See 5-2-1/17 FIGURE 1

= 2.20 deck transverse channel construction, See 5-2-1/17 FIGURE 1

- = 1.5 truss bottom chord, See 5-2-1/17 FIGURE 2
- = 1.5 truss top chord, See 5-2-1/17 FIGURE 2
- = 1.75 bottom transverse, See 5-2-1/17 FIGURE 3
- = 1.75 side transverse, See 5-2-1/17 FIGURE 3
- = 2.0 deck transverse, See 5-2-1/17 FIGURE 3
- h = as defined in 5-2-1/3
- s = spacing of the chords/transverses, in meters (feet). See 5-2-1/17 FIGURE 1, 5-2-1/17 FIGURE 2 and 5-2-1/17 FIGURE 3
- ℓ = unsupported span, in meters (feet), as shown in 5-2-1/17 FIGURE 1, 5-2-1/17 FIGURE 2 and 5-2-1/17 FIGURE 3. Deck, bottom or side transverses fitted with end brackets having a slope of approximately 45° and thickness given in 5-1-1/3.1 TABLE 1, the length ℓ may be measured to a point on the bracket equal to 25% of the length of the bracket.

13 Deck Chords or Transverses in Way of Deck Cargo

Where it is intended to carry deck cargo, the deck chords or transverses, in addition to complying with 5-2-1/11, are also to comply with 5-1-1/7.

15 Higher-strength Materials

Each beam, frame, girder, chord or transverse of higher-strength material, in association with the higher-strength plating to which it is attached, is to have a section modulus as required by the previous paragraphs reduced by the factor Q as defined in 3-2-1/11.3.

17 Trusses

Trusses are to be fitted in accordance with the requirements of 5-1-1/15

FIGURE 1
Single Skin Tank Barge with $L \leq 76$ meters (250 feet)

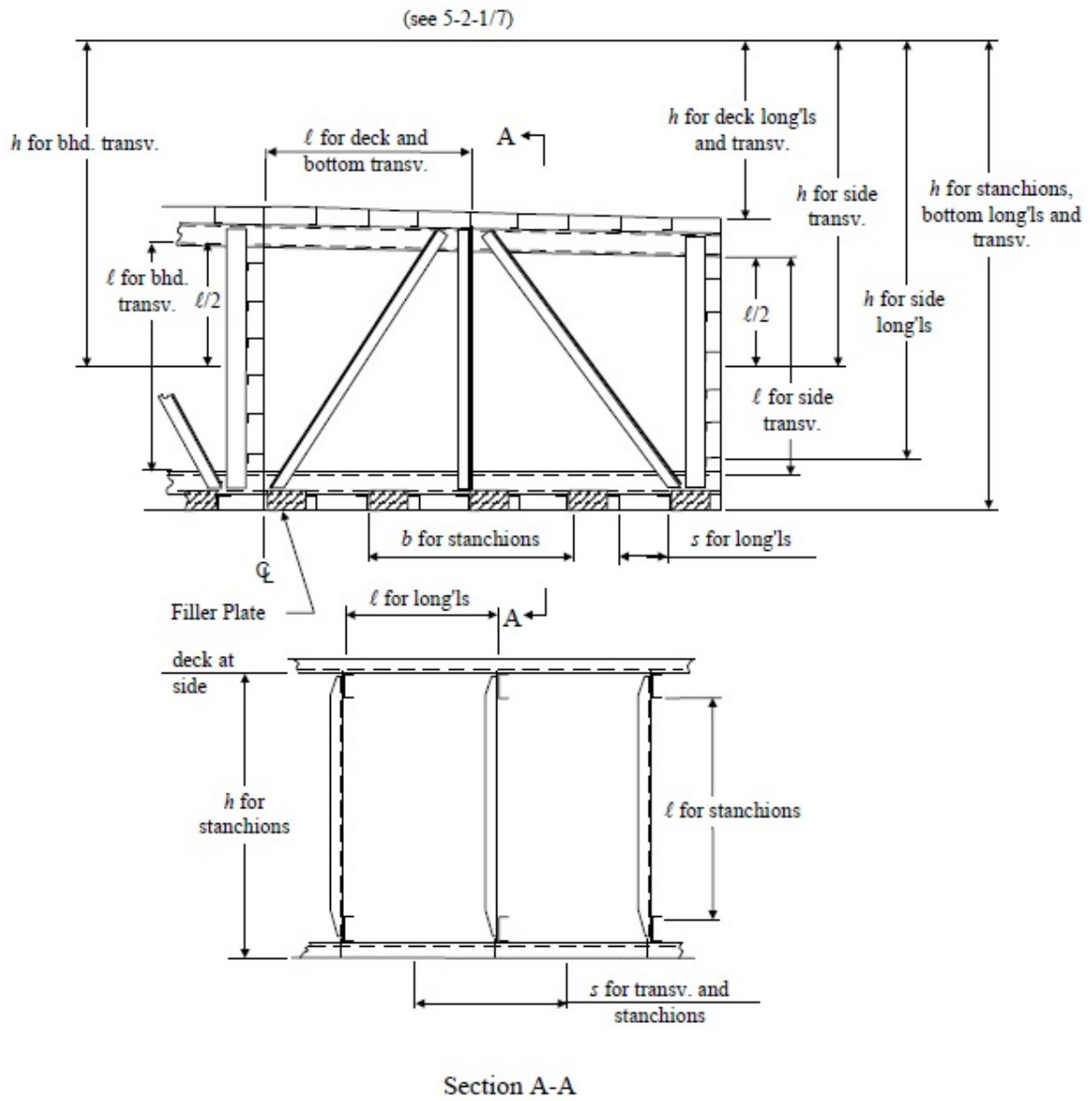
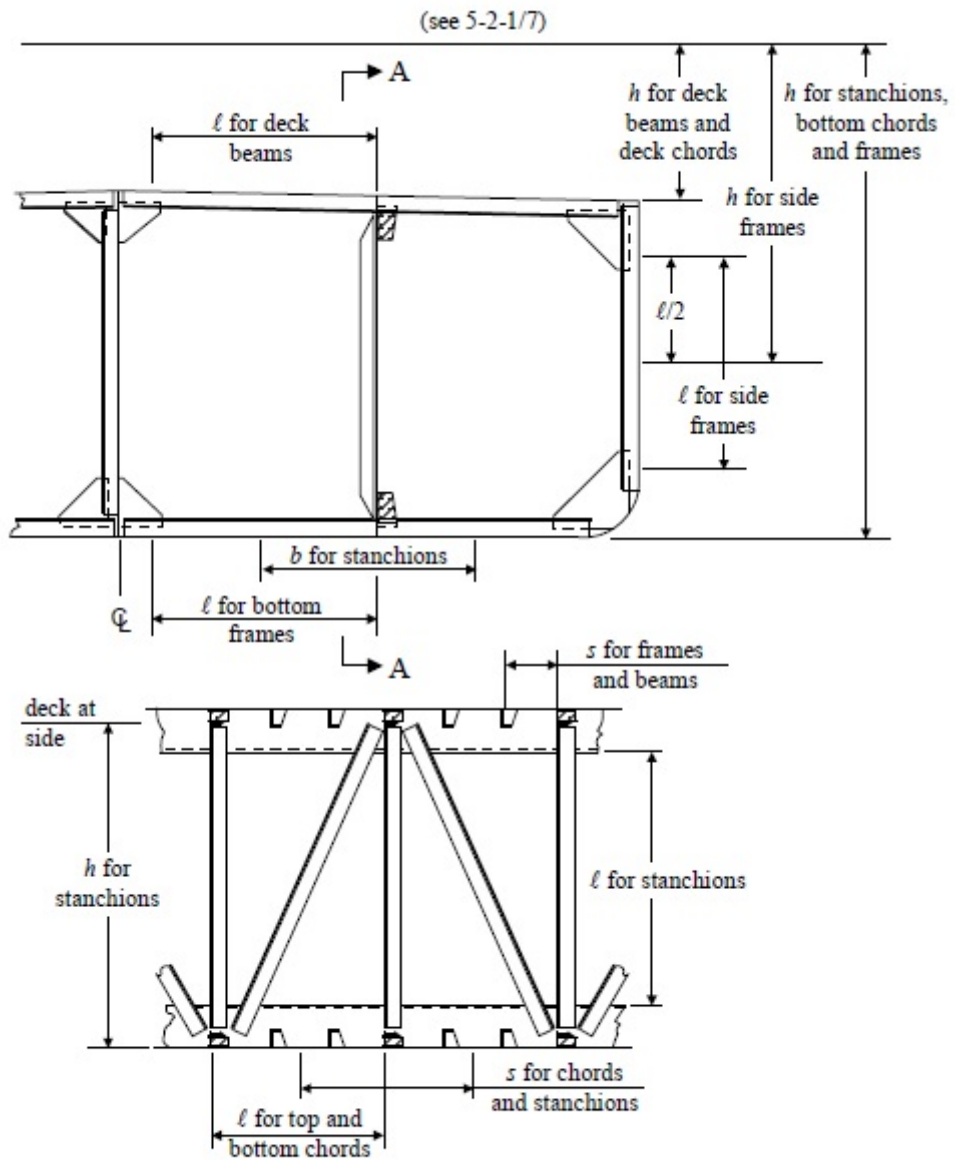
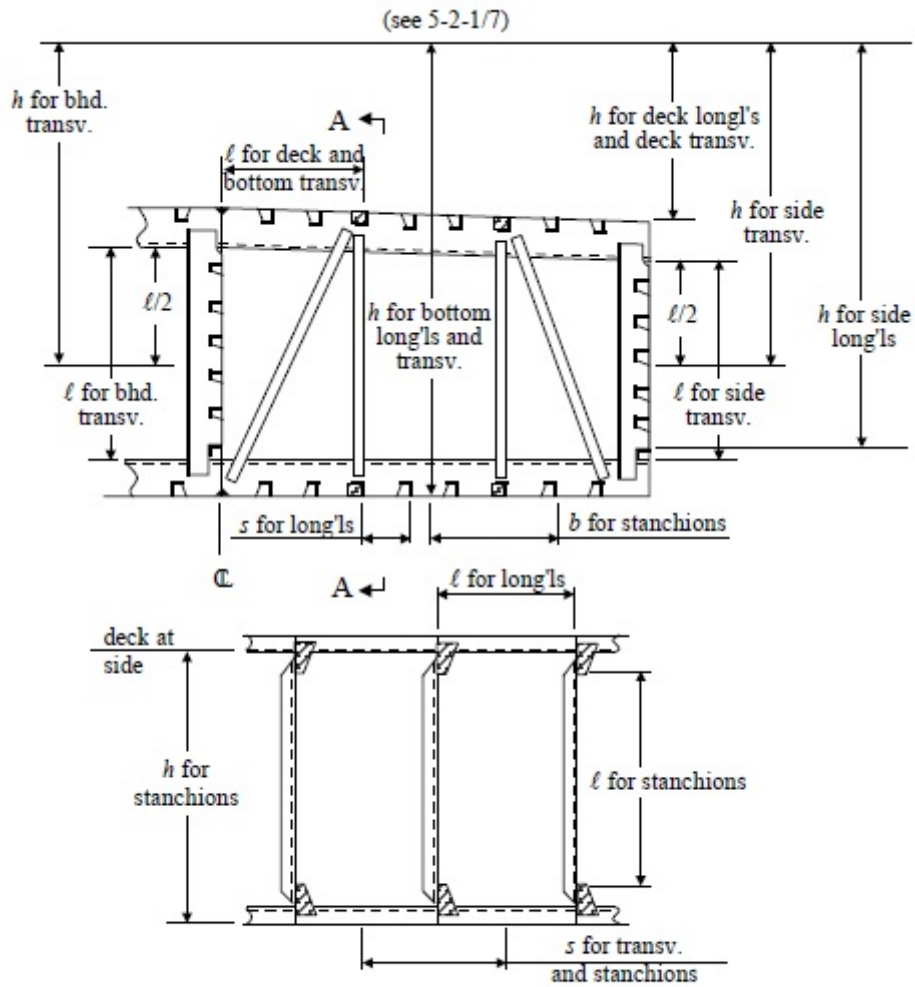


FIGURE 2
Single Skin Tank Barge



Section A-A

FIGURE 3
Single Skin Tank Barge



Section A-A

1 General (2017)

1.1 Application

The requirements of this Section are generally intended to apply to barges of the type illustrated by 5-2-2/11 FIGURE 1, 5-2-2/11 FIGURE 2, 5-2-2/11 FIGURE 3, 5-2-2/11 FIGURE 4, 5-2-2/11 FIGURE 5, designed for the carriage of liquids in bulk.

Unless specified otherwise in this Section, the required scantlings are to be developed from the appropriate paragraphs of this Section in association with 5-1-1/15.11 FIGURE 1, 5-1-1/15.11 FIGURE 2, 5-1-1/15.11 FIGURE 3, 5-1-2/5.27 FIGURE 3, 5-1-2/5.27 FIGURE 4, 5-2-1/17 FIGURE 1, 5-2-1/17 FIGURE 2 and 5-2-1/17 FIGURE 3, due regard being given to whether framing members are located in a tank or void compartment.

1.3 Scantlings (2018)

Where heated cargoes are to be carried in integral tanks, a temperature distribution is to be submitted where the cargo heating source is adjacent to or integral with the structure of the cargo tank boundaries which are not in contact with the sea, or where heated cargoes are to be carried at temperatures greater than 80°C (176°F) in tanks not having common boundaries with the sea.

Where the steel temperature exceeds 80°C (176°F), calculations are to be submitted indicating the resultant hull structure stresses in association with an air temperature of 5°C (41°F) and a sea temperature of 0°C (32°F). Reduced permissible still water bending moment and/or reinforcement of the hull structure may be required for heated cargo conditions.

For the performance of Finite Element Analysis calculations including thermal stresses, see the *ABS Guide for SafeHull-Dynamic Loading Approach for Vessels*. The stress results including thermal stresses are to be checked against the allowable stresses in Section 15 of the aforementioned Guide. On plating panels where local elastic buckling occurs due to thermal loads, a reduced stiffness is to be employed on the FEA model in order to account for buckling and obtain an equivalent stiffness distribution on the modeled hull structure.

For cargo temperatures up to 140°C (284°F), vertical and transverse tank bulkheads are to be corrugated or of stiffened panel construction. Vertical or horizontal deep girders may produce high stress concentration when subject to thermal loads. Adequate back up and connection details are to be provided with due consideration for effect of thermal stresses.

For cargo temperatures up to 200°C (392°F), integral cargo tanks are to be arranged so that the vessel has full double skin structure including inner bottom, double side structure, and double deck. The double bottom, inner deck, and wing bulkheads, are to be stiffened transversely in order to counter act the loads imposed by the heated cargo in the transverse direction of the vessel. The outer watertight envelope including bottom shell, side shell and strength deck are to be longitudinally stiffened to carry the full longitudinal hull girder loads. The longitudinal and transverse tank bulkheads are to be of corrugated type with vertical corrugations and without deep webs or bulkhead girders. For this type of vessel arrangement when calculating longitudinal strength, the inner hull envelope plate panels transversely stiffened may be allowed to reach elastic buckling. These plate panels are to be acceptable based on plate ultimate strength criteria as required by 5C-1-5/5 of the *Marine Vessel Rules*.

An alternative structural arrangement is acceptable provided it is proven adequate in terms of allowable stresses and buckling.

For cargo temperatures above 200°C (392°F), the cargo is to be carried in independent tanks. Appropriate arrangements are to be provided for independent tank foundations in order to allow for tank expansion and contraction due to heated cargo.

High stress concentration due to thermal loads at intersections between main bearing members should be avoided. Cut-outs and scallops between the transverse floors and the inner shell should be avoided at the turn of bilge area. Primary supporting members are to have adequate design in order to support thermal induced loads and present satisfactory behavior with respect to tripping, and shear stresses.

3 Double Bottom

3.1 Center Girder, Side Girder and Floors (2003)

In general, the scantlings and arrangement of girders and floors are to be as required by 5-1-2/5, unless otherwise specified in this paragraph. Where a centerline longitudinal bulkhead is provided, the scantlings and arrangement of side girders may be specially considered. Solid section stanchions fitted on tank top are not to be considered supports of double bottom structures, unless the stanchions are part of a truss system.

The floors and girders in the tank boundaries of double bottom are also to comply with Section 3-2-7 for deep tanks. The floors are to have stiffeners fitted at every longitudinal, unless the strength of the floors is proven by engineering analysis based on sound engineering principles. Where tanks adjacent to the double bottom are designed to be empty with the barge in a loaded condition, the floors and girders in the double bottom are to be specially considered.

3.3 Inner-bottom Plating

The thickness of the inner-bottom plating is not to be less than required by 5-1-2/5.17, nor is the thickness to be less than required by 3-2-7/3.1.

3.5 Inner-bottom Longitudinals (2003)

Each inner-bottom longitudinal, in association with the plating to which it is attached, is to have a section modulus SM not less than obtained from the following equation:

$$SM = 7.8chs\ell^2 \quad \text{cm}^3$$

$$SM = 0.0041chs\ell^2 \quad \text{in}^3$$

where

$$c = 1.0$$

$$= 0.5 \quad \text{where effective struts are fitted between inner bottom and bottom longitudinals.}$$

h = distance, in meters (feet), from the inner-bottom to the following point:

- as defined in 5-2-1/3 for a cargo or ballast tank, or
- the deck at side amidships for a void space

s = spacing of the inner-bottom longitudinals, in meters (feet)

ℓ = spacing of the floors, in meters (feet)

Where effective struts are fitted between inner bottom and bottom longitudinals, the section modulus of the inner bottom longitudinals, in addition to complying with above, is also to be not less than 85% of the requirement in 5-1-2/5.13 for bottom longitudinals with $c=0.715$.

3.7 Bottom Longitudinals (2003)

Scantlings of bottom longitudinals are to be obtained from 5-2-2/3.5 where:

c = 1.34

= 0.715 where effective struts are fitted between inner-bottom and bottom longitudinals

h = distance in meters (feet) from the bottom to the following point:

- to a point located at two-thirds of the distance from the deck to the top of the overflow for a ballast tank, or
- the deck at side amidships for a void space

3.9 Struts

Where struts are fitted between inner-bottom and bottom longitudinals, they are to satisfy the requirements of 5-1-1/15.

3.11 Higher-strength Materials

3.11.1 Inner-bottom Plating

Inner-bottom plating, where constructed of higher-strength material and where longitudinally framed, is to be not less in thickness than required by 5-2-2/3.3, as modified by the following equation:

$$t_{hts} = [t_{ms} - C][(Q + 2\sqrt{Q})/3] + C$$

where

t_{hts} = thickness of higher-strength material, in mm (in.)

t_{ms} = thickness of ordinary strength steel, as required by 5-2-2/3.3, in mm (in.)

C = $0.3t_{ms}$, but need not be taken greater than 3 mm (0.12 in.)

Q = as defined in 3-2-1/11.3

3.11.2 Bottom and Inner-bottom Longitudinals

The section modulus of bottom and inner-bottom longitudinals, where constructed of higher-strength material, and in association with the higher-strength plating to which they are attached, is to be determined as indicated in 5-2-2/3.5 and 5-2-2/3.7, except that the value may be reduced by the factor Q , as defined in 3-2-1/11.3.

3.11.3 Center Girder, Side Girders and Floors

Center girder, side girders and floors, where constructed of higher-strength materials, generally are to comply with the requirements of 5-2-2/3.5, but may be modified as permitted by the following equation:

$$t_{hts} = [t_{ms} - C][(Q + 2\sqrt{Q})/3] + C$$

where

t_{hts} = thickness of higher-strength material, in mm (in.)

t_{ms} = thickness of ordinary strength steel, as required by 5-2-2/3.1, in mm (in.)

C = $0.3t_{ms}$, but need not be taken greater than 3 mm (0.12 in.)

Q = as defined in 3-2-1/11.3

5 Trunk (2003)

Trunk structure is to comply with the required cargo tank design head of 5-2-1/3, as well as 3-2-3/3.

7 Deck Beams, Side Shell Frames and Longitudinal Bulkhead Stiffeners (2003)

Deck beams in way of cargo tanks, in association with the plating to which they are attached, are to have a section modulus SM as required by 5-2-1/7. Similarly, deck beams and side shell frames in wing ballast tanks, in association with the plating to which they are attached, are to have section modulus SM as required by 5-2-1/7, except that the design head h may be taken to two-thirds of the distance from the deck to the top of the overflow, or 0.91 meters (3 feet), whichever is greater. For void spaces, the design head h may be taken to the side amidships. For longitudinal bulkhead stiffeners, see 3-2-7/3.3.

9 Side and Deck Girders, Side Transverses and Vertical Web Frames on Longitudinal Bulkheads (2017)

Each deck girder and vertical web frame on longitudinal bulkheads in way of cargo oil tanks, in association with any plating to which it is attached, is to have a section modulus SM , as required by 5-2-1/11. Similarly, each side and deck girder and side transverse in wing ballast tanks, in association with any plating to which it is attached, is to have a section modulus SM , as required by 5-2-1/11, except that the design head h may be taken to two-thirds of the distance from the deck to the top of the overflow, or 0.91 meters (3 feet), whichever is greater. Struts, transverse trusses or combination of struts and trusses may be used to strengthen the side structure

11 Non-tight Bulkhead (2003)

Non-tight bulkheads, where fitted, are to be fitted in line with transverse webs, bulkheads or other structures with equivalent rigidity. They are to be suitably stiffened. The thickness of non-tight bulkheads is to be not less than the required plating of watertight bulkheads in 3-2-6/5.1, and the stiffeners are to have a section modulus SM of half of those required for watertight bulkheads in 3-2-6/5.3.

FIGURE 1
Double Skin Tank Barge

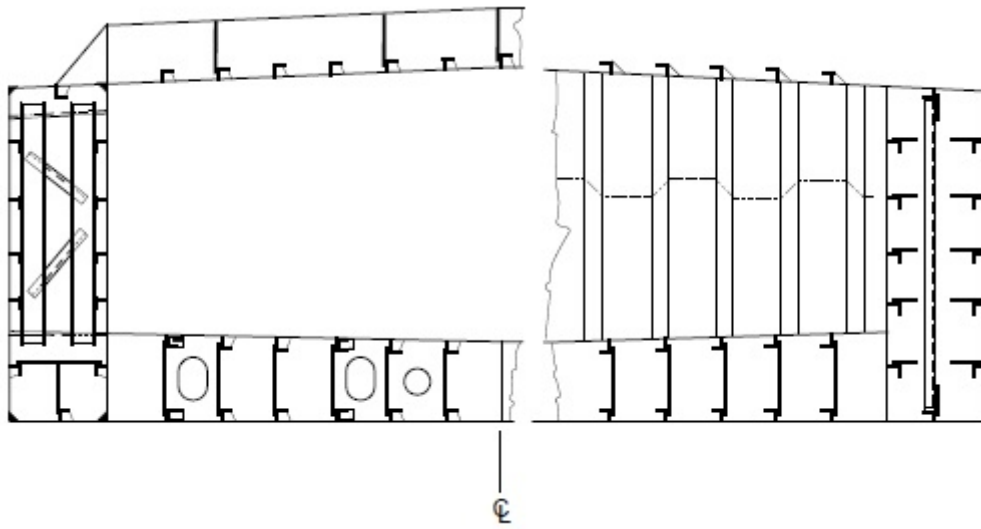


FIGURE 2
Double Skin Barge without Trunk (2003)

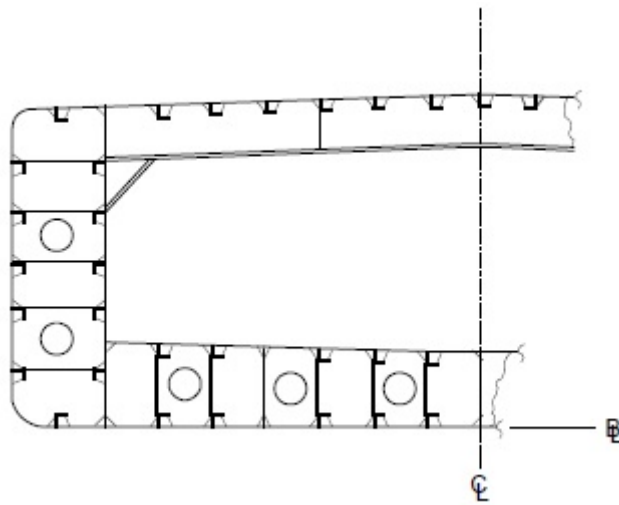
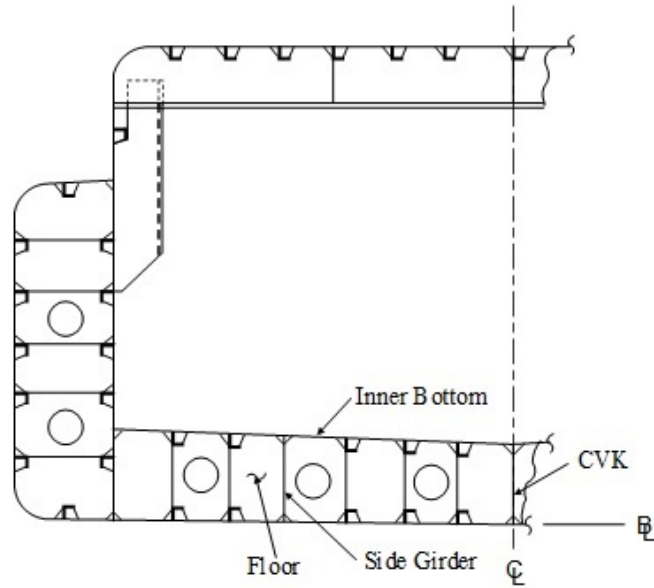
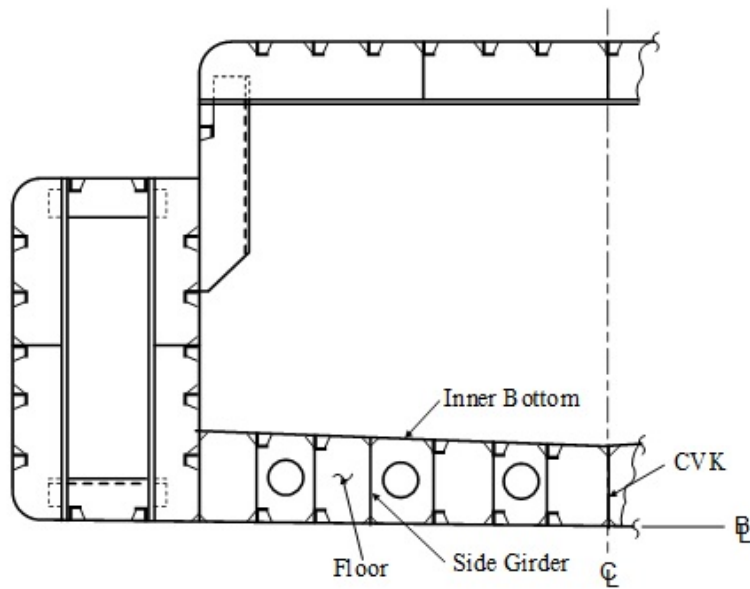


FIGURE 3
Double Skin Barge with Trunk (2017)



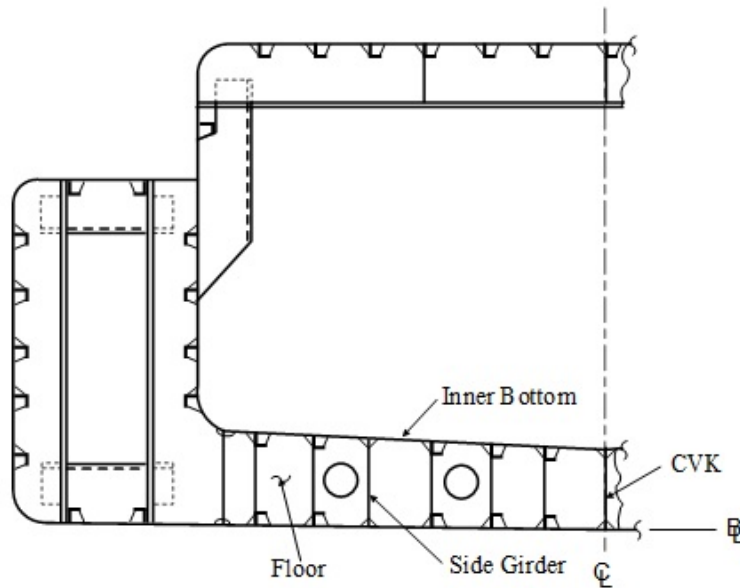
Double Skin Tank Barge with Longitudinal Framing

FIGURE 4
Double Skin Barge with Trunk (2017)



Double Skin Tank Barge with Longitudinal Framing

FIGURE 5
Double Skin Barge with Trunk (2017)



Double Skin Tank Barge with Longitudinal Framing

13 Intersection of Wing Bulkhead and Inner Bottom (2020)

This is a highly stressed area, and the following special considerations apply:

- i)* No scallops are allowed in the structure in this area.
- ii)* The welding of the wide-spaced floors and transverse bulkheads to the plating of the inner skin near the corner is to be either deep penetration or full penetration.
- iii)* The wing bulkheads should (preferably) extend from deck to bottom shell or side girders are to be fitted within a corner radius distance from the vertical plane of the wing bulkheads.
- iv)* The side girders should be welded to the corner plating with deep penetration or full penetration welds.



PART 5

CHAPTER 2 Tank Barges

SECTION 3 Oil Tank and Fuel Oil Tank Barges

1 General

1.1 Application

This Section applies to oil tank and fuel oil tank barges having integral tanks. Barges complying with this Section will be eligible to be classed **Oil Tank Barge** or **Fuel Oil Tank Barge**, as appropriate.

1.3 Scantlings (2018)

In general, scantlings are to be in accordance with Section 3-2-2.

Where heated cargoes are to be carried in integral tanks, a temperature distribution is to be submitted where the cargo heating source is adjacent to or integral with the structure of the cargo tank boundaries which are not in contact with the sea, or where heated cargoes are to be carried at temperatures greater than 80°C (176°F) in tanks not having common boundaries with the sea.

Where the steel temperature exceeds 80°C (176°F), calculations are to be submitted indicating the resultant hull structure stresses in association with an air temperature of 5°C (41°F) and a sea temperature of 0°C (32°F). Reduced permissible still water bending moment and/or reinforcement of the hull structure may be required for heated cargo conditions.

For the performance of Finite Element Analysis calculations including thermal stresses, see the *ABS Guide for SafeHull-Dynamic Loading Approach for Vessels*. The stress results including thermal stresses are to be checked against the allowable stresses in Section 15 of the aforementioned Guide. On plating panels where local elastic buckling occurs due to thermal loads, a reduced stiffness is to be employed on the FEA model in order to account for buckling and obtain an equivalent stiffness distribution on the modeled hull structure.

For cargo temperatures up to 140°C (284°F), vertical and transverse tank bulkheads are to be corrugated or of stiffened panel construction. Vertical or horizontal deep girders may produce high stress concentration when subject to thermal loads. Adequate back up and connection details are to be provided with due consideration for effect of thermal stresses.

For cargo temperatures up to 200°C (392°F), integral cargo tanks are to be arranged so that the vessel has full double skin structure including inner bottom, double side structure, and double deck. The double bottom, inner deck, and wing bulkheads, are to be stiffened transversely in order to counter act the loads imposed by the heated cargo in the transverse direction of the vessel. The outer watertight envelope

including bottom shell, side shell and strength deck are to be longitudinally stiffened to carry the full longitudinal hull girder loads. The longitudinal and transverse tank bulkheads are to be of corrugated type with vertical corrugations and without deep webs or bulkhead girders. For this type of vessel arrangement when calculating longitudinal strength, the inner hull envelope plate panels transversely stiffened may be allowed to reach elastic buckling. These plate panels are to be acceptable based on plate ultimate strength criteria as required by 5C-1-5/5 of the *Marine Vessel Rules*.

An alternative structural arrangement is acceptable provided it is proven adequate in terms of allowable stresses and buckling.

For cargo temperatures above 200°C (392°F), the cargo is to be carried in independent tanks. Appropriate arrangements are to be provided for independent tank foundations in order to allow for tank expansion and contraction due to heated cargo.

High stress concentration due to thermal loads at intersections between main bearing members should be avoided. Cut-outs and scallops between the transverse floors and the inner shell should be avoided at the turn of bilge area. Primary supporting members are to have adequate design in order to support thermal induced loads and present satisfactory behavior with respect to tripping, and shear stresses.

1.5 Arrangement (1993)

1.5.1 Tank Size and Arrangement (2020)

The arrangement of the oil tank barges or fuel oil tank barges is to be in accordance with the requirements in Annex I to the International Convention for the Prevention of Pollution from Ships (MARPOL) with regard to:

- Segregated ballast tanks [Regulation 18 (5-2-3/5.3 of these Rules)] and their protective locations [Regulation 18 (5-2-3/5.5 of these Rules) where the option in Regulation 19 (4) or (5) is exercised]
- Collision or stranding considerations (Regulation 19)
- Oil outflow calculations [Regulation 23 & 25 (5-2-3/3.5 of these Rules), as applicable]
- Limitations of size and arrangement of cargo tanks [Regulation 26 (5-2-3/3 of these Rules) and slop tanks (Regulation 29), as applicable]
- Note that regulations 25 and 26 are not applicable to barges delivered on or after 1 January 2010, as defined in Regulation 1.28.8

A valid International Oil Pollution Prevention Certificate issued by the Administration may be accepted as an evidence of compliance with these requirements.

1.5.2 Oil Tank Barges

1.5.2(a) Segregation

In oil tank barges, cofferdams, thoroughly oil tight and vented and having widths as required for easy access, are to be provided for the separation of all cargo tanks and slop tanks from galleys and living quarters, general cargo spaces which are below deck and spaces containing machinery where sources of ignition are normally present. Pump rooms, compartments arranged solely for ballast and fuel-oil tanks may be considered as cofferdams in compliance with the requirement.

1.5.2(b) Accommodation Spaces, etc.

Accommodation spaces, main cargo control stations, control stations and service spaces (excluding isolated cargo handling gear lockers) shall be positioned aft of all cargo tanks, slop tanks, cargo pump-rooms and cofferdams which isolate cargo or slop tanks from machinery spaces, but not necessarily aft of oil fuel tanks. Entrances, air inlets and openings to accommodation spaces, services spaces, and control stations shall not face the cargo area. They

are to be located on the transverse bulkhead not facing the cargo area, or on the outboard side of the superstructure or deckhouse at a distance of at least 0.04 but not less than 3 m (10 ft) from the end of the superstructure or deckhouse facing the cargo area. This distance, however, need not exceed 5 m (16.4 ft). Windows or portlights facing the cargo area and on the sides of a superstructure or deckhouse, within the limits specified above, are to be of the fixed (non-opening) type. Such windows or portlights in the first tier on the main deck are to be fitted with inside covers of steel or other equivalent material.

1.5.2(c) Machinery Spaces.

Where machinery spaces are located above a cargo area, cofferdams are to be provided as required in 5-2-3/1.5.2(a) and any direct entrances, air inlets and openings to the machinery spaces are to be located outside the hazardous locations in 4-1-3/11. Windows or portlights are to meet the requirements in 5-2-3/1.5.2(b) for accommodation spaces etc.

1.5.2(d) Cargo Pump Rooms, etc.

Skylights to cargo pump-rooms are to be of steel, contain no glass and capable of being closed from the outside pump-room.

Spaces containing pumps, piping and valves for handling liquids having flash points at or below 60°C (140°F), closed cup test, are to be completely separated from all sources of vapor ignition by gastight bulkheads. Steam driven engines are not considered sources of vapor ignition for the purposes of this requirement.

The gastight bulkheads may be pierced by pumping engine shafts and control rods, provided the shafts and rods are fitted with efficient stuffing boxes where they pass through the bulkheads. Lighting fixtures for pump room spaces are to be permanently wired and fitted outside the pump rooms, except as noted in Part 4, Chapter 8 of the *Marine Vessel Rules*.

1.5.2(e) Chain Lockers (2019)

Chain lockers are not to be located adjacent to tanks containing low flash point liquids (at or below 60°C (140°F) closed cup test). Cofferdams are to be provided for the separation of cargo tanks and chain lockers. In addition, anchor windlass, chain locker openings and any direct entrances to chain lockers are to be located outside of any designated hazardous area locations.

1.7 Aluminum Paint

Paint containing aluminum is not to be used in cargo oil tanks, on tank decks in way of cargo oil tanks, in pump rooms and cofferdams, or in any other area where cargo vapor may accumulate, unless it has been shown by appropriate tests that the paint to be used does not increase the fire hazard.

1.9 Cargoes

1.9.1 Fuel Oil Tank Barge (2020)

Those cargoes with a flashpoint over 60°C (140°F) (closed cup test) listed in Appendix 1 of MARPOL ANNEX I are those which are generally carried in barges classed **Fuel Oil Tank Barge**.

1.9.2 Oil Tank Barge (2020)

The cargoes with a flashpoint below 60°C (140°F) (closed cup test) listed in Appendix 1 of MARPOL ANNEX I are those which are generally carried in barges classed **Oil Tank Barge**.

Oil Tank Barges may also carry those cargoes listed in Section 5C-9-18 of the *Marine Vessel Rules* provided a copy of the Procedures and Arrangements Manual in accordance with MARPOL ANNEX II, or approval from the Administration is submitted. Those cargoes listed in Section 5C-9-17 of the *Marine Vessel Rules* may only be carried onboard barges classed as **Oil and/or Chemical Tank Barge**.

1.9.3 Bio-Fuel Blends (2020)

Oil Tank Barges may only carry those bio-fuel blends which are subject to ANNEX I of MARPOL. These bio-fuel blends contain 75% or more of petroleum oil as per MEPC.1/Circ.761/Rev.1. When installed, Oil Discharge Monitoring Equipment and deck fire-fighting systems requirements are to be in accordance with 5C-1-7/5.3.4 and 5C-1-7/27 of the *Marine Vessel Rules*, respectively, or to the satisfaction of the Administration.

Biofuel blends subject to ANNEX II of MARPOL may only be carried on board barges classed as **Oil and/or Chemical Tank Barge**.

1.11 Deck Cargo (1 July 2017)

Where it is intended to carry cargo on the deck, this is to be clearly indicated on the drawings submitted for approval. Where the liquid cargo is a combustible liquid having a flashpoint at or below 60°C (140°F) (closed cup test), a documented procedure to address the hazards is to be in place.

1.13 Spill Coaming (2020)

On manned barges, a steel coaming is to be provided to keep deck spills from flowing aft to accommodation and service areas. The coaming is to be continuous from side to side and is to have a height of at least 150 mm (6 in.) but not less than 50 mm (2 in.) greater than the height of the sheer strake upstand or gunwale bar. The coaming is to be located at least 915 mm (36 in.) forward of the superstructure or deckhouse front to allow free athwartship passage for personnel. Spill coamings along the periphery of the deck shall not extend more than 305 mm (12 in.) above the deck.

1.15 International Oil Pollution Prevention Certificate

Attention is drawn to the International Maritime Organization (IMO) Publication Regulations for the Prevention of Pollution by Oil (MARPOL, ANNEX I). Where authorized by the administration concerned and requested to do so by the Owner or builder, ABS will investigate compliance, with a view to issuing an International Oil Pollution Prevention (IOPP) Certificate. In instances where the barge is registered in a country which is not a signatory to MARPOL, ABS where requested by the Owner or Builder, will investigate compliance with a view to issuing a Non-Signatory Oil Pollution Prevention (OPP) Certificate.

While ABS's Rules do not cover the damage stability provisions of MARPOL, these will be investigated at the request of the Owner or builder and will be automatically dealt with where ABS is responsible for issuing an IOPP or an OPP Certificate.

1.17 Spaces Adjacent to Cargo Tanks (2022)

On oil tank barges, tanks and spaces separated from cargo tanks by a single deck or bulkhead may be contaminated by cargo oil or vapor due to possible impairment of the common boundary. These tanks and spaces are therefore, in principle, to be regarded as hazardous spaces. Piping serving or having an opening into these tanks or spaces is likewise to be regarded as contaminated and, therefore, is not permitted to enter machinery and other spaces normally containing sources of ignition except that short lengths of all welded steel pipe may be specially considered. The pipe is to be adequately secured and is to have minimum wall thickness according to Column E of 4-6-2/9.19 TABLE 4 of the *Marine Vessel Rules*. Fuel oil bunker tanks adjacent to cargo oil tanks and associated bunker fuel oil piping are specifically excluded from this consideration.

1.19 Pipes Passing Through Cargo Tanks (2022)

On oil tank barges, piping passing through cargo oil tanks, due to possible deterioration or leakage in the pipe or pipe joints, may lead to contamination of liquid within the piping by cargo oil or vapor. Such piping is therefore, in principle, not permitted to enter machinery and other spaces normally containing sources of ignition. Steam systems and thermal fluid systems used for heating cargo oil tanks, and hydraulic systems used for operating valves located in cargo tanks are specifically excluded from this consideration. See 5C-1-7/9.3 and 5C-1-7/3.5 of the *Marine Vessel Rules*, respectively.

1.21 Internal Combustion Engine Exhausts (2020)

On oil tank barges, the engine exhaust lines are to extend beyond the hazardous location in 4-1-3/11 and are to be fitted with spark arresters.

1.23 Ventilation (2020)

Cargo pump rooms on oil tank barges carrying liquids having a flashpoint at or below 60°C (140°F) closed cup test and similar spaces containing piping or equipment used for the handling of such liquids are to be provided with a mechanical ventilation system. The system is to be arranged in such a way as to remove vapors from points near the floor level of the bilges.

3 Cargo Tank Size and Arrangement Limitation

3.1 Cargo Tank Length (DWT < 5,000 tonnes) (2020)

The length of any cargo tank is not to exceed 10 m (32.8 ft) or the appropriate value obtained from 5-2-3/3.1 TABLE 1, whichever is the greater.

TABLE 1
Permissible Length of Cargo Tanks (1994)

Number of Tight Longitudinal Bulkheads Inside the Cargo Tanks	Length of Outboard Cargo Tank	Length of Inboard Cargo Tank(s)	
		$b_i > 0.2B$	$b_i < 0.2B$
3 (one on centerline)	$0.2L$	$0.2L$	$(0.15 + 0.25b_i/B)L$
2	$0.2L$	$0.2L$	$(0.1 + 0.5b_i/B)L$
1 (on centerline)	$(0.15 + 0.25b_i/B)L$		
0	$0.2L$ or $(0.1 + 0.5b_i/B)L$, whichever is less		

where

L = length, in m (ft), as defined in 3-1-1/3

B = breadth, as defined in 3-1-1/5

b_i = minimum distance from the barge's side to the outer longitudinal bulkhead of the tank in question, measured inboard at right angles to the centerline at the level corresponding to the assigned summer freeboard

3.3 Cargo Tank Volume (2020)

For oil tank barges with DWT of 5,000 tonnes and above, the cargo tank volume is to be in accordance with the requirements in MARPOL Annex 1, Regulation 23 (Accidental Oil Outflow Performance).

5 Segregated Ballast Tanks

5.1 General

Crude oil tank barges of 20,000 tonnes (19,685 tons) deadweight and above and product tank barges of 30,000 tonnes (29,525 tons) deadweight and above are to be provided with segregated ballast tanks.

5.3 Tank Capacity

The capacity of the segregated ballast tanks shall be such that the barge may operate safely on ballast voyages without recourse to the use of cargo tanks for water ballast, and that in any ballast condition at any

part of a voyage, including a condition consisting of lightweight plus segregated ballast only, the barge's drafts and trim can meet each of the following:

5.3.1 Minimum Draft Forward

$$0.2 + 0.02L + 3L^2 \cdot 10^{-5} \text{ m} \quad \text{for } L < 150 \text{ m}$$

$$2.0 + 0.0125L \text{ m} \quad \text{for } L \geq 150 \text{ m}$$

$$0.65 + 0.02L + 9.144L^2 \cdot 10^{-6} \text{ ft} \quad \text{for } L < 492 \text{ ft}$$

$$6.56 + 0.0125L \text{ ft} \quad \text{for } L \geq 492 \text{ ft}$$

5.3.2 Minimum Draft Amidships and Aft

$$0.2 + 0.032L \text{ m} \quad \text{for } L < 150 \text{ m}$$

$$2.0 + 0.02L \text{ m} \quad \text{for } L \geq 150 \text{ m}$$

$$0.65 + 0.032L \text{ ft} \quad \text{for } L < 492 \text{ ft}$$

$$6.56 + 0.02L \text{ ft} \quad \text{for } L \geq 492 \text{ ft}$$

5.3.3 Maximum Trim Aft

$$0.006L[4 - (L/100)] \text{ m} \quad \text{for } L < 150 \text{ m}$$

$$0.015L \text{ m} \quad \text{for } L \geq 150 \text{ m}$$

$$0.006L[4 - (L/328)] \text{ ft} \quad \text{for } L < 492 \text{ ft}$$

$$0.015L \text{ ft} \quad \text{for } L \geq 492 \text{ ft}$$

5.5 Protective Location of Segregated Ballast Tanks.

Segregated ballast tanks and void spaces (spaces other than oil or fuel oil tanks), located within the cargo tank length L_t , are to be arranged such that:

$$\Sigma PA_c + \Sigma PA_s \geq J [L_t(B + 2D)]$$

where

PA_c = side shell area, in m^2 (ft^2), of each segregated ballast tank or void space, based on projected molded dimensions.

In determining PA_c , the minimum width of each wing segregated ballast tank or void space extending for the full depth of the barge's side or from the deck to the top of a double bottom is to be not less than 2.0 m (6.56 ft).

The width is to be measured inboard from the barge's side at right angles to the centerline at a height of 0.2 D above the baseline (see 5-2-3/7.23 FIGURE 1). Where this width at any location along the entire length of a tank or void space is less than 2.0 m (6.56 ft.), then that entire tank or void space is not to be included in the determination of PA_c . Examples of projected dimensions to be used are given in 5-2-3/7.23 FIGURES 3 through 8.

PA_s = bottom shell area, in m^2 (ft^2), of each segregated ballast tank or void space, based on projected molded dimensions.

In determining PA_s , the minimum vertical height of each double bottom segregated ballast tank or void space is not to be less than 2.0 m (6.56 ft) or $B/15$, whichever is the lesser. The height is to be measured at a vertical plane $0.2D$ inboard of the intersection of the shell with a horizontal line $0.2D$ above the baseline (see 5-2-3/7.23 FIGURE 2). Where this height at any location along the entire length of a tank or void space is less than the minimum vertical height, then that entire tank or void space is not to be included in the determination of PA_s . If the projected dimensions of the bottom of a cargo tank above the double bottom falls entirely within the area of the double bottom tank or void space which meets the minimum height requirement and provided that the side bulkheads bounding the cargo tank, above, are vertical or have a slope of not more than 45° from the vertical, credit may be given to the part of the double bottom tank or void space defined by the projection of the cargo tank bottom. Where the wing tanks above the double bottom are segregated ballast tanks or void spaces, similar credit may be given (see 5-2-3/7.23 FIGURE 9 and 5-2-3/7.23 FIGURE 10).

- L_t = length, in m (ft), between the forward and after extremity of the cargo tanks.
- B = barge breadth, in m (ft), as defined in 3-1-1/5
- D = barge depth, in m (ft), as defined in 3-1-1/7
- J = $0.4667 - (DWT \cdot 10^{-5}/12)$ for $DWT < 200,000$ tonnes
 = $0.4667 - (DWT \cdot 10^{-5}/11.81)$ for $DWT < 196,840$ tons
 = $0.3 - a - \left(\frac{O_c + O_s}{40\Delta}\right)$ for $DWT \geq 200,000$ tonnes (196,840 tons)
 but J is not to be taken less than 0.2
- a = $(1.5DWT \cdot 10^{-6}) - 0.05$ for $DWT < 300,000$ tonnes
 = $(DWT \cdot 10^{-5}/12) + 0.15$ for $DWT \geq 300,000$ tonnes
 = $(1.524DWT \cdot 10^{-6}) - 0.05$ for $DWT < 295,260$ tons
 = $(DWT \cdot 10^{-5}/11.81) + 0.15$ for $DWT \geq 295,260$ tons
 but a is not to be taken greater than 0.5
- DWT = deadweight, in tonnes (tons), as defined in 3-1-1/45
- O_c = as defined in 5-2-3/3.5
- O_s = as defined in 5-2-3/3.5
- O_Δ = as defined in 5-2-3/3.3

5.7 Storage Service

When an Oil Tank Barge or Fuel Oil Tank Barge is used exclusively for storage service, compliance with 5-2-3/5.1, 5-2-3/5.3 and 5-2-3/5.5 is not required.

7 Cargo Vapor Emission Control Systems (2020)

Cargo vapor emission control systems are to meet the requirements of 5C-1-7/21 of the *Marine Vessel Rules*.

Electrical installations are to meet requirements 5C-1-7/31 of the *Marine Vessel Rules*, except that compliance with 5C-1-7/31.5.2.i is not required.

7.1 Ship to Ship Transfer Operations (STS Operations) (2020)

For oil tank barges of 150 gross tonnage and above engaged in the transfer of oil cargo between vessels at sea (STS Operation), attention is drawn to the International Maritime Organization (IMO) Publication Regulations for the Prevention of Pollution by Oil (MARPOL, ANNEX I). Where authorized by the Administration concerned and requested to do so by the Owner or builder, ABS will review the Ship to Ship Transfer Operations Plan, as required in MARPOL Annex I; Regulation 41.

9 Cargo Tank Protection (2020)

9.1 Inert Gas System (2021)

For oil tank barges of 8,000 tonnes deadweight and upwards, the protection of the cargo tanks is to be achieved by a fixed inert gas system, in accordance with the requirements of 5C-1-7/25 of the *Marine Vessel Rules*.

However, for oil carriers of 8,000 tonnes deadweight and upwards but less than 20,000 tonnes deadweight, in lieu of a fixed installation, equivalent arrangements or means of protection in compliance with 5C-1-7/23.1.4 of the *Marine Vessel Rules* may be accepted.

9.3 Crude Oil Washing

All crude oil carriers, regardless of size, operating with a cargo tank cleaning procedure using crude oil washing, are to be fitted with an inert gas system complying with the requirements in 5C-1-7/25 of the *Marine Vessel Rules* and with fixed tank washing machines.

9.5 Gas Detection

Oil Tank barges of 20,000 tonnes deadweight and above are to be fitted with a fixed hydrocarbon gas detection system complying with 5C-1-7/20 of the *Marine Vessel Rules* for measuring hydrocarbon gas concentrations in all ballast tanks, void spaces of double-hull and double-bottom spaces adjacent to the cargo tanks, including the forepeak tank and any other tanks and spaces adjacent to cargo tanks in accordance with 5C-1-7/19.5.4 of the *Marine Vessel Rules*.

Other standards recognized by the flag Administration will be also accepted by ABS.

11 Thermal Oil Heating Systems (2020)

Thermal oil heating systems are to meet the requirements of 5C-1-7/9.5 and 4-4-1/13 of the *Marine Vessel Rules* as well as Section 4-1-2 of these Rules.

13 Cargo Tank Venting (2020)

Cargo Tank Venting systems are to meet the requirements of 5C-1-7/11 of the *Marine Vessel Rules*.

15 Volatile Organic Compounds (VOC) (2020)

For oil tank barges carrying crude oil attention is drawn to the International Maritime Organization (IMO) Publication Regulations for the prevention of air pollution from ships (MARPOL, ANNEX VI). Where authorized by the Administration concerned and requested to do so by the Owner or builder, ABS will review the VOC Management Plan, as required in MARPOL Annex VI; Regulation 15.

17 Ballast Systems (2020)

Ballast systems onboard oil tank barges, in addition to the requirements in 4-1-2/9 of these Rules, are to meet the requirements of 5C-1-7/5 of the *Marine Vessel Rules* except that compliance with 5C-1-7/5.3.1(a) is not required. If the pump motor is over 135 HP, refer to the requirements in 4-1-1/9 of these Rules.

19 Cargo Oil Systems (2020)

Cargo Oil Systems onboard Oil Tank Barges are to meet the requirements of 5C-1-7/3.3 of the *Marine Vessel Rules*, except that compliance with 5C-1-7/3.3.1(i), 5C-1-7/3.3.1(j), 5C-1-7/3.3.1(k) and 5C-1-7/3.3.1(l) of the *Marine Vessel Rules* are not required.



PART 5

CHAPTER 2 Tank Barges

SECTION 4 Chemical Tank Barges

1 General

1.1 Application

This Section applies to tank barges intended for the carriage of bulk liquid cargoes of hazardous and noxious chemicals. Barges complying with this Section will be eligible to be classed **Chemical Tank Barge** with a cargo notation and list of defined cargoes.

1.3 Scantlings (2018)

In general, scantlings are to be in accordance with Section 5-2-1 or Section 5-2-2.

Where heated cargoes are to be carried in integral tanks, a temperature distribution is to be submitted where the cargo heating source is adjacent to or integral with the structure of the cargo tank boundaries which are not in contact with the sea, or where heated cargoes are to be carried at temperatures greater than 80°C (176°F) in tanks not having common boundaries with the sea.

Where the steel temperature exceeds 80°C (176°F), calculations are to be submitted indicating the resultant hull structure stresses in association with an air temperature of 5°C (41°F) and a sea temperature of 0°C (32°F). Reduced permissible still water bending moment and/or reinforcement of the hull structure may be required for heated cargo conditions.

For the performance of Finite Element Analysis calculations including thermal stresses, see the *ABS Guide for SafeHull-Dynamic Loading Approach for Vessels*. The stress results including thermal stresses are to be checked against the allowable stresses in Section 15 of the aforementioned Guide. On plating panels where local elastic buckling occurs due to thermal loads, a reduced stiffness is to be employed on the FEA model in order to account for buckling and obtain an equivalent stiffness distribution on the modeled hull structure.

For cargo temperatures up to 140°C (284°F), vertical and transverse tank bulkheads are to be corrugated or of stiffened panel construction. Vertical or horizontal deep girders may produce high stress concentration when subject to thermal loads. Adequate back up and connection details are to be provided with due consideration for effect of thermal stresses.

For cargo temperatures up to 200°C (392°F), integral cargo tanks are to be arranged so that the vessel has full double skin structure including inner bottom, double side structure, and double deck. The double bottom, inner deck, and wing bulkheads, are to be stiffened transversely in order to counter act the loads

imposed by the heated cargo in the transverse direction of the vessel. The outer watertight envelope including bottom shell, side shell and strength deck are to be longitudinally stiffened to carry the full longitudinal hull girder loads. The longitudinal and transverse tank bulkheads are to be of corrugated type with vertical corrugations and without deep webs or bulkhead girders. For this type of vessel arrangement when calculating longitudinal strength, the inner hull envelope plate panels transversely stiffened may be allowed to reach elastic buckling. These plate panels are to be acceptable based on plate ultimate strength criteria as required by 5C-1-5/5 of the *Marine Vessel Rules*.

An alternative structural arrangement is acceptable provided it is proven adequate in terms of allowable stresses and buckling.

For cargo temperatures above 200°C (392°F), the cargo is to be carried in independent tanks. Appropriate arrangements are to be provided for independent tank foundations in order to allow for tank expansion and contraction due to heated cargo.

High stress concentration due to thermal loads at intersections between main bearing members should be avoided. Cut-outs and scallops between the transverse floors and the inner shell should be avoided at the turn of bilge area. Primary supporting members are to have adequate design in order to support thermal induced loads and present satisfactory behavior with respect to tripping, and shear stresses.

1.5 Arrangement

Reference is made to the requirements in Annex II to the International Convention for the Prevention of Pollution from Ships (MARPOL).

Cofferdams having widths as required for easy access are to be provided for the separation of all cargo tanks and slop tanks from galleys and living quarters, service spaces, machinery spaces, potable water tanks and spaces containing stores for human consumption. Pump rooms, ballast tanks, voids and fuel-oil tanks may be considered as cofferdams in compliance with this requirement.

Cargoes, residues of cargoes or mixtures containing cargoes which react in a hazardous manner with other cargoes, residues or mixtures are to be segregated from such other cargoes by means of a cofferdam, void space, cargo pump-room, empty tank or tank containing a mutually compatible cargo.

Accommodation spaces, service spaces or control stations are not to be located within the cargo area. Entrances, air inlets and openings to accommodation spaces, service spaces, machinery spaces and control stations shall not face the cargo area. They shall be located on the end bulkhead not facing the cargo area or on the outboard side of the superstructure or deckhouse at a distance of at least $0.04L$ but not less than 3 m (10 ft) from the end of the superstructure or deckhouse facing the cargo area. This distance, however, need not exceed 5 m (16.4 ft). While doors in general are not permitted within these limits, special consideration will be given to permitting doors to cargo control stations and store rooms provided there is no further communicating access from these spaces. Windows and portlights facing the cargo area and on the sides of a superstructure or deckhouse within the limits specified above are to be of the fixed (non-opening) type. Such windows or portlights in the first tier on the main deck should be fitted with inside covers of steel or equivalent material.

Where provision is made to permit bow or stern loading and unloading, entrances, air inlets and openings to accommodation, service and machinery spaces and control stations shall not face the cargo shore connection location of bow or stern loading and unloading arrangements. They shall be located on the outboard side of the superstructure or deckhouse at a distance of at least $0.4L$ but not less than 3 m (10 ft) from the end of the house facing the cargo shore connection location of the bow or stern loading and unloading arrangements. This distance, however, need not exceed 5 m (16.4 ft). Windows and portlights facing the shore connection location and on the sides of a superstructure or deckhouse within the distance mentioned above should be of the fixed (non-opening) type. Special consideration will be given to small barges where compliance with this Paragraph is not possible.

1.7 Longitudinal Strength (2020)

Still water bending moment and shear force data for all anticipated loading conditions are to be submitted for all chemical tank barges, regardless of length. In general, the longitudinal strength of Chemical Tank Barges is to be in accordance with Section 3-2-1. Barges having a length $L \geq 76$ m (250 ft) in which the cargo is carried in independent tanks and in which these independent tanks are supported by three or more transverse foundations or are supported by longitudinal foundations are to be subjected to a wave analysis to determine the maximum hull and tank bending moments and tank foundation reactions.

1.9 Cargoes

The cargoes listed in the table in 5C-9-17 of the *Marine Vessel Rules* are those which are generally carried in barges classed **Chemical Tank Barge**.

Where a barge is designed to carry a limited number of specific cargoes, only the rule requirements appropriate to the particular hazards involved will be applied.

1.11 Information and Plans Required

In addition to the plans required by 1A-5-4/1 of to the *ABS Rules for Conditions of Classification (Part IA)*, the following plans and information are to be submitted:

1.11.1

General arrangement plan showing:

- i) Location of access hatches, tank cleaning hatches and other openings to cargo tanks
- ii) Location of doors, hatches and other openings to enclosed spaces used for cargo handling and spaces adjacent to cargo tanks
- iii) Location of doors, hatches and other openings such as vents and opening windows or portlights to superstructures, deckhouses, accommodation spaces, service spaces, machinery spaces and control stations.
- iv) Location of lined or coated tanks and tanks constructed of special material.
- v) Grouping of tanks for hazardous cargo segregation, where appropriate.

1.11.2

Structural plans of independent tanks, where appropriate.

1.11.3

Information:

- i) List of intended cargoes and advice as to which tanks will contain each and an indication of arrangements to prevent liquid or vapor release.
- ii) Chemical and physical properties of cargoes not listed in the table in Section 5C-9-17 of the *Marine Vessel Rules*.
- iii) Particulars of any special materials of construction, tank linings, tank coatings, etc.
- iv) Particulars of any special containment features such as temperature control
- v) Specific gravity of contemplated cargoes and intended pressure vacuum relief valve settings.

1.13 Maximum Allowable Quantity of Cargo per Tank

In a Type I barge, the maximum cargo to be carried in any one tank is not to exceed 1250 m³ (1635 yds³).

In a Type II barge, the maximum cargo to be carried in any one tank is not to exceed 3000 m³ (3924 yds³).

1.15 Spill Coaming (2020)

On manned barges, a steel coaming is to be provided to keep deck spills from flowing aft to accommodations and service areas. The coaming is to be continuous from side to side and is to have a height of at least 150 mm (6 in.), but not less 50 mm (2 in.) greater than the height of the sheer strake upstand or gunwale bar. The coaming is to be located at least 915 mm (36 in.) forward of the superstructure or deckhouse front to allow free athwartship passage for personnel. Spill coamings along the periphery of the deck shall not extend more than 305 mm (12 in.) above the deck.

1.17 International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk

Attention is drawn to the International Maritime Organization (IMO) Publication Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (MARPOL Annex II). Where authorized by the administration concerned and requested to do so by the Owner or Builder, ABS will investigate compliance with a view to issuing an International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk. In instances where the barge is registered in a country which is not signatory to MARPOL, ABS where requested by the Owner or Builder, will investigate compliance with a view to issuing a non-signatory Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk.

While ABS's Rules do not cover the damage stability provisions of MARPOL, these will be investigated at the request of the owner or builder and will be automatically dealt with when ABS is responsible for issuing an international or a non-signatory Pollution Prevention Certificate.

3 Barge Type

3.1 General

Barges subject to this Section are assigned a barge type number dependent upon the hazardous nature of the cargo to be carried. For this purpose, barge types are defined as follows:

3.1.1 Type I Barge

This is assigned to barges intended to transport products with very severe environmental and safety hazards, which require maximum preventive measures to preclude the uncontrolled release of the cargo.

3.1.2 Type II Barge

This is assigned to barges intended to transport products with appreciably severe environmental and safety hazards, which require significant preventive measures to preclude the uncontrolled release of the cargo.

3.1.3 Type III Barge

This is assigned to barges intended to transport products with sufficiently severe environmental and safety hazards, which require a moderate degree of control.

The Barge Type No. required is listed in column 'e' of the table in Section 5C-9-17 of the *Marine Vessel Rules* as ship type 1, 2 or 3, which is to be read as Barge Type I, II or III, respectively.

5 Cargo Tank Type

5.1 General

The type of cargo tank required is dependent upon the hazardous nature of the cargo to be carried as listed in column 'f' of the table in Section 5C-9-17 of the *Marine Vessel Rules*.

Cargo Tank types are defined as follows:

5.1.1 Independent Tank

An *Independent Tank* means a cargo containment envelope which is not contiguous with, or part of, the hull structure. An independent tank is built and installed so as to eliminate, whenever possible (or, in any event, to minimize), its stressing as a result of stressing or motion of the adjacent hull structure. An independent tank is not essential to the structural completeness of the barge's hull.

5.1.2 Integral Tank

An *Integral Tank* means a cargo containment envelope which forms part of the barge's hull and which may be stressed in the same manner and by the same loads which stress the contiguous hull structure and which is normally essential to the structural completeness of the barge's hull.

5.1.3 Gravity Tank

A *Gravity Tank* means a tank having a design pressure not greater than 0.7 bar (0.714 kgf/cm², 10.15 lbf/in²) at the top of the tank. A gravity tank may be independent or integral. A gravity tank is to be constructed and tested (in accordance with Section 3-4-1) taking account of the temperature of carriage and relative density of the cargo.

5.1.4 Pressure Tank

A *Pressure Tank* means a tank having a design pressure greater than 0.7 bar (0.714 kgf/cm², 10.15 lbf/in²). A pressure tank shall be an independent tank and is to be of a configuration permitting the application of pressure vessel design criteria according to Part 4, Chapter 4 of the *Marine Vessel Rules*.

7 Cargo Tank Location

7.1 General

Cargo tanks are to be located as required by 5-2-4/7.3 TABLE 1.

7.3 Fresh-Water and Fuel Oil Tanks

Cargo tanks are to be separated from fresh water tanks, unless the latter are intended solely for the carriage of tank-washing water and the arrangements are such that the water tanks cannot be used for any other purpose.

Cargo tanks which are intended for the carriage of water-reactive cargoes are to be separated by cofferdams from all water tanks. Alternatively, prior to loading water-reactive cargoes, adjacent tank-washing water or ballast tanks are to be certified dry.

Cargo tanks which are intended for the carriage of acids or toxic products are to be separated from oil fuel tanks by cofferdams, pump rooms or water ballast tanks (where not precluded above). Those cargoes requiring segregation are defined in column 'o' of the table in Section 5C-9-17 of the *Marine Vessel Rules*.

TABLE 1
Cargo Tank Location

<i>Barge Type</i>	<i>Minimum Distance Inboard</i>		
	<i>From Side Shell</i>	<i>From Bottom Shell</i>	<i>From Forward Perpendicular</i>
I	0.2B or 11.5 m (37.73 ft), whichever is less (note 1)	B/15 or 6 m (19.685 ft), whichever is less (note 3)	7.62 m (25 ft)
II	0.76 m (2.5 ft) (note 2)	B/15 or 6 m (19.685 ft), whichever is less (note 3)	7.62 m (25 ft)
III	No Requirement		

Notes:

- 1 The distance represents a vertical plane measured inboard from the molded line of the side shell at right angles to the barge centerline at the level of the assigned summer load line at all locations along the length of the tank. Nowhere throughout the length and depth of the tank is the distance to be less than 0.76 m (2.5 ft).
- 2 The distance is to be measured at all locations throughout the length and depth of the tank.
- 3 The distance represents a horizontal plane measured from the molded line of the bottom shell at the barge centerline at all locations along the length of the tank. Nowhere throughout the length and breadth of the tank is the distance to be less than 0.76 m (2.5 ft), notwithstanding that in Type II barges, suction wells may be permitted as follows:
 - a) In barges with double bottoms, suction wells may protrude into the double bottom provided the suction wells are as small as practicable and the protrusion below the inner bottom plating does not exceed 25% of the depth of the double bottom at the suction well location or 0.35 m (1.15 ft), whichever is less
 - b) In barges without double bottoms, the underside of the suction well is not to be below a horizontal plane $B/15 - 0.35$ m ($B/15 - 1.15$ ft) above the molded line of the bottom shell plating measured at the barge centerline at all locations along the length of the tank. Nowhere throughout the length and breadth of the tank is the suction well to be less than 0.57 m (1.87 ft) above the molded line of the bottom shell plating at the suction well location.

B = breadth of the barge, as defined in 3-1-1/5

9 Access to Spaces in the Cargo Area

9.1 General

Access to cargo tanks, ballast tanks, cofferdams and other spaces in the cargo area is to be direct from the weather deck. Where the spaces concerned are of confined or cellular construction, two separate means of access are to be provided.

Double bottom tanks are to be accessed from the weather deck but this may be via a pump room, deep cofferdam, pipe tunnel or similar compartment giving due consideration to ventilation and access arrangements. Each double bottom space is to be accessible without passing through other double bottom spaces.

Pipe tunnels and duct keels are to be accessed directly from the weather deck by way of trunks located at the extreme forward and after ends of the tunnel or duct. Where this distance is greater than 61 m (200 ft) additional access is to be provided such that the distance between accesses does not exceed 61 m (200 ft).

Below deck cargo pump rooms are to be provided with easy access from the weather deck and the arrangements within cargo pump rooms are to be such as to allow unrestricted passage at all times from any ladder platform and from the floor to all valves necessary for cargo handling, for a person wearing a self-contained breathing apparatus and protective clothing and equipment, and to facilitate the removal of injured personnel. In general, ladders in cargo pump rooms are not to be arranged vertically. They are to have an angle of inclination from the horizontal not greater than 60°, and intermediate platforms are to be provided at vertical intervals of about 6 m (20 ft).

Ladders and platforms are to be provided with guard rails. Hoisting arrangements with a lifting capacity of not less than 2.5 kN (255 kgf, 562 lbf), operable from the weather deck, are to be provided in below deck cargo pump rooms to facilitate the removal of an unconscious person. The hoistway is to be clear of any projecting obstacles and is to be directly in way of a deck opening having a cross-sectional clearance not less than required by 5-2-4/9.3.2.

9.3 Size of Access Openings and Inspection Clearances

9.3.1

Vertical openings providing access to the spaces defined in 5-2-4/9.1, or providing access within the length and breadth of these spaces, are to have clear openings of not less than 600 mm by 800

mm (23.5 in. by 31.5 in.) of typical manhole configuration. The sills of these openings are not to be more than 600 mm (23.5 in.) above the standing surface or foothold.

9.3.2

Horizontal openings providing access to, or within, the spaces defined in 5-2-4/9.1 are to have clear openings of not less than 600 mm by 600 mm (23.5 in. by 23.5 in.) of rectangular configuration having radius corners of not more than 100 mm (4 in.) and not less than 75 mm (3 in.).

Clear openings of circular configuration having a diameter of not less than 670 mm (26.25 in.) are also acceptable.

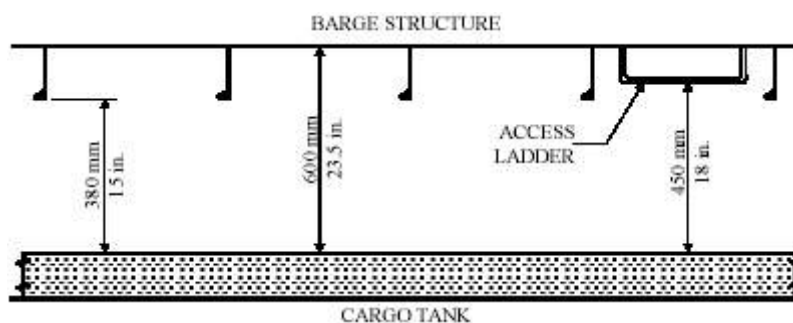
9.3.3

In order to provide for inspection, the distance between tanks or between a tank and the barge's structure is to be such as to provide adequate access for inspection and maintenance of all tank surfaces and hull structures.

Examples of minimum clearances are as follows:

9.3.3(a) Where the Surveyor is required to pass between the surface to be inspected and structural members such as a deck beams, bulkhead stiffeners, frames, etc., the distance between the surface to be inspected and the free edge of the structural member is not to be less than 380 mm (15 in.), and the distance between the surface to be inspected and the surface to which the above structural members are attached is not to be less than 600 mm (23.5 in.). See 5-2-4/9.3.3(a) FIGURE 1.

FIGURE 1



9.3.3(b)

Where the surveyor is required to pass between the surface to be inspected and a structural member such as a deck transverse, deep web frame, etc., the distance between the surface to be inspected and the free edge of the structural member is not to be less than 380 mm (15 in.), see 5-2-4/9.3.3(b) FIGURE 2. Where the Surveyor is not required to pass between the surface to be inspected and the structural member, the distance between the free edge of the structural member and the surface to be inspected is not to be less than half the breadth of the flange or face plate nor is the distance to be less than 50 mm (2 in.), see 5-2-4/9.3.3(b) FIGURE 3. Where thermal expansion of the cargo tank is anticipated due to the carriage temperature of the cargo, the clearance is to be such that a 50 mm (2 in.) clearance will be maintained when the tank is in its expanded state.

FIGURE 2

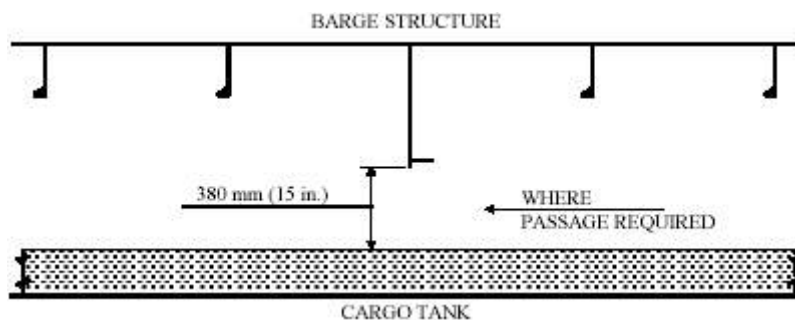
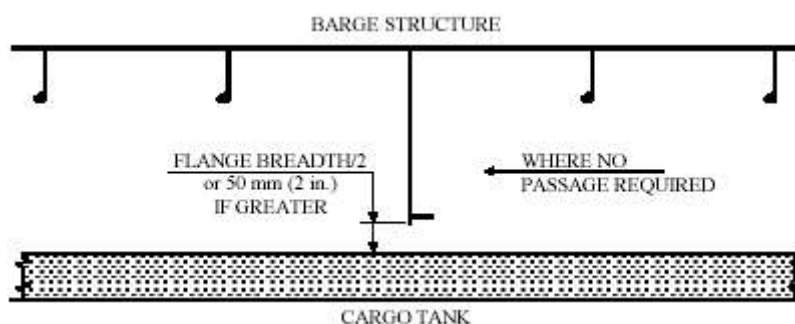


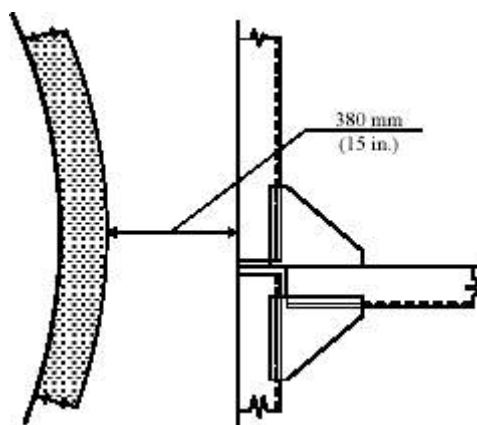
FIGURE 3



9.3.3(c)

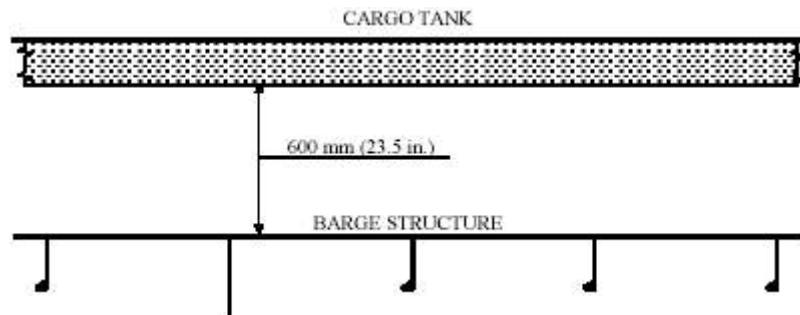
Where the Surveyor is required to pass between a curved surface and another surface, flat or curved, to which no structural members are fitted, the distance between the surfaces is not to be less than 380 mm (15 in.). See 5-2-4/9.3.3 FIGURE 4.

FIGURE 4



9.3.3(d) Where the Surveyor is required to pass between two flat surfaces that are approximately parallel, to which no structural members are attached, the distance between the surfaces is not to be less than 600 mm (23.5 in.). See 5-2-4/9.3.3 FIGURE 5.

FIGURE 5



9.3.3(e) The minimum distances between a cargo tank sump and the adjacent double bottom structure in way of a suction well are not to be less than shown in 5-2-4/9.3.3(e) FIGURE 6. Where there is no suction well, the distance between the cargo tank sump and the inner bottom is not to be less than 50 mm (2 in.). See 5-2-4/9.3.3(e) FIGURE 7.

FIGURE 6

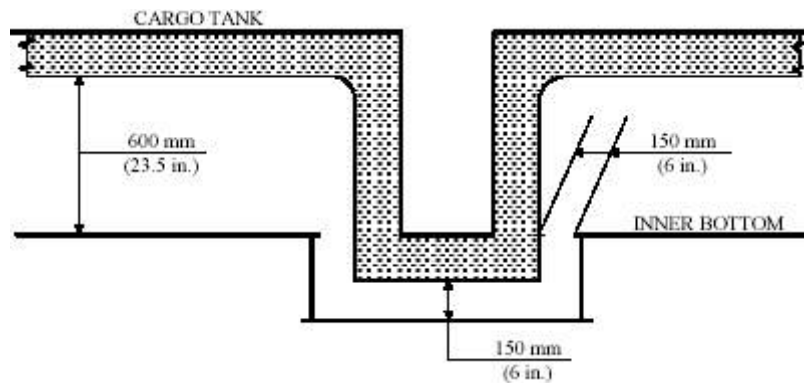
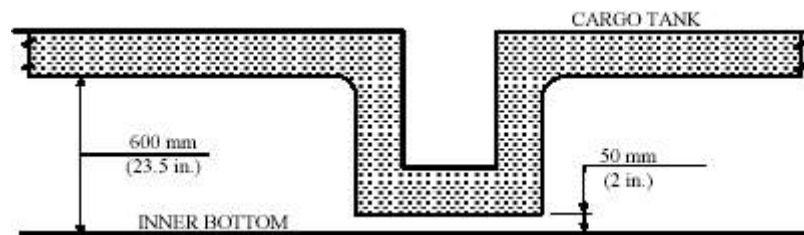
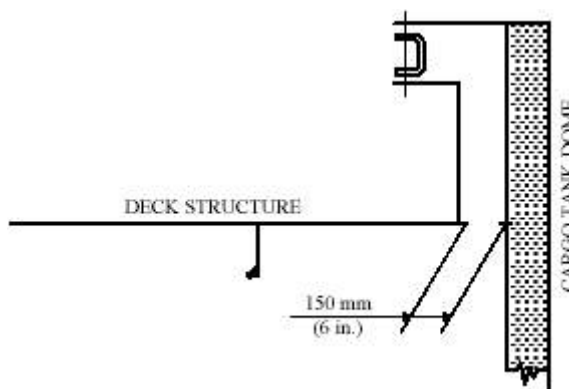


FIGURE 7



9.3.3(f) The minimum distance between a cargo tank dome and the barge structure is not to be less than 150 mm (6 in.). See 5-2-4/9.3.3 FIGURE 8.

FIGURE 8



11 Materials of Construction

11.1 General

Generally, steel is to be the normal material used for cargo tank construction.

11.3 Special Materials

Certain materials or their alloys may be unsuitable for use with certain cargoes. Reference is to be made to Section 5C-9-6 of the *Marine Vessel Rules*. The notch ductility at the operating temperature, the corrosive effect of the cargo, the possibility of hazardous reactions between the cargo and the material and the suitability of linings are to be considered in the selection of the material of construction.

13 Independent Gravity Tanks

13.1 General

The scantling requirements are related to independent gravity cargo tanks constructed of mild steel, solid stainless steel or stainless clad steel.

13.3 Plating

Plating of independent gravity cargo tanks is not to be less than the greatest thickness derived from the following equations:

13.3.1

$$t = 0.004sk\sqrt{q[(hg/1.025) + v]} + 2.5 \text{ mm}$$

$$= 0.0022sk\sqrt{q[(hg/1.025) + v]} + 0.1 \text{ in.}$$

13.3.2

$$t = 3.45sk\sqrt{qh_1g}10^{-3} + 1.5 \text{ mm}$$

$$= 1.93sk\sqrt{qh_1g}10^{-3} + 0.06 \text{ in.}$$

13.3.3

$$t = 2.5 + s/150 \text{ mm}$$

$$= 0.1 + s/150 \text{ in.}$$

13.3.4

$$t = 6.5 \text{ mm in.}$$

where

s = stiffener spacing in mm (in.)

$k = (3.075\sqrt{a} - 2.077)/(a + 0.272)$ where $1 \leq a \leq 2$
 $= 1.0$ where $a > 2$

a = aspect ratio of the plate panel (longer edge/shorter edge)

$q = 235/Y$ (24/Y, 34000/Y)

Y = yield point or yield strength, as defined in 3-1-1/35 or 3-1-1/37 or 72% of the specified minimum tensile strength, whichever is the less, in N/mm² (kgf/mm², lbf/in²)

g = specific gravity of the cargo. Where piping arrangements are such that independent tanks can be filled with water ballast, g is not to be taken less than 1.025.

$v = 9.948P_v m(9.756P_v m, 2.25P_v ft)$

P_v = pressure/vacuum relief valve positive setting, in bar (kgf/cm² or lbf/in²), but is not to be taken less than 0.2 bar (0.204 kgf/cm² or 2.9 lbf/in²)

h = distance, in m (ft), from the lower edge of the plate to the highest point of the tank, excluding expansion trunk or access hatchway

h_1 = distance, in m (ft), from the lower edge of the plate to the highest point the cargo could reach, such as the top of a vent, but the point is not to be taken less than 2.44 m (8 ft) above the top of the tank

13.5 Stiffeners

The stiffeners are to have their ends attached. Each stiffener, in association with the plating to which it is attached, is to have a section modulus SM not less than the greater value derived from the following equations:

13.5.1

$$SM = 7.86[(hg/1.025) + v]s\ell^2Q \cdot 10^{-3} \text{ cm}^3$$

$$= 3.45[(hg/1.025) + v]s\ell^2Q \cdot 10^{-4} \text{ in}^3$$

13.5.2

$$SM = 7.86ch_1gs\ell_1^2Q/1025 \text{ cm}^3$$

$$= 3.45ch_1gs\ell_1^2Q/10250 \text{ in}^3$$

where

s = stiffener spacing in mm (in.)

g = as defined in 5-2-4/13.3

v = as defined in 5-2-4/13.3

$Q = 1.0$ for ordinary strength steel
 $=$ as defined in 3-2-1/11.3 for other steel

h = distance, in m (ft), from the middle of ℓ to the highest point of the tank, excluding expansion trunk or access hatchway

- h_1 = distance, in m (ft), from the middle of ℓ , to the highest point the cargo could reach, such as the top of a vent, but the point is not to be taken less than 2.44 m (8 ft) above the top of the tank
- ℓ = unsupported length, in m (ft), between supports. Where brackets are fitted which have a slope of about 45° and a thickness indicated in 5-1-1/3.1 TABLE 1, the length ℓ may be measured to a point on the bracket equal to 25% of the length of the bracket
- ℓ_1 = distance, in m (ft), between the heel of the end attachments
- c = 0.3 for stiffeners having an effective bracket attachment at both ends.
 7
 = 0.4 for stiffeners having an effective bracket attachment at one end and a clip connection at the other
 6
 = 0.5 for stiffeners having a clip connection at both ends in the application of the values of c above, an effective bracket is to have scantlings not less effective than shown in 5-1-1/3.1 TABLE 1 and is to extend onto the stiffener for a distance not less than $0.125\ell_1$

13.7 Primary Support Structure

13.7.1 Strength Requirements

Each girder, web, stringer, etc., in association with the plating to which it is attached, is to have a section modulus SM not less than the greater value derived from the following equations:

13.7.1(a)

$$SM = 7.11[(hg/1.025) + v]s\ell^2Q \text{ cm}^3$$

$$= 3.75[(hg/1.025) + v]s\ell^2Q \text{ in}^3$$

13.7.1(b)

$$SM = 4.631h_1gs\ell^2Q \text{ cm}^3$$

$$= 2.439h_1gs\ell^2Q \cdot 10^{-3} \text{ in}^3$$

where

- s = sum of the half lengths, in m (ft), (on each side of the girder, web, etc.) of the stiffener supported
- g = as defined in 5-2-4/13.3
- v = as defined in 5-2-4/13.3
- Q = 1.0 for ordinary strength steel
 = as defined in 3-2-1/11.3 for other steel
- ℓ = unsupported length, in m (ft), between supports; where brackets are fitted which have a slope of about 45° and a thickness indicated in 5-1-1/3.1 TABLE 1, the length ℓ may be measured to a point on the bracket equal to 25% of the length of the bracket
- h = distance, in m (ft), from the middle of ℓ to the highest point of the tank, excluding expansion trunk or access hatch
- h_1 = distance, in m (ft), from the middle of ℓ to the highest point the cargo could reach, such as the top of a vent, but the point is not to be taken less than 2.44 m (8 ft) above the top of the tank

13.7.2 Proportions

Girders, webs, stringers, etc., are to have proportions in accordance with 3-2-4/3.9.

13.7.3 Tripping Brackets

Tripping brackets are to be fitted in accordance with 3-2-4/3.9.

13.7.4 Stiffeners

Stiffeners are to be fitted in accordance with 3-2-5/3.15.

13.7.5 Minimum Thickness

Web portions of girders, webs, stringers, etc., are to have a thickness not less than required by 3-2-4/3.11.

13.9 Overall Strength

Using the information obtained from the requirements in 3-2-1/7 and 5-2-4/1.7, the maximum tank bending moments and shear forces, and foundation reactions are to be determined.

In tanks with only two transverse foundations in which only still water conditions have been investigated, the still water tank bending moments and shear forces and foundation reactions are to be superimposed upon those obtained by simultaneous application of dynamic loadings due to rolling, pitching and heaving.

The tank scantlings are to be such that the maximum tank bending stress does not exceed $0.6Y$ or $0.42U$, whichever is less, and the maximum shear stress does not exceed $0.45Y$.

where

Y = yield strength of the material

U = minimum ultimate tensile strength of the material

15 Independent Tank Support Structure

15.1 Foundations

Independent tanks are to be supported on foundations of steel or other suitable material.

The structure and arrangement of foundations and the adjacent barge structure is to be suitable for the loads imposed as determined by 5-2-4/13.9 and the resulting stresses there are not to exceed the limits indicated in 5-2-4/13.9.

15.3 Collision Chocks

Independent tanks are to be provided with collision chocks. In Type I and Type II Barges, they are to be designed to withstand a longitudinal collision load of 1.5 times the combined weight of the tank structure and the cargo. In Type III Barges, they are to withstand a longitudinal collision load equal to the combined weight of the tank structure and the cargo.

The bearing stress is not to be greater than $2Y$ or $1.5U$, whichever is less:

where

Y = yield strength of the material

U = minimum ultimate tensile strength of the material

15.5 Anti-Lifting and Anti-Roll Chocks

To prevent tank movement, anti-lifting and anti-roll chocks are to be provided.

PART 5

CHAPTER 2 Tank Barges

SECTION 5 Liquefied Gas Tank Barges (2015)

1 General

In general, barges intended for the carriage of liquefied gases in bulk are to comply with the *International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)* as appropriate, or other national standard, as applicable to the non-propelled status of the vessel.

A special certificate attesting to the degree of compliance with the above codes or national standard may be issued upon request.

For manned barges, consideration is to be given for full compliance with the code. In all cases, it is the Owner's responsibility to determine the requirements of flag Administration and port Administration.

3 Application (2016)

This Section applies to barges (manned and unmanned as established by the flag Administration) intended to carry those liquid gases addressed by the *IGC Code*. Barges complying with this Section are eligible to be classed **Liquefied Gas Tank Barge** with a cargo notation and list of defined cargoes.

These requirements are intended to apply to steel barges regardless of their size, engaged in carriage of liquefied gases having a vapor pressure exceeding 2.8 bar (2.855 kgf/cm², 40.61 lbf/in²) absolute at a temperature of 37.8°C (100°F) and other products, as shown in Section 5C-8-19 of the *Marine Vessel Rules*, when carried in bulk.

Where corrosive cargoes are carried, the scantlings are to be suitably increased or an effective method of corrosion control to be adopted. Corrosive substances (solid or liquid) are those, excluding saltwater, that possess in their original stage the common property of being able through chemical action to cause damage by coming into contact with living tissues, the vessel or its cargoes, when escaped from their containment.

This Section applies to the cargo containment system and related systems. The remainder of the vessel is to comply with the hull and machinery requirements of the Rules, except as modified in this Section.

5 Submission of Data (2016)

The following plans, calculations and information, as appropriate, are to be submitted in addition to those required by Section 1A-5-4 of the *ABS Rules for Conditions of Classification (Part 1A)*.

- i)* Full particulars of the intended cargo or cargoes and its properties, including flashpoint, maximum vapor pressure, minimum and, if necessary, maximum temperature, and loading and carriage procedures.
- ii)* Arrangement plans of the vessel showing the position of the following:
- Cargo containment system, cargo tanks, fuel oil, water ballast and other tanks, and void spaces
 - Manholes in cargo tanks, opening for tank cleaning, any other opening of the cargo tanks
 - Doors and other openings in cargo pump and compressor rooms and other gas dangerous rooms
 - Ventilation ducts of cargo pump and compressor rooms and other “gas dangerous” spaces
 - Door, air-locks, manholes, ducts and other openings for “non-gas dangerous” spaces which are, however, adjacent to the cargo area, including rooms inside and under the forecastle deck
 - Cargo piping, both liquid and gaseous phases, located under and above deck
 - Vent piping and gas freeing piping and protective devices, such as flame screens, etc., fitted at the outlet end of the vents etc.
 - Gas dangerous spaces
- iii)* Plans of the hull structure in way of the cargo tanks, including the installation of attachments, accessories, internal reinforcements, saddles for support and tie-down devices.
- iv)* Plans of the structure of the cargo containment system, including the installation of attachments, supports and attachment of accessories
- v)* For independent pressure cargo tanks, the standard or Code adopted for the construction and design is to be identified. Detailed construction drawings together with design calculations for the pressure boundary, tank support arrangement and analysis for the load distribution. Anti-collision, chocking arrangement and design calculations.
- vi)* Distribution of the grades and types of steel proposed for the structures of the hull and of the cargo containment system, including attachments, accessories, etc., together with the calculation of the temperatures on all of the structures which can be affected by the low temperatures of the cargo
- vii)* Results of direct calculations of the stresses in the hull and in the cargo containment system
- viii)* Specifications and plans of the insulation system and calculation of the heat balance
- ix)* Procedures and calculations of the cooling down, loading and unloading operations
- x)* Loading and unloading systems, venting systems, and gas-freeing systems, as well as a schematic diagram of the remote controlled valve system
- xi)* Details and installation of the safety valves and relevant calculations of their relieving capacity
- xii)* Details and installation of the various monitoring and control systems, including the devices for measuring the level of the cargoes in the tanks and the temperatures in the containment system
- xiii)* Schematic diagram of the ventilation system indicating the vent pipe sizes and height of the openings above the main deck
- xiv)* Schematic diagram of the refrigeration system together with the calculations concerning the refrigerating capacity
- xv)* Details of the electrical equipment installed in the cargo area and of the electrical bonding of the cargo tanks and piping
- xvi)* Where fitted, plans and specifications relative to the use of the cargo as fuel for boilers and internal combustion engines (general installations; schematic diagram of the fuel-gas lines with the indication of all of the valves and safety devices; compressors of the fuel gas and relevant

- engines; fuel-gas heaters and pressure vessels; installation of the burners of the fuel-gas and of the fuel oil; electrical bonding systems)
- xvii)* Details of testing procedures of cargo tanks and liquid and vapor systems
 - xviii)* Diagram of inert-gas system or hold-space environmental-control system
 - xix)* Diagram of gas-detection system
 - xx)* Jettison arrangements, if provided
 - xxi)* Schematic-wiring diagrams
 - xxii)* Details of all cargo and vapor handling equipment
 - xxiii)* Details of fire extinguishing systems
 - xxiv)* Welding procedure
 - xxv)* Emergency shutdown arrangements
 - xxvi)* Construction details of cargo and booster pumps and compressors including material specification.
 - xxvii)* Hazardous area drawing showing access, openings, vent outlets.
 - xxviii)* Bilge and ballast arrangement for the cargo area.
 - xxix)* Emergency Towing Arrangement.

Plans and documentation are to be generally be submitted electronically to ABS. However, hard copies will also be accepted. All plan submittals originating from manufacturers are understood to be made with the cognizance of the shipbuilder.

7 Still-water Bending Moment and Shear Force Calculations

Refer to the requirements of 3-2-1/7.

Still-water bending-moment and shear force calculations are to be submitted for all liquefied gas tank barges, irrespective of their length.

9 Loading Guidance

9.1 Barges

A loading manual based on still water conditions is to be prepared and submitted for review where the length L is greater than 65 m (213 ft). The loading manual is to be in such a form that the effects on hull girder bending and shear along the length of the barge can be determined for any anticipated at-sea loaded or ballasted condition or any in-port loading or discharge sequence. A copy of the loading manual is to be maintained on board.

9.3 Integrated Tug-Barge Combinations

Tug-Barge combinations intended for the carriage of liquefied gases with a combined length L_c greater than 65 m (213 ft) are to have loading manuals prepared and submitted for review. The loading manual is to be in such a form that the effects on hull girder bending and shear along the length of the tug-barge combination can be determined for any anticipated at-sea loaded or ballasted condition or any in-port loading or discharge sequence. The loading manual is to be furnished to and retained by the master of the tug for guidance.

11 Hull Structure

11.1 Hull Scantlings (2020)

In general, the hull scantlings are to be in accordance with the applicable sections of the *Barge Rules*. Where structural arrangements are not provided for in these Rules, the *Marine Vessel Rules* are to apply.

For barges where the hull structure is similar to that of a typical gas carriers, the scantling requirements in Part 5C of the *Marine Vessel Rules* or the *ABS Guide for Building and Classing Liquefied Gas Carriers with Independent Tanks (LGC Guide)*, as applicable, may be applied in lieu of these Rules, including welding requirements, corrosion margins, and plate renewal criteria. Barges in full compliance with Part 5C of the *Marine Vessel Rules* or the *LGC Guide*, as applicable, will be eligible to receive the **SH**, **SHCM** notations.

11.3 Hull Scantlings in Way of Cargo Tanks (2020)

The hull structure in way of cargo tanks, foundations, chocks, keys and sway braces is to be of sufficient strength when subjected to design loadings.

For Type C tanks, the LNG tank saddle and the interfacing hull structure is to consider the load cases in the *LGC Guide*.

11.5 Double Bottom Floors and Girders (2016)

Where a double bottom is required to be fitted, the minimum depth is to be equal to or greater than the cargo tank distance requirements in 5C-8-2/4 of the *Marine Vessel Rules*. Double bottoms are to be designed to withstand the dynamic forces from the cargo containment system.

13 Access (Manned Only)

Satisfactory arrangements are to be provided to safeguard the crew in reaching all parts used in the necessary work of the vessel. See 3-2-17/3 of the *Marine Vessel Rules*.

15 Special Construction Requirements

Refer to 5C-8-1/17 of the *Marine Vessel Rules*.

17 Vessel Survival Capability and Location of Cargo Tanks

Refer to Section 5C-8-2 of the *Marine Vessel Rules*.

Where the conditions of service are such that compliance with the stability requirements of Section 5C-8-2 of the *Marine Vessel Rules* is impracticable and where a suitably reduced degree of hazard exists, the damage to be assumed may be specially considered subject to review.

19 Vessel Arrangements

19.1 Segregation of the Cargo Area (2016)

19.1.1

Hold spaces shall be segregated from machinery and boiler spaces, accommodation spaces, service spaces, control stations, chain lockers, domestic water tanks and from stores. Alternative arrangement may be accepted, based on SOLAS regulation II-2/17, after further consideration of involved risks, including that of cargo release and the means of mitigation.

19.1.2

Where cargo is carried in a cargo containment system not requiring a complete or partial secondary barrier, segregation of hold spaces from spaces referred to in 5-2-5/19.1.1 or spaces

either below or outboard of the hold spaces may be effected by cofferdams, fuel oil tanks or a single gastight bulkhead of all-welded construction forming an "A-60" class division. A gastight "A-0" class division is acceptable if there is no source of ignition or fire hazard in the adjoining spaces.

19.1.3

Where cargo is carried in a cargo containment system requiring a complete or partial secondary barrier, segregation of hold spaces from spaces referred to in 5-2-5/19.1.1 or spaces either below or outboard of the hold spaces which contain a source of ignition or fire hazard shall be effected by cofferdams or fuel oil tanks. A gastight "A-0" class division is acceptable if there is no source of ignition or fire hazard in the adjoining spaces.

19.1.4

When cargo is carried in a cargo containment system requiring a complete or partial secondary barrier:

19.1.4(a)

at temperatures below -10°C , hold spaces shall be segregated from the sea by a double bottom; and

19.1.4(b)

at temperatures below -55°C , the ship shall also have a longitudinal bulkhead forming side tanks.

19.1.5

Turret compartments segregation from spaces referred to in 5-2-5/19.1.1, or spaces either below or outboard of the turret compartment that contain a source of ignition or fire hazard, shall be effected by cofferdams or an "A-60" class division. A gastight "A-0" class division is acceptable if there is no source of ignition or fire hazard in the adjoining spaces.

19.1.6

In addition, the risk of fire propagation from turret compartments to adjacent spaces shall be evaluated by a risk analysis (see 5C-8-1/2.1.1 of the *Marine Vessel Rules*) and further preventive measures, such as the arrangement of a cofferdam around the turret compartment, shall be provided if needed.

19.1.7

Arrangements should be made for sealing the weather decks in way of openings for cargo containment systems.

19.3 Accommodation, Service and Machinery Spaces and Control Stations

Refer to 5C-8-3/2 of the *Marine Vessel Rules*.

The arrangement of machinery spaces may comply with 5-2-3/1.5.2(c) in lieu of 5C-8-3/2.4 of the *Marine Vessel Rules*.

19.5 Cargo Pump Rooms and Cargo Compressor Rooms

Refer to 5C-8-3/3 of the *Marine Vessel Rules*.

19.5.1 Manned Barge Only (2016)

With regard to 5C-8-3/3.1 of the *Marine Vessel Rules*, cargo machinery spaces and turret compartments shall be treated as cargo pump rooms for the purpose of fire protection according to SOLAS Regulation II-2/9.2.4 and for the purpose of prevention of potential explosion according to SOLAS Regulation II-2/4.5.10.

19.7 Cargo Control Rooms

Refer to 5C-8-3/4 of the *Marine Vessel Rules*.

19.9 Access to Spaces in the Cargo Area (2016)

Refer to 5C-8-3/5 of the *Marine Vessel Rules*.

Ballast spaces that could be considered hazardous areas are also to comply with 5C-8-3/5 of the *Marine Vessel Rules*.

19.11 Air-locks

Refer to 5C-8-3/6 of the *Marine Vessel Rules*.

19.13 Bilge, Ballast and Fuel Oil Arrangements

Refer to 5C-8-3/7 of the *Marine Vessel Rules*.

19.15 Bow or Stern Loading and Unloading Arrangements

Refer to 5C-8-3/8 of the *Marine Vessel Rules*.

19.17 Temperature of Steam or Heating Media within the Cargo Area

Refer to 5C-8-3/9 of the *Marine Vessel Rules*.

21 Cargo Containment

21.1 General

A structural analysis of the hull structure supporting a membrane tank is required using direct calculation procedures which are to be agreed to with ABS at an early stage of the design.

Where details are not provided for in this section, refer to Section 5C-8-4 of the *Marine Vessel Rules*.

21.3 Allowable Stresses and Design Criteria (2016)

The temperature on which the material properties are based as well as the material type, stress factors, and the design criteria for the ambient air and water temperature is to be submitted.

21.5 Supporting Arrangements (2016)

Refer to 5C-8-4/8 of the *Marine Vessel Rules*.

The cargo tanks shall be supported by the hull in a manner that prevents bodily movement of the tanks under the static and dynamic loads defined in 5C-8-4/12 to 5C-8-4/15 of the *Marine Vessel Rules* where applicable, while allowing contraction and expansion of the tanks under temperature variations and hull deflections without undue stressing of the tanks and of the hull.

Supports and supporting arrangements are to withstand the loads defined in 5C-8-4/13.9 and 5C-8-4/15 of the *Marine Vessel Rules*, but these loads need not be combined with each other or with wave-induced loads.

21.7 Guidance Formulae for Acceleration Components (2016)

A design analysis substantiating the acceleration components is to be submitted.

The following formulae are given as guidance for the components of acceleration due to barge's motions corresponding to a probability level of 10^{-8} in the North Atlantic and apply to barges with a length exceeding 50 m and at or near their service speed.

Vertical acceleration as defined in 5C-8-4/14.1.2 of the *Marine Vessel Rules*:

$$a_z = \pm a_0 \sqrt{1 + \left(5.3 - \frac{45}{L_0}\right)^2 \left(\frac{x}{L_0} + 0.05\right)^2 \left(\frac{0.6}{C_b}\right)^{1.5} + \left(\frac{0.6yK^{1.5}}{B}\right)^2}$$

Transverse acceleration as defined in 5C-8-4/14.1.2 of the *Marine Vessel Rules*:

$$a_y = \pm a_0 \sqrt{0.6 + 2.5 \left(\frac{x}{L_0} + 0.05\right)^2 + K \left(1 + 0.6K \frac{z}{B}\right)^2}$$

Longitudinal acceleration as defined in 5C-8-4/14.1.2 of the *Marine Vessel Rules*:

$$a_x = \pm a_0 \sqrt{0.06 + A^2 - 0.25A^2}$$

$$A = \left(0.7 - \frac{L_0}{1200} + 5 \frac{z}{L_0}\right) \left(\frac{0.6}{C_b}\right)$$

where

$\alpha_x, \alpha_y, \alpha_z$ = maximum dimensionless accelerations (i.e., relative to the acceleration of gravity) in the respective directions. They are considered as acting separately for calculation purposes. α_z does not include the component due to the static weight, α_y includes the component due to the static weight in the transverse direction due to rolling, and α_x includes the component due to the static weight in the longitudinal direction due to pitching. The accelerations derived from the above formulae are applicable only to barges at or near their service speed, not while at anchor or otherwise near stationary in exposed locations.

α_0 =

L_0 = length of the ship for determination of scantlings as defined in Recognized Standards, in m

C_b = block coefficient

B = greatest molded breadth of the barge, in m

x = longitudinal distance (m) from amidships to the center of gravity of the tank with contents; x is positive forward of amidships, negative aft of amidships

z = vertical distance (m) from the barge's actual waterline to the center of gravity of tank with contents; z is positive above and negative below the waterline.

V = service speed, in knots

K = 1 in general. For particular loading conditions and hull forms, determination of K according to the formula below may be necessary.

$$K = 13GM/B \quad \text{where } K \geq 1.0$$

GM = metacentric height, in m

23 Process Pressure Vessels and Liquid, Vapor, and Pressure Piping Systems (2016)

Refer to Section 5C-8-5 of the *Marine Vessel Rules*.

23.1 In lieu of 5C-8-5/2.2.1 of the *Marine Vessel Rules*

Any piping system which may contain cargo or cargo vapor shall:

23.1.1

Be segregated from other piping systems, except where interconnections are required for cargo-related operations such as purging, gas-freeing or inerting. The requirements of 5C-8-9/4.4 of the *Marine Vessel Rules* shall be taken into account with regard to preventing back-flow of cargo. In such cases, precautions shall be taken so that cargo or cargo vapor cannot enter such other piping systems through the interconnections;

23.1.2

Except as provided in 4-1-2/19, not pass through any accommodation space, service space or control station or through a machinery space other than a machinery space;

23.1.3

Be connected into the cargo containment system directly from the weather deck except where pipes installed in a vertical trunkway or equivalent are used to traverse void spaces above a cargo containment system and except where pipes for drainage, venting or purging may traverse cofferdams;

23.1.4

Be located in the cargo area above the weather deck except for bow or stern loading and unloading arrangements in accordance with 5-2-5/19.15 and emergency cargo jettisoning piping systems in accordance with 5-2-5/23.3, turret compartment systems in accordance with 5C-8-5/3.3 of the *Marine Vessel Rules* and except in accordance with 4-1-2/19, and

23.1.5

Be located inboard of the transverse tank location requirements of 5C-8-2/4.1 of the *Marine Vessel Rules* except for athwartship shore connection piping not subject to internal pressure at sea or emergency cargo jettisoning piping systems.

23.3 In lieu of 5C-8-5/3.1 of the *Marine Vessel Rules*

If fitted, an emergency cargo jettisoning piping system shall comply with 5-2-5/23.1, as appropriate, and may be led aft externally to accommodation spaces, service spaces or control stations or machinery spaces, but should not pass through them. If an emergency cargo jettisoning piping system is permanently installed, a suitable means of isolation from the cargo piping shall be provided within the cargo area.

23.5 Unmanned Barge

23.5.1 In lieu of 5C-8-5/5.1.2 of the *Marine Vessel Rules*

In addition, remotely operated valves shall also be fitted, as appropriate, as part of the emergency shutdown (ESD) system the purpose of which is to stop cargo flow or leakage in the event of an emergency when cargo liquid or vapour transfer is in progress. The ESD system is intended to return the cargo system to a safe static condition so that any remedial action can be taken. Due regard shall be given in the design of the ESD system to avoid the generation of surge pressures within the cargo transfer pipework. The equipment to be shut down on ESD activation includes manifold valves during loading or discharge, any pump or compressor, etc., transferring cargo internally or externally (e.g. to shore or another ship/barge) and cargo tank valves, if the MARVS exceeds 0.07 MPa. The ESD system for all remotely operated valves shall be arranged that all such valves may be operated by single controls situated in at least the two remote control locations as specified in 5-2-5/39 below.

25 Materials of Construction

Refer to Section 5C-8-6 of the *Marine Vessel Rules*.

27 Cargo Pressure/Temperature Control (2016)

Means are to be provided to control the pressure and temperature of the cargo in accordance with Section 5C-8-7 the *Marine Vessel Rules*.

Holding time calculations are to be submitted.

29 Cargo Tank Vent Systems

29.1 Unmanned Barge

- i) Refer to Section Section 5C-8-8 of the *Marine Vessel Rules*.
- ii) (2016) Isolation of the PRV shall be carried out under the supervision of the Master of the towing vessel. This action shall be recorded in the ship's log and a sign posted in the cargo control room, if provided, and at the PRV.
- iii) (2016) Cargo PRV vent exits and all other vent exits connected to the cargo containment system shall be arranged at a distance of at least 10 m from the nearest air intake, outlet or opening to accommodation spaces, service spaces and control stations, or other non-hazardous areas.

29.3 Manned Barge

- i) Refer to Section 5C-8-8 of the *Marine Vessel Rules*.
- ii) (2016) Cargo PRV vent exits shall be arranged at a distance at least equal to B or 25 m (82 ft), whichever is less, from the nearest air intake or opening to accommodation spaces, service spaces and control stations, or other non-hazardous areas. For barges less than 90 m in length, smaller distances may be permitted. All other vent outlets connected to the cargo containment system shall be arranged at a distance of at least 10 m (33 ft) from the nearest air intake, outlet or opening to accommodation spaces, service spaces and control stations, or other non-hazardous areas.

31 Cargo Containment System Atmosphere Control

Refer to Section 5C-8-9 of the *Marine Vessel Rules*.

33 Electrical Installations (2016)

Refer to Section 5C-8-10 of the *Marine Vessel Rules*, except that alternative arrangements of the hazardous areas may be specially considered on a case by case basis provided such arrangements are:

- i) Found to provide an acceptable level of safety through an appropriate safety case assessment, or
- ii) Determined to comply with published requirements of the flag Administration.

Permanent Notices and Booklet of Certified Equipment are to be in accordance with 4-1-3/11.3 of *Steel Barge Rules*.

35 Fire Protection and Fire Extinction (2016)

35.1 Unmanned Barge

- i) For protection of enclosed spaces containing cargo handling equipment, refer to 5C-8-11/5.1 and 5C-8-11/5.2 of the *Marine Vessel Rules*.
- ii) In the cargo manifold(s) area a permanently installed dry chemical powder extinguishing system is to cover all possible leak points. The capacity is to deliver a rate of discharge of not less than 3.5 kg/s (75 gpm) for a minimum of 45 seconds. The system is to be arranged for easy manual release from a safe location outside the protected area.
- iii) One portable dry powder extinguisher of at least 5 kg (11 lbs) capacity is to be located near the cargo manifold(s).

35.3 Manned Barge

- i) Fire water main equipment, water spray system, dry chemical powder fire-extinguishing systems, protection of enclosed spaces containing cargo handling equipment and firefighter's outfit are to be in accordance with Section 5C-8-11 of the *Marine Vessel Rules*.
- ii) One portable dry powder extinguisher of at least 5 kg capacity is to be located near the cargo manifold(s).
- iii) The fire pump shall be capable of local control. Means shall be provided for remote control from the towing vessel.
- iv) The water spray system shall be capable of remote control from the towing vessel.

37 Artificial Ventilation in the Cargo Area

Refer to Section 5C-8-12 of the *Marine Vessel Rules*.

39 Instrumentation and Automation System (2016)

Automation and instrumentation systems are to be provided to enable safe carriage, handling and conditioning of the liquefied gas as per Section 5C-8-13 of the *Marine Vessel Rules*.

For an unmanned barge application, the following alternative requirements are to be used:

39.1 In lieu of 5C-8-13/1 of the *Marine Vessel Rules*

If the loading and unloading of the barge is performed by means of remotely controlled valves and pumps, all controls and indicators associated with a given cargo tank shall be concentrated in two control positions, one on the barge and one on the towing vessel(s) satisfying the requirements of 5C-8-3/4 of the *Marine Vessel Rules*. Means of "hard real-time" communications with redundant transmission media are to be provided between the two cargo control positions. "Hard real-time" communications systems are those that the delivery delays for all messages are time-bounded (i.e. maximum delay time established ahead of time) for all anticipated survivable fault scenarios.

39.3 In lieu of 5C-8-13/3.7 of the *Marine Vessel Rules*

Where arrangements are provided for overriding the overflow control system, they shall be such that inadvertent operation is prevented. When this override is operated, continuous visual indication shall be given at the relevant control station(s) of the towing vessel(s) and on the barge.

39.5 In lieu of 5C-8-13/4.1 of the *Marine Vessel Rules*

The vapor space of each cargo tank shall be provided with a direct reading gauge. Additionally, an indirect indication shall be provided at the control position on the towing vessel. Maximum and minimum allowable pressures shall be clearly indicated.

39.7 In lieu of 5C-8-13/4.2 of the *Marine Vessel Rules*

A high-pressure alarm and, if vacuum protection is required, a low-pressure alarm, shall be provided on the navigation bridge and at the control position of the towing vessel(s). Alarms shall be activated before the set pressures are reached.

39.9 In lieu of 5C-8-13/4.5 of the *Marine Vessel Rules*

Local-reading manifold pressure gauges shall be provided to indicate the pressure between the barge's manifold valves and hose connections to the shore.

39.11 In lieu of 5C-8-13/5.2 of the *Marine Vessel Rules*

The temperature indicating devices shall be capable of providing temperature indication across the expected cargo operating temperature range of the cargo tanks at both control locations required by 5-2-5/39.1.

39.13 In lieu of 5C-8-13/6.1 of the *Marine Vessel Rules*

Gas detection equipment shall be installed to monitor the integrity of the cargo containment, cargo handling and ancillary systems, in accordance with 5C-8-13/6 of the *Marine Vessel Rules*. Gas detection equipment may be located in the control position required by 5-2-5/39.1, on the navigation bridge or at other suitable locations.

39.15 In lieu of 5C-8-13/6.8 of the *Marine Vessel Rules*

When sampling type gas detection equipment is used, the following requirements shall be met:

- i) The gas detection equipment shall be capable of sampling and analyzing from each sampling head location sequentially at intervals not exceeding 30 minutes.
- ii) Individual sampling lines from sampling heads to the detection equipment shall be fitted, and
- iii) Pipe runs from sampling heads shall not be led through non-hazardous spaces except as permitted by 5C-8-13/6.9 of the *Marine Vessel Rules*.

Audible and visual alarms should be provided at both cargo control locations required by 5-2-5/39.1 and in addition to the navigation bridge and engine room.

39.16 Remote Control and Monitoring of Essential Systems (1 July 2022)

In addition of 5C-8-13/9 of the *Marine Vessel Rules*, an unmanned barge fitted with essential machinery and systems in support of cargo management to be controlled, alarmed and monitored remotely from a manned location is to comply with the *ABS Requirements for Liquefied Gas Tank Barges with Remote Control and Monitoring of Essential Systems*.

41 Personnel Protection

41.1 Unmanned Barge (2016)

Refer to 5C-8-14/1, 5C-8-14/2 and 5C-8-14/4.1 of the *Marine Vessel Rules*.

41.3 Manned Barge

Refer to Section 5C-8-14 of the *Marine Vessel Rules*.

43 Filling Limits for Cargo Tanks

Refer to Section 5C-8-15 of the *Marine Vessel Rules*.

45 Use of Cargo as Fuel (2021)

Refer to Section 5C-8-16 of the *Marine Vessel Rules*.

47 Special Requirements

47.1 Unmanned Barge (2016)

Refer to Section 5C-8-17 of the *Marine Vessel Rules*, except that 5C-8-17/13.4, 5C-8-17/18.29, 5C-8-17/18.30 and 5C-8-17/18.31 do not apply.

47.3 Manned Barge

Refer to Section 5C-8-17 of the *Marine Vessel Rules*.

49 Operating Requirements

Refer to Section 5C-8-18 of the *Marine Vessel Rules*.

51 Surveys (2016)

See Section 3-4-3 of these Rules and Sections 7-3-2 and 7-6-2 of the *ABS Rules for Survey After Construction (Part 7)* requirements for barges intended to carry liquefied gases.

PART 5

CHAPTER 3 Other Barge Types

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1 General

1.1 Definitions (2020)

1.1.1 Rigid Connection System (2020)

A rigidly connected integrated tug-barge combination designed for pushing mode only is one in which the tug is connected to the stern of the barge in such a manner that there is no relative motion between the tug and barge, resulting in the two vessels acting as a single unit in a seaway.

1.1.2 Articulated Connection System (2020)

An integrated tug-barge connected by a system for dual mode operations that allows relative motion between the tug and the barge in one or more degrees of freedom is deemed to have an articulated connection system.

1.1.3 Length of Combination (L_c) (2020)

The combined length L_c , is to be measured with the tug and barge connected in their pushing mode. The combined length L_c is to be taken as the distance, in m (ft), measured on a waterline at 85% of the least molded depth of the barge, from the fore side of the stem of the barge to the after side of the rudder post or stern post of the tug. Where there is no rudder post or stern post, L_c is to be measured to the centerline of the rudder stock of the tug. L_c , however, is not to be taken less than 96% and need not be taken greater than 97% of the total waterline length of the combination measured at 85% of the least molded depth of the barge.

1.3 Classification (2020)

In an integrated tug-barge combination, a tug is integrated to a barge with a special connection system such that the tug is secured in the barge notch or on fenders by mechanical means, other than just wire ropes, chains, lines or other tackles.

The tug and the barge are to be classed as two separate vessels but where applicable will be cross-referenced in the *Record*.

1.3.1 Towing Vessel - ATB (Articulated Tug Barge) (2020)

The tug will be classed and distinguished in the *Record* by the notation **A1 Towing Vessel ATB**, which is in full compliance with the requirements of the Part 5C, Chapter 17 of the *Rules for*

Building and Classing Marine Vessels, and signifies that the vessel has the dual mode (DM) capabilities.

- i) Pushing the barge in Tug-Barge integrated mode
- ii) Towing the barge by hawser in a separate mode

1.3.2 Towing Vessel - ITB (Integrated Tug Barge) (2020)

The tug will be classed and distinguished in the *Record* by the notation **⊗ A1 (Geographical limitations) Towing Vessel ITB**. This class notation will be assigned to a tug which does not meet the requirements for intact stability during tow as specified in Section 5C-17-2 of the *Rules for Building and Classing Marine Vessels*, but does meet the requirements of the rest of the above Rules, and is intended to operate in a pushing mode (PM) only and remain fixed to the barge throughout the voyage and has Rigid Connection System.

1.3.3 Barge Class (2020)

The barge will be classed and distinguished in the *Record* by the symbols and designations in accordance with 5-3-1/5.1 of the *Rules for Building and Classing Steel Barges* followed by the operational limitation, **ATB, ITB**, whichever is applicable, such as

⊗ A1 (geographical limitations) Barge, ITB

⊗ A1 Barge, ATB

3 Plans (2020)

In addition to the plans required to be submitted by Section 1A-2-4 and Section 1A-5-4 of the *ABS Rules for Conditions of Classification (Part 1A)*, the following plans are to be submitted in the same manner.

- i) General Arrangements of Combined Unit
- ii) Loading Manual
- iii) Hull structural details in way of the connection of tug and barge for each vessel
- iv) Structural analysis of the connection
- v) Connection Details and Loads
- vi) Towing and Anchor Equipment Details
- vii) Guard Rail Details

5 Longitudinal Strength

5.1 Rigid Connection ITB

The barge of a rigid connection ITB is to have longitudinal strength in accordance with Section 3-2-1, using a length equal to the combined length L_c , as defined in 5-3-1/3.5, and a block coefficient $CB = \nabla_c / L_c B d$ where:

∇_c = volume of molded displacement, excluding appendages, of the combined unit, in m^3 (ft^3)

B = breadth of the barge, as defined in 3-1-1/5, in m (ft)

d = molded draft, in m (ft), from the molded baseline of the barge to the summer load line of the barge.

The amidship scantlings are to be effectively developed throughout the midship $0.4L_c$ where amidships is the middle of length L_c , and may be tapered towards the ends of the combined length L_c in the normal manner permitted for a single unit vessel.

5.3 Articulated Connection ATB (2020)

The barge of an articulated connection which allows movement about the transverse axis is to have longitudinal strength in accordance with Section 3-2-1, using the parameters of the barge alone to determine the requirements.

7 Scantling Requirements

7.1 Tug Hull Structure (2020)

In general, depending on the scantling length of the tug alone, the scantlings are to be in accordance with the requirements of the *Marine Vessel Rules*. In addition, those areas of the tug's hull structure which will be exposed to wave impact loading when the tug is acting as part of the combined unit should be designed accordingly.

A tug forming part of a rigid connection ITB and which is intended to remain fixed to the barge throughout a voyage under all weather conditions must nevertheless have the strength, stability characteristics and seakeeping capabilities to operate on its own at sea in order that the master will have the option of separating from the barge in extreme situations.

7.3 Barge Hull Structure (2020)

Material grade and location requirements and scantling requirements in general are to be in accordance with the various Sections of the *Barge Rules*. In the case of a rigid connection ITB, the combined length L_c is to be used as the length parameter in the various structural requirement equations, whereas the barge length L , as defined in 3-1-1/3, may be used in the case of an articulated connection ITB.

For barges, where the hull structure is similar to that of a typical ship, the scantling requirements in Part 5C of the *Marine Vessel Rules* or the *ABS Guide for Building and Classing Liquefied Gas Carriers with Independent Tanks (LGC Guide)*, as applicable, may be applied in lieu of these Rules; including welding requirements, corrosion margins, and plate renewal criteria. Barges in full compliance with Part 5C of the *Marine Vessel Rules* or the *LGC Guide*, as applicable, will be eligible to receive the **SH, SHCM** notations.

7.5 Collision Bulkhead Location (2020)

For rigid connections, ITB's, the barge is to have a collision bulkhead located aft of the forward perpendicular, a distance not less than permitted by the equations in 3-2-6/3.1 using the combined length L_c as the length parameter. The maximum permitted distance is to be determined using the barge length L alone.

7.7 Equipment

7.7.1 Towing Vessel-ATB (2020)

A tug intended to operate in dual mode (DM) is to have Anchoring & Towing equipment in accordance with 3-5-1/3.3.2 and 5C-17-3/3 of the *Marine Vessel Rules*.

7.7.2 Towing Vessel- ITB (2020)

A tug intended to operate in ITB, pushing mode (PM) is to have anchoring equipment in accordance with 3-5-1/3.3.2 of the *Marine Vessel Rules*, based on the scantling length of the tug alone.

7.7.3 Barges (2022)

The barge is to be provided with equipment of anchors and cables in accordance with the with requirements of 3-3-1/9 of the *Barge Rules*.

The equipment number of rigidly connected ITBs is to be determined based on the dimensions of the tug-barge combined unit. Apply 3-3-1/21 TABLE 1 of the *Barge Rules*.

The equipment number of articulated connection ATBs is to be determined based on the dimensions of the barge alone. Apply 3-3-1/21 TABLE 1 of the *Barge Rules* if symbol E is requested. Apply 3-3-1/21 Table 2 of the *Barge Rules* for manned and unmanned barges if symbol E is not requested.

7.9 Guard Rails (2020)

The ITB's are to be considered as a manned vessel or conditionally occupied in accordance with published flag Administration Requirements, and is to be provided with bulwarks and/or guardrails complying with Section 3-2-10 of the *Barge Rules*. If the barge is manned, additional secondary crew protection at or near the centerline accordance with the International Load Line Convention 1966, Regulation 25-1.

9 Still Water Bending Moment and Shear Forces

9.1 Integrated Tug Barge ITB- Rigid Connection (2020)

Still water bending moment and shear force calculations are to be submitted for both the combined unit and the barge by itself. The results of these calculations, for the anticipated at-sea loaded and ballasted conditions and for in-port loading and discharge sequences, are to be submitted in the form of curves showing hull-girder bending moment and shear force values along the entire length of the combination or the entire length of the barge alone, as appropriate.

9.3 Articulated Connection ATB (2020)

Still water bending moment and shear force calculations are to be submitted for the barge with and without the tug connected. The requirement to submit calculations with the tug connected will be waived where the connection device is such that no vertical loadings are imposed by the tug on the barge in any anticipated still water condition. The results of these calculations, for the anticipated at-sea loaded and ballasted conditions and for in-port loading and discharge sequences, are to be submitted in the form of curves showing hull-girder bending moment and shear force values along the entire length of the barge.

11 Structure In Way of Connection

11.1 Connector System (2020)

11.1.1

For classification purposes, the maximum lifetime connector loads are to be used for the design of the connection system between the tug and barge. The maximum lifetime value is to be determined based on a recognized prediction method for the long-term extreme value with an acceptable probability level. The design of the connector is to take into account the quasi-static loads, including the buoyancy and propulsion forces, and the dynamic seaway loads, as well as the steering loads. The methods of determining the maximum lifetime connector loads can be identified:

- i) Through a scale model test program covering a range of wave frequencies and headings so as to obtain the connector load response amplitude operators (RAOs) and then by analysis to identify the worst heading and predict the long term extreme connector load for that heading, or

- ii) By a motion response analysis, using a suitable seakeeping analysis program that can handle multiple bodies linked by articulation, in connection with a long term extreme analysis.

The design calculation of the connector loads is to be documented.

Fatigue strength is to be considered in the connector design and the design life is not to be less than the design life for the main barge structure.

11.1.2

Satisfactory service record may be considered in place of design calculations of the connector loads, when it can be documented that the connection system has a successful operational record. Information such as sizes of tug barge combinations, specific routes, operational history, etc., are to be provided.

11.3 Structure in way of Connection (2020)

The tug and barge structure in way of the connection is to be analyzed for stresses resulting from interactive forces. The analysis is to follow acceptable engineering practice and is to be submitted for review. The connector loads applied are to be in accordance with the loads determined from 5-3-1/11.1 above. The analysis is to take account of the range of buoyant forces which may reasonably be assumed to be acting on the hull structure and provide sufficient data to determine the motions of and between the tug, the barge and their connection. In the case of notch type connections, an analysis of the barge wing walls is to take account of torsional shear as well as primary and secondary shear and bending stresses. The allowable stresses for the structure will be subject to special consideration depending on the derivation of the loads and method of analysis used.

Finite Element Analysis (FEA) is to be used for evaluating the response of supporting structure in way of the connection. The procedures and criteria are to be in line with those in the *ABS Guidance Notes on SafeHull Finite Element Analysis of Hull Structures*.

Specific construction will vary depending on the type of linkage proposed. In general, however, the structure in the bow of the tug and the stern of the barge is to be substantially reinforced, both in the athwartship and fore and aft directions with a system of webs, stringers, bulkheads, etc., to withstand forces developed at these locations due to the connection, and also to transmit these forces into the main body of the vessels. In rigid connection ITBs, the internal structure of the barge in way of the notch or dock bottom is to align with the mating structure of the tug.

13 Loading Guidance

A loading manual based on still water conditions is to be prepared and submitted for review for tug-barge combinations having a combined length L_c greater than 122 m (400 ft), and where the barge is intended for the carriage of ore, bulk, fuel oil or oil cargoes, or where the barge is intended for the carriage of cargoes to be stowed in specific cells or locations. Combinations intended for the carriage of chemicals or liquefied gases are to have loading manuals prepared and submitted for review where the combined length L_c is greater than 65 m (213 ft). The loading manual is to be in such a form that the effects on hull girder bending and shear along the length of the barge can be determined for any anticipated at-sea loaded or ballasted condition or any in-port loading or discharge sequence. The loading manual is to be furnished to and retained by the master of the tug for guidance.

15 Navigation Bridge Visibility (2020)

In the absence of specific requirements of the flag Administration, the bridge visibility of the ITB towing vessel/barge combination is to comply with 3-6-1/2.5 of the *Marine Vessel Rules*.

17 Lifesaving Appliances and Equipment

17.1 The Tug (2020)

The tug independently is to have lifesaving appliances and equipment to the satisfaction of the flag state administration.

17.3 The Barge

The barge is to have lifesaving appliances and equipment in accordance with Section 3-5-3 where:

- Length is the length of the combined unit L_c
- Number of persons is the aggregate number of persons on board the combined unit.

The rescue boat required by 3-5-3/7 may be located on the tug.

19 Rudder and Steering Gear (2020)

The steering gear aboard the tug, in addition to satisfying the requirements for the tug alone, is to satisfy the requirements of Section 4-3-4 of the *Marine Vessel Rules* with the tug-barge combination considered as a single unit vessel. Where gross tonnage is referenced in the text, this is to be taken as the combined tug and barge tonnage. In order to demonstrate compliance with 4-3-4/21.7 of the aforementioned *Marine Vessel Rules*, the tug and barge are to be connected in their operation mode during the Sea trial.

For tugs of an articulated connection (<90 meters in length), where steering system is optimized for the integrated tug barge system, the requirements are to be in accordance with 4-3-4/1.9.3 of the *Marine Vessel Rules*.

21 Loadline and Stability

21.1 General (2020)

Application of loadline regulations to ITBs is subject to the interpretation of the administration of the country of registry of the unit (or countries of registry in the case where the tug and the barge are registered in different countries).

Where ABS is acting as the Load Line Assigning Authority on behalf of an administration and the administration has no special instructions, ABS will apply the Load Line regulations for calculation of the freeboard as follows:

21.3 The Tug (2020)

Where the tug length is 24 m (79 ft) or greater, the tug will be assigned a load line independently and will be required to satisfy all current Load Line and intact stability requirements as an individual vessel.

The intact stability of the tug intended to operate in ATB is to comply with a recognized standard. The submission of evidence showing approval by an Administration of stability of the vessel for the static bollard pull will be acceptable. Alternatively, upon request ABS will perform the review. See 5C-17-1/9.1 and Appendix 5C-17-A1 of the *Marine Vessel Rules* where $L_c < 90$ m (295 ft) for the static bollard pull and the guidelines for towing vessels, respectively.

21.5 The Barge

21.5.1 Independent Freeboard (2020)

A freeboard will be calculated for the barge alone as an independent vessel taking into account the current intact and damage (where applicable) stability requirements. Provided no accommodation spaces are located onboard the barge, the barge may be considered as unmanned in the application of load line regulation 27 (14).

21.5.2 Freeboard for Articulated Connection Barge (2020)

The barge will be assigned a freeboard corresponding to the freeboard calculated in accordance with 5-3-1/21.5.1.

21.5.3 Freeboard for ITB- Rigidly Connected Barge (2020)

Another freeboard will be calculated with the tug fixed to the barge in the tug-barge operating mode as though it were a single unit, manned, self-propelled vessel, taking into account all current intact and damage (where applicable) stability requirements.

21.5.4 Greater Freeboard for Rigidly Connected Barge (2020)

The barge will be assigned a freeboard corresponding to the greater freeboard calculated in accordance with 5-3-1/21.5.1 and 5-3-1/21.5.2.

23 Sea Trial (2020)

The sea trials are to be performed to the Surveyor's satisfaction. Depending on the intended operation modes, the following trials are to be carried out independently:

- i)* ATB
 - 1)* Tug only (incl. bollard pull testing)
 - 2)* Towing/pushing modes with a fully ballasted barge
- ii)* ITB
 - 1)* As a unit, integral tug/a fully ballasted barge combination only

During the sea trials, the following specific functions, if fitted, are also satisfactorily demonstrated:

- i)* Connection/disconnection of barge, (at calm sea or dockside, where deemed safe by the tug operator)
- ii)* A remote anchor drop system



PART 5

CHAPTER 3 Other Barge Types

SECTION 2 Oil Spill Recovery (2015)

1 General

1.1 Application

While adapting barges for the carriage of recovered oil from a spill poses some potential hazards similar to oil tankers, it is recognized that these barges are not likely to be originally designed to meet all the requirements of oil tankers. In consideration of the intended oil recovery services of these barges, particular attention has been paid to the stability and floatability of the barges in all relevant operating conditions including ballasting, safety against potential fire and explosion during handling, storage and transportation of recovered oil from a spill on moderate sea conditions, structural support of oil recovery equipment during oil recovery operations, and available electrical power supply to oil recovery equipment intended to be used during oil recovery operations. The purpose of this section is to stipulate the minimum requirements for ABS classification ensuring that such barges are suitably designed to carry out oil recovery operations. The Owner assumes the responsibility of operating the barge in a safe manner with suitably trained personnel onboard.

The requirements of these Rules apply to the design, construction, barge's equipment and operation of barges that may be employed occasionally to recover oil having any flash point, from a spill in emergency situations. As such, these barges may be equipped to handle, store and transport recovered oil.

1.3 Classification

1.3.1 Oil Spill Recovery – Standby Class 1

The classification **A1 Barge (OSR-S1)** will be assigned to barges built in compliance with these requirements for recovery of oil of unknown flash points and outfitted for the same in accordance with 5-3-2/5 and 5-3-2/7 and Parts 1 through 4 of these Rules, and approved for oil recovery service at the assigned freeboard.

1.3.2 Oil Spill Recovery – Capability Class 1

The classification **A1 Barge (OSR-C1)** will be assigned to barges built in compliance with these requirements for recovery of oil of unknown flash points but not outfitted for the same in accordance with 5-3-2/9 and Parts 1 through 4 of these Rules, and approved for oil recovery service at the assigned freeboard.

1.3.3 Oil Spill Recovery – Standby Class 2

The classification **A1 Barge (OSR-S2)** will be assigned to barges built in compliance with these requirements for recovery of oil having a flash point exceeding 60°C (140°F) and outfitted for the same in accordance with 5-3-2/11 and Parts 1 through 4 of these Rules, and approved for oil recovery service at the assigned freeboard.

1.3.4 Oil Spill Recovery – Capability Class 2

The classification **A1 Barge (OSR-C2)** will be assigned to barges built in compliance with these requirements for recovery of oil having a flash point exceeding 60°C (140°F) but not outfitted for the same in accordance with 5-3-2/13 and Parts 1 through 4 of these Rules, and approved for oil recovery service at the assigned freeboard.

1.3.5 Selection of Class

It is the responsibility of the Owner to select the class most suitable for the intended service and ensure that the barge is operated in a safe environment with respect to the risk of fire and explosion.

1.3.6 Administration Requirements

Requirements additional to those given in this Section may be imposed by the National Administration with whom the barge is registered or by the Administration within whose territorial jurisdiction the barge is intended to operate.

Approval of structural fire protection, fire extinguishing equipment and/or stability of the barge by a National Administration, in accordance with requirements equivalent to those by class, may be considered as complying with the class requirements provided such approval can be satisfactorily documented.

1.5 Submission of Plans

In addition to the plans required to be submitted by Section 1A-5-4 of the *ABS Rules for Conditions of Classification (Part 1A)* the following additional plans, supporting documents, and calculations are to be submitted in the same manner.

1.5.1 Plans

- i) Plans and particulars of recovered oil tanks indicating access
- ii) Structural and general arrangement plans indicating the location, support and fastening arrangements of oil recovery and handling equipment
- iii) Plan showing arrangement of structural fire protection and location, controls and particulars of fire extinguishing systems and fire safety equipment (see 5-3-2/1.3.6)
- iv) Diagrammatic plans of piping systems for handling recovered oil. These plans are to be accompanied by lists of material giving size, wall thickness, maximum working pressure and material of all pipes and the type, size, pressure rating and material of valves and fittings.
- v) Diagrammatic plans of recovered oil tank venting arrangements including the position of vent outlets
- vi) Diagrammatic plans of recovered oil heating systems, if installed
- vii) Plans showing hazardous locations and electrical equipment in these locations together with a listing of equipment manufacturers and model numbers and evidence of certification for explosion-proof, intrinsically-safe and pressurized equipment. Also, wiring plans, installation instructions and certification agency restrictions for intrinsically-safe systems.
- viii) Plans showing electrical power supply, protection and cabling for oil recovery equipment

- ix) Plans showing hazardous areas and spaces including the arrangement of ventilating systems for all hazardous areas along with complete particulars of the ventilating system such as capacities of fans, number of complete changes of air per hour, air flows, areas subject to positive or negative pressure, and location and direction of opening of self-closing doors.

1.5.2 Supporting Documents

- Detailed specifications for gas detection/measuring equipment
- Detailed Operations and Procedures Manual

1.5.3 Supporting Calculations

- Load analysis of structural support in way of deck equipment during oil recovery operations in at least moderate sea conditions
- Electrical load analysis considering the use of oil recovery equipment during oil recovery operations
- Stability analysis considering all relevant operational conditions including ballasting (see 5-3-2/1.3.6)

1.7 Operating Manual

It is incumbent upon the Owner to provide information, instructions, data and crew training for the oil recovery operations of the barge to help assure that the loadings and operational limits upon which the barge is designed and classification is based are not exceeded. An approved Operating Manual detailing operational and maintenance procedures, equipment and capacity data, and particulars on operation of the barge during oil recovery mode of operations is to be placed aboard the barge for the guidance of the operating personnel. The Operating Manual is to be submitted for review by ABS solely to ensure that the information included within is consistent with the design information and limitations considered in the barge's classification. ABS is not responsible for the operation of the barge. The barge is to be operated during oil recovery mode of operation in accordance with this approved Operating Manual.

The Operating Manual is, in general, to give information regarding the following:

- i) Arrangement and equipment
 - a) Tank arrangement with venting systems
 - b) Recovered oil transfer system
 - c) Gas measuring instruments
 - d) Gas detection systems, if installed
 - e) List of oil response equipment and supplies
- ii) Oil Recovery Operations and Procedures verifying that all equipment installed in hazardous locations and/or transferred onboard are certified for use in gas-hazardous atmosphere (see 5-3-2/7.3.6)
 - a) Instructions regarding the use of non-certified electrical equipment (see 5-3-2/7.3.6)
 - b) Changing-over to low sea suction for all sea water cooling pumps and fire pumps
 - c) Hook-up and equipment deployment
 - d) Tank filling procedures
 - e) Heating of recovered oil, if applicable
 - f) Discharging of recovered oil
 - g) List of spaces and equipment that may be required to be secured

- h)* List of deadlights that may be required to be secured
- i)* Recovered oil piping and venting configuration instructions
- j)* Space specific ventilation requirements
- k)* Storage location and use of portable gas detection/measuring instruments
- l)* Installation of spill coamings
- iii)* Safety Instructions
 - a)* Fire fighting
 - b)* Guidelines regarding safe distance from an oil spill source including specifying conditions when to withdraw the barge from oil recovery operations.
 - c)* Gas measurements during operation (on open deck and in spaces where gas might accumulate)
 - d)* Actions to be taken if gases are detected in enclosed spaces (cleaning, ventilation, emptying of adjacent tanks, etc.)
 - e)* Precautions against overfilling of tanks
- iv)* Cleaning and gas-freeing of tanks and pipes
- v)* Stability in all relevant operational conditions including ballasting guidance

1.9 Tests and Trials

1.9.1 Oil Spill Recovery – Standby

During trials, the transfer procedures to oil recovery mode of operation for the barge are to be simulated demonstrating the barge is suitable for the intended service. The arrangements and equipment referred to in 5-3-2/5 and 5-3-2/7 are to be examined and tested to the satisfaction of the attending Surveyor upon completion of the installation and, thereafter, annually on board the barge.

1.9.2 Oil Spill Recovery – Capability

Upon completion of installation, the arrangements and equipment referred to in 5-3-2/9 are to be examined and tested to the satisfaction of the attending Surveyor. During trials and thereafter annually, the attending Surveyor is to verify the barge is in compliance with the operation manual and general arrangement plan, and in particular:

- i)* Area in which the oil recovery equipment will be installed,
- ii)* Tanks to be used for recovered oil,
- iii)* Designation of hazardous areas, and
- iv)* Oil recovery equipment to be used, its location, and deployment and stowage procedures.

Oil recovery equipment stored ashore is to be maintained by the Operator and be readily available for use.

3 Definitions

The following definitions of terms are to be understood (in the absence of other specifications) where they appear in this Chapter.

3.1 Accommodation Space

Accommodation Spaces are those spaces used for public spaces, corridors, laboratories, cabins, offices, hospitals, game and hobby rooms, pantries containing no cooking appliances, and similar spaces.

3.3 Cargo Area

The *Cargo Area* is that part of the barge that contains recovered oil tanks, slop tanks and recovered oil pump rooms including cofferdams, ballast and void spaces adjacent to recovered oil tanks and also deck areas throughout the entire length and breadth of the part of the barge above the aforementioned spaces.

3.5 Control Station

Control Stations are those spaces in which the barge's radio or main navigation equipment (where applicable) or the emergency source of power is located or where the fire recording or fire control equipment is located.

3.7 Hazardous Areas

Hazardous Areas are areas where flammable or explosive gases or vapors are normally present or likely to be present. The flammable or explosive atmosphere may be expected to exist continuously or intermittently. See 5-3-2/7.9.

Safe areas are areas that are not hazardous areas.

3.9 Machinery Space

Machinery Spaces are those spaces and trunks to such spaces which contain propelling machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, thermal oil heaters, refrigerating, stabilizing, ventilation and air conditioning machinery.

3.11 Machinery Spaces of Category A

Machinery Spaces of Category A are those spaces and trunks to such spaces which contain either:

- i) Internal combustion machinery used for main propulsion or station keeping.
- ii) Internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW (500 hp)
- iii) Any oil-fired boiler or oil fuel unit, or any oil-fired equipment other than boiler, such as inert gas generator, incinerator, waste disposal units, etc.

3.13 Piping

The term *Piping* refers to assemblies of piping components and pipe supports.

3.15 Piping System

Piping System is a network of piping and any associated pumps, designed and assembled to serve a specific purpose. Piping systems interface with, but exclude, major equipment, such as pressure vessels, tanks, diesel engines, turbines, etc.

3.17 Piping Components

Piping Components include pipes, tubes, valves, fittings, flanges, gaskets, bolting, hoses, expansion joints, sight flow glasses, filters, strainers, accumulators, instruments connected to pipes, etc.

3.19 Pipes

Pipes are pressure-tight cylinders used to contain and convey fluids. Where the word 'pipe' is used in this Section, it means pipes conforming to materials and dimensions as indicated in Sections 2-3-12, 2-3-13, 2-3-16 and 2-3-17 of the *ABS Rules for Materials and Welding (Part 2)*, or equivalent national standards such as ASTM, BS, DIN, JIS, etc.

3.21 Pipe Schedule

Pipe Schedules are designations of pipe wall thicknesses as given in American National Standard Institute, ANSI B36.10. Standard and extra heavy (extra strong) pipes, where used in these sections, refer to Schedule 40 and Schedule 80, up to maximum wall thicknesses of 9.5 mm (0.375 in.) and 12.5 mm (0.5 in.), respectively.

3.23 Pump Room

Pump Rooms are those spaces that contain recovered oil transfer pumps, manifolds, separators or any other recovered oil handling equipment.

3.25 Oil

The term *Oil* refers to petroleum or petroleum products having flash points at or below 60°C (140°F), closed cup test, and specific gravity of not over 1.05, except where specifically indicated as oil having a flash point above 60°C (140°F).

3.27 Oil Recovery Operations

The term *Oil Recovery Operations* refers to the process used to contain and remove spilled oil from the sea to storage onboard the barge. The process also includes the removal of the recovered oil from onboard storage to a disposal facility.

3.29 Recovered Oil

Spilled oil that has been removed from the marine environment and includes mixtures of oil and water.

3.31 Service Space

Service Spaces are those spaces used for galleys, pantries containing cooking appliances, lockers, store rooms, workshops other than those forming part of the machinery spaces, and similar spaces and trunks to such spaces.

5 Hull Construction

5.1 General

Oil spill recovery barges are to be constructed of steel.

The barge is to be provided with safe working areas on deck for handling of hoses and oil recovery equipment during oil recovery operations. Working areas are to be provided with adequate lighting, hand-rails and gratings or other non-slip surfaces.

The barge is to be provided with storage tanks for recovered oil. Tanks used for the storage of liquid mud may be used for the storage of recovered oil. The coating used in recovered oil storage tanks is to be of an oil and dispersion resistant type.

The barge is to be arranged such that from the main control station visibility is to easily permit the monitoring of the oil recovery operations on deck and in the water. Alternatively, special consideration will be given to systems providing equivalent visibility and safe monitoring of the recovery operations.

5.3 Tank Arrangement

5.3.1 Location and Separation of Recovered Oil Tanks

5.3.1(a) General.

Oil spill recovery barges are not required to have double hulls.

Where double bottoms are fitted to comply with any applicable regulation or other purposes, they are to be fitted between the peaks or as near thereto as practicable. The double bottom is to be in accordance with 5-2-2/3.

Where wing tanks are located at a distance inboard of the molded line of the side shell plating, this distance is to be nowhere less than 600 mm (24 in.) to permit easy access for inspection.

The minimum size of the access openings to the double bottoms and wing tanks, where fitted, is to be at least 380 mm × 585 mm (15 in. × 23 in.) and circular openings to be at least 457 mm (18 in.).

5.3.1(b) Separation of Recovered Oil Tanks

- i)* Tanks for recovered oil are not to be located below machinery spaces, service spaces, control stations and accommodation spaces.
- ii)* Tanks for recovered oil may be located forward or aft of machinery spaces, service spaces, control stations and accommodation spaces. Recovered oil tanks are to be isolated from such spaces by means of a cofferdam. For the purposes of this requirement, void spaces, pump rooms, fuel oil tanks and compartments arranged solely for ballast may be considered cofferdams. For easy access, the minimum width of the cofferdam is not to be less than 600 mm (24 in.).
- iii)* Where it is impractical to meet the cofferdam requirement in *ii)* above, considerations may be granted in the case of other machinery spaces (See Note below). A cofferdam will not be required between the recovered oil tanks and other machinery spaces, provided the following items are met:
 - a)* The bulkhead plating/tank side wall is to be continuous through all joining structures to the top of the tank. Full penetration welding is required at the top of the tank and the contiguous boundaries.
 - b)* The common tank bulkhead/tank side wall is to be readily accessible under normal conditions for inspection.
 - c)* The machinery space adjacent to the recovered oil tanks is to be provided with forced power ventilation system as follows:
 - At least twenty (20) air changes per hour, based on the gross volume of the space
 - The system is to be operated at all times whenever recovered oil is carried in the tanks. This is to be clearly indicated in the Operating Manual.
 - The ventilation system is to be designed and arranged with redundancy such that at least 100% ventilation system is still available after a single failure in any part of the system.
 - Fitted with alarms to indicate ventilation failure
 - Fitted with non-sparking fans either with the uncertified motor outside of the ventilation duct or with a certified explosion proof motor located within the duct
 - d)* No penetrations that create a source of hazardous vapor or oil release are allowed through the common tank boundary bulkhead. Sources of hazardous vapor or oil include any openings, screwed and flanged pipe connections, valves, pumps, stuffing boxes, etc. All welded pipe connections are not considered sources of hazardous vapor or oil.
 - e)* The tanks are to be hydrostatically tested at the Special Surveys.

f) The common tank bulkhead is to be gauged at Intermediate and Special Surveys.

Note:

5-3-2/5.3.1(b).iii above does not apply to Machinery Spaces of Category A, service spaces, control stations or accommodation spaces. Recovered oil tanks are to be isolated from such spaces by means of a cofferdam.

5.3.2 Location of Recovered Oil Tank Openings

Openings from recovered oil storage tanks including sounding pipes, vents and hatches are not to be located in enclosed spaces. For the purposes of this requirement, spaces open on one side only are to be considered enclosed.

5.3.3 Penetration of Recovered Oil Tanks

Electrical cables are not to pass through recovered oil tanks unless enclosed within an oil tight trunk or equivalent.

Piping not related to the transfer of recovered oil is not to pass through recovered oil tanks unless the piping is made of steel, Extra-Heavy (see 5-3-2/3.21) and of all welded construction, without valves, flanges, fittings or take-down joints.

5.5 Structural Fire Protection

5.5.1 Fire Integrity of Exterior Bulkheads

For superstructures and deck houses enclosing accommodation and machinery spaces, the exterior bulkheads facing the cargo area and side bulkheads within a distance of 3 m (10 ft) from the end bulkhead facing the cargo area are to be of steel construction and insulated, up to the underside of the deck of the navigation bridge, to “A-60” standard as defined in Chapter II-2/Regulation 3 of the International Convention for the Safety of Life at Sea (SOLAS) 1974, as amended with the exception of the following:

- i) Insulation to “A-0” standard is acceptable provided the bulkheads are protected by a fixed water-spray system in accordance with 5-3-2/5.7 with a minimum water capacity of 10 liters/minute/m² (0.25 gpm/ft²).
- ii) Insulation to “A-0” standard is acceptable without a water-spray system provided the bulkheads are at least one deck above the cargo area and are at least 10 meters (33 ft) measured horizontally away from a vertical plane of the recovered oil tanks and sources of oil or vapor release (such as tank vents, valves, flanges, and fittings).

Access doors, windows, portlights and closing appliances for openings are to meet the same requirements as the bulkhead.

5.7 Fixed Water Spray System

Barges outfitted in accordance with 5-3-2/5.5.1.i are to be provided with a permanently installed water-spray system. The water-spray system is to provide protection for exterior superstructure and deck house bulkheads facing the cargo area and side bulkheads within a distance of 3 m (10 ft) from the end bulkhead facing the cargo area. All water-spray system piping, valves and nozzles are to be suitably protected from damage during firefighting operations.

5.7.1 Spray System Pumps

Spray system pumping capacity is to be sufficient to insure a supply pressure and volume for adequate operation of the water-spray system.

5.7.2 Maintenance

Water-spray systems are to be protected from corrosion. Drainage arrangements are to be provided to protect against freezing water damage. Deck scuppers and freeing ports are to be provided to assure efficient drainage of water from deck surfaces when the water-spray system is in operation.

5.9 Openings in Exterior Bulkheads

5.9.1 Accommodation Spaces, Service Spaces, Control Spaces, and Machinery Spaces

- i)* Accesses, including those in the first tier on the main deck, to accommodation spaces, service spaces, control stations and machinery spaces may face the cargo area and/or be located within the limits of 5-3-2/5.5.1 provided they are fitted with two doors, such that the door in the exterior bulkhead is weathertight and has a fire rating equivalent to the boundary in which it is installed and the interior door is self-closing, gastight, with no hold-back devices. The doors are to be spaced apart at least a distance that prevents an individual from opening both doors simultaneously. A notice is to be affixed to each side of each door to the effect that only one door is to be open at a time. Where the double door arrangement is located in a hazardous area, the hazardous area and ventilation requirements for an air lock apply. See 5-3-2/7.11.3.
- ii)* Access doors, air inlets and openings to accommodation spaces, service spaces, control stations and machinery spaces may face the cargo area and/or be located within the limits of 5-3-2/5.5.1 provided they are located at least one deck above the cargo area and are at least 3 meters (10 feet) measured horizontally away from a vertical plane of the recovered oil tanks and sources of oil or vapor release.
- iii)* Navigation bridge doors and windows may face the cargo area and/or be located within the limits of 5-3-2/5.5.1 provided they are capable of rapidly and efficiently being made gas tight.

5.9.2 Accesses and Openings Not Needed During Oil Recovery Operations

Accesses and ventilation openings for spaces containing essential equipment are to be available for use at all times. However, accesses and openings not needed during oil recovery operations may be within the limits of 5-3-2/5.5.1 provided the arrangements comply with the following:

- i)* Access doors are self-closing gas-tight, secured (i.e., kept closed), and fitted with signs indicating that the doors are to remain closed during oil recovery operations. In addition, the doors are to have a fire rating equivalent to the boundary in which they are installed.
- ii)* All access and means of escape otherwise required by the Rules are met without the use of the secured access doors.
- iii)* Closing devices for openings other than access doors are gas-tight, secured (i.e., kept closed), and fitted with signs indicating that the openings are to remain closed during oil recovery operations. In addition, the closing devices are to have a fire rating equivalent to the boundary in which they are installed.
- iv)* The oil recovery operating manual is to clearly indicate the procedure necessary to secure the accesses, openings, and/or the space. Also, see 5-3-2/7.3.6.

5.9.3 Other Spaces and Locations

- i)* Portlights and windows fitted in locations other than the navigation bridge may face the cargo area and/or be located within the limits of 5-3-2/5.5.1 provided they are of the fixed (non-opening) type. They are to be fitted with deadlights constructed of steel or other equivalent material, which must be secured during oil recovery operations.
- ii)* Bolted plates for the removal of machinery may face the cargo area and/or be fitted within the limits of 5-3-2/5.5.1.

5.9.4 Hazardous Areas and Ventilation

See 5-3-2/7.9 and 5-3-2/7.11 for hazardous area requirements and 5-3-2/7.13 for ventilation opening requirements which are to be applied independently of 5-3-2/5.9.

5.11 Spill Coaming

Oil handling areas and equipment on deck are to be provided with a coaming around all pumps, transfer flanges and other connections where leakage may be expected. Each coaming is to be adequately sized to contain deck spills and prevent recovered oil from entering accommodation, machinery, control and service spaces or passing overboard. The coaming is to have a height of at least 150 mm (6 in.).

Where drains are provided for the coaming, closing devices for these drains are to be permanently attached.

Spill coamings may be of the removable type. Removable coamings are to be constructed of rigid, non oil-absorbent material, leak proof, and can be temporarily fixed to the barge's structure.

7 Machinery Equipment and Systems

7.1 General

Machinery, equipment, electrical systems, piping and firefighting systems for oil spill recovery barges are to be in accordance with Part 4 of these Rules and the following additional requirements.

Oil recovery equipment and independent power-packages are to be permanently installed or stored on board the barge ready to be installed for use.

7.3 Machinery and Equipment Installation

7.3.1 Exhausts and Intakes

For machinery and equipment exhausts and intakes, refer to 5-3-2/7.15.

7.3.2 Pipes in Hazardous Areas

Exhaust pipes or any other pipes with surface temperatures exceeding 220°C (428°F) are not to pass through gas hazardous areas.

7.3.3 Pipes and Cables in Recovered Oil Tanks

For piping or cables which pass through tanks for recovered oil, refer to 5-3-2/5.3.3.

7.3.4 Propulsion or Station Keeping Shafting

Where fitted, propulsion or station keeping shafting is not to be led through recovered oil storage tanks and is to be effectively grounded.

7.3.5 Non-permanent Equipment

7.3.5(a) Power Supply.

The arrangement of power supply to non-permanent oil skimming and pumping equipment is as far as practicable to be permanently installed. Power outlets are to be arranged from a connection box provided with a means to prevent disconnection of the portable cable unless power has been removed from the cable (i.e., a door with interlock switch). The supply from the main switchboard to the connection box is to be permanently installed and provided with a separate switchgear with short-circuit and overcurrent protection. These boxes are to be located at easily accessible locations outside of hazardous areas and in such a manner that portable cables are not carried through doors or portlights leading from the working deck area to machinery or accommodation spaces.

7.3.5(b) Oil Recovery Equipment.

Non-permanent oil recovery equipment and independent power-packages are to be of the certified safe type and suitable for use in hazardous areas.

7.3.6 Electrical Equipment Not Intended To Be Used During Oil Recovery Operations

Electrical equipment located in hazardous locations that is not intended to be used during oil recovery operations and does not meet 4-1-3/11 (for example, equipment not certified intrinsically safe, pressurized enclosure, or explosion proof) may be permitted, provided the location is considered hazardous only during oil recovery operations and the arrangements meet the following requirements.

- i)* The electrical equipment is considered nonessential (see 4-8-1/7.3.3 of the *Marine Vessel Rules* for primary essential and secondary essential services) and is not to be used during oil recovery operations.
- ii)* A detailed list of such equipment in each hazardous area is to be submitted for review.
- iii)* The electrical equipment as submitted for review in item *ii)* above is to be arranged so that it cannot be energized when any oil recovery equipment is energized. Once de-energized, specific action by the crew is required to reenergize the equipment. Instruction plates are to be placed at the respective switches.
- iv)* The oil recovery Operating Manual is to clearly indicate the following:
 - a)* The systems that are de-energized during oil recovery operations and the procedure to be followed.
 - b)* The instructions and procedures to be followed relative to the cleaning and gas freeing of the oil recovery tanks in order to reset the electrical equipment to its original state after oil recovery operations are completed.

7.3.7 Mechanical Equipment in Hazardous Areas

All mechanical equipment for use in hazardous areas during oil recovery operations is to be certified for operation in gas-hazardous atmosphere (see 5-3-2/7.15).

7.3.8 Lifting Appliances on Deck and Supports for Oil Recovery Equipment

Lifting appliances such as masts and cranes intended to be used during oil recovery operations are to be designed and constructed to an acceptable standard, code of practice or satisfy, but need not be certified to, the applicable requirements of the *ABS Guide for Certification of Lifting Appliances (Lifting Appliances Guide)*, in addition to the following:

- i)* The dynamic loads due to the barge's motions are to be considered.
- ii)* The scantlings of the supporting structures for lifting appliances are to comply with 5-3-3/5.7.
- iii)* The calculations for the strength of the supporting structures of lifting appliances for oil recovery equipment may be carried out assuming the oil recovery operations are being conducted in moderate sea conditions.

7.5 Recovered Oil Piping Systems

7.5.1 General

A fixed recovered oil transfer system is to be provided and arranged to permit simultaneous filling and discharging operations. Piping may consist of movable pipe sections with suitable flanged connections.

Piping connections of systems not related to the oil recovery operations are to be provided with spool piece and blanking arrangements. The blanking devices are to be fitted to the nearest detachable pipe connections at the tank.

7.5.2 Recovered Oil Pumps

Recovered oil pumps are to be so designed as to minimize the danger of sparking. Care is to be taken in installation of the pumps to prevent leaks at the stuffing box. Where the shafts pass through gastight bulkheads, flexible couplings are to be provided in shafts between pumps and prime movers, and stuffing boxes which can be lubricated from outside the pump room are to be fitted at the bulkheads. The seal parts of the glands are to be of non-sparking construction. If a bellows piece is incorporated in the design, it is to be pressure tested before being fitted.

7.5.3 Relief Valves

A relief valve of suitable type is to be installed in the discharge of each recovered oil pump and piped back to the suction. Such valves need not be fitted when the system is served only by centrifugal pumps so designed that the pressure delivered cannot exceed that for which the piping is designed.

7.5.4 Pressure Gauges

One pressure gauge for each recovered oil transfer pump is to be located at the pump discharge and, where the pumps are operated by engines external to the pump room, additional gauges are to be provided which are to be visible from the operating station.

7.5.5 Piping in Machinery Spaces

Recovered oil transfer systems are not to pass through machinery spaces except for runs of steel, Extra-Heavy (see 5-3-2/3.21), all welded pipe which are to be provided with a positive closing valve, located outside the machinery space and operable from an accessible location on the open deck, to stop the flow of oil in the event of a fire or leak.

Recovered oil piping system components, such as pumps, manifolds, valves, flanges, slip-joints and other sources of vapor leakage are not to be located within machinery spaces.

7.5.6 Piping in Fuel Oil Tanks

Recovered oil piping is not to pass through fuel oil tanks unless it is steel, Extra-Heavy (see 5-3-2/3.21), all welded pipe without valves, flanges, fittings, or take-down joints.

7.5.7 Piping in Ballast Tanks

Recovered oil piping passing through ballast tanks is to be made of steel, Extra-Heavy (see 5-3-2/3.21) and all welded pipe; special consideration will be given to ferrous materials having corrosion resistant properties. Provisions are to be made for expansion of the piping within the tank.

7.5.8 Bow or Stern Discharge

Where bow or stern discharge connections are provided, cargo lines forward or aft of the cargo area are to be led outside accommodation spaces, service spaces, machinery spaces and control stations. Pipe joints outside the cargo area are to be welded except for connections to the manifold or equipment.

The cargo discharge lines are to be clearly identified and provided with means to segregate them from the cargo main line when not in use. The segregation is to be achieved by either two valves, located in the cargo area, which can be locked in the closed position, and fitted with means to detect leakage past the valves; or by one valve together with another closing device providing an equivalent standard of segregation, such as a removable spool piece or spectacle flange.

The discharge connection is to be fitted with a shut-off valve and a blank flange. The blank flange may be omitted if an equivalent means of closing is incorporated in the connection to the hose coupling.

Arrangements are to be provided for cargo lines outside the cargo area for easy draining to a slop tank or cargo tank and for cleaning and inerting. Spill containment is to be provided under the discharge manifolds. The space within 3 m (10 ft) of the manifold and oil spill containment boundary is to be considered as a hazardous area zone 1 with regard to electrical equipment or other sources of vapor ignition. See 5-3-2/7.9.2(b).vi.

7.7 Recovered Oil Tank Venting Systems

7.7.1 General

Each recovered oil storage tank is to be fitted with a pressure-vacuum type relief valve, or a suitably sized vent pipe is to be led from each tank into a common header fitted with an approved flame arrestor or pressure-vacuum relief valve at the outlet to the atmosphere. Means are to be provided to prevent any tank from being subjected to excessive pressure during any phase of the recovered oil handling process. Vent outlets are to direct gases upwards.

7.7.2 Height

Where the vent pipes from two or more tanks are led into a common header, the outlet from the header is to be located a minimum height of 2 m (6.6 ft) above the freeboard deck.

7.7.3 Size

The vent pipes, or overflows if fitted, are to be sized for 125% of the maximum loading rate to prevent the pressure in any recovered oil storage tank from exceeding the design pressure; however, the inside diameter (ID) of each vent pipe is to be not less than 63 mm (2.5 in.).

7.7.4 Location

Vent outlets from recovered oil storage tanks are to be located a horizontal distance of greater than 3 m (10 ft) away from openings to accommodation and other gas-safe spaces, ventilation intakes, non-certified safe electrical equipment and other machinery and equipment which may constitute an ignition hazard. See 5-3-2/7.9.2(b).iii.

7.7.5 Portable Vent Pipes

Portable vent pipes, intended for use during oil spill recovery operations only, are acceptable provided the vent pipe, vent and attachment are suitable for the location they are being employed and are stored in a readily accessible location.

7.7.6 Liquid Level Control

Provision is to be made to guard against liquid rising in the venting system to a height that would exceed to design head of the tanks. This may be accomplished by using high level alarms or overflow control systems or other equivalent means, together with gauging devices and tank filling procedures.

7.9 Hazardous Areas

7.9.1 Definitions

7.9.1(a) Hazardous Areas.

Hazardous areas are all those areas where a flammable atmosphere may be expected to exist continuously or intermittently. Hazardous areas are subdivided into Zones 0, 1, 2, defined as follows:

- *Zone 0* A zone in which ignitable concentrations of flammable gases or vapors are continuously present or present for long periods.

- *Zone 1* A zone in which ignitable concentrations of flammable gases or vapors are likely to occur in normal operating conditions.
- *Zone 2* A zone in which ignitable concentrations of flammable gases or vapors are not likely to occur, and if it occurs, it will exist only for a short time.

7.9.1(b) Enclosed Space.

An enclosed space is considered to be a space bounded by decks and bulkheads which may or may not have doors, windows or other similar openings.

7.9.1(c) Semi-Enclosed Space.

A semi-enclosed location is considered to be a location where natural conditions of ventilation are notably different from those on open decks due to the presence of structure such as roofs, windbreaks and bulkheads and which are arranged so that the dispersion of gas may not occur.

7.9.2 Classification of Areas

The following hazardous areas are those which normally apply to barges engaged in oil recovery operations.

7.9.2(a) Hazardous Areas Zone 0.

Hazardous Areas Zone 0 include:

- i)* The internal space of recovered oil tanks and pipes including the venting arrangements of the recovered oil tanks.
- ii)* Equipment containing recovered oil.
- iii)* Cofferdams and voids adjacent to recovered oil tanks, containing recovered oil pipe flanges, valves, or other sources of release.

7.9.2(b) Hazardous Areas Zone 1.

Hazardous Areas Zone 1 include:

- i)* Recovered oil pump rooms, spaces in which oil contaminated equipment for handling the recovered oil is located, and oil handling areas.
- ii)* Enclosed or semi-enclosed spaces in which recovered oil pipe flanges, valves, or other sources of release are located.
- iii)* Areas on the open deck within a 3 meter (10 ft) radius of any recovered oil tank opening, recovered oil tank vent, recovered oil pipe flange or valve.
- iv)* Areas on the open deck within a 3 meter (10 ft) radius of any entrance or ventilation opening to any hazardous area Zone 1 space.
- v)* Areas on the open deck within a 3 meter (10 ft) radius of any oil recovery equipment. Equipment includes but is not limited to skimmers, containment booms and reels, and separators.
- vi)* Areas on open deck within spillage coaming surrounding oil recovery manifold valves and 3 m (10 ft) beyond the coaming up to a height of 2.4 m (8 ft) above the deck.

7.9.2(c) Hazardous Areas Zone 2.

Hazardous Areas Zone 2 include:

- i)* Except machinery spaces that comply with 5-3-2/5.3.1, enclosed spaces immediately adjacent to recovered oil tanks in any direction, not containing recovered oil pipe flanges, valves, or other sources of release.
- ii)* Enclosed or semi-enclosed spaces having a direct access or opening to any hazardous area.

- iii)* Air lock spaces between Zone 1 and non-hazardous space, in accordance with 5-3-2/7.11.3(a).
- iv)* Areas on the open deck within 1.5 m (5 ft) radius of any entrance or ventilation opening to any hazardous area Zone 2 space excluding tanks adjacent to recovered oil tanks not containing recovered oil pipe flanges, valves, or other sources of release.

7.11 Openings, Access, and Ventilation Conditions Affecting the Extent of Hazardous Zones

Air inlets and openings to accommodation spaces, service spaces, control stations and machinery spaces are not to be located in hazardous areas.

Except for operational reasons, access doors are not to be provided between a non-hazardous space and a hazardous zone, nor between a Zone 2 space and a Zone 1 space.

Where such access doors are provided, any enclosed space not referred to under 5-3-2/7.9.2(b) or 5-3-2/7.9.2(c) and having a direct access to any Zone 1 location or Zone 2 location becomes the same zone as the location, except as noted below:

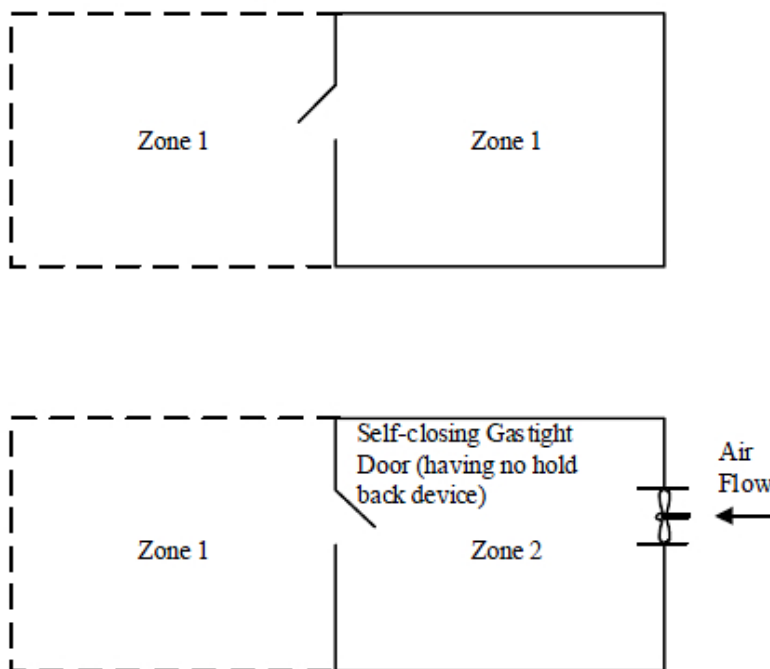
7.11.1 Enclosed Space with Direct Access to any Zone 1 Location

An enclosed space with direct access to any Zone 1 location is considered as Zone 2, provided: (see also 5-3-2/7.11.1 FIGURE 1):

- i)* The access is fitted with a self-closing gas-tight door (see 5-3-2/7.11.4) opening into the Zone 2 space,
- ii)* Ventilation is such that the air flow with the door open is from the Zone 2 space into the Zone 1 location, and
- iii)* Loss of ventilation is alarmed at a normally manned station. See 5-3-2/7.13.5.

FIGURE 1
Hazardous Zones (2015)

Broken lines represent open, semi-enclosed, or enclosed zone.



Note: Loss of ventilation is to be alarmed at a normally manned station

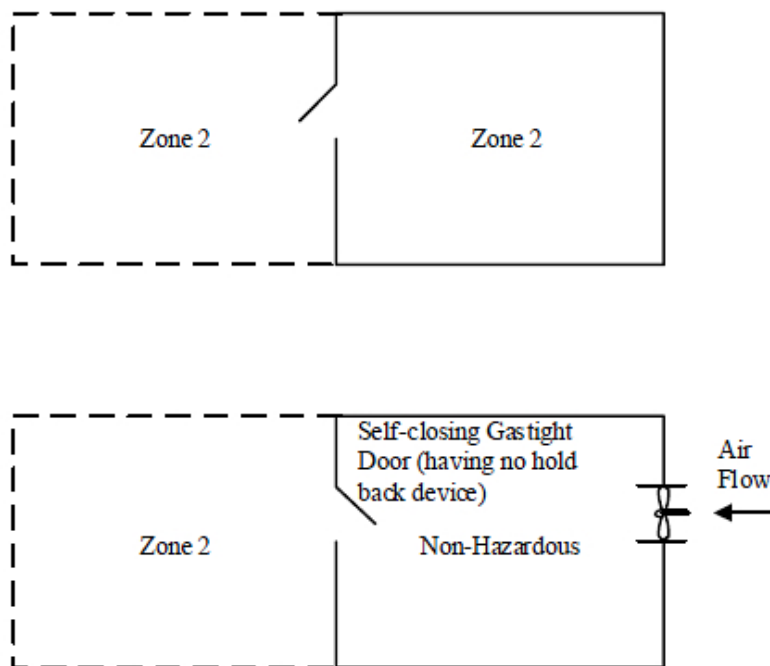
7.11.2 Enclosed Space with Direct Access to any Zone 2 Location

An enclosed space with direct access to any Zone 2 location is not considered hazardous, provided (see also 5-3-2/7.11.2 FIGURE 2):

- i)* The access is fitted with self-closing gas-tight door (see 5-3-2/7.11.4) that opens into the non-hazardous space,
- ii)* Ventilation is such that the air flow with the door open is from the non-hazardous space into the Zone 2 locations, and
- iii)* Loss of ventilation is alarmed at a normally manned station. See 5-3-2/7.13.5.

FIGURE 2
Hazardous Zones (2015)

Broken lines represent open, semi-enclosed, or enclosed zone.



Note: Loss of ventilation is to be alarmed at a normally manned station

7.11.3 Enclosed Space with Access to any Zone 1 Location

An enclosed space with access to any Zone 1 location is not considered hazardous, provided the access is through either arrangement described below (see also 5-3-2/7.11.3 FIGURE 3):

7.11.3(a) Air Lock

- i) The access is fitted with two self-closing doors forming an air lock, which open toward the nonhazardous space and has no hold-back devices,
- ii) The doors are spaced apart at least a distance that prevents an individual from opening both doors simultaneously with a notice affixed to each side of each door to the effect that only one door is to be open at a time,
- iii) An audible and visual alarm system to give a warning on both sides of the air lock is provided to indicate if more than one door is moved from the closed position,
- iv) Ventilation is such that the non-hazardous space has ventilation overpressure greater than 25 Pa (0.25 mbar) in relation to the Zone 1 location,
- v) The air lock space has independent mechanical ventilation from a gas-safe area such that, with any of the air lock doors open, the air flow is from the less hazardous space to the more hazardous space or area,
- vi) The air lock space is fitted with gas detection, and
- vii) Loss of ventilation overpressure between the non-hazardous space and the Zone 1 location and loss of ventilation in the air lock space are alarmed at a normally manned station. See 5-3-2/7.13.5.

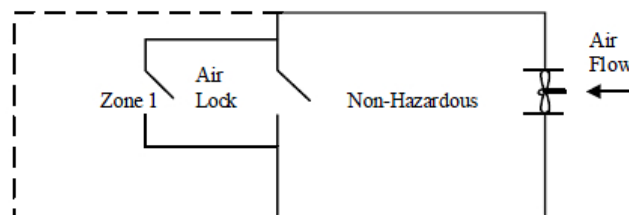
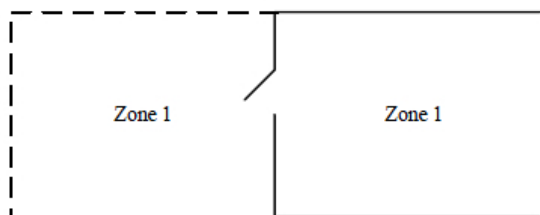
7.11.3(b) Single Door

- i) The access is fitted with a single self-closing, gas-tight door which opens toward the nonhazardous space and has no hold-back device,

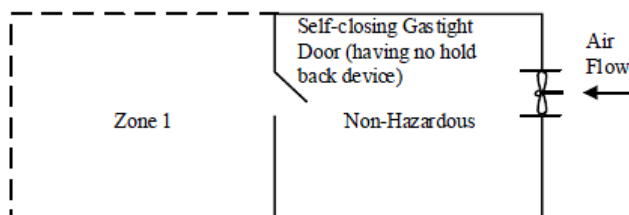
- ii) Ventilation is such that the air flow with the door open is from the non-hazardous space into the Zone 1 location with overpressure greater than 25 Pa (i.e., non-hazardous space has ventilation overpressure greater than 25 Pa (0.25 mbar) in relation to the Zone 1 location), and
- iii) Loss of ventilation overpressure is alarmed at a normally manned station. See 5-3-2/7.13.5.

FIGURE 3
Hazardous Zones (2015)

Broken lines represent open, semi-enclosed, or enclosed zone.



Note: Loss of ventilation overpressure is to be alarmed at a normally manned station. Alarms set to a minimum overpressure of 25 Pa (0.25 mbar) with respect to the adjacent Zone 1 location. See 5-3-2/7.13.5.



Note: Loss of ventilation overpressure is to be alarmed at a normally manned station. Alarms set to a minimum overpressure of 25 Pa (0.25 mbar) with respect to the adjacent Zone 1 location. See 5-3-2/7.13.5.

7.11.4 Hold-back Devices

Hold-back devices are not to be used on self-closing gas-tight doors forming hazardous area boundaries.

7.13 Ventilation Systems

7.13.1 General

Ventilation systems for gas hazardous areas and safe areas are to be independent of each other. Ventilation inlets are to be located in a safe area on the open deck and as far away from gas hazardous areas as practicable. The air outlet is generally to be located in a safe area on the open deck.

7.13.2 Pump Room Ventilation

Recovered oil pump rooms are to have a mechanical ventilating system capable of providing at least twenty air changes per hour based on the gross volume of the space. The system is to have a mechanical exhaust, natural or mechanical supply, and ducting as required to effectively purge all areas of the space. Fan motors are to be located outside the space and outside the ventilation ducts. Fans are to be of non-sparking construction in accordance with 4-8-3/11 of the *Marine Vessel Rules*. Provision is to be made for immediate shutdown of the fan motors upon release of the fire extinguishing medium.

7.13.3 Ventilation of Other Hazardous Areas

In general, enclosed hazardous spaces are to be provided with adequate ventilation so as to maintain them at a lower pressure than less hazardous zones. The arrangement of ventilation inlet

and outlet openings in the space is to be such that the entire space is efficiently ventilated, giving special consideration to locations where gas may accumulate.

Enclosed hazardous areas (other than tanks and cofferdams) which do not contain sources for vapor leakage such as pumps, manifold, flanges or valves for recovered oil systems are to have a mechanical ventilating system capable of providing at least eight air changes per hour based on the gross volume of the space. The system is to have a mechanical exhaust, natural or mechanical supply, and ducting as required to effectively purge all areas of the space. Construction and location of fan motors are to be as required by 5-3-2/7.13.2.

7.13.4 Ventilation of Non-hazardous Areas

Ventilation inlets and outlets for non-hazardous spaces are to be located in non-hazardous areas. Where passing through hazardous areas, ducts are to be constructed in a manner to avoid air leaks and are to have overpressure in relation to the hazardous area.

7.13.5 Ventilation Alarms

The alarms to indicate failure of the mechanical ventilation as required by 5-3-2/7.11.1.iii and 5-3-2/7.11.2.iii are to provide audible and visual signals at the designated normally manned station. The initiation of these alarms by a fan motor running or fan rotation monitoring device is not acceptable.

The alarms to indicate loss of ventilation overpressure as required by 5-3-2/7.11.3(a).iii and 5-3-2/7.11.3 are to be set to a minimum overpressure of 25 Pa (0.25 mbar) with respect to the adjacent Zone 1 location. A differential pressure monitoring device or a flow monitoring device may be used for the initiation of the alarm. When a flow monitoring device is used and a single self-closing gas-tight door is fitted, the minimum overpressure is to be maintained with the door fully open without setting off the alarm, or alternatively, an alarm is to be given if the door is not closed. The initiation by a fan motor running or fan rotation monitoring device is not acceptable.

7.15 Machinery Installations in Hazardous Areas

Electrical equipment and wiring in hazardous areas is to be in accordance with 5-3-2/7.3.6 of these Rules and 4-8-4/27 of the *Marine Vessel Rules*.

Internal combustion engines are not to be installed in Zone 0 hazardous areas. When essential for operational purposes, internal combustion engines may be installed in Zone 1 and 2 hazardous areas. Such installations will be subject to special consideration. Fired boilers are not to be installed in hazardous areas.

Exhaust outlets of internal combustion engines and boilers are to discharge outside of all hazardous areas. Air intakes are to be located not less than 3 m (10 ft) from hazardous areas. Exhaust outlets of internal combustion engines are to be fitted with suitable spark-arresting devices, and exhaust piping insulation is to be protected against possible oil absorption in areas or spaces where the exhausting piping is exposed to oil or oil vapors.

The outlets of vent pipes from internal-combustion engine crankcases are to discharge outside of all hazardous areas.

7.17 Fire Extinguishing Systems and Equipment

7.17.1 Deck Area

The following firefighting equipment is to be provided for protection of the operating deck area.

7.17.1(a) Fire Extinguishers.

Two dry powder fire extinguishers, each with a capacity of at least 50 kg (110 lb), are to be provided. The fire extinguishers are to be located in the vicinity of the deck area where the

equipment for handling of recovered oil is located and are to be fitted with hoses of adequate length to reach the oil handling equipment.

7.17.1(b) Portable Foam Applicator Units.

Two portable foam applicator units are to be provided. A portable foam applicator unit is to consist of an air-foam nozzle of an inductor type capable of being connected to the fire main by a fire hose together with a portable tank containing at least 20 liters (5 U.S. gallons) of foam-making liquid. The nozzle is to be capable of producing effective foam suitable for extinguishing an oil fire, at the rate of at least 90 m³/hr (3180 ft³/hr). A total of at least eight portable tanks of foam-making liquid are to be supplied on board. In instances where, due to the size of the barge, only one fire hydrant is required to be fitted, the barge need only be provided with one portable foam applicator unit.

7.17.2 Pump Rooms

Recovered oil pump rooms are to be provided with an approved fixed fire extinguishing system controlled from a readily accessible position outside the pump room. See also 5-3-2/7.13.3.

7.17.3 Gas Measuring Instruments

- i) Two portable instruments of an approved type are to be provided onboard the barge for hydrocarbon gas detection/measurements.
- ii) Two portable hydrogen sulfide gas monitoring devices are to be provided onboard the barge.

7.19 Oil Pollution Prevention Measures

Pollution prevention equipment such as oil discharge monitoring and control systems to process oil contaminated water from machinery space bilges are to be appropriate to the barge when engaged in operations other than oil recovery. This is to be in accordance with 4-6-4/5.7 of the *Marine Vessel Rules*.

During oil recovery operations, the oil content of any processed, recovered oil/water mixture discharged overboard is to comply with the requirements of the Administration having oversight of the spill response.

7.21 Other Requirements

7.21.1 Low Sea Suctions

Low sea suction are to be provided for the sea water cooling pumps for the machinery and all fire pumps.

7.21.2 Heating Coils

If installed, heating coils in recovered oil tanks and adjacent tanks are to be provided with means for blanking off. If applicable, the observation tanks for steam heating return lines from recovered oil tanks are to be located as far away from any sources of ignition as possible and adequately ventilated.

9 Oil Spill Recovery – Capability Class 1

9.1 General

Barges that comply with this Subsection and have been designed for oil recovery operations, but the oil recovery equipment has not been installed on board, are eligible for the class notation **⊠ A1Barge (OSR-C1)**.

The requirements of 5-3-2/1 to 5-3-2/7 apply, except as modified below.

9.3 Oil Spill Recovery – Capability

- i)* The area in which the oil recovery equipment will be installed and the tanks to be used for recovered oil are to be defined and marked on the general arrangement plan of the barge.
- ii)* Hazardous areas are to be delineated in accordance with 5-3-2/7.9 based on *i)* above.

9.5 Operating Manual

The operating manual is to reflect the expected list of oil recovery equipment to be used, its location and its deployment and stowage procedures.

9.7 Hull Construction

9.7.1 Recovered Oil Storage Tanks

Tanks primarily used for purposes other than oil recovery (e.g., ballast, fuel oil and fresh water tanks), excluding peak tanks, may be used for the storage of recovered oil during oil recovery operations.

9.7.2 Recovered Oil Storage Tank Openings

Suitable openings to facilitate tank cleaning and gas freeing of the recovered oil storage tanks are to be provided. These openings, together with any openings for the deployment of portable pumps and hoses, are to be located on the open deck.

9.9 Machinery Equipment and Systems

- i)* Use of movable (non-fixed) pipe sections and flexible hoses is permitted in the recovered oil piping system.
- ii)* Oil recovery equipment and independent power-packages may be stored ashore ready to be installed for use.

11 Oil Spill Recovery – Standby Class 2

11.1 General

Barges that comply with this Subsection and have been designed for the recovery of oil having a flash point, at the time of recovery, exceeding 60°C (140°F) are eligible for the class notation **A1 Barge (OSR-S2)**.

The requirements of 5-3-2/1 to 5-3-2/7 apply, except as modified below.

11.3 Plans and Operating Manual

In 5-3-2/1.5 and 5-3-2/1.7, provisions dealing with hazardous areas are not applicable.

The operating manual of 5-3-2/1.7 is to provide information regarding procedures to monitor and record the flash point of the recovered oil. The procedures are to include guidelines specifying conditions when to withdraw the barge from oil recovery operations should the flash point of the recovered oil not exceed 60°C (140°F).

11.5 Hull Construction

11.5.1 Separation of Recovered Oil Tanks

In lieu of 5-3-2/5.3.1(b), the barge is to comply with:

- i)* Tanks forward of a collision bulkhead are not to be arranged for the carriage of recovered oil.
- ii)* As far as practicable, recovered oil tanks are to be located away from the machinery spaces of category A. However, where it is found necessary to locate the recovered oil

tanks adjacent to or inside the machinery spaces of category A, the arrangements are to reduce the area of the tank boundary common with the machinery space of category A to a minimum and comply with the following:

- a) Recovered oil tanks having boundaries common with machinery spaces of category A are not to contain oils having flash point of 60°C (140°F) or less.
- b) At least one of their vertical sides is to be contiguous to the machinery space boundary.
- c) The bottom of the recovered oil tank is not to be so exposed that it will be in direct contact with flame should there be a fire in a Category A machinery space. The recovered oil tank is to extend to the double bottom. Alternatively, the bottom of the recovered oil tank is to be fitted with a cofferdam. The cofferdam is to be fitted with suitable drainage arrangements to prevent accumulation of oil in the event of oil leakage from the tank.
- d) Recovered oil tanks are to be located such that no spillage or leakage therefrom can constitute a hazard by falling on heated surfaces or electrical equipment. If this is not practicable, the latter are to be protected from such spillage or leakage by shields, coamings or trays as appropriate.

11.5.2 Penetration of Recovered Oil Tanks

In lieu of 5-3-2/5.3.3, the barge is to comply with:

- i) Electrical cables are not to pass through recovered oil tanks unless enclosed within an oil tight trunk or equivalent.
- ii) Pipes passing through recovered oil tanks are to be of steel except that other materials may be considered where it is demonstrated that the material is suitable for the intended service.

11.5.3 Structural Fire Protection

The provisions of 5-3-2/5.5 are not applicable.

11.7 Machinery Equipment and Systems

11.7.1 Machinery and Equipment Installation

For 5-3-2/7.3, the provisions of 5-3-2/7.3.1, 5-3-2/7.3.4, 5-3-2/7.3.5(a), and 5-3-2/7.3.8 are applicable. For piping or cables which pass through tanks for recovered oil, refer to 5-3-2/11.5.2.

11.7.2 Recovered Oil Piping Systems

Recovered oil piping systems are to be in accordance with 5-3-2/7.5 except compliance with 5-3-2/7.5.2, 5-3-2/7.5.5, and 5-3-2/7.5.8 is not required. Recovered oil piping systems passing through machinery spaces are to be in accordance with the requirements for fuel oil transfer systems. See 4-6-4/13 of the *Marine Vessel Rules*.

11.7.3 Recovered Oil Tank Venting Systems

A tank venting system complying with 5-3-2/7.7 is to be provided for recovered oil storage tanks. Alternatively, a venting system consisting of individual return-bend vents with corrosion resistant flame screens may be provided. Refer to 4-6-4/9 of the *Marine Vessel Rules*. Provisions of 5-3-2/7.7.5 and 5-3-2/7.7.6 are applicable for a venting system consisting of individual return-bend vents.

11.7.4 Hazardous Areas

The provisions of 5-3-2/7.9 and 5-3-2/7.11 are not applicable.

11.7.5 Ventilation Systems

In lieu of 5-3-2/7.13, recovered oil pump rooms are to have a mechanical ventilating system capable of providing at least eight air changes per hour based on the gross volume of the space. The system is to have a mechanical exhaust, natural or mechanical supply, and ducting as required to effectively purge all areas of the space.

11.7.6 Machinery Installations in Hazardous Areas

The provisions of 5-3-2/7.15 are not applicable.

11.7.7 Fire Extinguishing Systems and Equipment

For 5-3-2/7.17, the provisions of 5-3-2/7.17.1 and 5-3-2/7.17.3 are applicable. The provisions of 5-3-2/7.17.2 are not applicable.

13 Oil Spill Recovery – Capability Class 2

13.1 General

Barges that comply with this Subsection and have been designed for the recovery of oil having a flash point, at the time of recovery, exceeding 60°C (140°F) but the oil recovery equipment has not been installed on board, are eligible for the class notation **A1 Barge (OSR-C2)**.

The requirements of 5-3-2/1 to 5-3-2/7 apply except as modified below.

13.3 Plans and Operating Manual

In 5-3-2/1.5 and 5-3-2/1.7, provisions dealing with hazardous areas are not applicable.

In addition to the provisions of 5-3-2/1.5, the area in which the oil recovery equipment will be installed and the tanks to be used for recovered oil are to be defined and marked on the general arrangement plan of the barge.

The operating manual of 5-3-2/1.7 is to provide information regarding procedures to monitor and record the flash point of the recovered oil. The procedures are to include guidelines specifying conditions when to withdraw the barge from oil recovery operations should the flash point of the recovered oil not exceed 60°C (10°F).

The operating manual of 5-3-2/1.7 is to reflect the expected list of oil recovery equipment to be used, its location and its deployment and stowage procedures.

13.5 Hull Construction

13.5.1 Recovered Oil Storage Tanks

Tanks used primarily for purposes other than oil recovery (e.g., ballast, fuel oil and fresh water tanks), excluding peak tanks, may be used for the storage of recovered oil during oil recovery operations.

13.5.2 Separation of Recovered Oil Tanks

In lieu of 5-3-2/5.3.1(b), the barge is to comply with:

- i)* Tanks forward of a collision bulkhead are not to be arranged for the carriage of recovered oil.
- ii)* As far as practicable, recovered oil tanks are to be located away from the machinery spaces of category A. However, where it is found necessary to locate the recovered oil tanks adjacent to or inside the machinery spaces of category A, the arrangements are to reduce the area of the tank boundary common with the machinery space of category A to a minimum and comply with the following:

- a) Recovered oil tanks having boundaries common with machinery spaces of category A are not to contain oils having flash point of 60°C (140°F) or less.
- b) At least one of their vertical sides is to be contiguous to the machinery space boundary.
- c) The bottom of the recovered oil tank is not to be so exposed that it will be in direct contact with flame should there be a fire in a Category A machinery space. The recovered oil tank is to extend to the double bottom. Alternatively, the bottom of the recovered oil tank is to be fitted with a cofferdam. The cofferdam is to be fitted with suitable drainage arrangements to prevent accumulation of oil in the event of oil leakage from the tank.
- d) Recovered oil tanks are to be located such that no spillage or leakage therefrom can constitute a hazard by falling on heated surfaces or electrical equipment. If this is not practicable, the latter are to be protected from such spillage or leakage by shields, coamings or trays as appropriate.

13.5.3 Location of Recovered Oil Tank Openings

Where 5-3-2/13.5.1 applies, suitable openings to facilitate tank cleaning and gas freeing of the recovered oil storage tanks are to be provided. These openings, together with any openings for the deployment of portable pumps and hoses, are to be located on the open deck.

13.5.4 Penetration of Recovered Oil Tanks

In lieu of 5-3-2/5.3.3, the barge is to comply with:

- i) Electrical cables are not to pass through recovered oil tanks unless enclosed within an oil tight trunk or equivalent.
- ii) Pipes passing through recovered oil tanks are to be of steel except that other materials may be considered where it is demonstrated that the material is suitable for the intended service.

13.5.5 Structural Fire Protection

The provisions of 5-3-2/5.5 are not applicable.

13.7 Machinery Equipment and Systems

13.7.1 Machinery and Equipment Installation

Oil recovery equipment and independent power-packages may be stored ashore ready to be installed for use.

For 5-3-2/7.3, the provisions of 5-3-2/7.3.1, 5-3-2/7.3.4, 5-3-2/7.3.5(a), and 5-3-2/7.3.8 are applicable. For piping or cables which pass through tanks for recovered oil, refer to 5-3-2/13.5.4.

13.7.2 Recovered Oil Piping Systems

Recovered oil piping systems are to be in accordance with 5-3-2/7.5 except compliance with 5-3-2/7.5.2, 5-3-2/7.5.5 and 5-3-2/7.5.8 is not required. Recovered oil piping systems passing through machinery spaces are to be in accordance with the requirements for fuel oil transfer systems. See 4-6-4/13 of the *Marine Vessel Rules*.

Use of movable (non-fixed) pipe sections and flexible hoses is permitted in the recovered oil piping system.

13.7.3 Recovered Oil Tank Venting Systems

A tank venting system complying with 5-3-2/7.7 is to be provided for recovered oil storage tanks. Alternatively, a venting system consisting of individual return-bend vents with corrosion resistant flame screens may be provided. Refer to 4-6-4/9 of the *Marine Vessel Rules*. Provisions of

5-3-2/7.7.5 and 5-3-2/7.7.6 are applicable for a venting system consisting of individual return-bend vents.

13.7.4 Hazardous Areas

The provisions of 5-3-2/7.9 and 5-3-2/7.11 are not applicable.

13.7.5 Ventilation Systems

In lieu of 5-3-2/7.13, recovered oil pump rooms are to have a mechanical ventilating system capable of providing at least eight air changes per hour based on the gross volume of the space. The system is to have a mechanical exhaust, natural or mechanical supply, and ducting as required to effectively purge all areas of the space.

13.7.6 Machinery Installations in Hazardous Areas

The provisions of 5-3-2/7.15 are not applicable.

13.7.7 Fire Extinguishing Systems and Equipment

For 5-3-2/7.17, the provisions of 5-3-2/7.17.1 and 5-3-2/7.17.3 are applicable. The provisions of 5-3-2/7.17.2 are not applicable.

PART 5

CHAPTER 3 Other Barge Types

SECTION 3 Crane Barges (2015)

1 General

1.1 Application

The requirements in this section apply to cranes permanently installed on board the barge and intended for operations other than supply of provisions and maintenance of the barge.

They can be pedestal mounted rotating, heavy lift, gantry, shear leg, stiffleg and “A”-frame type cranes, as defined in 2-1/7.31, 2-1/7.53 and 2-1/7.75 of the *Lifting Appliances Guide*. Other types of cranes will be considered on an individual basis.

These Rules do not apply to crawler cranes on deck barges.

1.3 Scope

The following aspects are covered by the Classification requirements in this Section:

- Hull Structure
- Supporting structures for equipment applied in lifting operations
- Equipment, machinery and installations for lifting operations
- Equipment and machinery for anchoring and mooring related to lifting operations
- Equipment and machinery for barge positioning during lifting operations
- Stability and floatability

1.5 Classification

The notation **A1 BargeCrane CRC** will be assigned to barges equipped with a crane or cranes in accordance with 5-3-3/1.1, built in compliance with these requirements, the *Lifting Appliances Guide* and Parts 1 through 4 of these Rules.

The above notation will be assigned to barges having lifting equipment permanently installed and classified by ABS. Such barges will be distinguished in the *Record* with their assigned notation and information on the lifting capabilities. Lifting systems will be subject to the annual surveys.

Crane barges also fitted with accommodations in support of barge operations are to also comply with Section 5-3-6.

1.7 Submission of Data

In addition to the plans required to be submitted by Section 1A-5-4 of the *ABS Rules for Conditions of Classification (Part 1A)*, the following additional plans, supporting documents, and calculations are to be submitted in the same manner.

1.7.1 Hull Plans

For a list of drawings to be submitted together with the Trim and Stability Booklet for ABS review, refer to 5-3-4/1.5.1.

1.7.2 Crane Plans and Data

- i) General arrangement, assembly plans and description of operating procedure and design service temperature
- ii) Dead, live and dynamic loads. Environmental loads including effects of wind, snow and ice. Load swing caused by non-vertical lifts. Load due to the list and/or trim of the barge or structure.
- iii) Maximum reactions and overturning moments
- iv) Details of the principal structural parts, including crane pedestal, foundation and other crane supporting structure
- v) Welding details and procedures
- vi) Crane capacity rating charts
- vii) Wire rope specifications
- viii) Material specifications
- ix) Details of heave compensation arrangements if applicable
- x) Where applicable, details of swing circle assembly, arrangement of hold-down bolts, size, material, grade and pretensioning together with method used for pretensioning
- xi) Equipment for positioning during lifting operations

1.7.3 Design Analysis

The following calculations are to be submitted:

- i) Calculations demonstrating the adequacy of the barge's stability during lifting operations and transit operations (see also 5-3-3/3)
- ii) Calculations demonstrating adequacy of propulsion power, where required, for the barge to maintain station during lifting operations
- iii) Calculations demonstrating strength of the crane and supporting structures

1.7.4 Additional Data

The following items are also to be submitted:

- i) Plans of the electric installations of the crane
- ii) Diagrams of electrical, hydraulic and pneumatic systems and equipment for power supply and control systems for the cranes
- iii) Assembly plan showing principal dimensions of the crane and limiting positions of its movable parts
- iv) Piping diagrams for ballast and/or anti-heeling systems

1.7.5 Operations Manual

Crane Barges are to be furnished with an operating manual providing guidance on at least the following:

- i) Means of identifying that the Manual is for the subject barge, including principle particulars of the barge
- ii) Loading conditions on which the design of the barge has been based
- iii) There should also be evidence of approved loading and stability conditions on board. These should preferably be included in the operating manual. If they form a separate document, they should be referenced in the operating manual.
- iv) Crane manual for each crane installed on board, see 5-3-3/7
- v) Service Limitations, any scope of operations and/or operational limits as applicable
- vi) Position and application of watertight and weathertight (doors, hatches etc.) closing appliances necessary to meet the Load Line assignment or watertight integrity
- vii) Identification of doors and hatches to be kept closed at sea
- viii) Location of life saving appliances
- ix) Location of emergency escapes
- x) Anchoring/ mooring procedures
- xi) From the aspect of the flag Administration, depending on the Administration to which the barge is flagged, there will also be a need for other items to be included such as a safety plan, firefighting procedures, means of escape, evacuation procedures, operation of life saving appliances, and requirements for safe operation of the barge.

3 Seakeeping

3.1 Stability

3.1.1 General

In addition to the stability criteria required by the barge's flag Administration, each barge is to satisfy the intact stability requirements in 5-3-3/9. Stability calculations and corresponding information for the Master are to be submitted for review and approval. The submission of evidence showing approval by an Administration of stability of the barge for the lifting operations in accordance with a recognized standard may be accepted.

The dynamic load chart for each crane shall be included in the Trim and Stability Booklet and shall be posted at the crane operator's station in the clear view of the crane operator.

3.3 Station Keeping

3.3.1 General

Crane barges are to be capable of maintaining their positions safely during lifting operations. The means to maintain position may be a mooring system with anchors, a dynamic positioning system or combination of both.

3.3.2 Station Keeping with Anchors and Cables

Position mooring with anchors, cables and mooring winches when used to maintain the barge's position during lifting operations, are to comply with the requirements for the class notation[Ⓟ] (see Section 3-4-1 of the *ABS Rules for Building and Classing Mobile Offshore Units*). Safety precautions are to be considered to prevent damaging seabed equipment and installations by anchor deployment, recovery and station keeping.

3.3.3 Dynamic Positioning System

Dynamic positioning systems, when used to maintain the barge's position during heavy lifting operations, are to comply with the requirements for the class notation **DPS-2** or **DPS-3** (see the *ABS Guide for Dynamic Positioning Systems (DPS Guide)*).

Movement of the barge to and from work location and around the work location is to be by tug or towing vessel. Barges with Dynamic Positioning (DP) capability are not to utilize the DP thrusters for movements to or from work locations or for movements around work locations, except that barges complying with the requirement for the class notation **AMS-NP** in accordance with the *Marine Vessel Rules* are permitted short field moves (less than 12 hours in daylight) at the work location. (See 1A-5-2/5.35 of the *ABS Rules for Conditions of Classification (Part 1A)*).

5 Barge Design and Equipment

5.1 Work Deck

5.1.1 Reinforcements

The work deck is to be strengthened for the specified design loads and non-uniform loadings are to be specified. It is recommended that an allowance for corrosion, wear and tear be added on top of the Rule requirement. The strong points, if required, are to be situated, as far as practicable, on crossings of bulkheads and web frames. All deck stiffeners are to be double-continuous welded.

5.1.2 Arrangement

Fuel tanks are not to be located directly under the working decks, where hot works would be carried out, unless a void space, hold, store, cofferdam or water ballast tank forms a separation space between the working deck and fuel tank.

5.1.3 Obstructions

The working deck, as far as possible, is to be kept unobstructed, clear of engine room intakes and exhaust from tank vents and mooring equipment. Tank vents, mooring and deck access provisions are preferably to be grouped in way of the aft deck or boom rest.

5.3 Hull Arrangement and Strength

Where a barge is designed with dual drafts to meet the necessary stability for lifting and higher speed for transit, the barge's scantling calculations are to be carried out for the two draft conditions.

Where sponsons are added to the hull in way of the crane location, sufficient distance between the underside of the sponsons and the waterline is to be maintained to reduce wave-sponson interaction. In any case, the underside of the sponsons is to be strengthened to account of wave-sponson interaction based on Section 3-2-4 requirements.

In crane lifting conditions, the sponsons are to be designed to be immersed, while complying with freeboard requirements, and to avoid emergence of the sponsons out of the water during the operation.

Hogging or sagging effects resulting from the crane's location are to be considered in the hull girder strength calculations. Where the crane is located at barge side, torsional stress conditions are to be taken into account and submitted for review.

The most unfavorable load conditions during lifting operations are to be taken into account, including static and dynamic loads considering environmental conditions.

5.5 Cranes

Any crane permanently installed on board the barge and intended for operations other than supply of provisions and maintenance of the barge is to be certified by ABS in accordance with Chapter 2 of the *Lifting Appliances Guide* or API Spec. 2C.

For the cranes used for subsea lifting, see 5-3-3/11.

5.7 Supporting Structure Design Loads

5.7.1 Acceleration Loads

Barge structures supporting cranes are to be designed considering acceleration loads given below. Acceleration loads need not be combined with normal lifting operation loads of the cranes.

$$P_V = 0.102 * [(x - L/70)]W \text{ kN (tf)}$$

$$= 0.102 * [(x - L/229.7)]W \text{ Lt}$$

$$P_L = P_T = 0.5W$$

where

P_V = vertical force, in kN (tf, Lt)

P_L = longitudinal force, in kN (tf, Lt)

P_T = transverse force, in kN (tf, Lt)

L = length as per 3-1-1/3, in m (ft)

W = supported weight, in kN (tf, Lt)

The value of “ x ” is dependent on the location of the center of gravity of the specific equipment and is to be taken as that given in the table below. The value of “ x ” at intermediate locations is to be determined by interpolation. L is to be measured from AP to forward.

AP & aft of AP	0.1L	0.2L	0.3L~0.6L	0.7L	0.8L	0.9L	FP & forward
$x = 18$	17	16	15	16	17	18	19

Alternatively, accelerations derived from other recognized standards or direct calculations, model tests considering the most severe environmental conditions the barge is expected to encounter may be considered.

5.7.2 Lifting Loads

Maximum expected operational loads are to be applied for calculating scantlings of supporting structure. Lifting loads shall consider a minimum dynamic factor according to the *Lifting Appliances Guide* or one submitted by the crane manufacturer, if that be greater.

5.7.3 Acceptable Stresses (1 July 2017)

Scantlings of structure supporting cranes are to be based on the permissible stresses given below:

$$\text{Normal Stress} = 0.75Y$$

$$\text{Shear Stress} = 0.45Y$$

$$\text{Equivalent stress} = 0.85Y$$

where Y is the specified minimum tensile yield strength or yield point.

In addition, the buckling strength is to be adequate for the above loading.

5.9 Supporting Machinery and Systems

5.9.1 Power System

5.9.1(a) Crane with Self-contained or Independent Power Plant.

Where the crane is fitted with self-contained or independent power plant with the prime mover and its auxiliary systems including the power take-off means and the starting system, the power plant is to be sized such that the minimum required hook velocity can be achieved when lifting the corresponding rated load, taking into account simultaneous operations (hoist, luff, swing) requirements, efficiencies of the power plant and the system components.

Gasoline engines as prime movers are prohibited.

Engine exhausts are to be equipped with spark arrestors and all exhaust systems are to be guarded in areas where contact by personnel in the performance of their normal duties is possible.

Fuel tanks fills and overflows are not to run close to exhausts. Fuel tanks are to be equipped with filler necks and caps designed to prevent fuel contamination from external sources. Removable caps, where fitted, are to be securely tethered to the filler.

5.9.1(b) Cranes Driven by Barge's Power Systems.

Where the crane is driven by barge's power systems, either hydraulic or electric, the barge's main power plant is to be sized with sufficient capacity to operate the crane under the load conditions defined in 5-3-3/5.9.1(a) and arranged to ensure the functioning of all safety equipment and essential services for barge station keeping and floatability keeping are not impaired, jeopardized and degraded.

5.9.2 Heeling and Ballasting Systems

Where heeling systems are provided to counteract the crane's overturning moment, the systems are to be designed to ensure that the barge is capable of withstanding the sudden loss of the hook load in each condition of loading and operation. The free surface effects are to be considered for those tanks which are ballasted. Specific reference may be made to 5-3-3/9.3.

5.9.3 Controls and Communications

5.9.3(a) Controls.

All controls used during the normal crane operating cycle are to be located within easy reach of the operator while at the operator's station.

Control levers for boom hoist, load hoist, swing and boom telescope (when applicable) are to be returned automatically to their center (neutral) positions on release. Control operations and functions are to be clearly marked and easily visible by the operator at the operator's control station.

As appropriate, monitoring is to indicate availability of power, air pressure, hydraulic pressure, motor running and slewing brake mechanism engagement.

Cranes are to be provided with an overload-protection system. Motor running protection is to be provided and is to be set between 100% and 125% of motor rated current.

Provisions are to be made for emergency stop of the crane operations by the operator at the operator's control station.

5.9.3(b) Communications.

Hard-wired communications is to be provided between the crane operator's control station and the barge's station keeping control station.

7 Tests, Trials, and Surveys

7.1 General

To assist in survey, the barge is to be provided with approved crane manuals on board, accessible to the Surveyor, containing full information concerning design standard, operation, erection, dismantling and transportation; all limitations during normal and emergency operations with respect to safe working load, safe working moment, maximum wind, maximum heel and trim, design temperatures and braking systems; all safety devices; diagrams for electrical, hydraulic and pneumatic systems and equipment, materials used in construction, welding procedures and extent of nondestructive testing; guidance on maintenance and periodic inspection.

Installation of the crane, supporting machinery and systems on the barges is to be to the satisfaction of the attending Surveyor.

After each crane has been erected on board, and before it is placed in service, the functional integration tests of the crane systems and load tests are to be conducted in the presence of the Surveyor. A record of these tests and other information concerning initial certification is to be readily available.

Position mooring equipment is to be tested in accordance with the specifications of the owner and in the presence of a Surveyor.

Dynamic positioning systems are to be tested in accordance with Section 7 of the *DPS Guide*.

9 Intact Stability Requirements for Barges Equipped to Lift

9.1 Stability Information

9.1.1 Specific Applicability

This section applies to each barge that:

- i) Is equipped for lifting of cargo or other objects; and
- ii) Has a maximum heeling moment due to hook load greater than or equal to:

$$(0.67)(\Delta)(GM)(F/B) \text{ meter-metric tons (foot-long tons)}$$

where

Δ = displacement of the barge with the hook load included, in metric (long) tons

GM = metacentric height with hook load included, in meters (feet)

F = freeboard to the deck edge amidships, in meters (feet)

B = beam, in meters (feet)

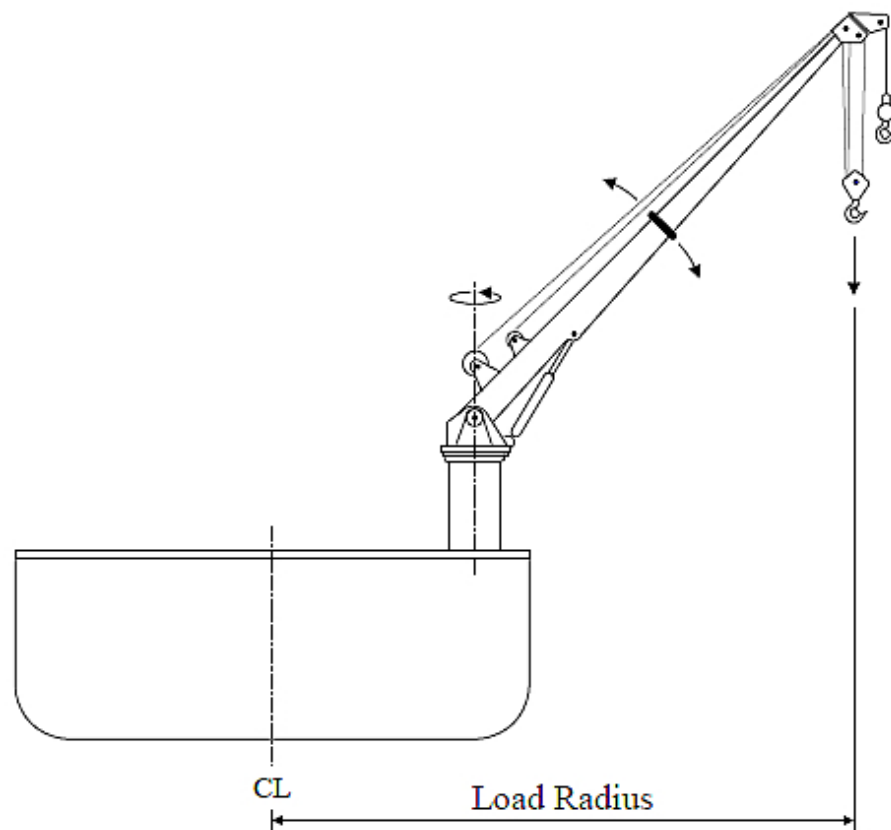
9.1.2 Definition

As used in this Section.

- i) Hook load means the weight of the object lifted by the crane, the weight of all lifting gear beneath the boom point that is not included as part of the crane (i.e., blocks, weight ball, slings, sheaves, etc.) and the weight of the wire rope between the boom tip and lifted object.
- ii) Load radius means the distance illustrated in 5-3-3/9.1.2 FIGURE 1

- iii) Crane Heeling Moment is the maximum heeling moment developed by multiplying the weight of the hook load and boom by the horizontal distance from barge's centerline to the hook load and boom center of gravity, considering the full range of crane elevations and weights. The resulting heeling moment is to be converted to a heeling arm at zero degrees by dividing it by the barge displacement. The heeling arm is to be assumed constant for all heel angles.
- iv) Equilibrium heel angle is the angle of heel under the combined effects of the hook load, counter-ballasting and a beam wind.

FIGURE 1
Load Radius (2015)



9.3 Counter-ballasted and Non-counter-ballasted Barges

9.3.1

Each barge that is equipped to lift is to comply, by design calculations, with this section under the following conditions:

- i) Either for each loading condition and pre-lift condition, or the range of conditions, including pre-lift conditions, delineated by the lifting operations guidelines contained in the trim and stability booklet; and
- ii) Crane Heeling Moment, and
- iii) The effect of beam wind on the projected area of the barge (including deck cargo or equipment) should be evaluated for 25.7 m/s (50 knots) wind speed. Should a lesser wind speed be used, that wind speed shall be listed in the trim and stability booklet as an operational restriction during lifting operations.

The wind heeling moment shall be calculated as:

$$P \times A \times H \text{ N-m (kgf-m, lbf-ft)}$$

where

P = wind pressure, calculated as per below

A = projected lateral area, in square meters (square feet), of all exposed surfaces (including deck cargo), in the upright condition

H = vertical distance, in meters (feet), from the center of A to the center of the underwater lateral area or approximately to the one-half draft point

This wind heeling moment is to remain constant for all heel angles.

$$P = fV_k^2 C_h C_s \text{ N/m}^2 \text{ (kgf/m}^2, \text{ lbf/ft}^2)$$

where

f = 0.611 (0.0623, 0.00338)

V_k = wind velocity in m/s (m/s, knots)

C_s = 1.0, shape coefficient

C_h = height coefficient from 5-3-3/9.3.1 TABLE 1

TABLE 1
Values of (2015)

H (meters)	H (feet)	C_h
0.0–15.3	0–50	1.00
15.3–30.5	50–100	1.10
30.5–46.0	100–150	1.20
46.0–61.0	150–200	1.30
61.0–76.0	200–250	1.37
76.0–91.5	250–300	1.43
91.5 and above	300 and above	1.48

9.3.2 (1 July 2021)

Each barge is to have a righting arm curve with the following characteristics:

- i)* The area under the righting arm curve from the equilibrium heel angle (based upon the wind heeling moment) up to the smallest of the following angles must be at least 0.080 meter-radians (15 foot-degrees):
 - a)* The second intercept
 - b)* The downflooding angle
 - c)* 40 degrees
- ii)* The lowest portion of the weather deck and downflooding point should not be submerged at the equilibrium heel angle.

- iii) The heeling angle based on the crane heeling moment and effect of the beam wind shall not exceed the maximum heel angle from the crane manufacturer.

The righting arm curve is to be corrected for the increase in the vertical center of gravity due to the lifting operation. (The increase in the VCG is due to the boom being in the elevated position, and the hook load acting at the elevated end of the boom.)

For lifting operations conducted under environmental and operational limitations, stability criteria in 2.9.4 of Resolution MSC.415(97) Amendments to Part B of the 2008 IS Code is to be complied with.

9.3.3 Additional Intact Stability Standards – Counter-ballasted Barges (1 July 2021)

The following recommended criteria are based on crane operations taking place in favorable weather conditions. The analysis should be carried out for the counter-ballast case when the barge is floating with a heel and trim not exceeding the maximum cross angle. The maximum cross angle is the angle corresponding to the crane operational restrictions.

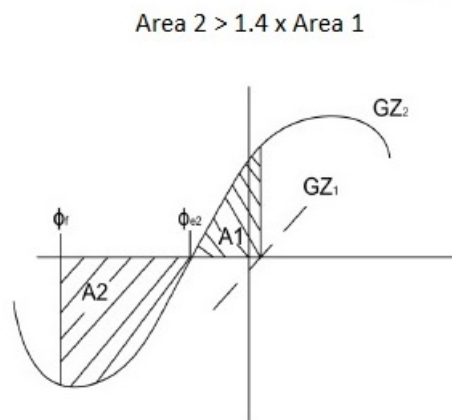
The righting arm curve is to be corrected for the increase in the vertical center of gravity due to the load. (The increase in the VCG is due to the boom being in the elevated position, and the hook load acting at the elevated end of the boom.)

- i) For any condition of loading and crane heeling moment, the first intercept of the heeling arm curve with the righting arm curve (equilibrium point) is to occur prior to submergence of the deck edge.

The following requirements are also to be met, with the barge at the maximum allowable vertical center of gravity, to provide adequate stability in case of sudden loss of crane load:

- ii) The area on the side of the ship opposite to the lift (Area 2) is not to be less than 40% in excess of the residual area on the side of the lift (Area 1) as shown in 5-3-3/9.3.3 FIGURE 2.
- iii) The angle of the first intercept between the righting lever curve after loss of crane load and the maximum permissible counter ballast lever curve is not to exceed 15°(angle of equilibrium after loss of crane load).

FIGURE 2
Criteria after Accidental Loss of Crane Load (1 July 2021)



where:

- GZ_1 = net righting lever (GZ) curve for the condition before loss of crane load, corrected for crane heeling moment and for the righting moment provided by the counter ballast if applicable;
- GZ_2 = net righting lever (GZ) curve for the condition after loss of crane load, corrected for the transverse moment provided by the counter ballast if applicable;
- ϕ_{e2} = the angle of static equilibrium after loss of crane load;
- ϕ_f = the angle of down-flooding or the heel angle corresponding to the second intersection between heeling and righting arm curves, whichever is less; and

11 Subsea Lifting

11.1 General

Subsea lifting is normally the operation of a lifting appliance handling a load which will be lowered through the splash zone and either held at an intermediate level, released on the seabed, or retrieved back through the splash zone on to the barge. Lifting appliances must first be certified by ABS for in air lifting according to the *Lifting Appliances Guide* and/or other recognized standards. They may then be eligible for subsea lifting provided these subsea lifts are engineered on a case by case basis by a responsible party associated with subsea lifting for the appropriate environmental conditions. This will result in some degree of de-rating the lifting appliance from its ABS certified in air capacity. In principle ABS does not approve these subsea lifts as the degree of variance precludes a general rule for this type of operation. In this section, ABS provides a recommended sequence to be followed for de-rating lifting appliances from the in air lifting mode to the subsea lifting mode.

11.3 Initial Certification for In-air Lifting (mandatory)

- i) The lifting appliance structure is to be initially approved according to the *Lifting Appliances Guide* for ship, offshore or heavy lift applications. The offshore application will additionally include approval to API Spec. 2C.
- ii) The machinery aspects such as winches, cylinders, accumulators, electric circuits will be approved according to the *Marine Vessel Rules* or other recognized standards.
- iii) Survey is required during manufacturing.
- iv) Testing is required at various stages during manufacturing and finally at installation.

11.5 Subsequent De-rating for Subsea Lifting (recommended)

- i)* The basic dynamic factors used for amplifying the lifted loads are to be derived according to API Spec. 2C from purchaser supplied lifting appliance boom tip velocities for the specific vessel the lifting appliance is to be mounted on.
- ii)* The use of active heave compensation, passive heave compensation, constant tension, or any combination of these systems can be decided by the purchaser.
- iii)* The use of manual overload protection systems or automatic overload protection systems can be decided by the purchaser.
- iv)* Modeling of the lifting appliance system should take the following aspects into account: basic dynamic factors based on boom tip velocities, buoyancy, added mass, drag, rope weight, resonance, sea bed suction.
- v)* Modeling results should produce revised dynamic factors that can be used to de-rate the crane from the initial certified capacity for in air lifts.
- vi)* A risk analysis according to the *ABS Guidance Notes on Risk Assessment Applications for the Marine and Offshore Industries* should be conducted.
- vii)* A failure mode and effects analysis (FMEA) should be conducted and this should include vessel power failure.
- viii)* Each subsea lift operation is to have its own unique modeling and analyses scenarios.

PART 5

CHAPTER 3 Other Barge Types

SECTION 4 Pipe Laying (2015)

1 General

1.1 Application

The requirements in this Section apply to barges intended for unrestricted service that are primarily engaged in installation of subsea pipelines.

1.3 Classification

The classification notation **⊗ A1 Barge Pipe Laying** will be assigned to barges built in compliance with these requirements and Parts 1 through 4 of these Rules.

Pipe laying barges also fitted with accommodations in support of barge operations are to also comply with Section 5-3-6.

1.5 Submission of Data

In addition to the plans required to be submitted by Section 1A-5-4 of the *ABS Rules for Conditions of Classification (Part 1A)*, the following additional plans, supporting documents, and calculations are to be submitted in the same manner.

1.5.1 Hull Plans

The following drawings are to be submitted with the Trim and Stability Booklet for ABS review:

- i)* General arrangement plan, with outboard profile
- ii)* Capacity plan or table with centers of gravity and free surface values
- iii)* Lines plan
- iv)* Tank Sounding Tables, if not included in the Trim and Stability Booklet
- v)* Cross curves of stability, if not included in the Trim and Stability Booklet
- vi)* List of down-flooding points, including their transverse, longitudinal and vertical locations, used in the calculation of the intact and damage stability criteria.
- vii)* Draft Marks Drawing showing the draft mark details, longitudinal locations of marks fore and aft referenced to the forward and after perpendiculars or to the nearest frames and vertical reference points. Navigational draft marks should be based on the vessel's lowest vertical projection.

- viii)* Intact and damage stability calculations supporting the maximum KG or minimum GM curve

1.5.2 Pipe Laying Plans and Data for Approval

- i)* Hull structural details related to pipe laying and abandonment and recovery (A & R) operations
- ii)* Equipment and installations for pipe laying and A & R operations
- iii)* Supporting structures for equipment engaged in the pipe laying and A & R operations
- iv)* Equipment for station-keeping/maneuvering during pipe laying

1.5.3 Design Analysis

The following calculations are to be submitted and documented.

- i)* Calculations demonstrating the adequacy of the barge's stability during all pipe laying operations (see also 5-3-4/3.1)
- ii)* Calculations demonstrating adequacy of maneuvering power required for the barge to maintain station during pipe laying operations
- iii)* Calculations for the supporting structure in way of all pipe-laying and pipe storing equipment interfaces with the ship structure
- iv)* Design loads and allowable deflection at each foundation of the pipe-laying and pipe storing equipment

1.5.4 Additional Information

The following items are to be submitted.

- i)* Arrangement plans showing the locations of all pipe laying equipment and control stations
- ii)* Pipe support arrangement on the pipe ramp, if provided; maximum forces are to be stated.
- iii)* Arrangement of tensioners and supporting structures; tension capacities are to be stated.
- iv)* Fastening of stinger to the hull; maximum forces are to be stated.
- v)* Location and support details of the cranes; reaction forces are to be stated.
- vi)* Supporting structures for pipes stowed on racks in holds and/or deck; maximum weights are to be stated.
- vii)* Supporting structures for reels and/or carousels and/or in baskets, in holds and/or deck; maximum weights are to be stated.
- viii)* Descriptions of equipment for moving skid frames, substructures, including piping and electrical systems, details of mechanical components, including hold-down devices and applicable strength calculations

1.5.5 Supporting Systems

- i)* Electrical schematics, load analysis, short circuits analysis and coordination study for the barge's electrical systems supplying pipe laying and A & R system operations
- ii)* Piping schematics and calculations for the barge's piping systems supplying pipe laying systems
- iii)* Arrangements and schematic diagrams for the anti-heeling and/or ballast systems, as appropriate
- iv)* Arrangement and details of communication systems between the barge and pipe laying systems

1.5.6 Operations Manual

Pipe Lay Barges are to be furnished with an operating manual providing guidance on at least the following:

- i)* Means of identifying that the Manual is for the subject barge, including principal particulars of the barge
- ii)* Loading conditions on which the design of the barge has been based
- iii)* There should also be evidence of approved loading and stability conditions on board. These should preferably be included in the operating manual. If they form a separate document, they should be referenced in the operating manual.
- iv)* Maximum approved lifting capacity and load charts of all cranes onboard
- v)* Service Limitations, any scope of operations and/or operational limits as applicable
- vi)* Position and application of watertight and weathertight (doors, hatches etc.) closing appliances necessary to meet the Load Line assignment or watertight integrity
- vii)* Identification of doors and hatches to be kept closed at sea
- viii)* Location of life saving appliances
- ix)* Location of emergency escapes
- x)* Anchoring/ mooring procedures
- xi)* From the aspect of the flag Administration, depending on the Administration to which the barge is flagged, there will also be a need for other items to be included such as a safety plan, firefighting procedures, means of escape, evacuation procedures, operation of life saving appliances, and requirements for safe operation of the barge.

3 Seakeeping

3.1 Stability

3.1.1 Stability of Pipe Laying Barges

In addition to the stability criteria required by the vessels flag administration, each barge is to satisfy the following:

In evaluating the loading conditions for pipe laying barges, the following loads are to be included:

- i)* The overturning moments due to environmental and operational loads on the pipe laying devices are to be included. When the pipe laying device is movable from stowage to operating condition, the full range of laying device positions is to be considered in order to investigate the most critical scenarios.
- ii)* The effect of the pipe racks and reels in the stability analysis is to be assessed for each operating condition.
- iii)* If the barge is fitted with or carries open cargo bins on the deck that may accumulate water, either effective means to drain water from these spaces shall be provided or an appropriate free surface correction applied.
- iv)* Carriage of pipe as deck cargo – see 5-3-4/3.1.3 for the requirements for the carriage of pipe on deck.
- v)* Where large and heavy equipment or structures are intended to be stowed on deck, the estimated weight and height of the center of gravity in the worst possible scenario are to be considered in the stability analysis.

- vi) If the barge's layout results in the pipeline creating a transverse moment relative to centerline, the barge shall comply with the stability requirements in 5-3-3/9 (except that compliance with 5-3-3/9.3.3 is not required), with the transverse heeling moment of the pipeline substituted for the crane heeling moment.
- vii) The following requirements are to be satisfied for the case where the pipe is flooded during the pipelay operations:
 - a) The final waterline, at the equilibrium heel angle due to the maximum design holding capacity of the A & R system, must be below the lower edge of any weathertight opening through which progressive flooding may occur.
 - b) The righting arm curve must be positive for a range of 20 degrees after the equilibrium heel angle due to the maximum design holding capacity of the A & R system.
 - c) The righting arm must be at least 100 millimeters (4 inches) within the 20 degree range.
 - d) Each opening submerged in the range of stability must be weathertight.

3.1.2 Barges Equipped with Lifting Devices

Pipe laying barges equipped with lifting devices in addition to the pipe laying device(s) are to comply with 5-3-3/9.

3.1.3 Carriage of Pipe as Deck Cargo

Where pipes are carried on deck, a quantity of trapped water equal to a certain percentage of the net volume of the pipe deck cargo should be assumed in and around the pipes. The net volume is to be taken as the internal volume of the pipes, plus the volume between the pipes. This percentage is to be 30% if the freeboard amidships is equal to or less than $0.015L$ and 10% if the free board amidships is equal to or greater than $0.03L$. For intermediate values of the freeboard amidships, the percentage is to be obtained by linear interpolation. In assessing the quantity of trapped water, the positive or negative sheer aft, actual trim and area of operation may be taken into account.

3.3 Station Keeping

Pipe laying barges are to be capable of maintaining their positions safely during pipe laying operations. The means to maintain position may be a mooring system with anchors or a dynamic positioning system.

3.3.1 Station Keeping with Anchors and Cables

Position mooring with anchors, cables and mooring winches when used to maintain the barge's position during pipe laying operations, are to comply with the requirements for the class notation **M** or **P** (see Section 3-4-1 of the *MOU Rules*). Safety precautions are to be considered to prevent damaging seabed equipment and installations by anchor deployment, recovery and station keeping.

3.3.2 Dynamic Positioning System

Dynamic positioning systems, when used to maintain the barge's position during pipe laying operations, are to comply with the requirements for the class notation **DPS-2** or **DPS-3** (see the *DPS Guide*).

Where the DP system has interfaces with the pipe tensioner system, the potential effects of the operations of the pipe tensioner system on the DP station keeping capability are to be addressed in the DP FMEA.

Movement of the barge to and from work location and around the work location is to be by tug or towing vessel. Barges with Dynamic Positioning (DP) capability are not to utilize the DP thrusters

for movements to or from work locations or for movements around work locations, except that barges complying with the requirement for the class notation **AMS-NP** in accordance with the *Marine Vessel Rules* are permitted short field moves (less than 12 hours in daylight) at the work location. (See 1A-5-2/5.35 of the *ABS Rules for Conditions of Classification (Part 1A)*).

3.5 Loading Conditions

Loading conditions covering departure and arrival in full load as well as ballast conditions, along with anticipated operational or intermediate conditions at site are to be included in the Trim and Stability Booklet of the barge.

5 Barge Design and Arrangements

5.1 General

The weather conditions for pipe-laying operations are to be clearly defined prior to the beginning of the project. Design parameters of the intended operating and abandonment swell heights, together with associated wind, current speeds and pipe pull, are to be used for calculation of the barge's motions and associated structural loads for the pipe-lay equipment and its interface with the ship structure.

The work deck is to be strengthened for the specified design loads and an allowance for corrosion, wear and tear is recommended. Uniform deck loadings are to be specified.

Fuel tanks are not to be located directly under the working decks, unless a void space, hold, store, cofferdam or water ballast tank forms a separation space between the working deck and fuel tank.

The working deck, as far as possible, is to be kept clear of engine room intakes and exhausts. Obstructions from tank vents are to be minimized.

A pipe laying moon-pool, when provided, shall be located near the center of the barge's motion. Openings are to be a suitable distance from the deck edge, from cargo hatch covers, from superstructure breaks and from other area of structure discontinuity. The side structure of moon pools are to be designed for impact loads from pipe laying. As a minimum, moon pool side structure is to comply with requirements for side shell plating given in 3-2-2. The corner radius of the moon pool opening is not be less than 0.125 times the width of the moon-pool opening but it need not exceed 600 mm (24 in.). Free edges of the moon pool opening are to be suitably rounded. Means are to be provided to prevent personnel from falling into the moon pool.

A clamping system capable of dealing with an emergency situation, such as flooded pipeline, and an A & R winch system capable of abandoning (lowering on seabed) and recovering the pipeline are to be considered when designing the foundations and their incorporation into the barge's structure.

5.3 Cranes

Cranes fitted on the barge and intended for operations other than supply of provisions and maintenance of the barge are to be certified by ABS and comply with requirements in the *Lifting Appliances Guide*.

5.5 Supporting Structure Design Loads

5.5.1 Lifting Loads

Maximum expected operational loads are to be applied for calculating scantlings of supporting structure of pipe laying equipment and cranes. Crane working loads are to consider a dynamic factor according to the *Lifting Appliances Guide* or one specified by the crane manufacturer, if that be greater.

5.5.2 Other Loads

Barge structures supporting heavy components of pipe laying equipment such as towers, reels, carousels, etc., and cranes are to be designed considering acceleration loads given below. Acceleration loads need not be combined with normal pipe laying or lifting operation loads of pipe laying equipment and deck cranes.

$$P_V = 0.102 * [(x - L/70)]W \text{ kN (tf)}$$

$$= 0.102 * [(x - L/229.7)]W \text{ Lt}$$

$$P_L = P_T = 0.5W$$

where

P_V = vertical force, in kN (tf, Lt)

P_L = longitudinal force, in kN (tf, Lt)

P_T = transverse force, in kN (tf, Lt)

L = length as per 3-1-1/3, in m (ft)

W = supported weight, in kN (tf, Lt)

The value of “ x ” is dependent on the location of the center of gravity of the specific equipment and is to be taken as that given in the table below. The value of “ x ” at intermediate locations is to be determined by interpolation. L is to be measured from AP to forward.

AP & aft of AP	0.1L	0.2L	0.3L~0.6L	0.7L	0.8L	0.9L	FP & forward
$x = 18$	17	16	15	16	17	18	19

Alternatively, accelerations derived from other recognized standards or direct calculations, model tests considering the most severe environmental conditions the barge is expected to encounter may be considered.

The hull structure supporting the stinger is to be strengthened for the maximum design loads (see 5-3-4/1.5.4).

5.5.3 Allowable Stresses (1 July 2017)

Scantlings of structure supporting pipe-laying equipment and cranes are to be based on the permissible stresses given below:

$$\text{Normal Stress} = 0.75Y$$

$$\text{Shear Stress} = 0.45Y$$

$$\text{Equivalent stress} = 0.85Y$$

where Y is the specified minimum tensile yield strength or yield point.

In addition, the buckling strength is to be adequate for the above loading.

7 Pipe Laying Equipment and Systems

7.1 General

Unless requested by the Owner and exceptions specified in 5-3-4/7.5, equipment and systems used solely for pipe laying operations are in general not subject to Classification by ABS, provided they are designed and constructed in compliance with an applicable recognized standard. The recognized standard used in design of pipe laying equipment and systems is to be specified by designer and acceptable to ABS. A manufacturer's affidavit or other acceptable documentation to verify compliance with applicable recognized standards is to be submitted to ABS. Their installations and onboard testing are to be supervised in the aspects of operational safety as to reduce to a minimum any danger to persons on board and marine pollution, due regard to be paid to moving parts, hot surfaces and other hazards. Considerations are to be given to the consequences of the failure of systems and equipment essential to the safety of the barge.

7.3 Pipe-lay Systems Arrangement

7.3.1 Control System

A central control station is to be provided for controlling or coordinating the operations of the pipe laying equipment. The central control station is to be located at a position that allows the operating personnel to have a clear view of the pipe departure location and to provide an overview of all systems and activities associated with the pipe laying operations.

Means are to be provided for measuring the tension applied on the paid-out pipe, which is to be displayed at the control stations.

7.3.2 Communications

The pipe laying central control station and the barge station keeping control station are to be linked by a hard-wired communication system and a manually operated alarm system. Means of communication are to be provided between the central control station and the local control stations for the pipe laying equipment.

7.5 Pipe-lay Equipment and Systems

7.5.1 Abandonment and Recovery System (A & R)

7.5.1(a) General.

An Abandonment and Recovery (A & R) system is to be provided to lay the pipe down on operation completion or the onset of harsh weather and for recovering the pipe after such an event. The system may consist of a hydraulic or electric motor driven traction winch, storage winch, and sheaves.

7.5.1(b) A & R System Capacity.

The A & R system is to be designed to provide adequate dynamic and brake holding capacity to control combined loads of the expected maximum tension generated by flooding the heaviest pipe and environmental forces such as waves, currents and tides, etc., exerting on the barge as well as the laid-off pipes.

7.5.1(c) Braking.

A & R system is to be provided with a power control braking means such as regenerative, dynamic, counter torque braking, controlled lowering or a mechanically controlled braking means capable of maintaining controlled lowering speeds.

Brakes are to be applied automatically upon loss of power or when the control lever is returned to neutral

7.5.1(d) Supporting Structures.

Detail drawings of the foundation and supporting structure on which the A & R winch are installed are to be submitted in accordance with 5-3-4/1.5.2 and 5-3-4/1.5.3. The foundations and supporting structures of the A & R winch and accessories are to be designed for the design static and dynamic loading conditions of the A & R winch defined in 5-3-4/7.5.1(b), using the allowable stresses formulated in 5-3-4/5.5.3.

7.5.2 Reels, Carousels, Pipe Racks and Support Structure

Pipe reels and carousels are to be designed, constructed and installed in accordance with a recognized standard.

Pipe racks and reel support structure including the reinforcements for the hull are to be designed to adequately resist the load effects of pipes, risers or reels imposed on the supports in the severe storm, normal operating and transit conditions with the allowable stresses defined in 5-3-4/5.5.3. Considerations should also be given to the unit in damaged conditions, where the pipe racks and reel support structure are to withstand the load effects caused by the trim and heel of the barge with the allowable stresses defined in 5-3-4/5.5.3.

7.5.3 J-lay/Flex-lay/Reel-lay Tower and Skid Frame

J-lay, Flex-lay, Reel-lay towers and skid frames are to be designed in accordance with a recognized standard.

Detail drawings of the foundation and supporting structure on which the pipe-lay towers and skid frames rest or other stowage arrangements are installed are to be submitted for review.

For strength calculations of supports, the tower's weight at extreme positions - upright and tilted position for J-lay/Flex-lay towers, upright elevation angles for pipe spooling-out and angled for pipe spooling-on and skid fleeting locations for Reel-lay towers, including associated center of gravity variations, static tension of the pipe and dynamic effects caused by environmental forces, are to be taken into account with the allowable stresses defined in 5-3-4/5.5.3.

7.5.4 Pipe Tensioners

7.5.4(a) General.

Reliable tensioners are to be provided for keeping the tension in the pipeline while it is being lowered onto seabed.

7.5.4(b) Capacity.

The tensioner is to be designed to provide adequate dynamic and brake holding capacity to control combined loads of the tension generated by the paid-out pipeline, motions and environmental forces such as waves, currents and tides, etc. The required type depends on pipe specifics and configuration of the pipe-lay system.

7.5.4(c) Control.

The tensioners are to be provided with power controlled system operable at a remote control station to control and monitor the paid out length with feedback to the lay speed setting or barge's station keeping system

7.5.4(d) Supporting Structures.

The foundations and supporting structures of the tensioner and accessories are to be designed for the load effects of pipe tensioner capacity defined in 5-3-4/7.5.4(b) using the allowable stresses formulated in 5-3-4/5.5.3.

7.5.5 Hang-off Clamps

Hang-off clamps are to be provided to hold the pipe when it is not suspended by tensioners or alternative means to hold the pipe such as A & R systems. Means are to be provided to ensure the holding power in case of electrical power black-out.

7.7 Offshore Construction Supporting Equipment

7.7.1 Remote Operated Vehicles (ROVs)

When the barge is equipped with work-class ROV to carry out underwater work, its handling system and control station are to be arranged in accordance with Sections 16 and 17 of the *ABS Rules for Building and Classing Underwater Vehicles and Hyperbaric Systems (Underwater Vehicles Rules)*.

Deck foundations, fastening arrangements and barge structures in way of ROVs are to be designed in accordance with 5D-5-3/5 of the *ABS Rules for Building and Classing Marine Vessels (MVR)*.

7.7.2 Pipe-laying Tracking System

Where the pipe-laying tracking system interfaces with barge's data and control networks, provision is to be made so that the operation or reliability of the barge's systems are not degraded.

9 Tests, Trials, and Surveys

9.1 General

Installation of the pipe laying equipment and systems on pipe laying barges is to be to the satisfaction of the attending Surveyor.

Position mooring equipment is to be tested in accordance with the specifications of the owner and in the presence of a Surveyor.

Dynamic positioning system is to be tested in accordance with Section 7 of the *DPS Guide*.

PART 5

CHAPTER 3 Other Barge Types

SECTION 5 Cable Laying (2015)

1 General

1.1 Application

The requirements in this Section apply to barges intended for unrestricted service that are primarily engaged in installation, maintenance and repair of underwater telecommunication cables and power transmission cables.

1.3 Classification

The classification **A1 Barge Cable Laying** will be assigned to barges built in compliance with these requirements and Parts 1 through 4 of these Rules.

Cable laying barges also fitted with accommodations in support of barge operations are to also comply with Section 5-3-6.

1.5 Submission of Data

In addition to the plans required to be submitted by Section 1A-5-4 of the *ABS Rules for Conditions of Classification (Part 1A)*, the following additional plans, supporting documents, and calculations are to be submitted in the same manner.

1.5.1 Hull Plans

For a list of drawings to be submitted together with the Trim and Stability Booklet for ABS review, refer to 5-3-4/1.5.1.

1.5.2 Cable Laying Plans and Data for Approval

- i)* Hull structural details related to cable laying
- ii)* Equipment and installations for cable laying
- iii)* Supporting structures for equipment engaged in the cable laying
- iv)* Equipment for station-keeping/maneuvering during cable laying.

1.5.3 Design Analysis

The following calculations are to be submitted and documented.

- i)* Calculations demonstrating the adequacy of the barge's stability during all cable laying operations (see also 5-3-5/3.1)

- ii)* Calculations demonstrating adequacy of maneuvering power required for the barge to maintain station during cable laying operations.
- iii)* Calculations for the supporting structure in way of all cable laying and cable storing equipment interfaces with the ship structure
- iv)* Design loads and allowable deflection at each foundation of the cable laying and cable storing equipment

1.5.4 Additional Information

The following items are to be submitted:

- i)* Arrangement plans showing the locations of all cable laying equipment and control stations
- ii)* Support arrangement for equipment used in cable laying operations such as cable drum, cable reels; maximum forces are to be stated.
- iii)* Location and support details of the cranes; reaction forces are to be stated.
- iv)* Supporting structures for cable stowed on racks in holds and/or deck; maximum weights are to be stated.
- v)* Supporting structures for cable drum and reels in holds and/or deck; maximum weights are to be stated.
- vi)* Descriptions of equipment for moving skid frames, substructures, including piping and electrical systems, details of mechanical components, including hold-down devices and applicable strength calculations.

1.5.5 Supporting Systems

- i)* Electrical schematics, load analysis, short circuits analysis and coordination study for the barge's electrical systems supplying cable laying
- ii)* Piping schematics and calculations for the barge's piping systems supplying cable laying systems
- iii)* Arrangement and details of communication systems between the barge and cable laying systems

1.5.6 Vessel Operations Manual

Cable Lay Barges are to be furnished with an operating manual providing guidance on at least the following:

- i)* Means of identifying that the Manual is for the subject barge, including principle particulars of the barge
- ii)* Loading conditions on which the design of the barge has been based
- iii)* There should also be evidence of approved loading and stability conditions on board. These should preferably be included in the operating manual. If they form a separate document, they should be referenced in the operating manual.
- iv)* Maximum approved lifting capacity and load charts of all cranes onboard
- v)* Service Limitations, any scope of operations and/or operational limits, as applicable
- vi)* Position and application of watertight and weathertight (doors, hatches etc.) closing appliances necessary to meet the Load Line assignment or watertight integrity
- vii)* Identification of doors and hatches to be kept closed at sea
- viii)* Location of lifesaving appliances
- ix)* Location of emergency escapes

- x) Anchoring/mooring procedures
- xi) From the aspect of the flag Administration, depending on the Administration to which the barge is flagged, there will also be a need for other items to be included such as a safety plan, firefighting procedures, means of escape, evacuation procedures, operation of life saving appliances, and requirements for safe operation of the barge.

3 Seakeeping

3.1 Stability

3.1.1 Stability of Cable Laying Barges

3.1.1(a) In addition to the stability criteria required by the barge's flag Administration, each barge is to satisfy the following:

In evaluating the loading conditions for cable laying barges, the following loads are to be included:

- i) The overturning moments due to environmental and operational loads on the cable laying devices are to be included. When the cable laying device is movable from stowage to operating condition, the full range of laying device positions is to be considered in order to investigate the most critical scenarios.
- ii) The effect of the cable drum and reels in the stability analysis is to be assessed for each operating condition.
- iii) If the barge is fitted with or carries open cargo bins on the deck that may accumulate water, either effective means to drain water from these spaces shall be provided or an appropriate free surface correction applied.
- iv) Carriage of cable as deck cargo – see 5-3-4/3.1.3 for the requirements for the carriage of cable on deck.
- v) Where large and heavy equipment or structures are intended to be stowed on deck, the estimated weight and height of the center of gravity in the worst possible scenario are to be considered in the stability analysis.

3.1.1(b) Cable laying barges equipped with lifting devices in addition to the cable laying device(s) are to comply with 5-3-3/9.

3.3 Station Keeping

Cable laying barges are to be capable of maintaining their positions safely during cable laying operations. The means to maintain position may be a mooring system with anchors or a dynamic positioning system.

3.3.1 Station Keeping with Anchors and Cables

Position mooring with anchors, cables and mooring winches when used to maintain the barge's position during cable laying operations, are to comply with the requirements for the class notation **M** or **P** (see Section 3-4-1 of the *MOU Rules*). Safety precautions are to be considered to prevent damaging seabed equipment and installations by anchor deployment, recovery and station keeping.

3.3.2 Dynamic Positioning System

Dynamic positioning systems, when used to maintain the barge's position during cable laying operations, are to comply with the requirements for the class notation **DPS-2** or **DPS-3** (see the *DPS Guide*).

Movement of the barge to and from work location and around the work location is to be by tug or towing vessel. Barges with Dynamic Positioning (DP) capability are not to utilize the DP thrusters

for movements to or from work locations or for movements around work locations, except that barges complying with the requirement for the class notation **AMS-NP** in accordance with the *ABS Marine Vessel Rules* are permitted short field moves (less than 12 hours in daylight) at the work location. (See 1A-5-2/5.35 of the *ABS Rules for Conditions of Classification (Part 1A)*).

3.5 Loading Conditions

Loading conditions covering departure and arrival in full load as well as ballast conditions, along with anticipated operational or intermediate conditions at site are to be included in the Trim and Stability Booklet of the barge.

5 Barge Design and Arrangements

5.1 General

The weather conditions for cable laying operations are to be clearly defined prior to the beginning of the project. Design parameters of the intended operating and abandonment swell heights, together with associated wind, current speeds and cable pull, are to be used for calculation of the barge's motions and associated structural loads for the cable laying equipment and its interface with the ship structure.

The work deck is to be strengthened for the specified design loads and an allowance for corrosion, wear and tear is recommended. Uniform deck loadings are to be specified.

The working deck, as far as possible, is to be kept clear of engine room intakes and exhausts. Obstructions from tank vents are to be minimized.

5.3 Cranes

Cranes fitted on the barge and intended for operations other than supply of provisions and maintenance of the barge are to be certified by ABS and are to comply with requirements in the *Lifting Appliances Guide*.

5.5 Supporting Structure Design Loads

5.5.1 Lifting Loads

Maximum expected operational loads are to be applied for calculating scantlings of supporting structure of cable laying equipment and cranes. Crane working loads are to consider a dynamic factor according to the *Lifting Appliances Guide* or one specified by the crane manufacturer, if that is greater.

5.5.2 Other Loads

Ship structures supporting heavy components of cable laying equipment such as cable drums, reels, and cranes are to be designed considering acceleration loads given in 5-3-4/5.5.2. Acceleration loads need not be combined with normal cable laying or lifting operation loads of cable laying equipment and deck cranes.

7 Cable Laying Equipment and Systems

7.1 General

Unless requested by the owner and exceptions specified in 5-3-5/7.5, equipment and systems used solely for cable laying operations are in general not subject to Classification by ABS, provided they are designed and constructed in compliance with an applicable recognized standard. The recognized standard used in design of cable laying equipment and systems is to be specified by designer and acceptable to ABS. A manufacturer's affidavit or other acceptable documentation to verify compliance with applicable recognized standards is to be submitted to ABS. Their installations and onboard testing are to be supervised in the aspects of operational safety as to reduce to a minimum any danger to persons on board and marine pollution, due regard to be paid to moving parts, hot surfaces and other hazards. Considerations

are to be given to the consequences of the failure of systems and equipment essential to the safety of the barge.

7.3 Cable-lay Systems Arrangement

7.3.1 Control System

A central control station is to be provided for controlling or coordinating the operations of the cable laying equipment. The central control station is to be located at a position that allows the operating personnel to have a clear view of the cable departure location and to provide an overview of all systems and activities associated with the cable laying operations.

7.3.2 Communications

The cable laying central control station and the barge station keeping control station are to be linked by a hard-wired communication system and a manually operated alarm system. Means of communication are to be provided between the central control station and the local control stations for the cable laying equipment.

7.5 Cable-lay Equipment and Systems

7.5.1 Cable Drums, Reels, Deployment Sheaves and Support Structure

Cable drums and reels are to be designed, constructed and installed in accordance with a recognized standard.

Cable drum, reel and deployment sheave support structure including the reinforcements for the hull are to be designed to adequately resist the load effects of cable, risers or reels imposed on the supports in the severe storm, normal operating and transit conditions with the allowable stresses defined in 5-3-4/5.5.3. Considerations should also be given to the unit in damaged conditions, where the cable reel support structure are to withstand the load effects caused by the trim and heel of the barge with the allowable stresses defined in 5-3-4/5.5.3.

7.7 Offshore Construction Supporting Equipment

7.7.1 Remote Operated Vehicles (ROVs)

When the barge is equipped with work-class ROV to carry out underwater works such as cable burying, cable cutting and recovery for repairing, its handling system and control station are to be arranged in accordance with Sections 16 and 17 of the *Underwater Vehicle Rules*.

Deck foundations, fastening arrangements and barge structures in way of ROVs are to be designed in accordance with 5D-5-3/5 of the *MVR*.

7.7.2 Dynamic Tracking System

Where the dynamic tracking system for the laid cables interfaces with barge's data and control networks, provision is to be made to ensure that the operation or reliability of the barge's systems are not degraded.

9 Tests, Trials, and Surveys

9.1 General

Installation of the cable laying equipment and systems on cable laying barges is to be to the satisfaction of the attending Surveyor.

Position mooring equipment is to be tested in accordance with the specifications of the owner and in the presence of a Surveyor.

Dynamic positioning system is to be tested in accordance with Section 7 of the *DPS Guide*.



PART 5

CHAPTER 3 Other Barge Types

SECTION 6 Accommodation Barges (2023)

1 Scope and Conditions of Classification

1.1 Classification

The requirements for conditions of classification are contained in the *ABS Rules for Conditions of Classification (Part 1A)*. Additional requirements specific to accommodation barges are contained within this Section.

1.3 Application

This Section applies to non-self-propelled floating marine structures which operate offshore as accommodation barges as defined in 5-3-6/3.3. The marine structure referred to herein is a displacement hull.

This Section is intended for offshore accommodation barges designed and constructed of steels having the properties as specified in *ABS Rules for Materials and Welding (Part 2)*. The use of steels or other materials having properties different from those specified in Part 2, as well as the corresponding scantlings, are subject to special considerations.

This Section covers the requirements specific to accommodation barges. The structural requirements are to comply with the applicable requirements of these Rules.

Requirements for accommodation units utilizing self-elevating and column-stabilized hulls are addressed separately in the *ABS Rules for Building and Classing Mobile Offshore Units (MOU Rules)*.

Gangways to other platforms/installations/vessels and any other aspect of combined operations are beyond scope of this Section.

1.5 Classification Symbols and Notations

A listing of Classification Symbols and Notations available to the Owners of vessels, offshore drilling and production units, and other marine structures and systems entitled “List of ABS Notations and Symbols” is available from the ABS website “www.eagle.org”.

The following notations are specific to accommodation barges.

1.5.1 Class Notations

1.5.1(a) Barges Built under ABS Survey

Accommodation barges built to the satisfaction of the ABS Surveyors to the full requirements of this Section, or to its equivalent, where approved by the Committee for service may be classed and distinguished in the *Record* by the symbols **A1 Accommodation Barge**, indicating compliance with the requirements of this Section and including compliance with the machinery requirements.

1.5.1(b) Barges Not Built under ABS Survey

Accommodation barges not built under ABS survey, but submitted for ABS classification, are subjected to special classification surveys. Where found satisfactory and thereafter approved by ABS, they may be classed and distinguished in the *Record* by **A1 Accommodation Barge**, but the symbol **A** signifying survey during construction will be omitted.

1.5.2 Limited Service

Accommodation barges built to the satisfaction of the ABS Surveyors to special modified requirements for limited or restricted services and approved by ABS for that particular service, are to be classed and distinguished in the *Record* by the symbols and notations as described in 5-3-6/1.5.1 above, followed by or including the appropriate service limitation. Also see Appendix 1.

1.5.3 Machinery and Systems

Machinery and systems for accommodation barges are to comply with the requirements specified in 5-3-6/15. Thruster machinery and systems used for short field moves (consisting of moving the barge from one work location to another location within the same area of operation, taking no longer than 12 hours and conducted in daylight hours) of non-propelled units and complying with the requirements of the *Marine Vessel Rules* as applied to self-propelled barges, manufactured and installed under ABS survey and found satisfactory after trials, will be distinguished in the *Record* by the notation **AMS-NP**, as appropriate.

1.5.4 Automatic or Remote Control and Monitoring Systems

For automatic or remote control and monitoring systems of the machinery other than the propulsion machinery referenced in Subsection 1/1 of the *ABS Guide for Automatic or Remote Control and Monitoring for Machinery and Systems (other than Propulsion) on Offshore Installations*, ABS will consider additional classifications with the symbols **AMCC** or **AMCCU**, as appropriate, provided that the applicable requirements of the *ABS Guide for Automatic or Remote Control and Monitoring for Machinery and Systems (other than Propulsion) on Offshore Installations* are satisfied.

1.5.5 Special Purpose

At the request of the Owner, accommodation barges that comply with the requirements in Section 5D-1-2 of the *ABS Rules for Building and Classing Marine Vessels (Marine Vessel Rules)* and the Code of Safety for Special Purpose Ships (SPS Code) adopted by the IMO Maritime Safety Committee as Resolution MSC 266(84) (SPS Code) will be assigned the class notation **SPS**.

1.7 Flag State Administration

Requirements additional to those given in 5-3-6/5 through 5-3-6/29 may be imposed by the flag Administration with whom the accommodation barge is registered or by the Administration within whose territorial jurisdiction the accommodation barge is intended to operate.

Approval of safety plans of the accommodation barge (such as fire safety measures and features, lifesaving appliances and equipment, radio communication installations, and subdivisions and stability etc.) by a flag Administration, in accordance with requirements equivalent to those by class, may be considered as complying with the class requirements provided such approval can be satisfactorily documented.

1.9 Submission of Plans

Plans and specifications specified in the following sections, together with supporting calculations as appropriate, are to be submitted before proceeding with the work. Detailed listing of plans can be found in 5-3-6/5 through 5-3-6/21.

Plans should generally be submitted electronically to ABS. However, hard copies will also be accepted.

1.9.1 Materials

This Section is intended for accommodation barges designed and constructed of steels having the properties as specified in the *ABS Rules for Materials and Welding (Part 2)*.

The use of steels or other materials that have properties different from those specified in *ABS Rules for Materials and Welding (Part 2)*, and the corresponding scantlings are subject to special considerations.

1.9.2 Hull Plans

In general, hull plans indicated in 1A-5-4/1 of the *ABS Rules for Condition of Classification (Part 1A)* are to be submitted for review, unless otherwise requested.

1.9.3 Machinery and Systems Plans

Plans showing machinery installations, pumps and piping systems, as well as electrical systems, as specified in Sections 4-1-1, 4-1-2 and 4-1-3, insofar as applicable, are to be submitted for ABS review. Dimensions, makes, and sizes of standard approved appliances, welding details, and other details are to be shown on the plans as clearly and fully as possible.

1.9.4 Safety Plans

- i) Plans showing the structural fire protection
- ii) Means of escape, fire pumps, fire mains, fire detection, fire alarms, fire-extinguishing system
- iii) Lifesaving appliances and equipment, rescue boats
- iv) Radio communications installations
- v) Subdivisions, stability, etc.

1.9.5 Stability, Loading and Operating Information

Information is to be submitted on ballast, fuel, supplies and hold arrangement and capacities; summary and distribution of fixed and variable weights for each reviewed condition; and information on all loaded and ballasted conditions in which the accommodation barge may be operated.

In accordance with the requirements contained in 5-3-6/11, stability calculations demonstrating that the accommodation barge meets the stability criteria in all loading and ballast conditions are to be submitted for review.

1.11 Operating Manual

An operating manual which is consistent with the information and criteria upon which classification is based is to be placed aboard the accommodation barge for the guidance of the operating personnel. Accommodation barges built for limited or restricted services and approved in accordance with 5-3-6/1.5.2 are to include the appropriate services limitation in the Operating Manual. Insofar as classification is concerned, the operating manual is to include, as appropriate, the following information:

- i) A general description of the barge, including major dimensions, lightship characteristics
- ii) Summaries of approved transit and operation conditions including:

- Limiting environmental conditions, such as wave height and period, wind velocity, current velocity, service temperature of the barge
 - Limiting conditions for mooring, including water depth, limiting mooring equipment capacity and a procedure for changing operation site (if the anchoring arrangement is the sole means of position keeping)
 - Design deck loadings, mooring loads, icing loads, variable load, cranes and types of helicopter for which the helideck is designed
 - Disposition (open or closed) of watertight and weathertight closures
 - Identification of “Restricted Service” or “Limited Service” conditions
- iii)* Vessel Information:
- General arrangement drawings
 - Watertight and weathertight boundaries, location of unprotected openings, and watertight and weathertight closures
 - Type, location and quantities of permanent ballast
 - Allowable deck loadings
 - Capacity, centers of gravity and free surface correction for each tank
 - Hydrostatic curves or equivalent
- iv)* Guidance for the maintenance of adequate stability and the use of the stability data
- v)* Guidance for the routine recording of lightweight alterations
- vi)* Examples of loading conditions for each mode of operation and instructions for developing other acceptable loading conditions, including the vertical components of the forces in the anchor cables
- vii)* Operation limitations:
- During transit of the accommodation barge, only members of the crew necessary for the transit operation are to be onboard.
 - Where applicable, limited or restricted services approved in accordance with 5-3-6/1.5.2.
 - Where applicable and subject to flag Administration agreement, short field moves in accordance with 5-3-6/1.5.3 for repositioning of a barge during daylight hours and taking no longer than 12 hours in duration. Barges may be manned during short field moves if the bow height and reserve buoyancy requirements of Loadline in 5-3-6/11.1.1 are met. Otherwise, the barges must be unmanned or the crew reduced to the minimum necessary to conduct the short field moves.
- viii)* Location of lifesaving appliances
- ix)* Location of emergency escapes
- x)* Anchoring/mooring procedures

The Operating Manual is to be in the language or languages required by the flag State. If the language is not English, a translation into English is to be included and submitted to ABS.

The Operating Manual is to be submitted for review by ABS solely to verify the presence of the above information which is to be consistent with the design information and limitations considered in the barge’s classification. ABS is not responsible for the operation of the barge.

The Operating Manual required by this Subsection does not need to be in addition to that required by flag and coastal Administrations. The administration may require that additional information be included in the Operating Manual.

1.13 Trial

A final sea trial is to be made of all machinery, and all automatic controls are to be tested to the satisfaction of the Surveyor.

3 Definitions

3.1 General

The following definitions of terms are to be understood (in the absence of other specifications) where they appear within this Section.

3.3 Accommodation Barge

An *Accommodation Barge* is a non-self-propelled manned vessel carrying more-than 36 persons, excluding members of the crew, who are industrial personnel engaged in some aspect of coastal, offshore, or related employment. It is intended to accommodate these persons only when the barge is moored or otherwise fixed on location. During transit of the accommodation barge, only members of the crew necessary for the transit operation are to be onboard.

3.5 Accommodation Spaces

Accommodation Spaces are those used for public spaces, corridors, lavatories, cabins, offices, hospitals, cinemas, games and hobbies rooms, pantries containing no cooking appliances, and similar spaces.

3.7 "A" Class Divisions

"A" *Class Divisions* are those divisions as defined in Regulation II-2/3.2 of the 1974 SOLAS Convention, as amended.

3.9 "B" Class Divisions

"B" *Class Divisions* are those divisions as defined in Regulation II-2/3.4 of the 1974 SOLAS Convention, as amended.

3.11 "C" Class Divisions

"C" *Class Divisions* are those divisions as defined in Regulation II-2/3.10 of the 1974 SOLAS Convention, as amended.

3.13 Control Stations

Control Stations are those spaces in which the barge's radio or main navigating equipment, or the emergency source of power is located or where the fire recording or fire control equipment is centralized. Spaces where the fire recording or fire control equipment is centralized are also considered to be a fire control station.

Spaces containing, for instance, the following battery sources are to be regarded as control stations, regardless of battery capacity:

- i) In general, all emergency batteries required in pursuance of 4-8-2/5 of the *Marine Vessel Rules*
- ii) Emergency batteries in separate battery room for power supply from black-out until start of emergency generator
- iii) Emergency batteries in separate battery room as reserve source of energy to radiotelegraph installation
- iv) Batteries for start of emergency generator

3.15 Crew

Crew means all persons employed on board the accommodation barge to provide maintenance and operation of the barge, its machinery, systems, and arrangements or who provide services for other persons onboard the barge.

3.17 Displacement Hull

Displacement Hull is a hull supported entirely by the buoyancy of the water it displaces.

3.19 Flag State Administration

Flag State Administration means the Government of the State whose flag the barge is entitled to fly.

3.21 Industrial Personnel

Industrial Personnel are individuals from the offshore or similar industry who are temporarily housed on the barge. These persons do not include members of the crew of the accommodation barge itself, but may include crew members or industrial personnel from other vessels, drilling units, offshore installations, etc.

3.23 Machinery Spaces

Machinery Spaces are all machinery spaces of Category A and all other spaces containing boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air-conditioning machinery, and similar spaces and trunks to such spaces.

3.25 Machinery Spaces of Category A

Machinery Spaces of Category A are all spaces and trunks to such spaces which contain internal combustion type machinery where such machinery has in the aggregate a total power of not less than 375 kilowatts (500 hp), or which contain any oil-fired boiler or oil unit; and trunks to such spaces.

3.27 MODU Code

MODU Code refers to the IMO Resolution A.1023(26) Code for The Construction and Equipment of Mobile Offshore Drilling Units, 2009.

3.29 Noncombustible Material

Noncombustible Material means a material which neither burns nor gives off flammable vapors in sufficient quantity for self-ignition when heated to approximately 750°C (1382°F), by an established test procedure. Any other material is a combustible material.

3.31 Non Self-Propelled

A *Non Self-Propelled* barge is one without propulsion or a barge with propulsion machinery (thrusters) utilized for positioning short field moves or to provide assistance while being towed to or from a site.

3.33 Public Spaces

Public Spaces are those portions of the accommodation which are used for meeting halls, dining rooms, lounges, and similar permanently enclosed spaces.

3.35 Safe Area

Safe Area in the context of a casualty is, any area(s) which is not flooded or which is outside the main vertical zone(s) in which a fire has occurred.

3.37 Safety Center

Safety Center is a control station dedicated to the management of emergency situations. Safety systems' operation, control, and/or monitoring are an integral part of the safety center.

3.39 Service Spaces

Service Spaces are those used for galleys, pantries containing cooking appliances, lockers and store-rooms, workshops other than those forming part of the machinery spaces, and similar spaces and trunks to such spaces.

3.41 Short Field Moves

Short Field Moves are those in which the barge transits from one work location to another within the same area of operation, which is conducted in daylight hours, and which takes no longer than 12 hours in duration.

3.43 SOLAS

SOLAS refers to the International Convention for the Safety of Life at Sea, 1974, as amended, applicable at the date of construction.

5 Fire Safety – Measures and Features

5.1 General

All accommodation barges are to meet the requirements of this Section with regard to fire and safety measures and features.

In general, fire and safety measures and features for accommodation barges are to comply with the applicable sections in Part 5 of the *ABS Rules for Building and Classing Mobile Offshore Units (MOU Rules)*.

5.1.1 Administration Review

Where a review of all or part of the requirements covered in this Section has been conducted by the Administration of the State whose flag the barge is entitled to fly and found acceptable, the same may be acceptable to ABS provided that:

- i) The designer or builder submits evidence that the Administration has reviewed the arrangements and the details are acceptable to that Administration.
- ii) ABS evaluates the Administration review to determine if the Administration's acceptance is acceptable to ABS as meeting the requirements of this section.

5.1.2 ABS Review

In all other cases, the required information and plans are to be submitted to ABS for review.

5.1.3 Materials Containing Asbestos

Installation of materials which contain asbestos is prohibited.

5.1.4 Alternative Design and Arrangements

When fire safety design or arrangements deviate from the prescriptive provisions of this Section, including innovative means of structural fire protection, an engineering analysis, evaluation and approval of the alternative design and arrangements is to be carried out in accordance with SOLAS Regulation II-2/17 and the *ABS Guidance Notes on Alternative Design and Arrangements for Fire Safety*.

5.1.5 Plans and Specifications

5.1.5(a) General

The following plans together with supporting data and particulars are to be submitted.

- General arrangement
- Structural fire protection layout plan for decks and bulkheads

- Plans or a booklet of joiner work details of construction for all decks, bulkheads and doors
- Ventilation plan showing all horizontal and vertical duct work listing all materials, duct size and gauge
- Penetration details through bulkheads and decks to accommodate ventilation, piping, electrical, etc.
- Escape plan
- Arrangement and details of fire main systems
- Fire extinguishing arrangements.
- Fire control plans
- Fire detection systems
- Fixed fire extinguishing systems
- Fire extinguishing appliances
- Control station for emergency closing of openings and stopping machinery
- Fireman’s outfits

5.1.5(b) Fire Control Plans

Fire control plans complying with SOLAS regulation II-2/15.2.4 are to be permanently exhibited.

5.3 Structural Fire Protection

All accommodation barges are to meet the requirements of this Section with regard to structural fire protection, protection of accommodation spaces, service spaces and control stations.

5.3.1 General

Structural fire protection for accommodation barges is to comply with 5-1-1/3 and 5-1-1/5 of the *MOU Rules*, as shown in 5-3-6/TABLE 1.

TABLE 1
Structural Fire Protection

	<i>Section of MOU Rules</i>
Construction Materials	5-1-1/3.1
Alternate Materials	5-1-1/3.3
Details, Materials and Methods of Construction	5-1-1/3.5
Fire Integrity of Bulkheads and Decks	5-1-1/3.7
Application of Tables	5-1-1/3.9
Other General Requirements	5-1-1/3.11 through 3.23
Protection of Accommodation Spaces, Service Spaces and Control Stations	5-1-1/5

5.3.2 Additional Requirements

In addition to complying with the requirements in 5-3-6/5.3.1, the following requirements apply to accommodation barges.

5.3.2(a) Main Vertical Zones

Hull, superstructure and deckhouses are to be subdivided into main vertical zones by “A” Class divisions.

- i) The length or width of the main vertical zone is the maximum distance between the furthestmost points of the bulkheads bounding it.
- ii) In general, the mean length and width of the main vertical zone on any deck is not to exceed 40 m (131 ft 3 in.)
- iii) The length and width of main vertical zones may be extended to a maximum of 48 m (157 ft 53/4 in.) in order to bring main vertical zone bulkheads into line with subdivision bulkheads below or to accommodate a large public space extending for the entire length of the zone provided the total area of the main vertical zone on any deck is not greater than 1600 m² (17220 ft²).
- iv) As far as practicable, bulkheads forming the boundaries of the main vertical zones above the bulkhead deck are to be in line with watertight subdivision bulkheads immediately below the bulkhead deck.
- v) Main vertical zone boundary bulkheads are to extend from deck to deck and to the shell or other zone boundaries.
- vi) For barges accommodating on board a total of more than 240 industrial personnel, the hull, superstructure and deckhouses are to be subdivided into main vertical zones as specified in 5-3-6/5.3.2(a)i) through 5-3-6/5.3.2(a)v) by “A-60” Class divisions. Where open deck spaces, sanitary and similar spaces or tanks, voids and auxiliary machinery spaces having little/no fire risk are on one side or where fuel oil tanks are on both sides of the division, the standard may be reduced to “A-0”. Ventilation systems are to be provided for each main vertical zone as per SOLAS Regulation II-2/9.7.4.2 and II-2/9.7.4.3 and relevant interpretations in MSC./Circ. 1120. In addition, two means of escape are to be provided above the bulkhead deck from each main vertical zones in accordance with SOLAS Regulation II-2/13.3.2.2.

The duct penetrating through the main vertical zone division are acceptable provided SOLAS Reg. II-2/9.4.1.1.9, II-2/9.7.2 and II-2/9.7.3 and relevant interpretations in IMO MSC.1/Circ.1120 are complied with and the ventilation/fire dampers are to comply with the relevant requirements of IMO Resolution MSC.365(93).

5.3.2(b) Corridor Bulkheads

All corridor bulkheads not required to be “A” class divisions are to be “B” class divisions extending from deck to deck except:

- i) When continuous “B” class ceilings and linings are fitted on both sides of the bulkhead, the portion of the bulkhead behind the continuous ceiling or lining is to be of material which, in thickness and composition, is acceptable in the construction of a “B” class division, but which may be required to meet “B” class integrity standards only insofar as considered reasonable and practicable by the Administration;
- ii) In the case of a barge protected by an automatic sprinkler system complying with Chapter 7 of the *International Code for Fire Safety Systems (FSS Code)*, the corridor bulkheads of “B” class material may terminate at a ceiling in the corridor provided the ceiling is of material which, in thickness and composition, is acceptable in the construction of “B” class divisions. Such corridor bulkheads and ceilings are to meet “B” class integrity standards insofar as considered reasonable and practicable by the Administration. All doors and frames in such bulkheads are to be of noncombustible materials and constructed and erected to provide substantial fire resistance to the satisfaction of the Administration.

5.3.2(c) Exterior Boundaries of Accommodation Space

The exterior boundary of superstructures and deckhouses enclosing accommodations, including any overhanging decks supporting such accommodations, is to be an “A-60” Class boundary for the whole of the portion which faces and is within 30 m (98 ft) of any area in the adjacent drilling

or production platform served by the accommodation barge where a hydrocarbon fire may arise. If the distance is more than 30 m (98 ft), but less than 100 m (328 ft), an “A-0” Class boundary is required. If the distance is more than 100 m (328 ft), the boundary is required to be of steel or equivalent material.

Where an “A-60” Class boundary is required, an “A-0” Class boundary used in conjunction with a water curtain system designed to provide a density of at least 6.1 liters/min/m² (0.15 gpm/ft²) of the exposed surface area may be used as an equivalent means of meeting the “A-60” class rating.

The ventilation inlets and outlets and other space openings in the deckhouse and superstructure exterior boundaries are to be located as far away from the adjacent drilling and production platform as practicable.

5.5 Fire Protection Systems and Equipment

All accommodation barges are to meet the requirements of this Section with regard to fire protection systems and equipment.

5.5.1 Governmental Authority

Attention is drawn to the appropriate governmental authority in each case, as there may be additional requirements, depending on the size, type and intended service of the barge, as well as other particulars and details. Consideration will be given to fire extinguishing systems which comply with the published requirements of the governmental authority in which the barge is to be registered, as an equivalent alternative or addition to the requirements of this section.

5.5.2 Fixed Fire Fighting Systems

5.5.2(a) Fire Pumps, Fire Main, Hydrants, Hoses and Nozzles

Fire pumps, fire main, hydrants, hoses and nozzles for accommodation barges are to comply with Section 5-2-2 of the *MOU Rules*, as shown in 5-3-6/TABLE 2.

TABLE 2
Fire Main Systems

	<i>Section of MOU Rules</i>
Fire Pumps	5-2-2/1.1
Fire Main	5-2-2/1.3
Hydrants, Hoses and Nozzles	5-2-2/1.5

5.5.2(b) Additional Fixed Fire Fighting Systems

In addition to the fire main system, other fixed fire fighting systems for accommodation barges are to comply with Section 5-2-3 of the *MOU Rules*, as shown in 5-3-6/TABLE 3.

TABLE 3
Additional Fixed Fire Fighting Systems

	<i>Section of MOU Rules</i>
Fixed Firefighting Systems	5-2-3/1
Gas Smothering Systems	5-2-3/3
Foam Systems	5-2-3/5
Fixed Pressure Water Spraying Systems	5-2-3/7

	<i>Section of MOU Rules</i>
Clean Agent Fire Extinguishing Systems	5-2-3/8
Paint and Flammable Liquid Lockers	5-2-3/11

5.5.3 Portable Fire Fighting Systems

Portable fire fighting systems for accommodation barges are to comply with Section 5-2-4 of the *MOU Rules*, as shown in 5-3-6/TABLE 4.

**TABLE 4
 Portable Fire Fighting Systems**

	<i>Section of MOU Rules</i>
Portable Fire Extinguishers and Sand	5-2-4/1
Firefighters' Outfit	5-2-4/3

5.5.4 Other Fire Protection Requirements

Fire detection in machinery spaces is to comply with Section 5-2-5 of the *MOU Rules*, as shown in 5-3-6/TABLE 5.

**TABLE 5
 Fire Detection and Alarms**

	<i>Section of MOU Rules</i>
Fire Detection and Alarm Systems	5-2-5/1.1

5.5.5 Arrangement of Fire Water Supply

The arrangements for the ready availability of water supply are to be such that at least one effective jet of water is immediately available from any hydrant in an interior location and so as to provide for the continuation of the output of water by the automatic starting of one required fire pump. At interior locations, fire hoses are to be connected to the hydrants at all times.

5.5.6 Fixed Fire Detection and Fire Alarm Systems, and Fixed Automatic Sprinkler, Fire Detection and Fire Alarm Systems

There is to be installed throughout each separate vertical fire zone, in all accommodation and service spaces and, where it is considered necessary also in control stations, except spaces which afford no substantial fire risk such as void spaces, sanitary spaces, etc., either:

- i) A fixed fire detection and fire alarm system of an approved type and complying with the requirements of 4-7-3/11 of the *Marine Vessel Rules* and so installed and arranged as to detect the presence of fire in such spaces and provide smoke detection in corridors, stairways and escape routes within accommodation spaces; or
- ii) An automatic sprinkler, fire detection and fire alarm system of an approved type and complying with the requirements of 4-7-3/9 of the *Marine Vessel Rules* or equivalent and so installed and arranged as to protect such spaces, and in addition a fixed fire detection and fire alarm system of an approved type complying with the requirements of 4-7-3/11 of the *Marine Vessel Rules* and so installed and arranged as to provide smoke detection in corridors, stairways and escape routes within accommodation spaces.

5.5.7 General Alarm

Alarm signal devices are to produce a distinctive and loud sound. Attention is directed to the proper government authority concerning the requirements for general alarm systems on accommodation barges.

5.7 Outfitting

Means of escape and other fire and safety measures and features for accommodation barges are to comply with Section 5-3-1 of the *MOU Rules*, as shown in 5-3-6/TABLE 6.

TABLE 6
Outfitting

	<i>Section of MOU Rules</i>
Means of Escape	5-3-1/1
Means of Access and Egress	5-3-1/3
Guards and Rails	5-3-1/5
Arrangements in Machinery Space	5-3-1/9
Segregation of Fuel Oil Purifiers	5-3-1/11
Fire Precautions for Machinery Spaces	5-3-1/15

Note: Any reference to “drilling” in the *MOU Rules* is to be interpreted as referring to the type of operation for which the accommodation barge is designed and/or intended.

7 Lifesaving Appliances and Equipment

7.1 General

For the purpose of this Subsection, unless expressly provided otherwise, the terms used for lifesaving appliances are as defined in Chapter III of 1974 SOLAS, as amended, and with applicable provisions of the International Life Saving Appliance (LSA) Code.

Life-saving appliances and equipment for accommodation barges are to comply with Chapter 10 of the IMO Code for the Construction and Equipment of Mobile Offshore Drilling Units (MODU Code) and the relevant sections of the International Life-Saving Appliance (LSA) Code.

9 Radio Communication Installations

9.1 General

The purpose of this Subsection is to provide minimum requirements for distress and safety radio communications between accommodation barges and coast stations, ships, and supporting aircraft in the Maritime Mobile Service.

The following requirements are applicable to accommodation barges when being towed or stationary at a site.

In general, radio communication for accommodation barges is to comply with the applicable requirements in Chapter 11 of the IMO Code for the Construction and Equipment of Mobile Offshore Drilling Units (MODU Code).

11 Subdivision, Stability, and Freeboard

11.1 General

11.1.1 Load Line

Every accommodation barge is to have marks denoting the maximum permissible draft when the barge is in the afloat condition. Such marks are to be placed at suitable visible locations on the structure, to the satisfaction of ABS.

The load lines are to be established under the terms of the International Convention on Load Lines (1966 ICLL) as a manned vessel. Where minimum freeboards cannot be computed by the normal methods laid down by the Convention, they are to be determined on the basis of compliance with the intact or damage stability requirements for afloat modes of operation.

The requirements of the International Convention on Load Lines with respect to weathertightness and watertightness of decks, superstructures, deckhouses, doors, hatchway covers, other openings, ventilators, air pipes, scuppers, inlets and discharges, etc., are to be taken as a basis for all barges in the afloat condition.

11.1.2 Inclining Test

An inclining test will be required for the first accommodation barge of a series, as near to completion as practical, to determine accurately the lightship weight and position of the center of gravity. An inclining test procedure is to be submitted for review prior to the test, which is to be witnessed by a Surveyor. For successive barges of a series, which are considered by ABS to be basically identical with regard to hull form and arrangement, with the exception of minor changes in machinery, outfit, etc., detailed weight calculations showing only the differences of weight and centers of gravity will be satisfactory, provided the accuracy of the calculations is confirmed by a deadweight survey. The results of the inclining test, or deadweight survey and inclining experiment adjusted for weight differences, are to be submitted for review.

11.3 Stability and Watertight/Weathertight Integrity

All accommodation barges are to have positive metacentric heights in calm water equilibrium positions for all afloat conditions.

An arrangement plan of watertight compartmentation is to be submitted as early in the design stage as possible, for the review of damage stability.

Diagrams showing the extents to which the watertight and weathertight integrity is intended to be maintained, the location, type, and disposition of watertight and weathertight closures are to be submitted.

Stability calculations, both intact and damaged, are to be submitted.

For the purpose of determining compliance with the stability requirements contained herein, it is to be assumed that the barge is floating free of mooring restraints. However, detrimental effects of catenary mooring systems or of the thrusters for dynamically positioned barges are to be considered.

Trim and stability calculations are to be submitted for all loading and ballast conditions with possible combinations of fixed and variable weight distribution, in which the accommodation barge may operate. The wind speeds referenced in this section are to be used to calculate heeling moments for intact and damage stability calculations. These wind speeds are not intended to represent actual environmental limits.

Stability requirements in accordance with 3-3-2/1 of the *MOU Rules* are to be complied with, as shown in 5-3-6/TABLE 7.

TABLE 7
Stability

	<i>Section of MOU Rules</i>
Stability Afloat	3-3-2/1.3
Intact Stability	3-3-2/1.3.1
Damage Stability	3-3-2/1.3.2, 3-3-2/1.3.3

11.3.1 Intact Stability

Righting moment curves and heeling moment curves with supporting calculations are to be prepared for the full range of anticipated operating drafts. The calculations are to be performed in a manner to reflect a sustained wind force from any horizontal direction in order to determine the critical stability axis. For purposes of these calculations, the configuration of the barge is to reflect the actual condition of the barge during afloat operation.

The stability criteria in accordance with 3-3-2/3 of the *MOU Rules* are to be applied to accommodation barges, as shown in 5-3-6/TABLE 8.

TABLE 8
Stability Criteria

	<i>Section of MOU Rules</i>
Righting Moment	3-3-2/3.3.1
Heeling Moment	3-3-2/3.7
Wind Tunnel Tests	3-3-2/3.9

11.3.2 Damage Stability

In assessing the damage stability of accommodation barges, as required by 3-3-2/1.3.2 and 3-3-2/1.3.3 of the *MOU Rules*, the following extent of damage is to be assumed.

If damage of a lesser extent results in a more severe condition, such lesser extent is to be assumed.

The extent of damage for accommodation barges is defined in 3-3-2/3.5 of the *MOU Rules* and assumed to occur between effective watertight bulkheads.

- i)* Horizontal depth of penetration of 1.5 m (5 ft)
- ii)* Vertical extent of damage from the bottom shell upwards without limit

All piping, ventilating systems, trunks, etc., within the area of assumed damage are to be considered damaged. Positive means of closure are to be provided to preclude progressive flooding of other intact spaces. In addition to the above, the compartments adjacent to the bottom shell are to be considered flooded individually. See 3-2-2/7 of the *MOU Rules* for specific requirements for watertight bulkheads and flats.

11.3.3 Watertight/Weathertight Integrity

Watertight and weathertight integrity in accommodation barges is to be in compliance with 3-3-2/5 of the *MOU Rules*, as shown in 5-3-6/TABLE 9.

TABLE 9
Watertight/Weathertight Integrity

	<i>Section of MOU Rules</i>
Weathertight Integrity	3-3-2/5.1
Watertight Integrity	3-3-2/5.3
Penetrations	3-3-2/5.5

11.3.4 Onboard Computers for Stability Calculations

The use of onboard computers for stability calculations is not a requirement of class. However, if stability software is installed onboard accommodation barges, it should cover all stability requirements applicable to the barge and is to be approved by ABS for compliance with the requirements of Appendix 3-3-A2 of the *MOU Rules*, “Onboard Computers for Stability Calculations”.

13 Helicopter Facilities

13.1 General

Where provided, helicopter decks are to be of steel or equivalent fire-resistant construction. If the space below the helicopter deck is a high fire risk space, the insulation standard is to be to the satisfaction of ABS. Each helicopter deck is to be of sufficient size and located so as to provide a clear approach and take-off sector to enable the largest helicopter using the deck to operate under the most severe conditions.

13.3 Construction

13.3.1 General

Plans showing the arrangement, scantlings and details of the helicopter deck are to be submitted for review and approved before construction is commenced.

- These plans are to clearly indicate the scantlings, structural details and welding, or other methods of connection.
- The arrangement plan is to show, in both plan view and elevation, the overall size of the helicopter deck and the designated landing area. If the arrangement provides for the securing of a helicopter or helicopters to the deck, the predetermined position(s) selected to accommodate the secured helicopter, in addition to the locations of deck fittings for securing the helicopter, are to be shown.
- The type of helicopter to be considered is to be specified and calculations for appropriate loading conditions are to be submitted.

Plans should generally be submitted electronically to ABS. However, hard copies will also be accepted.

13.3.2 Structure

Scantlings of helicopter decks and supporting structure are to be determined on the basis of the following loading conditions, whichever is greater, in association with the allowable factors of safety shown in 5-3-6/TABLE 10. Plastic design considerations may be applied for deck plating and stiffeners.

Scantlings of helicopter decks and supporting structures are to be such that the resulting stress in members does not exceed:

$$Y/F_s$$

where

Y = specified minimum yield point or yield strength of the material

F_s = factor of safety, as given in 5-3-6/TABLE 10

13.3.2(a) Overall Distributed Loading

For platform type helicopter decks, minimum distributed loading of 2010 N/m² (205 kgf/m², 42 lbf/ft²) is to be taken over the entire helicopter deck.

For all other helicopter decks provided on part of the barge's structure deck (e.g., deckhouse/superstructure top or strength/weather deck), the minimum weather load as specified for each type of structures is also to be applied (see also 5-3-6/13.3.2(f)).

13.3.2(b) Helicopter Landing Impact Loading

A load of not less than 75% of the helicopter maximum take-off weight is to be taken on each of two square areas, 0.3 m × 0.3 m (1 ft × 1 ft). Alternatively, the manufacturer's recommended wheel impact loading will be considered. The deck is to be considered for helicopter landings at any location within the designated landing area. The structural weight of the helicopter deck is to be added to the helicopter impact loading when considering girders, stanchions, truss supports, etc. Where the upper deck of a superstructure or deckhouse is used as a helicopter deck and the spaces below are normally manned (quarters, abridge, control room, etc.), the impact loading is to be multiplied by a factor of 1.15.

TABLE 10
Allowable Factors of Safety F_s for Helicopter Decks

Y = specified minimum yield point or yield strength of the material as defined in 2-1-1/13 of the ABS *Rules for Materials and Welding (Part 2)*

<i>Loading</i>	<i>Plating</i>	<i>Beams</i>	<i>Girders, Stanchions, Truss Support, etc. (See Note 3)</i>
Overall Distributed Loading	1.67	1.67	1.67
Helicopter Landing Impact Loading	(See Note 1) 1.00 ⁽²⁾	1.00	1.10
Stowed Helicopter Loading	1.00	1.10	1.25

Notes:

1 The minimum plate thickness t is generally not to be less than obtained from the following:

<i>Beam Spacing</i>	<i>t</i>	<i>Beam Spacing</i>	<i>t</i>
460 mm	4.0 mm	18 in.	0.16 in.
610 mm	5.0 mm	24 in.	0.20 in.
760 mm	6.0 mm	30 in.	0.24 in.

2 Alternatively, ultimate state limit methods may be considered.

3 For members subjected to axial compression, the factor of safety is to be based on the yield stress or critical buckling stress, whichever is less.

4 The minimum plate thickness for materials other than steel will be specially considered.

13.3.2(c) Stowed Helicopter Loading

If provisions are made to accommodate helicopters secured to the deck in a predetermined position, the structure is to be considered for a local loading equal to the manufacturer's recommended wheel loadings at maximum take-off weight, multiplied by a dynamic amplification factor based on the predicted motions of the barge for this condition, as may be applicable for the barge under consideration.

In addition to the helicopter load, a uniformly distributed loading of 490 N/m² (50 kg/m², 10.5 lb/ft²), representing wet snow or ice, is to be considered, if applicable. For the girders, stanchions, truss supports, etc., the structural weight of the helicopter deck is also to be considered.

13.3.2(d) Loading due to Motions of Barge

The structure supporting helicopter decks is to withstand the loads resulting from the motions of the barge.

13.3.2(e) Special Landing Gear

Helicopters fitted with landing gear other than wheels will be specially considered.

13.3.2(f) Environmental Loading

Calculations are to consider anticipated wind and wave impact loading on helicopter decks and their supporting structures.

13.3.3 Size

13.3.3(a)

In general, the helicopter deck is to be of sufficient size to contain a circle of a diameter equal to at least the rotor diameter of the largest helicopter using the helicopter deck. The helicopter deck is to have an approach/departure sector of at least 180° free of obstructions. The base of this sector is to be tangent to the periphery of the circle described above, as shown in 5-3-6/FIGURE 1. Outside the approach/departure sector, obstructions within one-third of the rotor diameter from the periphery of the circle described above are not to extend above a plane measured vertically from the edge of the deck with a rise equal to half of the horizontal distance from the periphery of the above circle.

13.3.3(b)

Where adverse climatic conditions are prevalent for normal helicopter operation, a helicopter deck is to have sufficient size to contain a circle of a diameter at least equal to the overall length of the largest helicopter using the helicopter deck. The approach/departure sector is to be not less than 210° free of obstruction and is to intersect the periphery of the circle described above as shown in 5-3-6/FIGURE 1. Outside the approach/departure sector, obstructions within one-third of the helicopter's overall length from the periphery of the circle described above are not to extend more

than 1/20 of the helicopter overall length above the level of the helicopter deck. The overall length of a helicopter (*D* or *D-value*) is the distance from the tip of the main rotor blade to the tip of the tail rotor when the rotor blades are aligned along the longitudinal axis of the helicopter.

13.3.4 Drainage

The helicopter deck is to have drainage facilities to prevent the collection of liquids and prevent liquids from spreading to or falling on other parts of the barge having regard to the use of fire-fighting equipment and the possible spillage of fuel.

13.3.5 Surface

The helicopter deck is to have a non-skid surface.

13.3.6 Grating Type Construction

Where the helicopter deck is constructed in the form of grating, the under deck should be such that the ground effect is maintained.

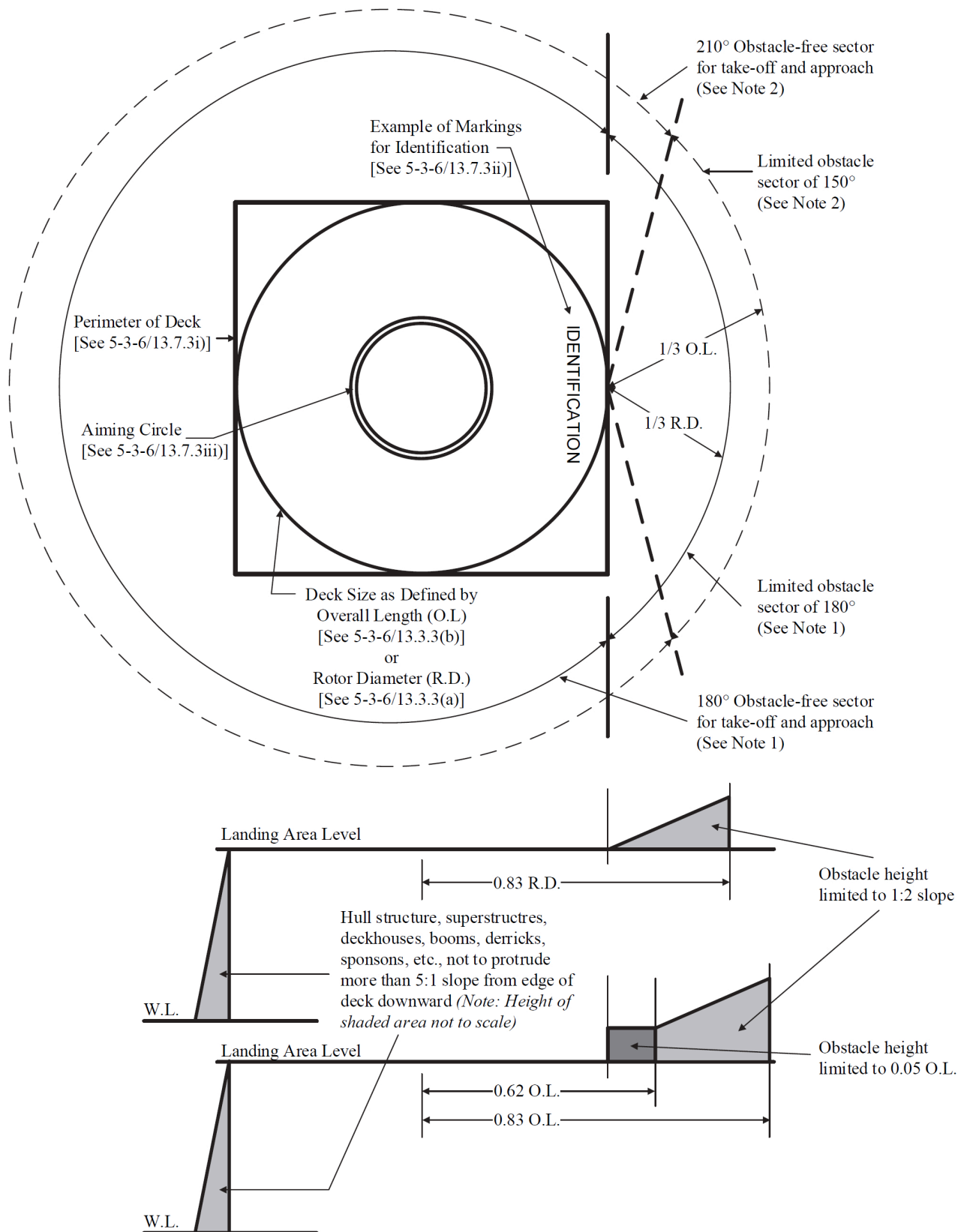
13.3.7 Materials

In general, the construction of helicopter decks is to be of steel or other material with equivalent ability to retain structural capacity in a fire (at least A-0 class). If the helicopter deck forms the deckhead of a deckhouse or superstructure, it is to be insulated to A-60 class standard.

Aluminum alloys may be used for helicopter decks above deckhouses, provided the following conditions are complied with:

- i)* There are to be no openings in the exterior bulkheads directly below the helicopter deck
- ii)* All windows in the lower exterior bulkheads are to be fitted with steel shutters.

FIGURE 1
Example of Helicopter Deck Arrangement



Notes:

- 1 Approach/departure sector and limited obstruction area defined in 5-3-6/13.3.3(a) shown by solid line.
- 2 Approach/departure sector and limited obstruction area defined in 5-3-6/13.3.3(b) shown by broken line.
- 3 Although a square helicopter deck is shown, other configurations are commonly used.

13.5 Arrangements

13.5.1 Projections

The helicopter deck is to be free of projections except that landing lights or other essential projections may be installed on or around the periphery of the deck provided they do not rise more than 150 mm (6 in.) above the level of the helicopter deck.

13.5.2 Tie Downs

The helicopter deck is to have sufficient recessed tie-down points for securing the maximum sized helicopter for which the helicopter deck is designed.

13.5.3 Safety Net

For personnel protection, a safety net 1.5 m (5 ft) wide is to be provided around the periphery of the helicopter deck, except where structural protection exists. The net should be inclined upwards and outwards from below the edge of the helicopter deck to a horizontal distance of 1.5 m, at a slope of approximately 10 degrees. The outer edge is not to rise above the level of the helicopter deck.

13.5.4 Means of Escape and Access

The helicopter deck is to be provided with both a main and an emergency means of escape and access for fire fighting and rescue personnel. These means are to be located as far apart from each other as practicable and preferably on opposite sides of the helicopter deck.

13.7 Visual Aids

13.7.1 General

Coastal States may have specific requirements that must be incorporated into the design. Where the coastal state has no requirements, the following (requirements for wind indicator, marking, and lights, in line with the latest International Code) are to be complied with.

13.7.2 Wind Indicator

A wind direction indicator located in an unobstructed area readily visible to helicopters approaching the helicopter deck is to be provided. Accommodation barges on which night helicopter operations take place should have provisions to illuminate the wind direction indicators.

13.7.3 Markings

Unless specific requirements are provided by the flag Administration or the cognizant authority (in which territorial waters the barge is being operated), the helicopter deck is to be marked as follows (see also 5-3-6/FIGURE 2):

- i)* The perimeter with a continuous white line of at least 0.3 m (1 ft) in width. Perimeter marking for single main rotor helicopters is typically for a 1 *D value*, where the *D-value* is the reference diameter as described in 5-3-6/13.3.3(b).
- ii)* Barge identification, positioned between the origin of the obstacle-free sector and aiming circle, with characters not less than 1.2 m (4 ft) in height in a color contrasting with the background.
- iii)* Aiming circles in yellow, taking into account deck configuration, helicopter type and operational requirements. The inside diameter is to be equal to 0.5 *D* and the width of the line is to be 1 m (3.3 ft).

- iv) A white “H” centered on the landing area with the horizontal bar of the “H” on the bisector of the obstacle-free sector. The “H” is to be 4 m (13.15 ft) high, 3 m (9.85 ft) wide and 0.75 m (2.45 ft) wide lines.
- v) A black chevron positioned in the perimeter marking, each leg being 0.8 m (2.6 ft) long and 0.1 m (4 in.) wide forming an angle that indicates the origin of the obstacle-free sector and the directions of the limits of the sector.
- vi) The actual *D-value* of the helicopter deck inboard of the chevron in alphanumeric symbols of 0.1 m (4 in.) in height.
- vii) The *D-value* in the perimeter marking every 90 degrees starting from the chevron, in color contrasting with the helicopter deck (preferably white, but not black or grey for night use). The *D-value* is to be expressed to the nearest whole number with 0.5 rounded down (i.e., 18.5 marked as 18). Markings for some helicopters may require special consideration.
- viii) The maximum allowable mass marking consisting of a two- or three-digit number followed by the letter “t” to indicate the allowable helicopter mass in tonnes (1000 kg) expressed to one decimal place, rounded to the nearest 100 kg. The marking is to be located in a position which is readable from the preferred final approach direction (i.e., towards the obstacle-free sector origin), and the height of the figures is to be 0.9 m (2.95 ft) with a line width of approximately 0.12 m (4.75 in.) and in a color contrasting with the helicopter deck (preferably white, but not black or grey for night use). Where the coastal State requires the marking in pounds, it is to consist of a two- or three-digit number to indicate the maximum allowable mass in thousands of pounds, rounded to the nearest 1,000 pounds.

The helicopter deck is to be painted preferably in dark green color as background to the markings. Markings on aluminum helicopter decks of natural light grey color are to be enhanced with contrasting colors.

13.7.4 Lights

13.7.4(a) Perimeter Lights

The perimeter of the helicopter deck is to be fitted with green lights visible omni-directionally from on or above the landing area. These lights are to be above the level of the deck, but not to exceed 0.25 m (10 in.) in height for helicopter decks sized to a 1 D value. These lights are to be positioned around the perimeter of the deck not more than 3 m (9'-10") apart, coincident with the perimeter line as per 5-3-6/13.7.3i). In the case of square or rectangular decks, at least four lights are to be fitted along each side, including a light at each corner. Flush fitting lights may be used at the inboard edge of the helicopter deck (150° limited obstacle sector origin) where there is a need to move a helicopter or large equipment off the helicopter deck.

13.7.4(b) Floodlights

The whole of the helicopter deck landing area should be adequately illuminated if intended for night use. Helicopter deck floodlights, where fitted, should be located so as to avoid glare to pilots. The arrangement and aiming of floodlights should be such that helicopter deck markings are illuminated and that shadows are kept to a minimum.

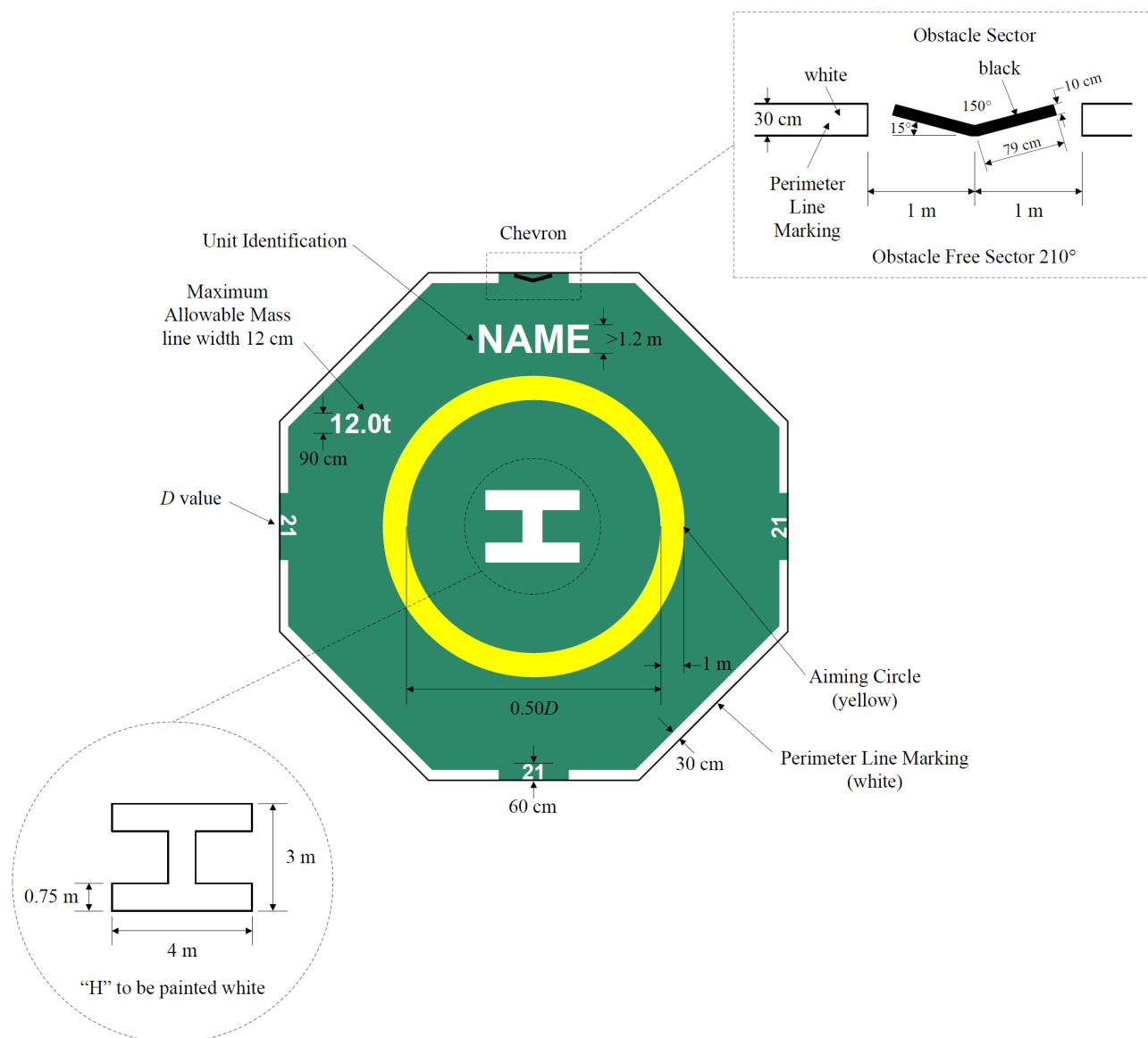
13.7.4(c) Obstacles

Fixed obstacles which present a hazard to helicopters should be readily visible from the air. Examples of such fixed obstacles include but are not limited to any lattice tower structures and crane booms which are in the vicinity of the helicopter deck. Omni-directional red lights should be fitted at suitable locations to provide the helicopter pilot with visual information on the proximity and height of objects which are higher than the landing area and in the vicinity of the helicopter deck. Objects which are more than 15 meters higher than the landing area should be fitted with

intermediate red lights spaced at 10 meter intervals down to the landing area, except where such lights would be obscured by other objects.

Additionally, at least one omni-directional red light is to be fitted to the highest point on the hotel or accommodation barge.

FIGURE 2
Example of Helicopter Deck Markings



13.9 Fire-Fighting for Helicopter Facilities

13.9.1 Hoses and Nozzles

At least two combination solid stream and water spray nozzles and hoses sufficient in length to reach any part of the helicopter deck are to be provided.

13.9.2 Portable Extinguishers

The helicopter deck area is to be protected by at least two dry powder extinguishers of a total capacity of not less than 45 kg (100 lb).

13.9.3 Back-up System

A back-up fire-fighting system is to be provided, consisting of CO₂ extinguishers of a total capacity of not less than 18 kg (40 lb) or equivalent, one of these extinguishers being equipped to enable it to reach the engine area of any helicopter using the landing and winch area. The back-up system is to be located so that the equipment would not be vulnerable to the same damage as the dry powder extinguishers required by 5-3-6/13.9.2.

13.9.4 Fixed-Foam System

When refueling capabilities are provided onboard, in addition to the fire-fighting system as required by 5-3-6/13.9.1, 5-3-6/13.9.2, and 5-3-6/13.9.3, a fixed-foam fire-extinguishing system consisting of monitors or hose streams or both is to be installed to protect the helicopter landing area in all weather conditions in which helicopters can operate and fuel storage areas. The helicopter landing area is the area contained within a circle of diameter "D" where "D" is the distance across the main rotor and tail rotor in the fore and aft line of a helicopter with a single main rotor and across both rotors for a tandem rotor helicopter or the full area of the deck, whichever is less. The system is to be capable of delivering foam solution at a rate of 6.0 liters per square meter per minute (0.15 gpm per square foot) of the areas protected for at least five minutes. The pump is to be capable of maintaining a pressure of 7 bar (7 kgf/cm², 100 psi) at the foam installation.

The foam agent is to meet the performance standards for Level B foam in the International Civil Aviation Organization's Airport Services Manual (Part 1 Chapter 8, Paragraph 8.1.5, TABLE 8-1) and be suitable for use with sea water. Foam delivery at the minimum application rate is to start within 30 seconds of system activation.

The operation of the foam system is not to interfere with the simultaneous operation of the fire main.

13.9.5 Fire-fighter's Outfits

In addition to the fire-fighter's outfits required in 5-3-6/3.5.3, two additional sets of fire-fighter's outfits are to be provided and stored near the helicopter deck.

13.9.6 Other Equipment

The following equipment (of sizes appropriate for the types of helicopter expected to use the facility) is to be provided near the helicopter deck and is to be stored in a manner that provides for immediate use and protection from the elements:

- Adjustable wrench
- Fire resistant blanket
- Bolt cutters with arm length of 60 cm (24 in.) or more
- Grab hook or salving hook
- Heavy duty hack saw, complete with six spare blades
- Ladder (two-piece - for access to casualties in an aircraft on its side)
- Lifeline of 5 mm (³/₁₆ in.) diameter × 15 m (50 ft) length
- Side cutting pliers
- Set of assorted screwdrivers
- Harness knife, complete with sheath

- Large crowbar
- Large rescue axe (non-wedge or aircraft type)

13.11 Helicopter Fuel Oil Storage and Transfer Facilities

13.11.1

A designated area is to be provided for the storage of fuel tanks and transfer facilities which are to be as remote as is practicable from accommodation spaces, escape routes, and embarkation stations and suitably isolated from areas containing a source of vapor ignition.

The storage and transfer area is to be permanently marked as an area where smoking and open flames are not permitted.

13.11.2

Fixed fuel storage tanks are to be of metal construction. Special attention is to be given to the design, mounting, securing arrangement, and electrical bonding of the storage tank and the fuel transfer system.

13.11.3

Tank vents are to be sized in accordance with the 4-1-2/5, or other criteria. Vent outlets are to be fitted with corrosion-resistant flame screens and are to be located such that vapors will disperse freely.

13.11.4

Storage tank outlet valves are to be provided with a means of remote closure in the event of fire. Means are also to be provided for remote shutdown of the fuel transfer unit.

13.11.5

The helicopter fuel oil storage and transfer facilities are to have drainage facilities to prevent the collection of liquids and prevent liquids from spreading to or falling on other parts of the barge having regard to the use of fire-fighting equipment and the possible spillage of fuel.

To contain spillage and retain fire-extinguishing agents, a coaming at least 150 mm (6 in.) in height is to be provided. The coaming is to surround the fuel storage area, which consists of the fuel tank, associated piping, and any pumping unit adjacent to the storage tank. Where the pumping unit is remote from the tank, a separate coaming around the unit is to be provided. A coaming will be required only around the fuel pumping unit where the installation is such that the fuel storage tank is cantilevered from the barge and arranged to be jettisoned.

Drainage is to be provided for the area enclosed by the coaming complying with the following:

- The area within the coaming is to be sloped toward the drain line.
- Drainage from the area within the coaming is to be led through a valve designed for selective output (e.g., 3-way valve) either to a holding tank complying with 5-3-6/13.11.2 and 5-3-6/13.11.3 or directly overboard. No other valves may be fitted in the drain line.
- The drain line cross sectional area of the drain line from the fuel tank coaming is to be at least twice that of the fuel storage tank outlet connection.

Fuel tank coamings not provided with drainage arrangements in accordance with the above are to be sized to contain the full volume of the fuel storage tank plus 150 mm (6 in.) of foam.

13.11.6

Tanks and associated equipment are to be protected against physical damage and from a fire in an adjacent space or area.

13.11.7

The fuel pumping unit is to be connected to one tank at a time and the piping between the tank and the pumping unit is to be of steel or equivalent material, as short as possible, and protected against damage.

13.11.8

Fire-extinguishing arrangements for protection of the designated area are to be submitted for review.

13.13 Helicopter Fuel Oil Pumping Arrangements

13.13.1

Electrical fuel pumping units and associated control equipment are to be of a type suitable for the location and potential hazard.

13.13.2

Fuel pumping units are to incorporate a device which will prevent over-pressurization of the delivery or filling hose.

13.13.3

The procedures and precautions during refueling operations are to be in accordance with good recognized practice.

13.13.4

Attention is to be paid to the electrical bonding of all equipment used in refueling operations.

13.13.5

“NO SMOKING” signs are to be displayed at appropriate locations.

13.15 Electrical Systems

13.15.1 Permanent Equipment Grounding Arrangements

Where not obtained through normal construction, arrangements are to be provided to effectively ground all machinery, armored cables and metal structures of helicopter decks.

13.15.2 Emergency Source of Power

The power available is to be sufficient to supply for at least 18 hours all services necessary for safety in an emergency, particular attention being given to the following:

- i) Navigation and special purpose lights and warning systems including helicopter landing lights
- ii) Emergency lighting for helicopter landing decks

15 Mechanical Systems

15.1 General

In general, machinery, boilers, pressure vessels, pumps, piping, materials, electrical systems and fire extinguishing systems are to be in accordance with the applicable requirements of the *Marine Vessel Rules*, except as modified herein. Mechanical and electrical machinery not related to additional optional notations, such as **DPS**, **AMS-NP**, **AMCC**, or **AMCCU**, need not be inspected at the plant of the manufacturer, but will be accepted subject to satisfactory performance witnessed by the Surveyor after installation. Mechanical and electrical machinery of 135 horsepower and over is to be of an approved design. All machinery under 135 horsepower is to be constructed and equipped in accordance with good commercial practice.

Plans showing the general arrangement of all machinery spaces are to be submitted for review and/or approval.

15.3 Pumps and Piping Systems

15.3.1 General

Piping system design, fabrication and testing is to comply with Part 4, Chapter 6 of the *Marine Vessel Rules*.

15.3.2 Plans and Data to be Submitted

As applicable, three copies of plans showing clearly the arrangement and details of the following are to be submitted (see also 5-3-6/1.7):

- i) Fresh water and portable water systems
- ii) Sanitary system
- iii) Vent and overflow pipes
- iv) Fuel systems
- v) Lubricating-oil systems
- vi) Liquid level indicating systems
- vii) Hydraulic systems
- viii) Sea water and fresh water systems
- ix) Compressed air systems
- x) Fire-main and fire-extinguishing systems
- xi) Ballast systems

The plans are to consist of a diagrammatic drawing of each system accompanied by lists of material giving size, wall thickness, maximum working pressure and material of all pipes and the type, size, pressure rating, and material of valves and fittings.

In addition to the above plans, a booklet of standard details containing standard practices to be used in the construction of the barge, typical details of such items as bulkhead, deck and shell penetrations, welding details, pipe joint details, etc. This information may be included in the system plans.

15.5 Fabrication and Tests of Metallic Piping

15.5.1 Welded Fabrication

Requirements for welding of pipes and fittings, heat treatment and nondestructive testing are given in Section 2-4-4 of the *ABS Rules for Materials and Welding (Part 2)*. For the purpose of radiography, see 2-4-4/11.3.1 of the *ABS Rules for Materials and Welding (Part 2)*.

15.5.2 Hydrostatic Tests

15.5.2(a) Hydrostatic Test of Pipes Before Installation Onboard

All Classes I and II pipes and integral fittings after completion of shop fabrication, but before insulation and coating, are to be hydrostatically tested in the presence of a Surveyor, preferably before installation. See 4-6-2/7 of the *Marine Vessel Rules*.

15.7 Plastic Piping

Rigid plastic piping is to be in accordance with a recognized national or international standard acceptable to ABS. Specifications for the plastic piping, including thermal and mechanical properties and chemical resistance, are to be submitted for review in accordance with Section 4-6-3 of the *Marine Vessel Rules*.

Pipes and piping components made of thermoplastic or thermosetting plastic materials, with or without reinforcement are not to be used in lubricating oil, fuel oil, bilge or fire-extinguishing and protection piping systems. For all other systems plastic piping may be used as permitted by 4-6-3/TABLE 1 of the *Marine Vessel Rules*.

Plastic piping acceptance and testing is to be in accordance with Section 4-6-3 of the *Marine Vessel Rules*.

15.9 Vent Pipes

15.9.1 General

The structural arrangement of all tanks is to be such as to permit the free passage of air and gases from all parts of the tanks to the vent pipes. Vent pipes are to be arranged so that drainage of the vent pipe will be possible under normal conditions.

15.9.2 Protection from Weather and Sea Water Ingress

All vents terminating in the weather are to be fitted with return bends (gooseneck), or equivalent, and the vent outlet is to be an automatic type, i.e., close automatically upon submergence (e.g., ball float or equivalent). See also 4-6-4/9.3.5 of the *Marine Vessel Rules*.

15.9.3 Size and Height

The size of each vent pipe is not to be less than 38 mm (1.5 in.) I.D. for fresh-water tanks, 51 mm (2 in.) I.D. for water ballast tanks and 63 mm (2.5 in.) I.D. for oil tanks unless otherwise specially approved. Where tanks are to be filled by pump pressure, the aggregate area of the vents in the tank is to be at least 125% of the effective area of the filling line. Where overflows are fitted, in addition to vent pipes, the area of the overflow is to be at least 125% of the effective area of the filling line, and the vents need not exceed the above minimum sizes. Notwithstanding the above, the pump capacity and pressure head are to be considered in the sizing of vents and overflows.

Where vent pipes from tanks are exposed to the weather, their height is to be at least 760 mm (30 in.) above the freeboard deck or 450 mm (17.5 in.) above the superstructure deck, except that where these heights may interfere with the working of the barge, a lower height may be specifically approved. The height of vents on barges under 20 m (65 ft) will be specially considered.

15.9.4 Fuel Oil Tanks Vent Outlets

Vent outlets from fuel oil tanks are to be fitted with corrosion-resistant flame screens having a clear area through the mesh of not less than the required area of the vent pipe and are to be located where the possibility of ignition of gases issuing from the vent outlets is remote.

15.11 Sounding Arrangements

All tanks are to be provided with separate sounding pipes or with approved tank-level indicating apparatus. Where a tank-level indicating system is used, a supplementary manual means of sounding is to be provided, where applicable, for tanks which are not always accessible. Where a sounding pipe exceeds 20 m (65.6 ft) in length, the internal diameter is to be at least 50 mm (2 in.).

In general, void compartments adjacent to the sea or to tanks containing liquids, and void compartments through which piping carrying liquids pass are to be fitted with separate sounding pipes, approved tank liquid level indicating apparatus, or be fitted with means to determine if the void tanks contain liquids. Voids as defined above which do not comply with this requirement are to be accounted for in the unit's stability analysis.

15.13 Leakage Containment and Drain System

Fuel oil overflows, drains from fuel and lubricating oil tanks and from drip pans of oil pumps and tanks are to be led to a drain tank fitted with a level indicating device and with an independent suction from the fuel oil transfer pumps.

Where a gutter bar is fitted to intercept the seepage from oil tanks, the well-formed is to be drained into the oil-drain tank by way of drain valves, or the well is to have a suction from the fuel-transfer pump. Tanks are to be vented to the open atmosphere.

15.15 Fuel Oil Systems

15.15.1 General

Fuel oil pumping arrangements are to be separate from other pumping systems.

No fuel-oil tank is to be situated where spillage or leakage can constitute a hazard by falling on heated surfaces. Precautions are to be taken to prevent any oil that may escape under pressure from any pump, filter or heater from coming into contact with heated surfaces.

Fuel-oil pipes, valves and fittings are to be of steel or other approved materials. All packing is to be of a composition not affected by fuel oil.

15.15.2 Pipes in Fuel Oil Tanks

Oil pipes and other pipes, where passing through fuel oil tanks, are to be of steel, except that other materials may be considered where it is demonstrated that the material is suitable for the intended service. All packing is to be of a composition not affected by fuel oil.

Pumps, strainers, etc., are to have drip pans with drains to an oil drain tank.

15.15.3 Valves on Fuel Oil Tanks

Where pipes come out from fuel oil tanks at a level at which they will be subjected to a static head of oil from the tank, they are to be fitted with positive closing valves located at the tank or where the pipes run through adjacent tanks at the point where the pipe enters the machinery space. For tanks with capacity 500 liters (132 US gallons) and above, arrangements are to be provided for closing the valves from a readily accessible and safe location outside the compartment in which the valve is located, see 4-6-4/13.5.3 of the *Marine Vessel Rules*. Where independent filling lines are fitted, they are to enter at or near the top of the tank; but if this be impracticable, they are to be fitted with non-return valves at the tank.

For remote shutdown of pumps see 5-3-1/9.3 of the *MOU Rules*.

15.15.4 Independent Tanks

Tanks not forming part of the structure are to have suitable drip pans with drains to oil drain tanks.

15.17 Lubricating-oil Systems

The lubricating systems are to be so arranged that they will function satisfactorily under normal operating conditions. The lubricating-oil piping is to be entirely separated from other piping systems. In addition, the requirements of 5-3-6/15.15 are applicable. Sight flow glasses may be used in lubricating systems provided they are fire-resistant.

15.19 Bilge Systems

15.19.1 General

All accommodation barges are to be provided with a fixed power operated bilge system capable of pumping from and draining any compartment below the freeboard or bulkhead deck. Bilge pumping systems are to be capable of draining the spaces when the barge is on even keel or either

upright or listed 5 degrees on either side. At least two power driven bilge pumps are to be provided, and each is to have a capacity of not less than 11.0 m³/hour (50 gpm).

The bilge pumps and their sources of power are to be so distributed throughout the length of the barge that at least one pump in an undamaged compartment will be available.

The least internal diameter of bilge suction pipes is to be that of the nearest commercial size within 6 mm (0.25 in.) of the diameter determined by the following equations.

15.19.2 Barges 61 Meters (200 Feet) and Over

On barges 61 meters (200 ft) and over, at least three power pumps are to be fitted to the bilge main. Each power bilge pump is to be capable of pumping water through the required main bilge at a speed of not less than 2 m/sec (6.56 ft/sec). Sanitary, ballast and general service pumps may be accepted as independent power bilge pumps.

One of the required independent power pumps is to be fitted with a suction led directly from the pump room bilge to the suction main of the pump, so arranged that it can be operated independently of the bilge system. The size of this line is to be such that the pump will deliver its full capacity. The direct bilge suction is to be controlled by a stop-check valve. Barges with multiple pump rooms will be subject to special considerations.

15.19.3 Main Line

For the diameter of main-bilge-line suction and direct bilge suction to the pumps:

$$d = 25 + 1.68\sqrt{L(B + D)} \quad \text{mm}$$

$$d = 1 + \sqrt{\frac{L(B + D)}{2500}} \quad \text{in.}$$

15.19.4 Branch Lines

For the equivalent diameter of the combined branch suction to a compartment:

$$d_B = 25 + 2.16\sqrt{c(B + D)} \quad \text{mm}$$

$$d_B = 1 + \sqrt{\frac{c(B + D)}{1500}} \quad \text{in.}$$

where

- d = internal diameter of pipe in millimeters (inches)
- L = length of barge in meters (feet)
- B = breadth of barge in meters (feet)
- D = molded depth to main deck in meters (feet)
- c = length of compartment in meters (feet)

15.19.5 Size Limits

No main or branch suction piping is to be less than 50 mm (2.0 in.) internal diameter.

15.21 Ballast Systems

Water ballast systems are systems that use the movement of sea water (or other fluids) into, out of, or between ballast tanks to alter the draft, heel or trim of the barge. Water ballast systems are to be in compliance with the requirements of 4-6-4/7 of the *Marine Vessel Rules*.

15.23 Boilers and Pressure Vessels Including Heat Exchangers

15.23.1 General

Boilers and pressure vessels, including heat exchangers, are to be designed, constructed, and installed in accordance with the applicable requirements of Section 4-4-1 of the *Marine Vessel Rules* or other recognized standards.

17 Electrical Systems

17.1 General

Electrical installations are to comply with this Section and the applicable requirements of Part 4, Chapter 8 of the *Marine Vessel Rules*, as far as acceptable details for generators, motors, switchgear, transformers, electric cable and methods of installation. Alternatively, reference may be made to a recognized standard such as the National Electric Code (NEC – National Fire Protection Association No. 70). All generators, including emergency generators, motors, and other rotating machines of 100 kW (135 hp) and over are to be tested in the presence of and inspected by the Surveyor, preferably at the plant of the manufacturer. For machines of less than 100 kW (135 hp), the tests may be carried out by the manufacturer provided that the certificate of tests is to be submitted and thereafter accepted by ABS.

17.3 Plans and Data to be Submitted

The following plans and data are to be submitted as applicable:

- i) Electrical load analysis
- ii) Generators and motors including complete rating, class of insulation, rated ambient temperature, rated temperature rise, enclosure type, and standard to which manufactured
- iii) Transformers including rating, class of insulation, rated ambient temperature, rated temperature rise, installation details including cooling, fire protection, and vault details
- iv) Switchgear, switchboards and power distribution boards including arrangements and details, front view, installation arrangements, wiring diagram including arrangements, wiring diagram including a schematic diagram and the setting or rating of each overcurrent device, and its associated interrupting capacity
- v) Motor-control center equipment including terminal arrangements, degree of enclosure, and wiring diagram including a schematic diagram and the setting or rating of each overcurrent device, and its associated interrupting capacity
- vi) Electrical elementary wiring plan, with a complete feeder list, giving for each feeder and branch circuit the load, wire size, type of wire or cable, rating or setting of circuit breakers, rating of fuses, and switches
- vii) Short-circuit analysis and coordination study. The analysis is to be submitted giving the maximum calculated short-circuit current at each point in the distribution system. A system coordination study is to be submitted to show that selective coordination is achieved under all fault conditions.
- viii) Cathodic protection where the plan is to give details of impressed-current-cathodic protection systems
- ix) Batteries having a charging facility of over 2 kW give the details of the arrangement, ventilation, and corrosion protection
- x) Emergency Lighting and power isometric or deck plan
- xi) Fire detection and alarm system
- xii) Emergency warning system
- xiii) Hazardous area plans (such as battery rooms, paint rooms if provided) and documentation for all electrical equipment installed therein

17.5 General Considerations

17.5.1 Watertightness

Electrical equipment exposed to the weather or other severe moisture conditions is to be of watertight or protected by a watertight enclosure.

17.5.2 Corrosion Resistance

Enclosures, working and other parts of electrical equipment which may be damaged or rendered ineffective by corrosion are to be made of corrosion-resistant materials or of material rendered corrosion resistant.

17.5.3 Grounding

Where not obtained through normal construction, arrangements are to be provided to effectively ground all machinery, metal structures of derricks, masts, and helicopter platforms.

17.5.4 Structure

The structure is not to be used as a normal current carrying conductor.

17.7 Rotating Electrical Machinery

Motors and generators are to be designed, constructed and tested to 4-8-3/3 of the *Marine Vessel Rules*. Motors and generators manufactured to a recognized standard such as NEMA, BSS, VDE, or IEC may be considered. Where equipment has been rated on ambient temperatures less than the ambient temperatures expected, the application of the equipment is to be such that the total temperature for which the equipment is rated will not be exceeded.

17.9 Cables and Wiring

Cables and wiring are to be constructed in accordance with 4-8-3/9.1 of the *Marine Vessel Rules*. All electrical cables are to be at least of a flame retardant type that complies with the requirements of 4-8-3/9.5 of the *Marine Vessel Rules*. Industrial cables, such as ICEA, NEMA cables may be used provided they are of a type suitable for use in damp and wet locations as well as of a type that meets the flame retardancy properties mentioned above.

17.11 Protection and Coordination

Cables, wiring, and equipment are to be provided with overcurrent (overload and short circuit) protection in accordance with 4-8-2/9 of the *Marine Vessel Rules*. Compliance with a recognized standard such as IEC and IEEE standards or the NEC may be considered. The coordination of protective devices is to be in accordance with 4-8-2/9.7 of the *Marine Vessel Rules*.

17.13 Power Supply

At least two independent sources of electrical power are to be provided. The capacity of the sources is to be such that the full electrical load may be generated with any one source not in operation.

17.15 Emergency Source of Power

17.15.1 General

A self-contained emergency source of power, located on or above the freeboard or bulkhead deck, and its associated equipment is to be provided if a fire or other casualty in any space will make the two independent sources of electrical power required by 5-3-6/17.13 inoperative. The space containing the emergency source of power is to be separated from category "A" machinery space by a Class A-60 bulkhead.

Where an emergency source of power is not fitted, the two independent sources of electrical power required by 5-3-6/17.13 are to have their own systems, including power distribution and control systems, completely independent of the system in the other space and such that a fire or other casualty in any one space will not affect the power distribution in the other. In addition, the

two independent source of electrical power are to comply with 5-3-6/17.15.2, 5-3-6/17.15.4, and 5-3-6/17.15.5.

17.15.2 Power Supply

The power available is to be sufficient to supply for at least 18 hours all services necessary for safety in an emergency, particular attention being given to the following:

- i) Navigation and special purpose lights and warning systems including helicopter landing lights
- ii) Emergency lighting for machinery spaces, control stations, alleyways, stairways, exits, and elevators
- iii) Emergency lighting at embarkation stations on decks and over sides
- iv) General alarm and communications systems
- v) Emergency lighting at stowage position(s) for firemen's outfits
- vi) Fire detection and alarm systems
- vii) Fire-extinguishing systems
- viii) Emergency lighting at helicopter landing decks
- ix) Abandonment systems dependent on electrical power

17.15.3 Emergency Source of Power

The emergency source of power may be either a generator or an accumulator battery.

17.15.3(a) Emergency Generator

If the emergency source of electrical power is a generator, the generator is to have an independent supply of fuel, be started automatically upon failure of the electrical supply from the main source of electrical power and be connected automatically to the emergency switchboard. Unless a second independent means of starting the emergency generator is provided, the single source of stored energy should be protected to preclude its complete depletion by the automatic starting system.

The automatic starting system and the characteristic of the prime mover is to be such as to permit the emergency generator to carry its full rated load as quickly as is safe and practicable, subject to a maximum of 45 seconds.

17.15.3(b) Accumulator Battery

Where the emergency source of power is an accumulator battery it is to be capable of carrying the emergency load without recharging while maintaining the voltage of the battery throughout the discharge period within plus or minus 12 percent of its nominal voltage, automatically connecting to the emergency switchboard in the event of failure of the main power supply and immediately supplying at least those services specified in 5-3-6/17.15.2.

17.15.4 Transitional Source of Emergency Power

Where an emergency source of power is not fitted or where the emergency source of power is a generator, a transitional source of emergency power is to be installed consisting of storage batteries of sufficient capacity to supply the rated voltage and amperage for at least 30 minutes to the following:

- i) Emergency lighting
- ii) Fire detection and alarm systems
- iii) General alarm and communications systems

Arrangements are to be such that the transitional source of emergency power will come into operation automatically in the event of failure of the main electrical supply.

17.15.5 Testing

A means is to be provided for periodic testing of the emergency source of power and the transitional source of power, if provided, and is to include the testing of automatic arrangements.

19 Mooring Equipment

19.1 General

The following position mooring equipment notations or position mooring system certification are to be performed at the request of the Owner.

The symbols are not required as a condition of classification.

19.3 Temporary Mooring Equipment

At the request of the Owner, the symbol **ⓔ** can be placed after the symbols of classification in the Record; for example, **⊗ A1 ⓔ** signifies that the equipment for temporary mooring is in compliance with the applicable requirements of Section 3-3-1. For barges with symbol **Ⓟ**, this requirement may be met if position mooring equipment can be released in an emergency while the barge is in the transit mode.

The equipment weight and size for accommodation barges, where the symbol **ⓔ** is requested, are to be in accordance with 3-3-1/Table 1

Accommodation barges for which the symbol **ⓔ** is not requested in the classification designation are to have equipment in accordance with 3-3-1/Table 2. Wire rope of equal breaking strength to the required tabular normal strength steel (Grade 1) stud-link bower chain will be approved in lieu of the required anchor chain, but the length of the wire rope is to be not less than 1.5 times the tabular chain length. See also 5-3-6/19.5.

19.5 Position Mooring System

Class notation **Ⓟ**, as defined in 2/3.5 of the *ABS Requirements for Position Mooring Systems*, is required for accommodation barges with the anchoring arrangement as sole means of position keeping (i.e., DP system is not installed or does not have the required redundancy).

The symbol **Ⓟ** placed after the symbols of classification in the *Record*; for example, **⊗ A1 Ⓟ** **Accommodation Barge** signifies the mooring system has the position mooring capability of the barge under owner specified environmental conditions and meets the requirements specified in the *ABS Requirements for Position Mooring Systems*, and that the mooring equipment, anchors, chain or wire rope for position mooring are satisfactorily tested in accordance with the specifications of the Owner and in the presence of a Surveyor.

Accommodation barges intended to be moored at the same site for periods longer than 5 years are to meet site-specific mooring criteria in Section 6-1-1 of *ABS Rules for Building and Classing Floating Production Installations*.

Dynamic positioning systems complying with the requirements of the *ABS Guide for Dynamic Positioning Systems*, manufactured and installed under ABS survey and found satisfactory after trials, will be distinguished in the Record by the notation **⊗ DPS-0**, **⊗ DPS-1**, **⊗ DPS-2** or **⊗ DPS-3**, as appropriate.

Position (pre-laid) mooring system complying with the requirements of the *ABS Guide for the Classification Symbols Pre-laid Position Mooring Systems and Equipment for Mobile Offshore Units*,

manufactured and installed under ABS survey and found satisfactory after trials, will be distinguished in the *Record* by the notation (**P-PL**) (Position (pre-laid) mooring systems).

21 Surveys

21.1 Testing, Trials and Surveys During Construction

The requirements for hull testing, trial, and survey during construction are given in Part 3, Chapter 4.

21.3 Surveys After Construction

For the requirements for surveys after construction, refer to Chapters 1 through 9 of the *ABS Rules for Survey After Construction (Part 7)*, as applicable.

23 Limited or Restricted Service

23.1 General

This Section is intended for Accommodation Barges which are intended to operate in offshore locations. 5-3-6/1.5.2 provides that special modified requirements can be accepted for limited or restricted service.

There is a multitude of limited or restricted services that could be considered, each with special modified requirements to meet the intention of this Section. It is not possible to indicate all combinations acceptable to ABS and as an example we have indicated below what could be accepted for accommodation barges for a harbor installation.

23.3 Harbor Service

For an accommodation barge tied up at a pier or land mass and safe egress thereto and power and utilities supplied from shore, the following modifications to this Section are acceptable to ABS.

23.3.1 Fire Pumps

The fire pumps, fire mains, hydrants and hoses are to be in accordance with 5-3-6/3.5.2 except that where shore supply of water is available for fire-fighting purposes, the requirements for fire pumps may be as indicated below.

Where the shore side pressure is not sufficient to meet 5-3-6/5.5.2, a booster pump with automatic starting is to be provided. In addition, an independently driven emergency fire pump of the capacity specified in 5-3-6/5.5.2 is to be provided and the fire main is to be fitted with a non-return valve between the shore connection and the first hydrant.

23.3.2 Lifesaving Appliances and Equipment

The only life-saving appliances and equipment required are the following.

- i) *Life Jackets*. Life jackets for five percent of the number of persons onboard the barge are to be provided in suitable locations on the offshore side of the barge.
- ii) *Life Buoys*. Life buoys in accordance with Section 4 are to be provided.
- iii) *Emergency Procedures*. Emergency procedures in accordance with 5-3-6/7 are to be provided as applicable.
- iv) *Guards and Rails*. Guards and rails are to be provided in accordance with 5-3-6/5.7 are to be provided.

23.3.3 Radio Communication Installations

Radio communication installations are not required if land communications are provided.

23.3.4 Electrical Power

Where the electrical power is supplied from shore, the two independent sources of power indicated in 5-3-6/17.13 are not to be required. However, if the accommodation barge does not have its own source of power, an emergency source of power required by 5-3-6/17.15 is to be fitted the supply to be sufficient for at least 6 hours for the services listed.

PART 5

CHAPTER 3 Other Barge Types

SECTION 7

Wind Turbine Installation, Maintenance, and Repair (Wind-IMR) (2019)

1 General

1.1 Application

The requirements in this Section apply to barges intended for unrestricted service which are engaged in the installation, maintenance, and repair of offshore wind turbines and may include various equipment used to perform or support functions such as pile driving, installation, maintenance, and repair of jackets, towers, nacelles, and/or blades.

1.3 Classification

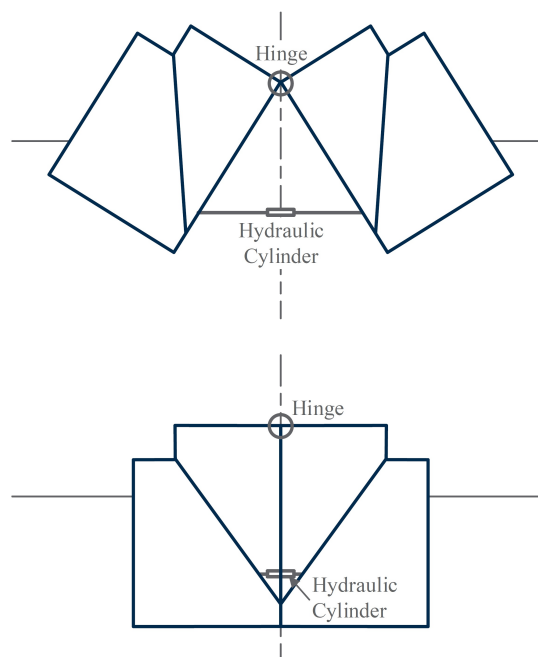
The classification **A1 Barge (Wind IMR)** will be assigned to barges built in compliance with 5D-14-1 of the *ABS Rules for Building and Classing Marine Vessels*.

1 General**1.1 Purpose**

This Section provides requirements for review of split-hull hopper barges that are divided longitudinally into two separate hulls, with their cargo carried in a hopper forming the double skin.

1.3 Background

Traditionally, split-hull hopper barges comprise two half hulls connected by hinges at the top of the coaming and affixed by hydraulic cylinders located in a recess beneath the hinges, with one located at each end of the cargo hold. The cargo is unloaded by forcing the two halves apart using hydraulics, thus releasing the cargo into the sea by gravity as shown in 5-3-8/Figure 1 below.

FIGURE 1

Unlike conventional vessels/barges, each half of the split-hull hopper barge articulates independently, and the hull girder loads act similarly.

1.5 Application

This Section applies to barges only. Other vessels will be subject to special consideration by ABS upon request.

The global strength of a split-hull barge is to comply with these requirements. The local scantlings are to be evaluated to the current *Marine Vessel Rules* and/or *Barge Rules*, as applicable.

1.7 Definitions

Split Hull. A barge that is divided longitudinally into two separate hulls.

3 Design Review of Split Hull Hopper Barge

3.1 General

The following drawings are to be submitted for review:

- i) General arrangement
- ii) Tank capacity plan
- iii) Scantlings

The specific drawings and details to be submitted depend on the specific barge design. Contact ABS for guidance.

3.3 Administration Review

Where the flag Administration has additional requirements, the hull structures are to be reviewed for compliance with the same in addition to these requirements.

Any limits to the Administration review and the acceptance criteria used are to be appropriately reflected in the ABS approval letter.

3.5 Structural Requirements

The hull scantlings are to be reviewed in accordance with this Section, in addition to the requirements in the *Barge Rules*.

3.5.1 Primary Hull Strength

In addition to the moments due to vertical forces usually considered, moments due to horizontal forces are also to be considered. As the main inertia axes of each half are oblique with respect to the general axes, the loads exert torsional forces.

Each split hull will experience vertical loads due to still-water and wave bending, and horizontal loads due to still-water and wave bending and torsional forces whose line of action do not pass through its shear center.

3.5.1(a) Vertical Still-water and Wave Bending Moment

For vertical bending moment loads, refer to Section 3-2-1 of the *Marine Vessel Rules*.

3.5.1(b) Horizontal Still-water and Wave Bending Moment

The horizontal still-water bending moment resulting from the cargo and external hydrostatic pressure is to be obtained from the equation below. The horizontal bending moments are applied to one-half of the hull assuming that the hopper well is simply supported at each end. Where the

hopper wells are not simply supported at ends, the loads will be subject to special consideration by ABS.

i) *Horizontal Still Water Bending*

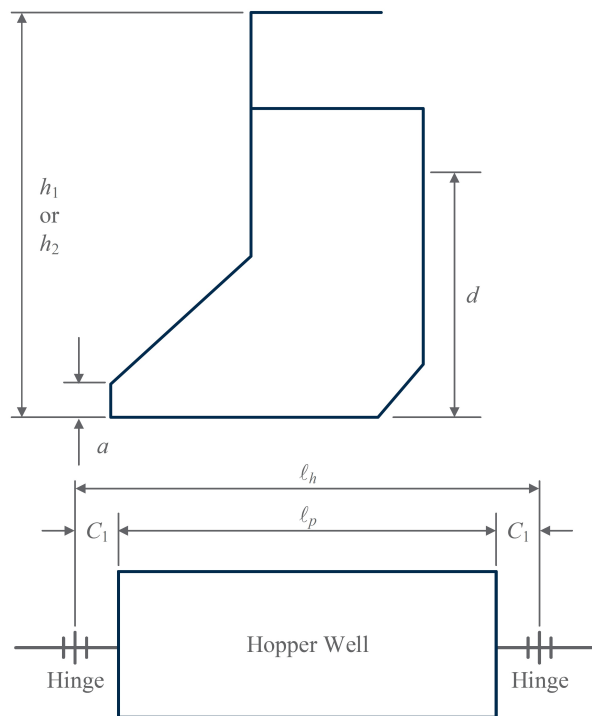
The horizontal bending moments caused by the forces exerted by horizontal cargo and hydrostatic loads acting on the hull are calculated as follows.

$$M_{HS} = F * \ell_p^2 * (1 + 4 * C_1 / \ell_p) / 8 \text{ kN-m}$$

where

- C_1 = distance from deck hinges to ends of hopper well, in m
- F = $F_{hf} - F_{df}$, load per meter, in kN/m, applied along the hopper well
- F_{df} = $4.9\rho[(h_1 \text{ or } h_2) - a]^2$, horizontal load due to cargo, in kN/m
- h_1, h_2 = cargo height based on stability or cargo specific gravity, in m
- ρ = cargo specific gravity
- F_{hf} = $5.026(d - a)^2$, horizontal external hydrostatic pressure, in kN/m
- ℓ_p = length of the hopper well, in m

FIGURE 2



ii) *Horizontal Wave Bending*

The horizontal wave bending moments are calculated using the following equation.

$$M_{HW} = [d - 0.079 * C * (2 * \ell_h / L - 1)(C_b + 0.7)] M_{vw} / B \text{ kN-m}$$

where

- d = draft, in m
- C = wave coefficient (see 3-2-1/3.5 of the *Marine Vessel Rules*)
- ℓ_h = distance between hinges, in m
- L = scantling length, in m
- C_b = block coefficient of the barge
- M_{VW} = vertical wave bending moment, in kN-m
- B = breadth of the barge, in m

iii) *Combined Bending Moment*

The total vertical bending moment M_V acting on each half-hull is to be obtained from the following equation.

$$M_V = (M_{VS} + M_{VW})/2 \text{ kN-m}$$

The total horizontal bending moment M_H acting on each half-hull is to be obtained from the following equation.

$$M_H = M_{HS} + M_{HW} \text{ kN-m}$$

3.5.1(c) *Hull Girder Stress*

i) *Hull Girder Axes*

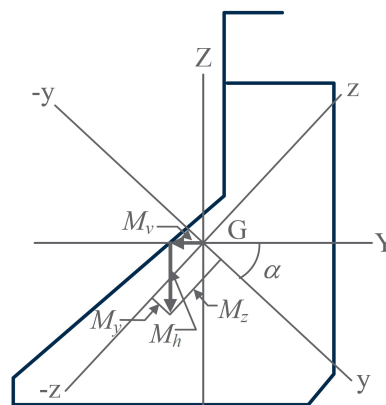
The principal axes G_y and G_z are obtained from closed hull axes GY and GZ by the rotation of hull around the center of gravity G about an angle α using the following equation.

$$\alpha = 0.5 \text{atan}[2I_{YZ}/(I_Z - I_Y)]$$

where

- I_Y = moment of inertia of the transverse section around GY axis, in m^4
- I_Z = moment of inertia of the transverse section around GZ axis, in m^4
- I_{YZ} = moment of inertia product of the transverse section about GY, GZ axes, in m^4

FIGURE 3



ii) *Bending Moment about Principal Axes*

The bending moments in relation to principal axes Gy and Gz are obtained using the following equation. The equation is reliant on the basis of angle of the principal axis. If the principal axis is rotated α , clockwise about the origin, then the following equation is to be used.

$$M_y = M_V \cos \alpha + M_H \sin \alpha \text{ kN-m}$$

$$M_z = -M_V \sin \alpha + M_H \cos \alpha \text{ kN-m}$$

where

M_V = vertical total bending moment, in kN-m

M_H = horizontal total bending moment, in kN-m

If the principal axis is rotated α , counterclockwise about the origin, the corresponding functional forms are to be used.

iii) *Hull Girder Normal Stresses*

At any point of the transverse section of each hull, the hull girder normal stresses are to be calculated using the following equation.

$$\text{Normal Stress} = \left[(z * M_y / I_y) + (y * M_z / I_z) \right] 10^{-3} \text{ N/mm}^2$$

where

y = y coordinate of the calculation point with respect to principal axes Gy, in m

z = z coordinate of the calculation point with respect to principal axes Gz, in m

I_y = principal moment of inertia along Gy axis, in m⁴

I_z = principal moment of inertia along Gz axis, in m⁴

As a minimum, the hull girder stresses are to be calculated at extreme fibers, bilge, hatch coaming, and seal bottom at centerline.

3.5.1(d) *Allowable Hull Girder Stress*

The nominal bending stress values are not to exceed 17.5 kN/cm². For shear stress, refer to the applicable sections of Part 3.

3.5.1(e) *Torsion*

For unsymmetrical hulls, the torsional loads acting on the hull are to be determined. Hull structures are to be adequately designed to withstand these loads. The torsional moment along the hold can be obtained by integrating the unit torque over the hold length.

Torsional strength evaluation is to be performed for barges having hopper well length exceeding 61 m.

For barges with unsymmetrical hulls or with a hopper length exceeding 61 m, detailed calculations of the torsional moment along the length of the hold are to be submitted to ABS for review. Global torsional strength analysis may be performed in lieu of detailed calculations of the torsional moment along the length of the hold according to 5-3-8/3.7 below.

3.5.1(f) *Limitations*

Split hopper hull with horizontal compression plates welded at the deck and vertical shear plates welded on shell plating as inserts near the hinges at the barge's centerline will cause a degree of fixity at these hinges and thus render the equations statistically indeterminate. The degree of fixity may be determined using the theorem of three moments. Split-hull design with compression plates and shear plates will be subject to special consideration by ABS.

Where compression plates and shear plates are provided, additional detailed calculations are to be submitted to ABS review. Alternatively, global analysis may be performed as per 5-3-8/3.7 below.

3.5.1(g) Structural Continuity

The scantlings of the midship region are generally to be maintained over the full length of the hopper well.

The fore and aft ends of the longitudinal bulkheads of the hopper spaces are to be extended by large brackets generally having a length and a width equal to $D/4$. It is recommended that radiused brackets be provided.

3.5.2 Hinges and Cylinders

The hinges and cylinders are the main elements of split hulls subject to static and dynamic forces. Longitudinal chocks are to be provided at the bottom and deck level to prevent relative displacement of the two hulls.

3.5.2(a) Cylinders

The loads acting on deck cylinders are calculated based on the following assumptions:

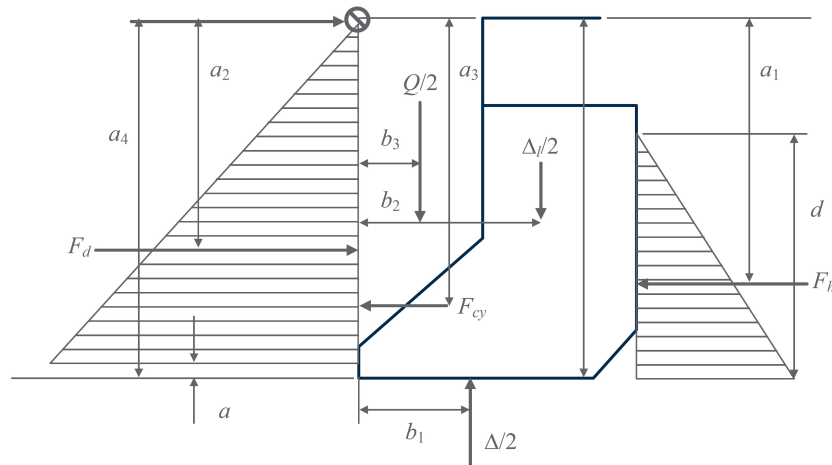
- 1) The total number of hydraulic cylinders connecting both hulls is even.
- 2) Only one cylinder is installed at a transverse section.
- 3) There is a deck hinge at each end of the hopper well.

All other arrangements will be subject to special consideration by ABS.

The cylinder foundation supporting structures is to be designed to withstand the force F_{CY} in each jack, greater of F_{MC} or F_P .

F_{MC}	=	minimum force required to keep the split hull in closed position = $M_h/n_{cy}a_3$, in kN
M_h	=	moment with respect to hinge (positive to open and negative to close) = $-F_h a_1 + F_d a_2 + 0.5(\Delta b_1 - \Delta_l b_2 - Q b_3)$, in kN-m
n_{cy}	=	number of cylinders
Δ	=	total displacement of the barge with spoil, in kN
Δ_l	=	total displacement of the barge without spoil, in kN
Q	=	total weight of the spoil in hold, in kN
a_1, a_2, a_3, a_4	=	lever arm for horizontal forces, in m
b_1, b_2, b_3, b_4	=	lever arm for vertical forces, in m
F_P	=	cylinder force corresponding to pressure on the rod side equal to maximum pressure of the pumps and of their pressure limiting device, in kN

FIGURE 4



3.5.2(b) Hinges

The designer/shipyard is to submit design documentation showing the structural adequacy of the hinge and pin. This may include test reports, calculations or evidence of satisfactory service experience. The design loads submitted by the designer/shipyard are to consider static and dynamic loads for the intended service of the barge.

The material grades of the hinges and pins are to be in accordance with the *ABS Rules for Materials and Welding (Part 2)*.

The hinge foundation supporting structures are to be designed to withstand the minimum load as calculated using the following equation.

$$F_{HG} = 0.5[F_h - F_d + n_{cy}(1 - (a_3/a_4))F_{CY} + (M_h/a_4)] \text{ kN}$$

where,

$$F_h = 5.026(d - a)^2 \ell_p, \text{ horizontal external hydrostatic force, in kN}$$

$$F_d = 4.9\rho[(h_1 \text{ or } h_2) - a]^2 \ell_p, \text{ horizontal force due to cargo, in kN}$$

3.5.2(c) Allowable Stresses

For beam and grillage models, the following allowable stress values are to be used. For FEA with plate models, refer to 3-2-20/9 of the *Marine Vessel Rules*.

Normal Stress - 60% of material yield strength

Shear Stress - 40% of material yield strength

3.5.2(d) Material

For material grade up to 4 inches, refer to 3-1-2/Tables 1 and 2. Where the plate thickness is more than 4 inches, the material grade is to be "E" or "EH". Also refer to the requirements of 2-1-1/16 of the *ABS Rules for Materials and Welding (Part 2)*. Forged material or other equivalent material grades will subject to special consideration by ABS.

3.5.2(e) Welding

Welds in way of hinge and cylinder foundation supports are to be full penetration welds. Welds in other locations with high stresses are to be full penetration welds.

3.7 Direct Analysis Approach

In lieu of complying with the above guidelines, an alternate direct analysis approach using Finite Element Method (FEM) will be specially considered by ABS. For FEM guidelines, see the ABS *Guide for Safe Hull Dynamic Loading Approach for Vessels*.