RUSSIAN MARITIME REGISTER OF SHIPPING

Электронный аналог печатного издания,
утвержденного 17.07.06

RULES

FOR THE CARRIAGE OF GRAIN

НД No 2-020101-013-E

Saint-Petersburg
2006

Rules for the Carriage of Grain have been approved in accordance with the established approval procedure Regulations and come into force since their publication.

With publication of the present Rules, the Rules of the same name, 1996, cease to be effective.

Paragraphs marked with the symbol * contain requirements which are specific for the Russian Maritime Register of Shipping and are not contained in the International Code for the Safe Carriage of Grain in Bulk.

ISBN 5-89331-073-X

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PART I. MAIN REQUIREMENTS

1 APPLICATION, SCOPE OF SURVEY AND GENERAL TECHNICAL REQUIREMENTS

1.1 Rules for the Carriage of Grain[1] apply to ships regardless of size, including cargo ships of less than 500 gross tonnage, engaged in the carriage of grain in bulk.

The present Rules have been developed in accordance with Part C of Chapter VI of International Convention for the Safety of Life at Sea, 1974, as amended and with Resolution MSC. 23(59) of International Maritime Organization, and comprise all the requirements of the International Code for the Safe Carriage of Grain in Bulk attached to this Resolution.

1.2 For the purpose of the present Rules the term "ship constructed " means "the ship a keel of which is laid or which is at the similar stage of construction".

1.3 * Scope of survey.

1.3.1 For each ship covered by the present Rules requirements Russian Maritime Register of Shipping carries out:

.1 examination and approval of the technical documentation relating to grain carriage prior to construction, conversion or modification of a ship;

.2 approval of Information on Stability of the Ship Loaded With Grain during construction and trials of a ship, and also for ships in service;

.3 performance of surveys for detection of changes in light ship loading during operation, repair, conversion or modification of a ship with a purpose to conclude about the further suitability of Information on Stability of the Ship Loaded With Grain.

1.3.2 General provisions relating to a survey procedure are given in General Regulations for the Classification and Other Activity and in Part I "General Provisions on Technical Supervision of Ships in Service" of Guidelines on Technical Supervision of Ships in Service.

1.3.3 Prior to ship's construction the following technical documentation (approval not stamped) shall be submitted to the Register for consideration:

.1 materials required in 3.2.5, Part I "Classification" of Rules for the Classification and Construction of Sea-Going Ships;

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[1] Hereinafter referred to as "the present Rules".

[2] Hereinafter referred to as "the Register".

.2 calculation and curves of volumes and centres of gravity of cargo compartments depending on the level of their filling;

.3 calculation and curves of heeling moments due to grain shifting (with arrangements limiting grain shifting and without them) depending on the level of compartment filling for a common and separate loading of cargo compartments;

.4 diagram or table for stability checking by maximum permissible heeling moments and calculations on the basis of which it is made (may be presented in the course of approval of Information on Stability of the Ship Loaded With Grain);

.5 calculated materials on typical grain loading plans (distribution of stores, ballast and load, loading calculation, checking stability calculations, calculations validating ballasting recommendations, etc). Calculations are carried out for the ship under departure and arrival conditions and, if necessary, under the worst intermediate service condition;

.6 drawings of devices for grain carriage, if fitted, along with strength calculations (approval is stamped);

.7 checking calculations of ship's strength for cases of non-uniform loading along the ship.

1.3.4 In order to approve the Information on Stability of the Ship Loaded With Grain, in addition to the documentation mentioned in 1.3.3, the Register-authenticated Inclining Test Report on the basis of which the Information was drawn up shall be submitted.

1.4* General technical requirements.

1.4.1 The ship's stability shall meet the requirements of Part IV "Stability" of Rules for the Classification and Construction of Sea-Going Ships, and also the requirements of the Rules.

1.4.2 The longitudinal and local strength of a ship shall be sufficient and comply with the requirements of Part II "Hull" of Rules for the Classification and Construction of Sea-Going Ships.

1.4.3 Calculations shall be carried out in accordance with the requirements of 3.8, Part II "Technical Documentation" of Rules for Technical Supervision During Construction of Ships and Manufacture of Materials and Products for Ships and with the requirements of Part IV "Stability" of Rules for the Classification and Construction of Sea-Going Ships.

2 DEFINITIONS

2.1 For the purpose of the present Rules the following defenitions have been adopted.

2.1.1 Grain covers wheat, maize (corn), oats, rye, barley, rice, pulses, seeds and processed forms thereof, whose behaviour is similar to that of grain in its natural state.

2.1.2 Filled compartment, trimmed, is any cargo space in which, after loading and trimming as required under 10.2, the grain in bulk is at its highest possible level.

2.1.3 Filled compartmen, untrimmed, is a cargo space which is filled to the maximum extent possible in way of the hatch opening but which has not been trimmed outside the periphery of the hatch opening either by the provisions of 10.3.1 for all ships, or 10.3.2 for specially suitable compartments.

2.1.4 Partly filled compartment is any cargo space wherein the grain in bulk is not loaded in the manner prescribed in 2.1.2 or 2.1.3.

2.1.5 Angle of flooding (θ_1) is an angle of heel at which openings in the hull, superstructures or deckhouses, which can not be closed weathertight, immerse. In applying this definition, small openings through which progressive flooding can not take place need not be considered as open.

2.1.6 Stowage factor for the purposes of calculating the grain heeling moment caused by a shift of grain is the volume per unit weight of the cargo as attested by the loading facility, i. e. no allowance shall be made for lost space when the cargo space is nominally filled.

2.1.7 Specially suitable compartment is a cargo space which is constructed with at least two vertical or sloping, longitudinal, grain-tight bulkheads which are coincident with the hatch side girders or are so positioned as to limit the effect of any transverse shift of grain. If sloping, the bulkhead shall have an inclination of not less than 30° to the horizontal.

3 DOCUMENT OF AUTHORIZATION (CERTIFICATE OF FITNESS)

3.1 A Document of Authorization is issued for every ship loaded in accordance with the Rules by the Register on behalf of the Flag State Administration. It shall be accepted as evidence that the ship is capable of complying with the requirements of the Rules and the International Grain Code.

3.2 The Document of Authorization shall accompany the Information on Stability of the Ship Loaded With Grain provided to enable the Master to meet the requirements of Section 7. The Information shall meet the requirements of 6.3.

3.3 The Document of Authorization, Information on Stability of the Ship Loaded With Grain and associated plans may be drawn up in the official language or languages of the issuing country. If the language used is neither

English nor French, the text shall include a translation into one of these languages.

3.4 The Information on Stability of the Ship Loaded With Grain and associated plans shall be placed on board so that the Master, if so required, shall produce them for inspection to official representatives of the country of the port of loading.

3.5 A ship without such a Document of Authorization shall not load grain until the Master demonstrates to the satisfaction of the Administration or of the Contracting Government of the port of loading acting on behalf of the Administration that the ship in its proposed loading condition will comply with the requirements of the present Rules (see also 8.3 and Section 9).

4 EQUIVALENTS

4.1 Where an equivalent accepted by the Administration in accordance with Regulation I/5 of International Convention for the Safety of Life at Sea, 1974, as amended, is used, particulars shall be included in the Document of Authorization or in the Grain Loading Manual.

5 EXEMPTIONS FOR CERTAIN VOYAGES

5.1 On behalf of the Flag State Administration the Register may, if it considers that the sheltered nature and voyage conditions are such as to render the application of any of the requirements of the present Rules unreasonable or unnecessary, exempt from those particular requirements individual ships or group of ships.

6 INFORMATION ON STABILITY OF THE SHIP LOADED WITH GRAIN

6.1 Information in printed booklet form shall be provided to enable the Master to ensure that the ship complies with the requirements of the present Rules (see 6.2 and 6.3).

6.2 General information shall include:

.1 particulars of ship (name, call sign, port of registry, main dimensions, etc.);

.2 inclining test results of the ship or its prototype;

.3 table of liquid free surface corrections;

.4 capacities and centres of gravity of cargo spaces and tanks; cargo spaces layout;

.5 curves or tables of angles of flooding for all openings considered as open;

.6 curves or tables of hydrostatic properties suitable for the range of operating draughts;

.7 cross curves of stability which are sufficient for the purpose of the requirements of Section 7 and which include curves at 12° and 40°.

6.3 Information associated with ship's loading with grain shall include:

.1 curves or tables of volumes, vertical centres of volumes and assumed volumetric heeling moments for every compartment, filled or partly filled, or combination thereof, including the effects of temporary fittings;

.2 tables or curves of maximum permissible heeling moments for varying displacements and varying vertical centres of gravity to allow the Master to demonstrate compliance with the requirements of 7.1;

.3 details of the scantlings of any temporary fittings and, where applicable, the provisions necessary to meet the requirements of Sections 7, 8 and 9;

.4 loading instructions in the form of notes summarizing the requirements of the present Rules;

.5 a worked example for the guidance of the Master;

.6 typical loaded service departure and arrival conditions and, where necessary, intermediate worst service conditions[1].

7 STABILITY REQUIREMENTS

7.1 The intact stability characteristics of any ship carrying grain in bulk shall be shown to meet, throughout the voyage, at least the following criteria after taking into account in the manner described in Part II "Calculation of Assumed Heeling Moments and General Assumptions" and shown in Fig. 7.1, the heeling moments due to grain shift:

.1 the angle of heel due to the shift of grain shall not exceed 12° or the angle at which the deck edge is immersed, whichever is the less;

.2 in the righting lever curve, the net or residual area between the heeling lever curve and the righting lever curve up to the angle of heel of maximum difference between the ordinates of the two curves, or 40° or the angle of flooding (θ_1), whichever is the less, shall in all conditions of loading be not less than 0,075 metre-radians;

[1] It is recommended that loading conditions be provided for three representative stowage factors, e.g. 1,25; 1,50 and 1,75 m^3 per t.

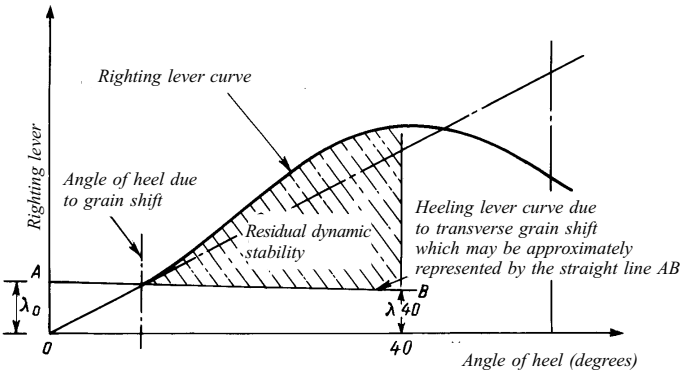

Fig. 7.1

(1) Where:

$$\lambda_0 = \frac{\text{assumed volumetric heeling moment due to transverse grain shift}}{\text{stowage factor} \times \text{displacement}};$$

$$\lambda_{40} = 0{,}8 \times \lambda_0;$$

stowage factor = volume per unit weight of grain cargo;
displacement = weight of ship, fuel, fresh water, stores etc. and cargo.

(2) The righting lever curve shall be derived from cross curves which are sufficient in number to accurately define the curve for the purpose of these requirements and shall include cross curves at 12° and 40°.

.3 the initial metacentric height, after correction for the free surface effects of liquids in tanks, shall be not less than 0,30 m.

7.2 Before loading grain in bulk the Master shall, if so required by official representatives of the country of the port of loading, demonstrate the ability of the ship at all stages of any voyage to comply with the stability criteria required by this Section.

7.3 After loading, the Master shall ensure that the ship is upright before proceeding to sea.

8 STABILITY REQUIREMENTS FOR EXISTING SHIPS

8.1 E x i s t i n g s h i p is a ship, the keel of which is laid before 25 May, 1980.

8.2 An existing ship loaded in accordance with documents previously approved under regulation 12 of chapter VI of SOLAS 1960 Convention, IMO Resolutions A.184(VI) or A.264(VIII) shall be considered to have intact stability characteristics at least equivalent to the requirements of Section 7 of the

present Rules. Documents of Authorization permitting such loadings shall be accepted for the purposes of 7.2.

8.3 Existing ships not having on board a Document of Authorization issued in accordance with Section 3 of the present Rules may apply the provisions of Section 9 without limitation on the deadweight which may be used for the carriage of grain in bulk.

9 OPTIONAL STABILITY REQUIREMENTS FOR SHIPS WITHOUT DOCUMENTS OF AUTHORIZATION

9.1 A ship not having on board a Document of Authorization issued in accordance with Section 3 of the present Rules may be permitted to load grain in bulk provided that:

.1 the total weight of the grain in bulk shall not exceed one third of the deadweight of the ship;

.2 all filled compartments, trimmed, shall be fitted with centreline bulkheads extending, for the full length of such compartments, downwards from the underside of the deck or hatch covers to a distance below a deck line of at least one eighth of the maximum breadth of the compartment or 2,4 m, whichever is the greater, except that saucers constructed in accordance with Section 14 may be accepted in lieu of a centreline bulkhead in and beneath a hatchway except in the case of linseed and other seeds with similar properties;

.3 all hatches to filled compartments, trimmed, shall be closed and covers secured in place;

.4 all free grain surfaces in partly filled compartments shall be trimmed level and secured in accordance with Section 16, 17 or 18;

.5 throughout the voyage the metacentric height after correction for the free surface effects of liquids in tanks shall be 0,3 m or that given by the following formula, whichever is the greater:

$$GM_R = \frac{L\,B\,Vd(0{,}25B - 0{,}645\sqrt{Vd\,B})}{SF \times \Delta \times 0{,}0875} \qquad (9.1.5)$$

where

L = total combined length of all full compartments, m;

B = moulded breadth of the vessel, m;

SF = stowage factor, m^3 per t;

Vd = calculated average void depth calculated in accordance with Section 1 Part II "Calculation of Assumed Heeling Moments and General Assumptions", m (Note: not mm);

Δ = displacement, t;

.6 on demand of official representatives of the country of the port of loading, the Master shall demonstrate that the ship in the proposed loading condition will meet the requirements of this Section.

10 STOWAGE OF GRAIN IN BULK

10.1 All necessary and reasonable trimming shall be performed to level all free grain surfaces and to minimize the effect of grain shifting.

10.2 In any filled compartment, trimmed, the grain in bulk shall be trimmed so as to fill all the spaces under the decks and hatch covers to the maximum extent possible.

10.3 In any filled compartment, untrimmed, the grain in bulk shall be filled to the maximum extent possible in way of the hatch opening but may be at its natural angle of repose outside the perifery of the hatch opening. A filled compartment may qualify for this classification if it falls into one of the following categories:

.1 the Register issuing the Document of Authorization (see Section 3) may, according to Section 6 Part II "Calculation of Assumed Heeling Moments and General Assumptions", grant dispensation from trimming in those cases where, the underdeck void geometry resulting from free flowing grain into a compartment, which may be provided with feeder ducts, perforated decks or other similar means, is taken into account when calculating the void depths;

.2 the compartment is "specially suitable" as defined in 2.1.7, in which case dispensation may be granted from trimming the ends of that compartment.

10.4 If there is no grain in bulk or other cargo above a lower cargo space containing grain, the hatch covers shall be secured in an approved manner having regard to the mass and permanent arrangements for securing such covers.

10.5 When grain in bulk is stowed on top of closed tween-deck hatch covers which are not grain-tight, such covers shall be made grain-tight by taping the joints, covering the entire hatchway with tarpaulins or separation cloths, or other suitable means.

10.6 After loading, all free grain surfaces in partly filled compartments shall be levelled.

10.7 Unless account is taken of the adverse heeling effect due to the grain shift according to the present Rules, the surface of the grain in bulk in any partly filled compartment shall be secured so as to prevent a grain shift by overstowing as described in Section 16. Alternatively, in partly filled compartments, the grain in bulk surface may be secured by strapping or lashing as described in Section 17 or 18.

10.8 Lower cargo spaces and tween-deck spaces in way thereof may be loaded as one compartment provided that, in calculating transverse heeling moments, proper account is taken of the flow of grain into the lower spaces.

10.9 In filled compartments, trimmed; filled compartments, untrimmed; and in partly filled compartments, longitudinal bulkheads may be installed as a device to reduce adverse heeling effect of grain shift, provided that:

.1 the bulkhead is grain-tight;

.2 the construction meets the requirements of Section 11, 12 and 13;

.3 in tween-decks, the bulkhead extends from deck to deck, and in other cargo spaces the bulkhead extends downwards from the underside of the deck or hatch covers (as described in 2.2.1.1.2, Note 2, in 2.2.1.3, Note 3 or in 5.2, Part II "Calculation of Assumed Heeling Moments and General Assumptions".

11 STRENGTH OF GRAIN FITTINGS

11.1 Timber

All timber used for grain fittings shall be of good sound quality and of a type and grade which has been proved to be satisfactory for this purpose. The actual finished dimensions of the timber shall be in accordance with the dimensions specified below. Plywood of an exterior type bonded with waterproof glue and fitted so that the direction of the grain in the face plies is perpendicular to the supporting uprights or binders may be used provided that its strength is equivalent to that of solid timber of the appropriate scantlings.

11.2 Working stresses

When calculating the dimensions of bulkheads loaded on one side (Tables 13.1.1 to 13.3.2), the following working stresses shall be adopted:

for bulkheads of steel — 19,6 kN/cm^2;

for bulkheads of wood — 1,57 kN/cm^2;

(1 N is equivalent to 0,102 kg).

11.3 Other materials

Materials other than wood or steel may be approved for such bulkheads provided that proper regard has been paid to their mechanical properties.

11.4 Uprights

11.4.1 Unless means are provided to prevent the ends of uprights being dislodged from their sockets, the depth of housing at each end of each upright shall be not less than 75 mm. If an upright is not secured at the top, the uppermost shore or stay shall be fitted as near thereto as is practicable.

11.4.2 The arrangements provided for inserting shifting boards by removing a part of the cross-section of an upright shall be such that the local level of stresses is not unduly high.

11.4.3 The maximum bending moment imposed upon an upright supporting a bulkhead loaded on one side shall, as a rule, be calculated assuming that the ends of the uprights are freely supported. However, if an Administration is satisfied that any degree of fixity assumed will be achieved in practice, account may be taken of any reduction in the maximum bending moment arising from any degree of fixity provided at the ends of the upright.

11.5 Composite section

Where uprights, binders or any other strength members are formed by two separate sections, one fitted on each side of a bulkhead and interconnected by through bolts at adequate spacing, the effective section modulus shall be taken as the sum of the two moduli of the separate sections.

11.6 Partial bulkhead

Where bulkheads do not extend to the full depth of the cargo space, such bulkheads and their uprights shall be supported or stayed so as to be as efficient as those which do extend to the full depth of the cargo space.

12 BULKHEADS LOADED ON BOTH SIDES

12.1 Shifting boards

12.1.1 Shifting boards shall have a thickness of not less than 50 mm and shall be fitted grain-tight and where necessary supported by uprights.

12.1.2 The maximum unsupported span for shifting boards of various thicknesses shall be as follows:

Thickness	Maximum unsupported span
50 mm	2,5 m
60 mm	3,0 m
70 mm	3,5 m
80 mm	4,0 m

If thicknesses greater than these are provided, the maximum unsupported span will vary directly proportional to the increase in thickness.

12.1.3 The ends of all shifting boards shall be securely housed with 75 mm minimum bearing length.

12.2 Other materials

Bulkheads formed by using materials other than wood shall have a strength equivalent to the shifting boards required in 12.1.

12.3 Uprights

12.3.1 Steel uprights used to support bulkheads loaded on both sides shall have a section modulus determined by the formula:

$$W = a \times W_1 \qquad (12.3.1\text{-}1)$$

where

W = section modulus, cm^3;

a = horizontal span between uprights, m.

The section modulus per metre span W_1 shall be not less than that determined by the formula:

$$W_1 = 14{,}8(h_1 - 1{,}2)\ cm^3/m \qquad (12.3.1\text{-}2)$$

where

h_1 = the vertical unsupported span, m, and shall be taken as the maximum value of the distance between any two adjacent stays or between a stay and either end of the upright. Where this distance is less than 2,4 m the respective modulus shall be calculated as if the actual value were 2,4 m.

12.3.2 The moduli of wood uprights shall be determined by multiplying by 12,5 the corresponding moduli for steel uprights. If other materials are used their moduli shall be at least that required for steel increased in proportion to the ratio of the permissible stresses for steel to that of the material used. In such cases attention shall be paid also to the relative rigidity of each upright to ensure that the deflection is not excessive.

12.3.3 The horizontal distance between uprights shall be such that the unsupported spans of the shifting boards do not exceed the maximum span specified in 12.1.3.

12.4 Shores

12.4.1 Wood shores, when used, shall be in a single piece and shall be securely fixed at each end and heeled against the permanent structure of the ship except that they shall not bear directly against the side plating of the ship.

12.4.2 Subject to the provisions of 12.4.3 and 12.4.4, the minimum size of wood shores shall be as follows:

Shores of 7 m or more in length shall be securely bridged at approximately mid-length.

12.4.3 When the horizontal distance between the uprights differs significantly from 4 m, the moments of inertia of the shores may be changed in direct proportion to the distance between the uprights.

Table 12.4.2

Length of shore, m	Rectangular section, mm	Diameter of circular section, mm
Not exceeding 3 m	150 × 100	140
Over 3 m but not exceeding 5 m	150 × 150	165
Over 5 m but not exceeding 6 m	150 × 150	180
Over 6 m but not exceeding 7 m	200 × 150	190
Over 7 m but not exceeding 8 m	200 × 150	200
Exceeding 8 m	200 × 150	215

12.4.4 Where the angle of the shore to the horizontal exceeds 10°, the next larger shore to that required by 12.4.2 shall be fitted provided that in no case shall the angle between any shore and the horizontal exceed 45°.

12.5 Stays

Where stays are used to support bulkheads loaded on both sides, they shall be fitted horizontally or as near thereto as practicable, well secured at each end and formed of steel wire rope. The sizes of the wire rope shall be determined assuming that the bulkheads and upright which the stay supports are uniformly loaded at 4,9 kN/m^2. The working load so assumed in the stay shall not exceed 1/3 of its breaking load.

13 BULKHEADS LOADED ON ONE SIDE ONLY

13.1 Longitudinal bulkheads

13.1.1 The load (P) in kN per metre length of the bulkheads shall be taken as follows:

Table 13.1.1

	B, m							
h, m	2	3	4	5	6	7	8	10
1,50	8,336	8,826	9,905	12,013	14,710	17,358	20,202	25,939
2,00	13,631	14,759	16,769	19,466	22,506	25,546	28,733	35,206
2,50	19,466	21,182	23,830	26,870	30,303	33,686	37,265	44,473
3,00	25,644	27,900	30,891	34,323	38,099	41,874	45,797	53,740
3,50	31,823	34,568	37,952	41,727	45,895	50,014	54,329	63,008
4,00	38,148	41,286	45,013	49,180	53,691	58,202	62,861	72,275
4,50	44,473	47,955	52,073	56,584	61,488	66,342	71,392	81,542
5,00	50,847	54,623	59,134	64,037	69,284	74,531	79,924	90,810
6,00	63,498	68,009	73,256	78,894	84,877	90,859	96,988	109,344

h = height of grain, m, from the bottom of the bulkhead. When a cargo space is filled, the height shall be taken to the overhead deck in way of the bulkhead. In a hatchway, or if the distance from a bulkhead to a hatchway is 1 m or less, the height shall be taken to the level of the grain in the hatchway.

B = transverse extent of the grain in bulk, m.

Note. The linear interpolation may be used in Table 13.1.1 for intermediate values of B and h if $h \leqslant 6{,}0$ m.

13.1.2 For values of h exceeding 6,0 m, the load P in kN per metre length of the bulkheads may be determined from Table 13.1.2 by entering with the ratio B/h and using the formula:

$$P = f \times h^2 \qquad (13.1.2)$$

Table 13.1.2

B/h	f	B/h	f	B/h	f
0,2	1,687	1,2	2,556	2,8	4,204
0,3	1,742	1,4	2,762	3,0	4,410
0,4	1,809	1,6	2,968	3,5	4,925
0,5	1,889	1,8	3,174	4,0	5,440
0,6	1,976	2,0	3,380	5,0	6,469
0,7	2,064	2,2	3,586	6,0	7,499
0,8	2,159	2,4	3,792	8,0	9,559
1,0	2,358	2,6	3,998		

13.2 Transverse bulkheads

13.2.1 The load P in kN per metre length of bulkheads shall be taken as follows:

Table 13.2.1

	L, m										
h, m	2	3	4	5	6	7	8	10	12	14	16
1,50	6,570	6,767	7,159	7,649	8,189	8,728	9,169	9,807	10,199	10,297	10,297
2,00	10,199	10,787	11,474	12,209	12,994	13,729	14,416	15,445	16,083	16,279	16,279
2,50	14,318	15,347	16,426	17,456	18,437	19,417	20,349	21,673	22,408	22,604	22,604
3,00	18,878	20,251	21,624	22,948	24,222	25,399	26,429	27,900	28,684	28,930	28,930
3,50	23,781	25,546	27,164	28,733	30,155	31,430	32,558	34,127	35,010	35,255	35,255
4,00	28,930	30,989	32,901	34,667	36,187	37,559	38,736	40,403	41,286	41,531	41,580
4,50	34,274	36,530	38,638	40,501	42,120	43,542	44,767	46,582	47,562	47,856	47,905
5,00	39,717	42,218	44,473	46,434	48,151	49,622	50,897	52,809	53,839	54,182	54,231
6,00	50,749	53,593	56,094	58,301	60,164	61,782	63,204	65,263	66,440	66,832	66,930

h = height of grain, m, from the bottom of the bulkhead. If a cargo space is filled, the height shall be taken to the overhead deck in way of the bulkhead. In a hatchway, or if the distance from a bulkhead to a hatchway is 1 m or less the height shall be taken to the level of the grain in the hatchway.

L = longitudinal extent of the grain in bulk, m.

13.2.2 Intermediate values of L_1 and h, if $h \leqslant 6{,}0$ m, may be determined by linear interpolation using Table 13.2.1.

13.2.3 For values of h exceeding 6,0 m the load P in kN per metre length of bulkheads may be determined from Table 13.2.3 by entering with the ratio L/h and using the formula:

$$P = f \times h^2. \qquad (13.2.3)$$

Table 13.2.3

L/h	f	L/h	f	L/h	f
0,2	1,334	1,2	1,725	2,8	1,859
0,3	1,395	1,4	1,769	3,0	1,859
0,4	1,444	1,6	1,803	3,5	1,859
0,5	1,489	1,8	1,829	4,0	1,859
0,6	1,532	2,0	1,846	5,0	1,859
0,7	1,571	2,2	1,853	6,0	1,859
0,8	1,606	2,4	1,857	8,0	1,859
1,0	1,671	2,6	1,859		

13.3 The total load per unit length of bulkheads shown in Tables 13.1.1 to 13.2.3 may, if considered necessary, be assumed to have a trapezoidal distribution with height. In such cases, the reaction loads at the upper and lower ends of a vertical member or upright are not equal. The reaction loads at the upper end expressed as percentages of the total load supported by the vertical member or upright may be taken to be those shown in Tables 13.3.1 and 13.3.2.

13.3.1 Longitudinal bulkheads loaded on one side only.

Bearing reaction at the upper end of an upright as a percentage of load according to 13.1.

Table 13.3.1

	B, m							
h, m	2	3	4	5	6	7	8	10
1,5	43,3	45,1	45,9	46,2	46,2	46,2	46,2	46,2
2,0	44,5	46,7	47,6	47,8	47,8	47,8	47,8	47,8
2,5	45,4	47,6	48,6	48,8	48,8	48,8	48,8	48,8
3,0	46,0	48,3	49,2	49,4	49,4	49,4	49,4	49,4
3,5	46,5	48,8	49,7	49,8	49,8	49,8	49,8	49,8
4,0	47,0	49,1	49,9	50,1	50,1	50,1	50,1	50,1
4,5	47,4	49,4	50,1	50,2	50,2	50,2	50,2	50,2
5,0	47,7	49,4	50,1	50,2	50,2	50,2	50,2	50,2
6,0	47,9	49,5	50,1	50,2	50,2	50,2	50,2	50,2
7,0	47,9	49,5	50,1	50,2	50,2	50,2	50,2	50,2
8,0	47,9	49,5	50,1	50,2	50,2	50,2	50,2	50,2
9,0	47,9	49,5	50,1	50,2	50,2	50,2	50,2	50,2
10,0	47,9	49,5	50,1	50,2	50,2	50,2	50,2	50,2

B = transverse extent of the grain in bulk, m.
For other values of h or B, the reaction loads shall be determined by linear interpolation or extrapolation as necessary.

13.3.2 Transverse bulkheads loaded on one side only.

Bearing reaction at the upper end of an upright as a percentage of load according to 13.2.

Table 13.3.2

	L, m										
h, m	2	3	4	5	6	7	8	10	12	14	16
1,5	37,3	38,7	39,7	40,6	41,4	42,1	42,6	43,6	44,3	44,8	45,0
2,0	39,6	40,6	41,4	42,1	42,7	43,1	43,6	44,3	44,7	45,0	45,2
2,5	41,0	41,8	42,5	43,0	43,5	43,8	44,2	44,7	45,0	45,2	45,2
3,0	42,1	42,8	43,3	43,8	44,2	44,5	44,7	45,0	45,2	45,3	45,3
3,5	42,9	43,5	43,9	44,3	44,6	44,8	45,0	45,2	45,3	45,3	45,3
4,0	43,5	44,0	44,4	44,7	44,9	45,0	45,2	45,4	45,4	45,4	45,4
5,0	43,9	44,3	44,6	44,8	45,0	45,2	45,3	45,5	45,5	45,5	45,5
6,0	44,2	44,5	44,8	45,0	45,2	45,3	45,4	45,6	45,6	45,6	45,6
7,0	44,3	44,6	44,9	45,1	45,3	45,4	45,5	45,6	45,6	45,6	45,6
8,0	44,3	44,6	44,9	45,1	45,3	45,4	45,5	45,6	45,6	45,6	45,6
9,0	44,3	44,6	44,9	45,1	45,3	45,4	45,5	45,6	45,6	45,6	45,6
10,0	44,3	44,6	44,9	45,1	45,3	45,4	45,5	45,6	45,6	45,6	45,6

L = longitudinal extent of the grain in bulk, m.
For other values of h or L, the reaction loads shall be determined by linear interpolation or extrapolation as necessary.

13.3.3 The strength of the end connections of such vertical members or uprights may be calculated on the basis of the maximum load likely to be imposed at either end. These loads are as follows:

Longitudinal bulkheads.
Maximum load at the top 50 % of the appropriate total load from 13.1.
Maximum load at the bottom 55 % of the appropriate total load from 13.1.

Transverse bulkheads.
Maximum load at the top 45 % of the appropriate total load from 13.2.
Maximum load at the bottom 60 % of the appropriate total load from 13.2.

13.3.4 The thickness of horizontal wooden boards may also be determined having regard to the vertical distribution of the loading represented in Tables 13.3.1 and 13.3.2 and in such cases:

$$t = 10a\sqrt{\frac{p \times k}{h \times 2091{,}8}}\ , \qquad (13.3.4\text{-}1)$$

where t = thickness of board, mm;
a = horizontal span of the board i. e. distance between uprights, m;
h = head of grain to the bottom of the bulkhead, m;
p = total load per unit length derived from tables, N;
k = factor dependent upon vertical distribution of the loading.

When the vertical distribution of loading is assumed to be uniform, i. e. rectangular, k shall be taken as equal to 1,0. For a trapezoidal distribution:

$$k = 1{,}0 + 0{,}06(50 - R) \qquad (13.3.4\text{-}2)$$

where R = is the upper end bearing reaction taken from Table 13.3.1 or 13.3.2.

13.3.5 Stays or shores.

The sizes of stays and shores shall be so determined that the loads derived from Tables 13.1.1 to 13.2.3 shall not exceed 1/3 of the breaking loads for these elements.

14 SAUCERS

14.1 To reduce a heeling moment a saucer may be used in place of a longitudinal bulkhead in way of a hatch opening only in a filled, trimmed, compartment, as specified in 2.1.2, except in the case of carriage of linseed or other seeds having similar properties, where a saucer may not be substituted for the longitudinal bulkhead. If a longitudinal bulkhead is provided, it shall meet the requirements of 10.9.

14.2 The saucer depth measured from the bottom of the saucer to the deck line shall be as follows:

for ships with a moulded breadth of up to 9,1 m — not less than 1,2 m;

for ships with a moulded breadth of 18,3 m or more — not less than 1,8 m;

for ships with a moulded breadth between 9,1 m and 18,3 m the minimum depth of the saucer shall be calculated by interpolation.

14.3 The top of the saucer shall be formed by the underdeck structure in way of the hatchway, i. e. hatch side girders or coamings and hatch end beams. The saucer and hatchway above shall be completely filled with bagged grain or other suitable cargo laid down on a separation cloth or its equivalent and stowed tightly against adjacent structure so as to have a bearing contact with such structure to a depth equal to or greater than a half of the depth specified in 14.2. Where the hull structure to provide such bearing surface is not available the

saucer shall be fixed in position by a steel wire rope, chain or double steel strapping as specified in 17.1.4 and spaced not more than 2,4 m apart.

15 BUNDLING OF GRAIN IN BULK

15.1 As an alternative to filling the saucer in filled, trimmed, compartment with bagged grain or other suitable cargo, a bundle of grain in bulk may be used provided the following conditions are met.

15.1.1 The dimensions and means for securing the bundle in place are the same as specified for a saucer in 14.2 and in 14.3.

15.1.2 The saucer is lined with a material approved by the Register having a tensile strength of not less than 2,687 kN per 5 cm strip and which is provided with suitable means for securing at the top.

15.1.3 As an alternative to 15.1.2, a material approved by the Register having a tensile strength of not less than 1,344 kN per 5 cm strip may be used if the saucer is constructed as follows:

.1 athwartship lashings approved by the Administration shall be placed inside the saucer formed in the grain in bulk at intervals of not more than 2,4 m. These lashings shall be of sufficient length to permit being drawn up tight and secured at the top of the saucer;

.2 dunnage not less than 25 mm in thickness or other suitable material of equal strength and between 150 and 300 mm in width shall be placed fore and aft over these lashings to prevent the cutting or chafing of the material which shall be placed thereon to line the saucer.

15.1.4 The saucer shall be filled with grain in bulk and secured at the top except that when using material approved under 15.1.3 further dunnage shall be laid on top after lapping the material before the saucer is secured by setting up the lashings.

15.1.5 If more than one sheet of material is used to line the saucer, they shall be joined at the bottom either by sewing or by a double lap.

15.1.6 The top of the saucer shall be coincidental with the bottom of the beams when these are in place and suitable general cargo or grain in bulk may be placed between the beams on top of the saucer.

16 OVERSTOWING ARRANGEMENTS

16.1 Where bagged grain or other suitable cargo is used for the purpose of securing partly filled compartments, the free grain surface shall be levelled and covered with a separation cloth or equivalent or by a suitable platform. Such a platform shall consist of bearers spaced not more than 1,2 m apart and 25 mm boards laid thereon spaced not more than 100 mm apart. Platforms may be constructed of other materials provided they are deemed by the Register to be equivalent.

16.2 The platform or separation cloth shall be topped off with bagged grain tightly stowed and extending to a height of not less than 1/16 of the maximum breadth of the free grain surface or 1,2 m whichever is the greater.

16.3 The bagged grain shall be carried in sound bags which shall be well filled and securely closed.

16.4 Instead of bagged grain, other suitable cargo tightly stowed and exerting at least the same pressure as bagged grain stowed in accordance with 16.2 may be used.

17 STRAPPING OR LASHING

17.1 When, in order to eliminate heeling moments in partly filled compartments, strapping or lashing is used, the securing of grain surface shall be accomplished as follows.

17.1.1 The grain surface shall be trimmed and levelled to the extent that it is very slightly crowned and covered with burlap separation cloths, tarpaulins or the equivalent.

17.1.2 The separation cloths and/or tarpaulins shall overlap at least 1,8 m.

17.1.3 Two solid floors of rough 25 mm by 150 mm to 300 mm lumber shall be laid with the top floor running longitudinally and nailed to an athwartships bottom floor.

Alternatively, one solid floor of 50 mm lumber, running longitudinally and nailed over the top of a 500 mm bottom bearer not less than 150 mm wide, may be used.

The bottom bearers shall extend the full breadth of the compartment and shall be spaced not more than 2,4 m apart. Arrangements using other materials and deemed by the Register to be equivalent to the foregoing may be accepted.

17.1.4 Steel wire rope (19 mm diameter or equivalent), double steel strapping (50 mm $\times$ 1,3 mm and having a breaking load of at least 49 kN), or chain of equivalent strength, each of which shall be set tightly by means of a

32 mm turnbuckle, may be used for lashings. A winch tightener, used in conjunction with a locking arm, may be substituted for such a turnbuckle when steel strapping is used, provided suitable wrenches are available for setting up as necessary. When steel strapping is used, not less than three crimp seals shall be used for securing the ends. When wire is used, not less than four clips shall be used for forming eyes in the lashings.

17.1.5 Prior to the completion of loading the lashing shall be positively attached to the framing at a point approximately 450 mm below the anticipated final grain surface by means of either a 25 mm shackle or beam clamp of equivalent strength.

17.1.6 The lashings shall be spaced not more than 2,4 m apart and each shall be supported by a bearer nailed over the top of the longitudinal floor. This bearer shall consist of not less than 25 mm × 50 mm lumber or its equivalent and shall extend the full breadth of the compartment.

17.1.7 During the voyage the strapping shall be regularly inspected and set up where necessary.

18 SECURING WITH WIRE MESH

18.1 When, in order to eliminate heeling moments in partly filled compartments, strapping or lashing is used, the grain surface securing may, as an alternative to the method specified in Section 17, be accomplished as follows.

18.1.1 The grain surface shall be trimmed and levelled to the extent that it is very slightly crowned along the fore and aft centreline of the compartment.

18.1.2 The entire grain surface shall be covered with burlap separation cloths, tarpaulins or the equivalent. The covering material shall have a tensile strength of not less than 1,344 N per 5 cm strip.

18.1.3 Two layers of wire reinforcement mesh shall be laid on top of the burlap or other covering. The bottom layer shall be laid athwartships and the top layer shall be laid longitudinally. The lengths of wire mesh shall be overlapped at least 75 mm. The top layer of mesh shall be positioned over the bottom layer in such a manner that the squares formed by the alternate layers measure approximately 75 mm × 75 mm. The wire reinforcement mesh shall be the type used in reinforced concrete construction. It shall be manufactured of 3 mm diameter steel wire having a breaking strength of not less than 52 kN/cm^2, welded in 150 mm × 150 mm squares. Wire mesh having mill scale may be used but mesh having loose, flaking rust may not be used.

18.1.4 The boundaries of the wire mesh, at the port and starboard side of the compartment, shall be retained by wood planks 150 mm × 50 mm.

18.1.5 Hold-down lashings, running from side to side across the compartment, shall be spaced not more than 2,4 m apart, except that the first and last lashing shall not be more than 300 mm from the fore or aft bulkhead, respectively. Prior to the completion of the loading, each lashing shall be positively attached to the framing at a point approximately 450 mm below the anticipated final grain surface by means of either a 25 mm shackle or beam clamp of equivalent strength. The lashing shall be led from this point over the top of the boundary plank (described in 18.1.4), which distributes the downward pressure exerted by the lashing. Two layers of 150 mm × 25 mm planks shall be laid athwartships centered beneath each lashing and extending the full breadth of the compartment.

18.1.6 The hold-down lashings shall consist of steel wire rope (19 mm diameter or equivalent), double steel strapping (50 mm × 1,3 mm and having a breaking load of at least 49 kN), or chain of equivalent strength, each of which shall be set tight by means of a 32 mm turnbuckle. A winch tightener, used in conjunction with a locking arm, may be substituted for such a turnbuckle when steel strapping is used, provided suitable wrenches are available for setting up as necessary. When steel strapping is used, not less than three crimp seals shall be used for securing the ends. When wire rope is used, not less than four clips shall be used for forming eyes in the lashings.

18.1.7 During the voyage the hold-down lashings shall be regularly inspected and set up where necessary.

PART II. CALCULATION OF ASSUMED HEELING MOMENTS AND GENERAL ASSUMPTIONS

1 GENERAL ASSUMPTIONS

1.1 For the purpose of calculating the adverse heeling moment due to a shift of cargo surface in ships carrying grain in bulk the following shall be assumed.

1.1.1 In filled compartments which have been trimmed in accordance with 10.2, Part I "Main Requirements", a void exists under all boundary surfaces having an inclination to the horizontal less than 30° and that the void is parallel to the boundary surface having an average depth calculated according to the formula:

$$Vd = Vd_1 + 0{,}75(d - 600) \qquad (1.1.1)$$

where

Vd = average void depth, mm;
Vd_1 = standard void depth from Table 1.1.1 below;
D = actual girder depth, mm.

In no case shall Vd be assumed to be less than 100 mm.

Table 1.1.1

Distance from hatch end or hatch side to boundary of compartment, m	Standard void depth Vd_1, mm
0,5	570
1,0	530
1,5	500
2,0	480
2,5	450
3,0	440
3,5	430
4,0	430
4,5	430
5,0	430
5,5	450
6,0	470
6,5	490
7,0	520
7,5	550
8,0	590

(1) For boundary distances greater than 8,0 m, the standard void depth Vd_1 shall be linearly extrapolated at 80 mm increase for each 1,0 m increase in distance.

(2) In the compartment corner, the boundary distance shall be the perpendicular distance from the line of the hatch side girder or the line of the hatch end beam to compartment boundary, whichever is the greater. The girder depth *d* shall be taken to be the depth of the hatch side girder or hatch end beam, whichever is the less.

(3) Where there is a raised deck clear of a hatchway the average void depth measured from the underside of the raised deck shall be calculated using the standard void depth in association with a girder depth of the hatch end beam plus the height of the raised deck.

1.1.2 Within filled hatchways and in addition to any open void within the hatch cover there is a void of average depth of 150 mm measured down to the grain surface from the lowest part of the hatch cover or the top of the hatch side coaming, whichever is the lower.

1.1.3 In a filled compartment, untrimmed, which is exempted from trimming outside the periphery of the hatchway according to the provisions of 10.3.1, Part I "Main Requirements" it shall be assumed that the grain surface after loading will slope into the void space underdeck, in all directions, at an angle of 30° to the horizontal from the edge of the opening which establishes the void.

1.1.4 In a filled compartment, untrimmed, which is exempted from trimming in the ends of the compartment according to the provisions of 10.3.2, Part I "Main Requirements", it is assumed that the grain surface after loading will slope in all directions away from the filling area at an angle of 30° from the lower edge of the hatch end beam. However, if feeding holes in hatch end beams are provided in accordance with Table 1.1.4, the grain surface after loading shall be assumed to slope in all directions at an angle of 30° from a line on the hatch end beam which is the mean of the peaks and valleys of the actual grain surface as shown in Fig. 1.1.4.

Table 1.1.4

Minimum diameter, mm	Area, cm^2	Maximum spacing, m
90	63,6	0,60
100	78,5	0,75
110	95,0	0,90
120	113,1	1,07
130	133,0	1,25
140	154,0	1,45
150	177,0	1,67
160	201,0	1,90
227 or above	227,0	2,00

1.2 The description of the pattern of grain surface behaviour to be assumed in partly filled compartments is contained in Section 5.

1.3 For the purpose of demonstrating compliance with the stability criteria in Section 7, the ship's stability calculations shall normally be based upon the

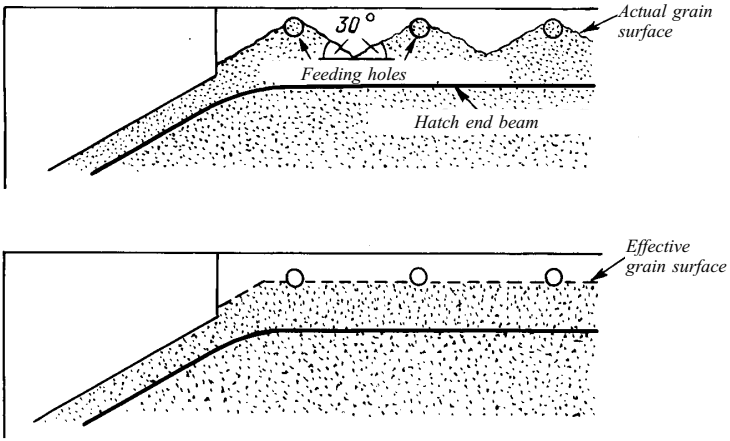

Fig. 1.1.4

assumption that the centre of gravity of cargo in a filled compartment, trimmed, is at the volumetric centre of the whole cargo space. Where the Register authorizes account to be taken of the effect of assumed underdeck voids on the vertical position of the centre of gravity of the cargo in filled compartments, trimmed, it will be necessary to compensate for the adverse effect of the vertical shift of grain surface by increasing the assumed heeling moment due to the transverse shift of grain as follows:

$$\text{total heeling moment} = 1{,}06 \times \text{calculated transverse heeling moment.}$$

In all cases the weight of cargo in a filled compartment, trimmed, shall be the volume of the whole cargo space divided by the stowage factor.

1.4 The centre of gravity of cargo in a filled compartment, untrimmed, shall be taken to be the volumetric centre of the whole cargo compartment without regard for voids. In all cases the weight of cargo shall be the volume of cargo (on assumptions specified in 1.1.3 or 1.1.4) divided by the stowage factor.

1.5 In partly filled compartments the adverse effect of the vertical shift of grain surfaces shall be taken into account as follows:

$$\text{total heeling moment} = 1{,}12 \times \text{calculated transverse heeling moment.}$$

1.6 Any other equally effective method may be adopted to make the compensation required in 1.3 and 1.5.

2 ASSUMED VOLUMETRIC HEELING MOMENT OF A FILLED COMPARTMENT, TRIMMED

2.1 General

2.1.1 The pattern of grain surface movement relates to a transverse section across the portion of the compartment being considered and the resultant heeling moment shall be multiplied by the length to obtain the total moment for that portion.

2.1.2 The assumed transverse heeling moment due to grain shifting is a consequence of final changes of shape and position of voids after grain has moved from the high side to the low side.

2.1.3 The resulting grain surface after shifting shall be assumed to be at 15° to the horizontal.

2.1.4 In calculating the maximum void area that can be formed against a longitudinal structural member, the effects of any horizontal surfaces, e. g. flanges or face bars, shall be ignored.

2.1.5 The total areas of the initial and final voids shall be equal.

2.1.6 The longitudinal structural members which are grain-tight may be considered effective over their full depth except where they are provided as a device to reduce the adverse effect of grain shift. In the last case the provisions of 10.9, Part I "Main Requirements", shall be considered.

2.1.7 A discontinuous longitudinal bulkhead (partial bulkhead) may be considered effective over its full length.

2.2 Assumptions

2.2.1 In the following paragraphs it is assumed that the total heeling moment for a compartment is obtained by adding the results of separate consideration of the following parts.

2.2.1.1 Fore and aft of hatchways:

.1 if a compartment has two or more main hatchways through which loading may take place, the depth of the underdeck void for the parts(s) between such hatchways shall be determined using the fore and aft distance to the midpoint between the hatchways;

.2 after the assumed shift of grain the final void pattern shall be as shown in Fig. 2.2.1.1.2.

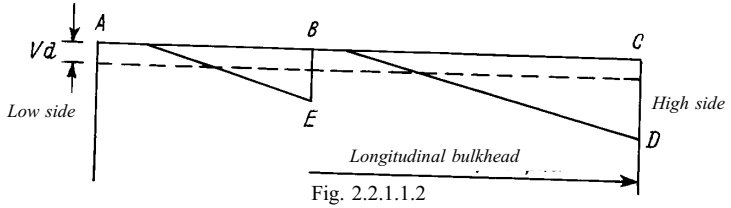

Fig. 2.2.1.1.2

(1) If the maximum void area which can be formed against the girder at *B* is less than the initial area of the void under *AB*, i. e. $AB \times Vd$, the excess area shall be assumed to transfer to the final void on the high side.

(2) If, for example, the longitudinal bulkhead at *C* is one which has been provided in accordance with 10.9, Part I "Main Requirements", it shall extend to at least 0,6 m below *D* or *E* whichever gives the greater depth.

2.2.1.2 In and abrerast of hatchways without a longitudinal bulkhead.

After the assumed shift of grain the final void pattern shall be as shown in Fig. 2.2.1.2 or Fig. 2.2.1.3.

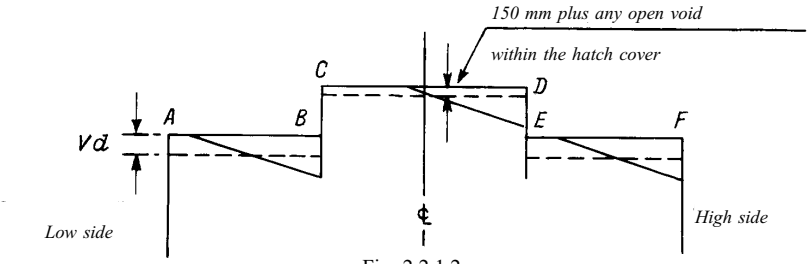

Fig. 2.2.1.2

(1) *AB* Any area in excess of that which can be formed against the girder at *B* shall transfer to the final void area in the hatchway.

(2) *CD* Any area in excess of that which can be formed against the girder at *E* shall transfer to the final void area on the high side.

2.2.1.3 In and abrerast of hatchways with a longitudinal bulkhead.

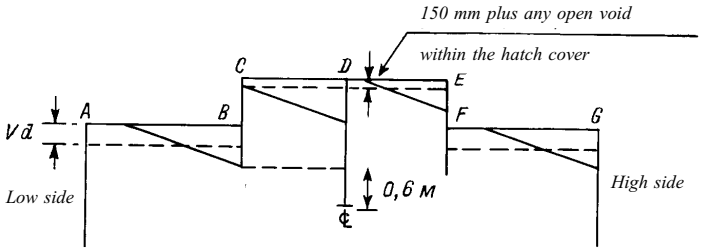

Fig. 2.2.1.3

(1) The excess void area from *AB* shall transfer to the low side half of the hatchway in which two separate final void areas will be formed: one against the centreline bulkhead and the other against the hatch side coaming on the high side.

(2) If a bagged saucer or bulk bundle is formed in a hatchway, it shall be assumed, for the purpose of calculating the transverse heeling moment, that such a device is at least equivalent to the centreline bulkhead.

(3) If the centreline bulkhead is one which has been provided in accordance with 10.9, Part I "Main Requirements", it shall extend to at least 0,6 m below *H* or *J*, whichever gives the greater depth.

2.3 Compartments loaded in combination

2.3.1 The following paragraphs describe the pattern of void behaviour which shall be assumed when compartments are loaded in combination.

2.3.1.1 Without effective centreline bulkheads:

.1 under the upper deck — as for the single deck arrangement as specified in 2.2.1.1.2 and 2.2.1.2;

.2 under the second deck — the area of void available for transfer from the low side, i. e. original void area less area against the hatch side girder, shall be assumed to transfer as follows: 1/2 to the upper deck hatchway and 1/4 each to the high side under the upper and second decks;

.3 under the third and lower decks — the void areas available for trainsfer from the low side of each of these decks shall be assumed to transfer in equal quantities to all the voids under the decks on the high side and the void in the upper deck hatchway.

2.3.1.2 With effective centreline bulkheads which extend into the upper deck hatchway:

.1 at all deck levels abreast of the bulkhead the void areas available for transfer from the low side shall be assumed to transfer to the void under the low side half of the upper deck hatchway;

.2 at the deck level immediately below the bottom of the bulkhead the void area available for transfer from the low side shall be assumed to transfer as follows: 1/2 to the void under the low side half of the upper deck hatchway and the remainder in equal quantities to the voids under the decks on the high side;

.3 at deck levels lower than those specified in 2.3.1.2.1 or 2.3.1.2.2 the void area available for transfer from the low side of each of those decks shall be assumed to transfer in equal quantities to the voids in each of the two halves of the upper deck hatchway on each side of the bulkhead and the voids under the decks on the high side.

2.3.1.3 With effective centreline bulkheads which do not extend into the upper deck hatchway:

.1 since no horizontal transfer of voids may be assumed to take place at the same deck level as the bulkhead, the void area available for transfer from the low side at this level shall be assumed to transfer above the bulkhead to voids on the high side in accordance with the principles in 2.3.1.1 and 2.3.1.2.

3 ASSUMED VOLUMETRIC HEELING MOMENT OF A FILLED COMPARTMENT, UNTRIMMED

3.1 All the provisions for filled compartments, trimmed, given in Section 2 shall also apply to filled compartments, untrimmed, except given below.

3.2 In filled compartments, untrimmed, which are exempted from trimming outside the periphery of the hatchway according to the provisions of 10.3.1, Part I "Main Requirements":

.1 the resulting grain surface after shifting shall be assumed to be at an angle of 25° to the horizontal. However, if in any part of the compartment, fore, aft, or abreast of the hatchway the mean transverse void area in that part is equal to or less than the area that would obtain by application of 1.1, then the angle of the grain surface after shifting in that part shall be assumed to 15° to the horizontal;

.2 the void area at any transverse part of the compartment shall be assumed to be the same both before and after the grain shift, i. e. no additional feeding of grain takes place simultaneously with grain shift.

3.3 In filled compartments, untrimmed, which are exempted from trimming in the ends, fore and aft of the hatchway according to the provisions of 10.3.2, Part I "Main Requirements":

.1 the resulting grain surface abreast of the hatchway after shifting shall be assumed to be at an angle of 15° to the horizontal;

.2 the resulting grain surface in the ends, fore and aft of the hatchway after shifting shall be assumed to be at an angle of 25° to the horizontal.

4 ASSUMED VOLUMETRIC HEELING MOMENT IN TRUNKS

4.1 After the assumed shift of grain the final void pattern shall be as shown in Fig. 4.1:

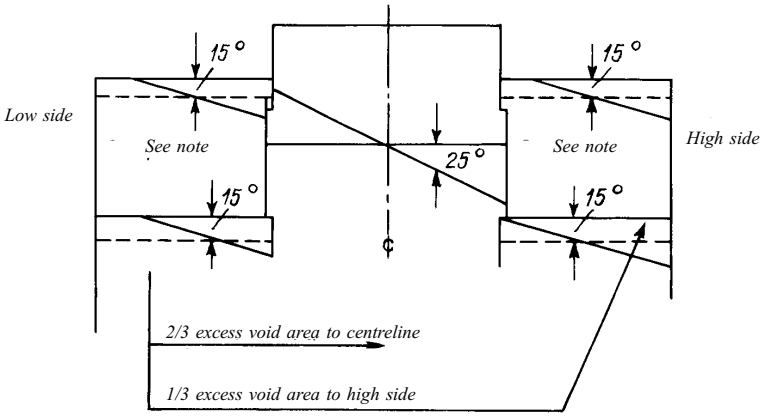

Fig. 4.1

If the wing spaces in way of the trunk cannot be properly trimmed in accordance with Section 10, Part I "Main Requirements", it shall be assumed that a 25° surface shift takes place.

5 ASSUMED VOLUMETRIC HEELING MOMENT OF A PARTLY FILLED COMPARTMENT

5.1 When the free surface of the grain in bulk has not been secured in accordance with Sections 16, 17 and 18, Part I "Main Requirements", it shall be assumed that the grain surface after shifting shall be at 25° to the horizontal.

5.2 In a partly filled compartment, a bulkhead, if fitted, shall extend from 1/8 of the maximum breadth of the compartment above the level of the grain surface and to the same distance below the grain surface.

5.3 In a compartment in which the longitudinal bulkheads are not continuous between the transverse boundaries, the length over which any such bulkheads are effective as devices to prevent full width shifts of grain surfaces shall be taken to be the actual length of the part of the bulkhead under consideration less 2/7 of the greater of the transverse distances between the bulkhead and its parallel bulkhead or ship's side. This correction does not apply in the lower compartments of any combination loading in which the upper compartment is either a filled compartment or a partly filled compartment.

6 OTHER ASSUMPTIONS

6.1 The Register on behalf of a Flag State Administration may authorize departure from the assumptions contained in the present Rules in those cases where it considers this to be justified having regard to the provisions for loading or structural arrangements, provided the stability criteria in Section 7, Part I "Main Requirements", are met. Where such authorization is granted under this regulation, the relevant particulars shall be included in the Document of Authorization and grain loading data.

Российский морской регистр судоходства

Правила перевозки зерна
2006 г.

Russian Maritime Register of Shipping

Rules for the Carriage of Grain
2006

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