CONTENTS

CARRIAGE OF GRAIN CARGOES[1]

1. GENERAL

Chapter VI of SOLAS 74, as amended, requires the shipper to provide the master or his representative with appropriate information on the cargo. Beyond this, it is the master's responsibility to take precautions for the proper stowage of the cargo.

Chapter VI further requires a cargo ship carrying grain to comply with the International Grain Code ("Code") and to have a document of authorization as required by that Code. Grain cargoes are generally loaded within the limitations of the vessel's Document of Authorization and the approved Grain Loading Manual.

Only the practical aspects of grain loading will be pointed out in detail in this procedure.

2. DEFINITIONS

2.1. The term grain covers wheat, maize (corn), oats, rye, barley, rice, pulses, seeds, sorghum, soya beans, and processed forms thereof, whose behaviour is similar to that of grain in its natural state.

2.2. The term "pulses" includes edible seeds for such leguminous crops as peas, beans or lentils. Nuts such as peanuts in the decorticated form (shells removed) are included.

However. undecorticated forms (shells not removed) are not included. These requirements apply to saw-delinted cottonseed and acid-delinted cottonseed but not to linted cottonseed. The requirements do not apply to processed grains such as flour or soybean meal, but processing is not the determining criteria. For example, the requirements do apply to rapeseed pellets. In general, when there is a question as to whether or not the requirements apply to an agricultural commodity, the angle of repose (i.e. the natural angle which a freely poured pile will attain with the horizontal) should be carefully measured. If it is 30 degrees or less, the requirements of the Code should be deemed to apply.

3. LEVELLING / TRIMMING

The term "trimming", as generally used in this context of grain loading, refers to the physical act of filling underdeck voids, typically outside the perimeter of the hatch coaming, to the extent possible or practicable. Common methods include spout trimming (slow free-pour with an angled spout or directional spout fitting (Figure 1)), hand trimming (shovelling), and use of mechanical trimming machines of various types (Figure 2).

[1] W 44 / 2020 (Entire Chapter added)

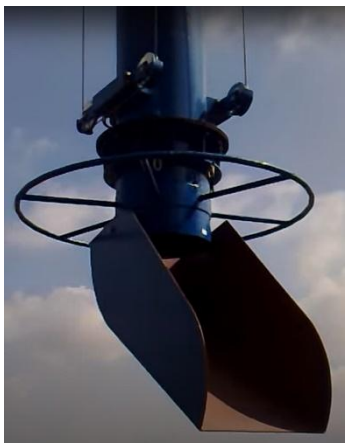


Figure 1. Angled spout

Figure 2. Telescopic loading chute

The term filled compartment, trimmed, refers to any cargo space in which, after loading and trimming as required under A 10.2 of the Code, the bulk grain is at its highest possible level.

This is understood to mean that, in the hatchway itself, the grain is at a height corresponding to the position of the closed hatch covers or the underside of the hatch beams which either frame or support the hatch covers. The grain surface must be levelled at this height.

Beneath the deck, outboard and fore and aft of the hatch opening, the grain must be trimmed to the maximum extent possible. Due to the capabilities of many of the machines used for trimming, this is generally to a level slightly above the bottom of the hatch side girders and hatch end beams.

Figure 3 illustrates a transverse section through a filled compartment, trimmed. Figure 4 shows a compartment which appears to be filled, trimmed. but which is not because the spaces outside the periphery of the hatchway were merely free-poured. It is, therefore, filled, untrimmed.

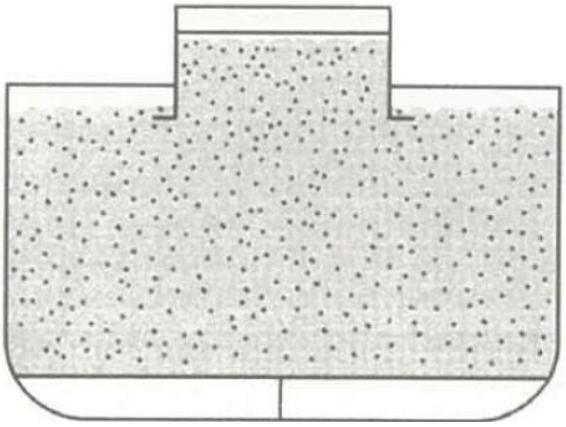


Figure 3

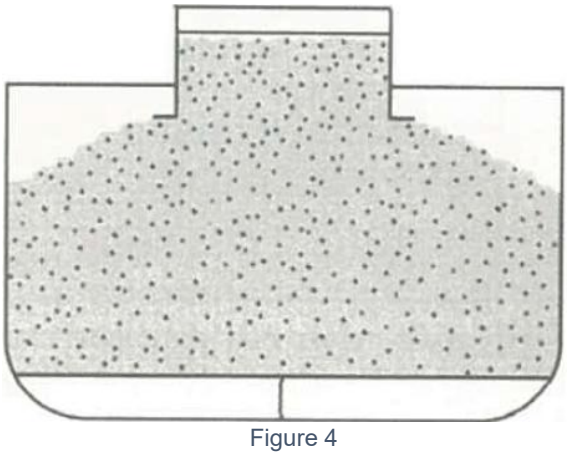


Figure 4

The term filled compartment, untrimmed, refers to 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 A 10.3.1 of the Code for all ships or A 10.3.2 of the Code for specially suitable compartments.

As illustrated in Figure 5, below, the grain does not have to be trimmed if its surface is permanently restrained by grain-tight structure which slopes at an angle of 30 degree or more. On most bulk carriers this is achieved by the structural design, which includes upper wing tanks extending the lengths or the holds, port and starboard. In accordance with A 2.7 of the Code, compartments so fitted are termed specially suitable. While, in a filled specially suitable compartment, the grain is restrained against shift in the areas to the port and starboard of the hatch opening, it is not similarly restrained forward and aft of the hatch opening. In accordance with A 10.3.2 of the Code, dispensation may be granted from trimming the ends, provided the compartment is specially suitable and otherwise filled (i.e., the compartment is filled to the maximum extent possible in way or the hatch opening). Such dispensation must be included in the approved grain loading information referenced in the ship's Document of Authorization.

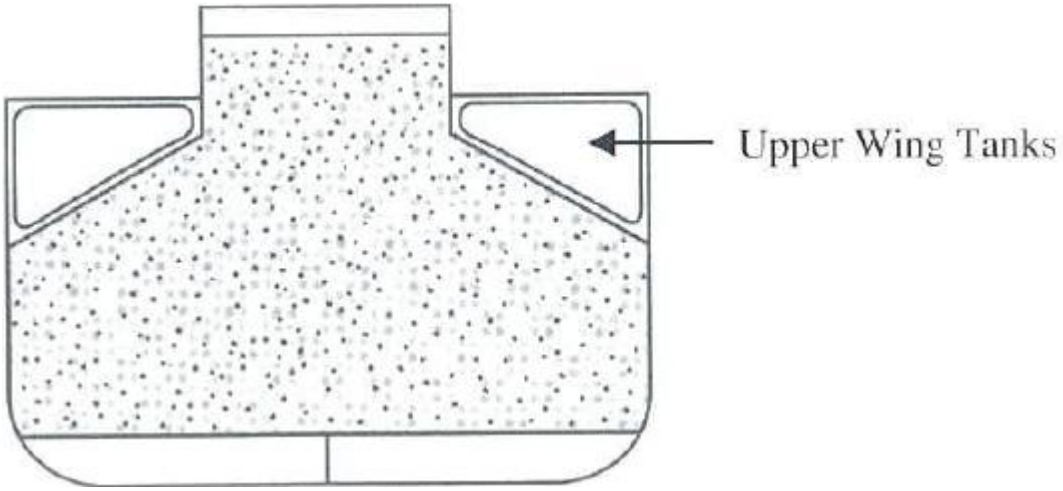
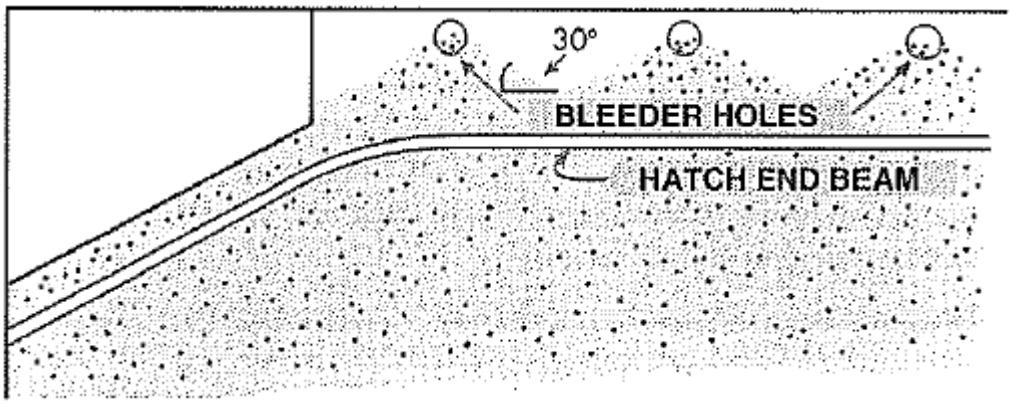


Figure 5



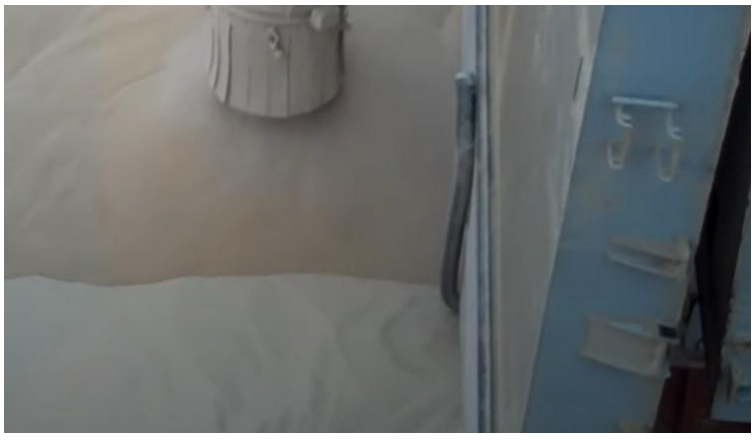
In the case of specially suitable compartments which are filled, untrimmed, in accordance with A 10.3.2, the grain in the spaces forward and aft of the hatchway is disposed at its angle of repose, flowing outward from the lower edges of the hatch end beams. However, if there are bleeder holes, as shown in Figure 6, the grain flows through the holes, thereby reducing the void space which would be present if the grain flowed only from the lower boundary. Where such holes are provided the tabulated Volumetric Heeling Moment is reduced to credit the smaller void space. Thus, the hatchway is filled, time must be allowed for bleeding through the holes to be completed. When bleeding ceases and the hatchway is filled, then the loading is complete and the hatch can be closed.

The term partly filled compartment refers to any cargo space wherein the bulk grain is not loaded in the manner prescribed in A 2.2 or A 2.3 of the Code.

Whenever a compartment is not filled then, as required by A 10.6 of the Code, the grain surface must be levelled to minimize the possibility of grain shift. It is to be especially noted that there is no such status as almost filled. Either a compartment is filled, as prescribed in A 2.2 or A 2.3 of the Code, or it must be regarded as partly filled. In the former case, the Grain Rules assume a potential shift of 15 degrees. In the latter case, the rules assume the more severe effect of a 25-degree shift. Figure 8 and 9 show examples of partly filled compartments

Figure 6

Figure 7. Grain flowing through the bleeder holes



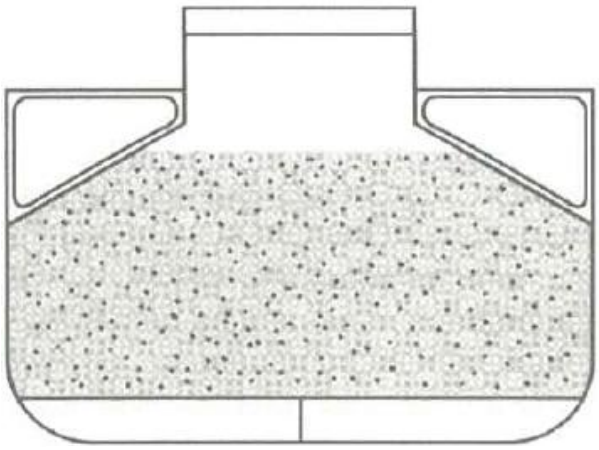


Figure 8

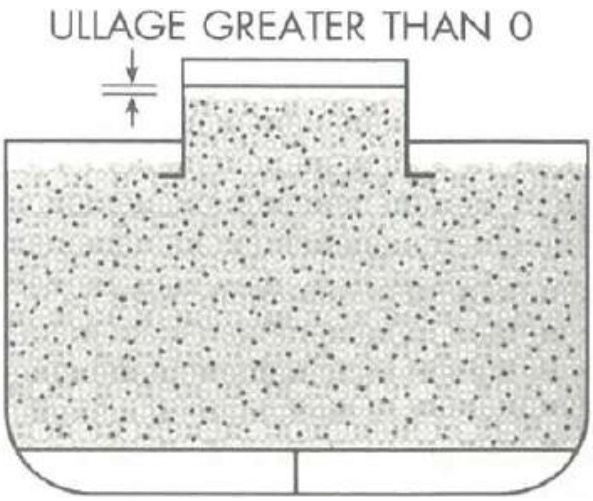


Figure 9

After loading, all free grain surfaces in partly filled compartment shall be trimmed level.

4. GRAIN LOADING BOOKLET / MANUAL

Information in printed booklet form shall be provided to enable the master to ensure that the ship complies with the Code when carrying grain in bulk on an international voyage. This information shall include that which is listed in A 6.2 and A 6.3 of the Code.

5. DOCUMENT OF AUTHORIZATION

A document of authorization shall be issued for every ship loaded in accordance with the regulations of the Code either by the Administration or an organization recognized by it or by a Contracting Government on behalf of the Administration. It shall be accepted as evidence that the ship is capable of complying with the requirements of these regulations.

6. ACTIONS WHEN RECEIVING A PRE-STOW PLAN QUERY

Prepare two acceptable conditions using ship's loading computer, one with ends trimmed and the other ends untrimmed. The reason why preparing the two conditions is that the trimming method is not yet determined at this stage.

Common mistakes in using the loading computer are, one, incorrect stowage factor (SF) used, the other one is the value for the free surface moments for the liquids is set to Max Value instead of the correct Level Value.

The two conditions should be prepared for the worst condition that can occur during the voyage.

Complete the form 2.03.01 Pre-Stow Plan with ends trimmed and ends untrimmed proposals. And send the form along with the loading computer results.

In most cases during loading, some holds are loaded simultaneously and with deballasting being done at the same time, it is quite difficult to get the exact quantity on a filled hold. Thus, ship staff, on most cases, will assume the quantity is as on the agreed pre-stow plan.

7. ACTIONS WHEN RECEIVING VOYAGE ORDERS TO LOAD GRAIN

Obtain from the local agent or other authoritative source at the loading port, the confirmed quantity of, and accurate stowage factor for, the grain to be loaded and trimming methods available.

8. WHEN IS A FILLED COMPARTMENT SAID TO BE TRIMMED OR UNTRIMMED?

If the trimming method is not as per section 2.1 of this chapter then the compartment is said to be *filled compartment, untrimmed*.

However, in the case of *filled compartment, untrimmed*, the volumetric capacities shown in the Grain loading Booklet for this condition generally understate the volume(s) of grain that can actually be loaded in the compartment(s). This is because Part B of the Code directs the naval architect to base his calculation on an angle of repose of 30 degrees, whereas the actual angle of repose of the grain may be as low as 22 degrees. Thus, if the tabulated “untrimmed” capacities are used, more grain may be loaded in the “filled, untrimmed” compartments than calculations anticipated. This could result in a deeper draft and/or much less grain than planned in another compartment. This, then, could result in a significantly increased Volumetric Heeling Moment, potentially leading to an unsafe condition. Final trim may also be affected. Unless there is prior experience to rely upon, it is wise to use the “full, trimmed” capacities in initial calculations, rather than the reduced “full, untrimmed” capacities, even though no trimming is intended. Any differences between the initially calculated condition and the final, loaded, conditions will then be on the safe side. – NCBI General Information for Grain Loading

9. PROPER RECAUTIONS MUST BE TAKEN FOR THE PROPER STOWAGE OF THE CARGO WHICH INCLUDE:

- cargo planning should allow for the possibility that the actual stowage factor could vary substantially from that expected;
- calculations of stability and shear force / bending moments for all conditions of loading and all stages of the voyage while carrying grain, from commencement of loading to arrival at the last port of discharge. These calculations should demonstrate compliance with the Code and all relevant statutory and classification society requirements. Please note that the stability must be calculated for the worst condition that can occur during the voyage, this requirement is standard and it is what AMSA and NCBI require to be inputted on their respective forms;

- ensuring that all cargo space bilge wells are clean, suctions clear and pumping arrangements operating satisfactorily.
- ensuring bilge well covers have sufficient holes for drainage and, after pre-loading inspection by shore-based personnel, are covered with burlap or similar material to allow drainage while preventing loss of grain into the wells;
- ensuring that any necessary portable fittings and/or hinged partitions are securely erected and made suitably grain-tight, and
- ensuring that all light fittings, and other electrical circuits not required for the safe operation of the ship, within the cargo space are isolated from the power source.
- During loading operations serious fires, or even explosions, can be caused by faulty electrical circuits in cargo compartments and by portable cargo lights left unattended in grain compartments. All electrical circuits in grain compartments must be disconnected or defuzed and portable lights must be removed when not in use.

10. PERSONAL SAFETY

- Refer to chapter 4.10 ENCLOSED SPACE ENTRY of HSE PROCEDURES MANUAL.
- Refer to chapter 26 SAFETY OF STEVEDORES of DRY CARGO MANUAL.
- Refer to chapter 24 CARGO FUMIGATION of DRY CARGO MANUAL.

11. STABILITY REQUIREMENTS

The intact stability characteristics of any ship carrying bulk grain shall be shown to meet, throughout the voyage, at least the following criteria after taking into account in the manner described in part B of the Code and, in figure A 7 of the Code, the heeling moments due to grain shift:

the angle of heel due to the shift of grain shall not be greater than 12° or in the case of ships constructed on or after 1 January 1994 the angle at which the deck edge is immersed, whichever is the lesser; in the statical stability diagram, the net or residual area between the heeling arm curve and the righting arm 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), whichever is the least, shall in all conditions of loading be not less than 0.075 metre-radians; and

the initial metacentric height, after correction for the free surface effects of liquids in tanks, shall be not less than 0.30 m.

Before loading bulk grain, the master shall, if so required by the Contracting Government 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.

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

12. METHOD OF GRAIN LOADING CALCULATION

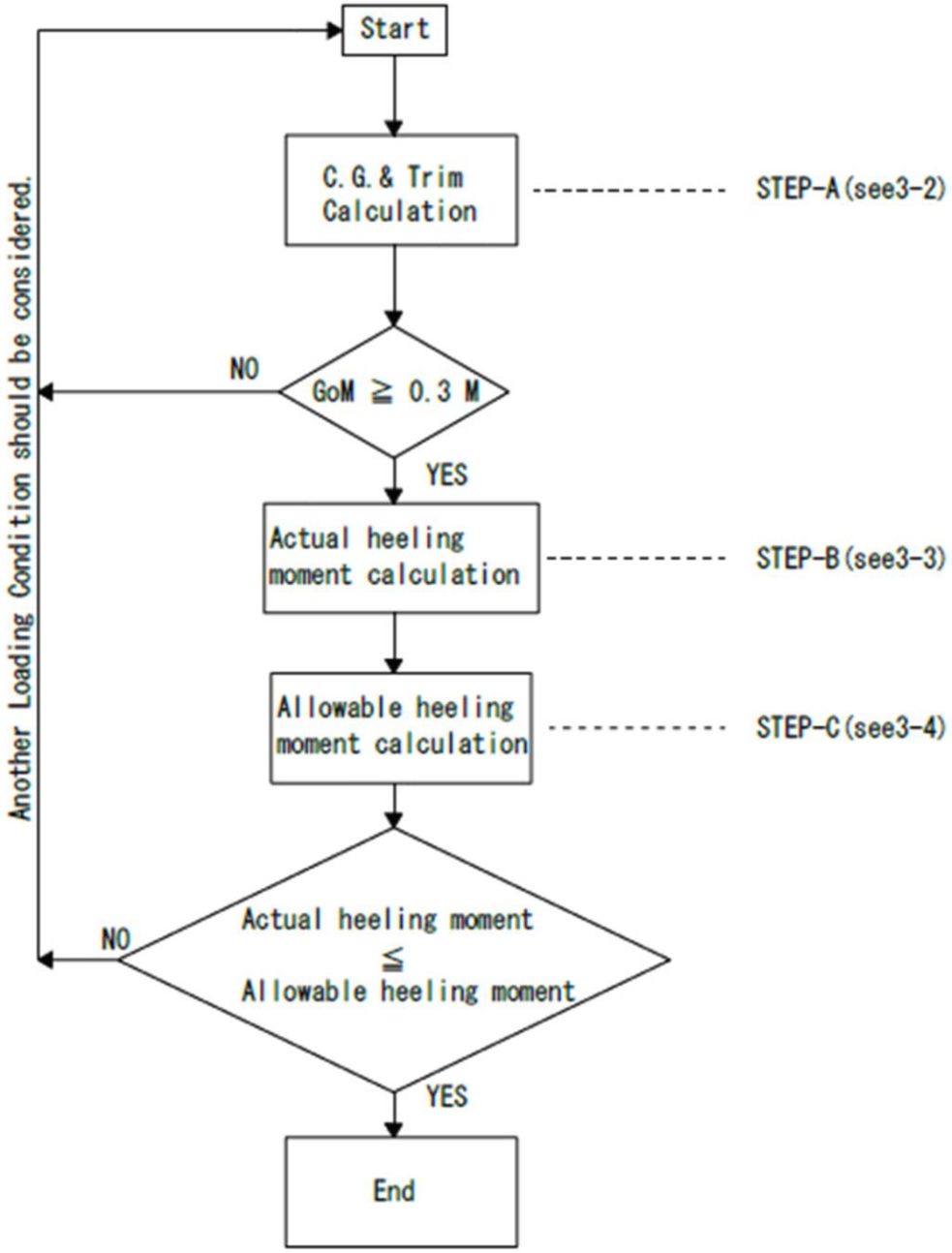
Most booklet contains two ways of calculating the intact stability for the purpose of the requirements in the relevant regulation; one is a method using the Table of Allowable Grain Heeling Moment and the other is to obtain directly the heeling angle and residual dynamical stability from the stability curve, the latter being more accurate in particular.

We will only illustrate here the usually used method, the Table of Allowable Grain Heeling Moment. Worked example from IVS Kinglet Loading Booklet.

3 . GRAIN LOADING CALCULATION USING ALLOWABLE GRAIN HEELING MOMENT

Grain loading calculations using "Table of Allowable Heeling Moment" proceed as shown in a flow chart below.
For quick reference, sample calculation have been given in 3-5.

3-1 Flow chart



3-2 STEP-A : Metacentric height calculation

The metacentric height is obtained in an usual method of calculation for the center of gravity and the trim as follows.

(1) Estimate the weight and their center of gravity of consumables on board and write them into the proper column in the calculation form.

(2) Decide the weights and their center of gravity of the grain cargoes and others, and write them into the proper columns in the calculation form.

(3) Decide the vertical center of gravity(VCG) of the loading condition under consideration.

(4) Then the corrected metacentric height GoM can be obtained from :

$$GoM = TKM - VCG - GGo$$

where ; TKM is transverse metacentric height above base line, which is read from the hydrostatic table.
GGo is loss in GM due to free surface effects.
(See also the following paragraph (5).)

(5) Free surface effects
Provided a tank is completely filled with liquid, no movement of the liquid is possible and the effect of the liquid on the vessel's stability is precisely the same as if tank contained solid material.
When a quantity of liquid is withdrawn from the tank, the situation changes completely and the stability of the vessel is adversely affected by what is known as the " free surface effects ".
This adverse effect on the stability is referred to as a " loss in GM " or as a " Virtual rise in VCG " and is calculated as follows :

$$\text{Loss in GM due to Free Surface Effects (GGo)} = \frac{\text{Sum of free surface moments}}{\text{Displacement of vessel in tons}}$$

Tanks where free surface is taken into account;

(1) For tanks containing liquid which may be consumed or discharged during navigation, the expected maximum moment of free surface is to be given.

(2) When liquid in tank is maintained constant at partly filled condition during navigation, the moment of free surface may be calculated on the basis of actual quantity of the liquid.
The moment of free surface should be calculated by " Specific gravity of liquid × Inertia ", and the inertia of each tank should be referred to " Volume Curves (with correction curves of free surface effect) ".

Notes : The corrected metacentric height is shown in this booklet as " GoM ".

3-3 STEP-B : Actual heeling moment calculation

The heeling moment is obtained in the following procedure as shown below.

(1) Read the weight(MT) of grain cargo in each hold from " STEP-A Calculation " and write it into the column WEIGHT(MT).

(2) Calculate the volume(M^3) from the following formula.

$$\text{Volume } (M^3) = \frac{\text{Stowage factor (CF/LT)} \times \text{Weight (MT)}}{35.88}$$

1 M3/MT = 35.88 CF/LT

(3) In case of partly filled compartments, find out the Heeling Moment(M^4) (=1.12 × Trans Heeling Moment) corresponding to the volume(M^3) from "Table of Volume, center of Gravity & Heeling Moment" or "Heeling Moment, Volume & VCG Diagram".
In case of filled compartments, find out the heeling moment(M^4) from "Summary Table of Heeling Moment for Filled Hold of End-Trimmed or End-Untrimmed".

(4) Transform "Heeling Moment(M^4)" into heeling moment(MT-M) from the following formula and write it into the column heeling moment(MT-M).

$$\text{Heeling moment (MT-M)} = \frac{35.88 \times \text{Heeling moment } (M^4)}{\text{Stowage factor (CF/LT)}}$$

1 M3/MT =35.88 CF/LT

3-4 STEP-C : Allowable heeling moment

Allowable heeling moment can be determined by the following procedure.

(1) Correct the VCGo by the free surface effect.

$$VCGo = VCG + GGo$$

where : VCG : Vertical center of gravity of the vessel for the loading condition.
GGo : Loss in GoM, i.e. apparent rise of center of gravity.

(2) Read the allowable transverse heeling moment(MT-M) from the table of allowable grain heeling moment at the displacement and the above "VCGo ".
For intermediate displacement and " VCGo ", the allowable grain heeling moment to be obtained by interpolation.

3-5 Sample calculation using allowable grain heeling moment

(CONDITION : NO.33 S.F.45 CF/LT DEPARTURE UNTRIMMED)

(1) At first, the weight of loading items are investigated and entered in column " Weight ".
For instance, from page

Item	Weight (MT)	Notes
LIGHT SHIP	8,352	Constant
PROVISION	0	Investigated
CONSTANTS	202	Constant
CARGO	30,934	Investigated
WATER BALLAST	0	Investigated
FRESH WATER	578	Investigated
F.O. & D.O.	1,418	Investigated
TOTAL	41,484	

(2) VCG of each tank or hold can be found by the drawing " Volume Curves (with correction curves of free surface effect)", or " Heeling Moment, Volume & VCG Diagram ". The weight and vertical moment will be summed up.
namely : -

W = 41,484 MT
VERTICAL MOMENT = 366,183 MT-M

and

$$VCG = \frac{\text{Vertical moment}}{W} = 8.83\ M$$

(3) The effect of free surface of liquid (l) will be also found by the same drawing as above " Volume Curves (with correction curves of free surface effect) " and their moment will be summed up.

Item	l	ρ	l × ρ
* F.W.T. (P)	262.3	1.000	262
* D.W.T. (S)	167.6	1.000	168
* NO.1 F.O.T. (P)	1079.2	0.980	1058
* NO.1 F.O.T. (S)	1079.2	0.980	1058
* NO.2 F.O.T. (P)	1119.3	0.980	1097
* NO.2 F.O.T. (S)	1127.6	0.980	1105
* D.O.T. (P)	248.7	0.900	224
* D.O.T. (S)	248.7	0.900	224
		Total	5,196 MT-M

and

$$GGo = \frac{\text{Total } l \times \rho}{W} = \frac{5,196}{41,484} = 0.13\ M$$

* : The tank containing liquid which may be consumed during navigation.

(4) VCGo is calculated by using result of preceding paragraphs as follows :

VCGo = VCG + GGo
= 8.83 + 0.13
= 8.96 M

(5) The allowable grain heeling moment can be found by the " Table of Allowable Grain Heeling Moment " by interpolation.

DISPLACEMENT = 41,484 MT
VCGo = 8.96 M
Trim = 1.56 M

Trim = 1.50 M

	DISP. = 41,000	DISP. = 42,000	DIFF. 1000
VCGo = 8.90	32,602	33,073	471
VCGo = 9.00	31,696	32,144	448

Where : -

VCGo = 8.90 M W = 41,484 MT

$$32,602 + \frac{471 \times 484}{1000} = 32,830 \text{ MT-M}$$

Where : -

VCGo = 9.00 M W = 41,484 MT

$$31,696 + \frac{4489 \times 484}{1000} = 31,913 \text{ MT-M}$$

Where : -

VCGo = 8.96 M W = 41,484 MT

31,913 - 32,830 = -917

$$32,830 + \frac{-917 \times 0.06}{0.10} = 32,280 \text{ MT-M}$$

Trim = 2.00 M

	DISP. = 41,000	DISP. = 42,000	DIFF. 1000
VCGo = 8.90	32,892	33,341	449
VCGo = 9.00	31,985	32,412	427

Where : -

VCGo = 8.90 M W = 41,484 MT-M

$$32,892 + \frac{449 \times 484}{1000} = 33,109 \text{ MT-M}$$

Where : -

VCGo = 9.00 M W = 41,484 M

$$31,985 + \frac{427 \times 484}{1000} = 32,192 \text{ MT-M}$$

Where : -

VCGo = 8.96 M W = 41,484 MT

32,192 - 33,109 = -917

$$33,109 + \frac{-917 \times 0.06}{0.10} = 32,559 \text{ MT-M}$$

Where : -

Trim = 1.56 M

32,559 - 32,280 = 279

Trim = 1.56 M W = 41,484 MT

$$32,280 + \frac{279 \times 0.06}{0.50} = 32,313 \text{ MT-M}$$

Allowable grain heeling moment = 32,313 MT-M

(6) The actual heeling moment can be found by the " Summary Table of Heeling Moment for Filled Hold " for the filled holds (Nos. 1, 2, 4 and 5 hold) and can be found by " Table of Volume, Center of Gravity & Heeling Moment " or " Heeling Moment, Volume & VCG Diagram " for partly filled hold (No. 3 hold).

DATA FOR EACH CARGO HOLD

Hold capacity table

COMPARTMENTS	LOCATION (FR. NO.)	TRIMMED		UNTRIMMED		CENTER OF GRAVITY	
		CAPACITY (m^3)	HEEL, M'T (m^4)	CAPACITY (m^3)	HEEL, M'T (m^4)	LCG (m)	VCG (m)
NO. 1 CARGO HOLD	167-200	5,647.2	926.7	5,393.8	1,190.9	-63.01	9.69
NO. 2 CARGO HOLD	132-167	9,846.5	2,429.3	9,637.2	2,812.7	-36.68	8.79
NO. 3 CARGO HOLD	97-132	9,846.5	2,417.6	9,637.2	2,812.7	-7.98	8.79
NO. 4 CARGO HOLD	62-97	9,846.5	2,417.6	9,637.2	2,812.7	20.72	8.79
NO. 5 CARGO HOLD	30-62	7,442.0	2,260.0	7,253.7	2,572.6	48.26	10.10
T O T A L		42,628.7	10,451.2	41,559.1	12,201.6	-	-

Total heeling moment will be summed up as follows:

HOLD NAME	GRAIN HEELING MOMENT (UNTRIMMED)
No. 1 CARGO HOLD (Full)	1,191 × 0.7974 = 950
No. 2 CARGO HOLD (Full)	2,813 × 0.7974 = 2,243
No. 3 CARGO HOLD (Partly filled = 6,873 m^3)	*16,619 × 0.7974 = 13,252
No. 4 CARGO HOLD (Full)	2,813 × 0.7974 = 2,243
No. 5 CARGO HOLD (Full)	2,573 × 0.7974 = 2,0521
TOTAL	26,009 m^4 20,740 MT-M
	(STOWAGE FACTOR 45 CF/LT = 0.7974 MT/M^3)

The vessel's grain heeling moment (20,740 MT-M) are less than the allowable grain heeling moment (32,313 MT-M).

* Heeling moment of No.3 CARGO HOLD

No.3 CARGO HOLD (70% Filled = 6,873 m^3)

Volume (m^3)	Trans heeling moment (m^4)
6875.1	14835.5
6703.1	15072.3
DIFF. 172.01	-236.8

$$\text{Trans heeling moment} = 15,072.3 + \frac{-236.8 \times (6,873 - 6,703.1)}{172.0}$$

$$= 14,838\ m^4$$

$$\text{Total heeling moment} = 1.12 \times 14,838 = 16,619\ m^4$$

(7) In this condition : -

(a) The angle of heel due to the shift of grain is not greater than 12 degrees or the angle at which the deck edge is immersed, whichever is the lesser.

(b) The area or residual dynamical stability is not less than 0.075meter-radians.

(c) The initial metacentric height after correction for the free surface effects of liquids in tanks, is not less than 0.30 meters.

Therefore, this condition is complied with the intact stability requirement of international grain code.

[SAMPLE CALCULATION] CONDITION NAME : NO.33 S.F.45 CF/LT DEPARTURE UNTRIMMED

ITEM	%	WEIGHT (MT)	LCG (M)	MOMENT (MT-M)	VCG (M)	MOMENT (MT-M)	INERTIA (MT-M)
LIGHT WEIGHT		8352	7.49	62556	9.82	82016	
CONSTANTS		202	52.90	10686	8.73	1764	
PROVISION							
[FRESH WATER TANK]							
F.W.T. (P)	100	289	80.93	23389	11.85	3425	262
D.W.T. (S)	100	197	82.16	16186	11.97	2358	168
DIST.W.T. (S)	100	92	78.33	7206	11.59	1066	
SUB TOTAL		578		46781		6849	430
[FUEL OIL TANK]							
NO.1 F.O.T. (P)	96	341	-61.35	-20920	2.96	1009	1058
NO.1 F.O.T. (S)	96	341	-61.35	-20920	2.96	1009	1058
NO.2 F.O.T. (P)	96	306	46.68	14284	2.97	909	1097
NO.2 F.O.T. (S)	96	312	46.92	14639	2.97	927	1105
SUB TOTAL		1300		-12917		3854	4318
[DISEL OIL TANK]							
D.O.T. (P)	96	59	37.12	2190	2.97	175	224
D.O.T. (S)	96	59	37.12	2190	2.97	175	224
SUB TOTAL		118		4380		350	448
[WATER BALLAST TANK]							
F.P.T. (C)							
NO.1 W.B.T. (P)							
NO.1 W.B.T. (S)							
NO.2 W.B.T. (P)							
NO.2 W.B.T. (S)							
NO.3 W.B.T. (P)							
NO.3 W.B.T. (S)							
NO.4 W.B.T. (P)							
NO.4 W.B.T. (S)							
NO.5 W.B.T. (P)							
NO.5 W.B.T. (S)							
A.P.T. (C)							
SUB TOTAL							
[IN CARGO HOLD]							
NO.1 CARGO HOLD	100	4301	-63.01	-271006	9.69	41677	
NO.2 CARGO HOLD	100	7684	-36.68	-281849	8.79	67542	
NO.3 CARGO HOLD	70	5480	-7.98	-43730	6.59	36113	
NO.4 CARGO HOLD	100	7684	20.72	159212	8.79	67542	
NO.5 CARGO HOLD	100	5785	48.26	279160	10.10	58423	
SUB TOTAL		30934		-158213		271297	
[OTHER TANK]							
GRAND TOTAL		41484		-46727		366130	5196

DISPLACEMENT : W	MT	41484	LCB	M	-1.08	TKM	M	12.37
EQUIVAL.DRAFT : d	M	10.04	LCG	M	1.13	VCG	M	8.83
FORE DRAFT : df	M	9.21	HBG	M	-0.05	GM	M	3.55
AFT DRAFT : da	M	10.77	LCF	M	5.07	GGo	M	0.13
MEAN DRAFT : dm	M	9.99	MTC	MT-M	592.28	GoM	M	3.42
TRIM	M	1.56	I/D	%	133	VCGo	M	8.96

GRAIN HEELING MOMENT (G.H.M.)

COMPARTMENT	%	VOL. (M^3)	G.H.M (M^4)	FACTOR	S.G. (MT/M^3)	G.H.M (MT-M)
NO.1 CARGO HOLD	100	5394	1191	1.00	0.7974	950
NO.2 CARGO HOLD	100	9636	2813	1.00	0.7974	2243
NO.3 CARGO HOLD	70	6872	14838	1.12	0.7974	13252
NO.4 CARGO HOLD	100	9636	2813	1.00	0.7974	2243
NO.5 CARGO HOLD	100	7254	2573	1.00	0.7974	2051
TOTAL		38792	24227			20739
		ALLOWABLE GRAIN HEELING MOMENT (MT-M)				32313

13. NATIONAL GARGO BUREAU, INC GRAIN STABILITY CALCULATION FORM

Required figures to be entered on this form can be taken from the loading computer results or from manual calculation as above illustrated method of calculation.

14. AMSA225 & AMSA226 FORMS

Required figures to be entered on these forms can be taken from the loading computer results or from manual calculation as above illustrated method of calculation.

Please note that these forms require the stability to be calculated for the worst condition that can occur during the voyage.

On these phrases on the forms “AMSA does not accept “partly filled” compartments untrimmed and “partly filled” (trimmed only)”, these should be understood to mean as “trimmed level” as mentioned in section 2.11 of this chapter.

It is important to note that some AMSA surveyors in some ports do not accept filled holds to be calculated with ends trimmed, they only accept filled holds ends untrimmed, even though the forms allow entry for filled holds with ends trimmed.

15. OTHER METHODS OF ACHIEVING COMPLIANCE

Ballasting, Overstowing, Saucers, Bundling Bulk Grain, Strapping or Lashing, Securing with Wire Mesh, Temporary Longitudinal Divisions. – see International Grain Code and NCBI General Information for Grain Loading

16. REFERENCE PUBLICATIONS

- International Grain Code
- NCBI General Information for Grain Loading
- NCBI Grain Stability Calculation Form
- AMSA225 & AMSA226 forms
- IVS Kinglet’s Grain Loading Booklet

17. PROTECTION AGAINST HEAT[2]

Grain cargo must be protected from the surfaces where the temperature is likely to exceed 40 degrees Centigrade – engine room bulkheads and fuel oil tank surfaces for example.

The Master and CNO should discuss this phenomenon with the CEO and 2EO prior to loading.

The pattern of damage in cargoes situated close to fuel tanks which have overheated will be obvious as grain will discolour and clump where there has been heat transfer. If possible, stow grain cargoes in holds which will not be affected by heated fuel tanks. Fuel oil temperature should be closely regulated and recorded during the voyage.

As far as possible, the bunkers used during the voyage should be drawn from tanks situated well away from holds containing hygroscopic products. If impracticable, bunker tanks adjoining cargo spaces should be heated only when required, ensuring that the temperature does not rise above normal operational levels.

In vessels with full heating coils, blanking of steam lines to adjacent tanks to cargo may be considered as an extra precaution.

[2] W 39 / 2023