NYK Maritime College

NYK SHIPMANAGEMENT

NMC-66
Bulker Cargo Operations Training (Advanced Course)

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Objective

Nowadays, there are many reports of problems being blamed on inexperienced bulk carrier crews, who follow a cargo-handling sequence with no regard for theory, fail to discharge ballast within the scheduled time, or are unable to calculate cargo trimming quantities, overdraft and short cargo.

This Course will provide you to basic knowledge and skill for related cargo work planning, operating and ballasting operation, which was targeted for Master and Chief Officer, and illustrated with exercise of calculation of basic matters regarding stowage plan and cargo sequences.

Loss of cargo is loss of freight, in other words remain ballast is loss of cargo. Consequently, you must make the plan optimally, and you have highest responsibility of cargo planning and operation.

1. The process of determination of Loading Plan

1.1 Preparatory Work for Loading & Discharging Cargo

Preparations for entering loading cargo are to be made according to the processes given below. All vessels loading dry bulk cargoes shall comply with the following:

(Extract : Bulker Operation Manual / BLK-02SLI-01 Upon Receipt of Sailing Instruction Stowage / Planning)

(1) Prior to Loading of Dry Bulk Cargo

Upon Receipt of Sailing Instructions

3.1.1

Master shall contact the operators, charterers, load and discharge port agents and the company to obtain all required information to safely carry out the intended voyage.

3.1.2

Vessels shall commence updating the relevant information in the "BLK-02SLI.01-01CHK Checklist Upon Receipt of Sailing Instruction".

3.1.3

Vessels shall keep the company in copy to all messages sent to the charterers and operators. All messages received from the charterers and operators shall be forwarded to company. This includes the Voyage Orders/Sailing Instructions, Shippers Declaration and any other cargo related documents and instructions.

3.1.4

Update the checklist, namely "BLK-02SLI.01-01CHK Checklist Upon Receipt of Sailing Instruction", whenever changes, or new information is received either from operator or agent.

3.1.5

Forward the updated checklist with relevant information to company. The checklist shall be discussed with relevant vessel staff.

3.1.6

The checklist shall be filled up with details and the source of the information for the various check points.

3.1.7

Discuss with company if marine tape is to be applied based on the condition of hatch cover water tightness and nature of cargo.

3.2 Cargo Loadable Quantity Calculation

3.2.1

Vessel shall send the Cargo Loadable Quantity Calculation to company, basis instructions in the Voyage Orders, for review. Use "BLK-02SLI.02-01FRM Cargo Loadable Quantity and Stow Plan" for this purpose and sent in excel format only and all calculation sheets.

3.2.2

Company (HSEQ&Marine Operations) / his back-up shall review the cargo loadable and inform the vessel accordingly

3.2.3

Vessel shall declare the company reviewed cargo loadable quantity to the charterers by sending Stowage Plan.

3.2.4

Cargo loadable quantity and loading sequences shall be prepared in line with the basic principles of bulk carrier loading, and the instructions provided by the company and the owners.

3.2.5

Cargo loadable calculations / loading sequence prepared by Chief Officer shall be verified by the Master. After verification by the Master, same shall be sent to company for review.

3.2.6

Calculations shall be sent to company without delay once the instructions are received from the charterers.

3.2.7

The excel sheet Forms given shall not be modified.

3.2.8

Company (HSEQ&Marine Operations) / his back-up shall review the loading sequence and inform the vessel accordingly.

3.3 Stowage Planning

3.3.1

The Master should confirm from "IMSBC Code Certificate", "Charter Party", and Exemption Certificate if the ship is able to load that nominated cargo.

3.3.2

Master shall review the Appendix of IMSBC Code's attached "List of cargoes permitted to be carried", for the cargo to be loaded to ensure all those points that the ship must pay attention to.

3.3.3

Make a cargo plan considering the ship's on-hands, consumptions and loadline areas.

3.3.4

Apply Zeal Correction in taking into account the difference of Loadline Hydrometer and Draft Survey Hydrometer, if loading port uses Draft Survey Hydrometer.

Refer to BLK-03LOD-01 Loading Cargo Work Operations Deballasting, Section 3.6 Draft Survey Hydrometers (Zeal Hydrometer)" and other port using Zeal Hydrometer.

3.3.5

Once a deliberated Stowage Plan is ready, submit to company for review, including below;

a) Printout results of calculation on Loading Computer including;

i) Arrival / departure load port

ii) Arrival / departure discharge port

iii) Arrival at boarder line of any of Load Line Zone, if applicable

iv) Arrival / departure at intermediate bunkering port

b) Cargo Loadable Quantity and Pre-Stowage Plan

c) Sailing Instruction, or Voyage Order (Cargo Stem), if necessary

3.3.6

Submit the Pre-Stowage plan to the Charterer, upon receiving REVIEW from company.

3.3.7

Items to be considered for Stowage Planning

a) Draft Limitation of Loading Port(s)

Draft Limitation of Loading Port(s) should always be studied / considered and the ship's draft needs to be cleared from all restrictions.

b) Load Line Restriction

Midship Draft / Plimsoll Mark shall be NOT exceeding the International Load Line (Seasonal Load Line) anytime at sea water density of 1.025 g/cm3, unless there is suitable regulation at the port.

c) Deflection of the Ship

Deflection (Hogging or Sagging) should be minimized as practically as possible when planning the stowage.

Be reminded that estimated deflection need to be considered to maximum draft during computation.

i) When Stowage Planning, result of calculated drafts may require to be corrected with Hogging or Sagging effect.

Cross Check is required for the ship equipped with Loading Computer.

ii) Drafts (Forward, Aft, Midship and Mean) reporting to the Charterer should be the Drafts corrected with Hogging or Sagging, including the amount of the deflection.

iii) Basically, it is recommended and advisable to make a stowage plan with minimal deflection, either Hogging or Sagging.

d) Stowage Factor(s)

Stowage Factor of Cargo should always be confirmed carefully.

Consideration of relation between "Stowage Factor" and "shape of Cargo Hold" might be necessary to determine maximum loadable capacity.

Several kinds of UNIT are used for Stowage Factor or Cargo Density. It is essential to ensure to correct UNIT when prior input in Loading Computer.

The UNIT of most Loading Computer is either "MT/m3" or "Ft3/LT".

UNIT conversion can also be found in BLK-02SLI.02-01FRM Cargo Loadable Quantity and Stow Plan– Stowage Factor Conversion Table.

Also, be reminded that Local Agent at Loading Port might inform the Stowage Factor in different UNIT from the Ship's Loading Computer, such as "Ft3/MT".

e) Contracted Quantity (Cargo Stem)

Contracted Quantity should be well confirmed when planning the stowage. Confirm through the Sailing Instruction. Consider necessity of Safe Margin of Stowage Factor, Shore Scale Error and Belt Weight, etc.

f) Maximum Cargo Weight / Maximum Cargo Mass in each Hold.

Neither the Maximum allowed cargo "Weight" or the "Mass" of each cargo hold should be exceeded. "Two Adjacent Hold" as well, to be confirmed its acceptability on the Loading Computer.

g) Dead Ballast Water

Unpumpable Ballast Water quantity should be grasped correctly.

h) Plural Cargoes

In case of two or more grades of cargoes are loaded, Loading Sequence should be computed and confirmed at the same time of Loading Plan is prepared for any difficulty. Simulation of the Loading Sequence on Loading Computer should be exercised to confirm Sheering Force and Bending Moment are within the range.

i) Port Regulations / Requirements

All Port and Terminal Regulations / Requirements should be well studied before arriving at the Port.

j) Ship's Requests

If the ship has any requests to Port or Terminal, declare them in the earliest opportunity through Local Agent and consult with them.

k) Consumption / ROB

Consumptions, such as FO, DO and FW, and bunkering plan on the way to discharging port should be well considered upon discussing with C/E to maintain ships condition (trim, heel and deflection). Refer to Sailing Instructions and SMS manual for standard bunker margin.

l) Plural Discharging Ports

In case of two or more discharging ports were expected, confirm whether discharging at each port can be carried safely on Loading Computer. Cargo distribution of discharging holds should be simulated on Loading Computer for Sheering Force and Bending Moment is all acceptable.

m) Difference of Cargo Nomination

If cargo type or cargo quantity nominated by loading terminal is different from the one described in Sailing Instruction, contact with the charterer/operator, agent and company immediately through telephone call to confirm what is correct type or correct quantity.

Master should inform any changes to the company.

n) When charterer request Stowage Plan in rush / urgent.

If charterer request Stowage Plan to submit in rush, it is not necessary to wait for REVIEW of company. Stowage Plan may be send to Charterer as soon as ready but CC to company.

3.4 Loading Sequence

3.4.1

Vessels must send the Loading Sequence to company for review before sending it to the charterers. The sequence shall be sent with berthing calculation sheet using "BLK-02SLI.04-01FRM Loading- Unloading Sequence" in excel format only.

3.4.2

Upon Stowage Plan is approved by the Charterer, the Master and C/O shall:

a) Prepare a Loading Sequence as described in para. 3.4.3.

b) Once Loading Sequence is ready, submit it to company for review and include; (refer to Stowage Planning, para. 3.3.5, if further required).

c) UPON receiving REVIEW message from company, submit the Loading Sequence to Operator, then to Loading Terminal via Local Agent and Charterer. Consult the Sailing Instruction for any form or sequence of reporting is required.

d) Maintain "SEA-GOING" condition at the end of each pour as possible. This shall be compulsory, if the loading port is Open-Sea Port, such as Port Walcott, Port Dampier, Goa, etc. (This is a requirement of PSC at Port Walcott). If cannot be maintained, there should be a contingency plan to ballast/deballast, in any condition, that may allow the ship to proceed to sea at any time, in an emergency.

e) If two or more Loading Ports are scheduled, all the documents listed in (Stowage Planning, para. 3.3.5) above for each Loading Port is required to submit to company.

3.4.3

Items to be considered for preparing Loading Sequence.

a) Final Trimming

Preferable Trimming Holds is listed in below table. If ship cannot use the trimming holds written below for any reason, inform the company.

Bulk Carrier with	Trimming Hold
9 Cargo Holds	No.3 and No.7, or No.2 and No.8
7 Cargo Holds	No.2 and No.6
5 Cargo Holds	No.2 and No.5
Alternative for 5 Cargo Holds	No.1 or 2 and No.5

b) Loading Rate and Deballasting Rate

Expected Loading Rate per hour and Average Deballasting Rate per hour should be coincide and synchronized, as much as practicable. If there is any deviation and cause of concern, inform the company and other relevant parties.

c) Stripping Ballast Water

Loading Sequence should be so planned to have sufficient Trim by the Stern during deballasting, especially during stripping. Avoid being Trimmed by the Head during stripping.

d) Air Height (Air Draft)

Air Height should always be monitored and adjusted as NOT to exceed the terminal's designated clearance.

Hourly Tidal Height should be prepared before entering port. Apply at all times when calculating air drafts.

Air Draft at loading hatch, both of before and after pouring should be computed from ship's air height at right position, not from mean draft.

Vessel to confirm the air draft restriction Is based on chart datum. Then apply the height of tide to get the correct air draft. Do not solely rely on Loadicator results. Always take into account the increase in air draft due to the height of tide.

Seq. No.	Hold No.	Loading Quantity	Air Draft		
			Before	After	
1	4	10,000	19.5	19.3	Based on Draft at No.4CH
2	2	10,000	19.7	18.9	Based on Draft at No.2CH

e) Running Draft Check

C/O or OOW under instruction of C/O should perform Running Draft Check to compare with the calculated Drafts described in Loading Sequence to grasp approximate Shore Scale Error.

f) Ballast Hold

Commencement of loading operations into Ballast Hold should be planned with enough spare time for deballasting and preparation of Ballast Hold.

g) In-Port-Use Ballast-Holds

If ballasting into In-Port-Use Ballast-Hold(s) is necessary for air-draft restriction or for any reason, both ballasting and deballasting of such hold(s) shall be computed and indicated in Loading Sequence.

It is important to confirm with the ship's Stability Booklet / Loading Manual for what is the maximum quantity of such ballast in advance to the plan.

However, minimizing the ballast quantity is recommended.

Ballast water can be kept in In-Port-Use Ballast-Hold(s) only when the vessel is alongside.

Below are enumerating some of important points;

i) Quantity of ballast water should be minimal as possible.

ii) Maximum allowed Ballast Quantity, which is described in "Stability Booklet", or "Loading Manual" or "Loading Guidance", should NEVER be exceeded.

iii) Do not make a plan to take Maximum Ballast Water into In-Port-Use Ballast-Hold.

iv) Complete "Ballasting Safety Checklist" and "Deballasting Safety Checklist", especially confirm Water Level in In-Port-Use Ballast-Hold(s) by actual sounding during taking in the ballast water into In-Port-Use Ballast-Hold(s).

h) Record of ship's draft

Below should be observed and recorded into "Loading Cargo Operation Log" at every end of pours (every end of sequences).

i) Actual Draft shall be observed.

ii) If for any reason like suitable access is not provided, or loading rate is too high, reading draft gauge is acceptable if fitted. Report result to C/O.

iii) Compare draft gauge with the actual draft regularly to determine draft gauge error.

iv) Remember that the Gauge Accuracy may varies from time to time.

v) Loaded Quantity (Shore Scale Figure) to confirm with Stevedore.

vi) Tidal Height.

vii) Clearance between Loading Shooter and Top of Hatch Cover of Loading Hold(s).

i) Stress

Loading Sequence should be well planned so as to minimize Sheering Force and Bending Moment. It is recommended to maintain "Sea Going" condition through the Loading period so that the ship is ready to sea anytime when port or terminal emergency occurred. "In-Port" condition can be applied if necessary unless otherwise the ship is in Open-Sea Ports, such as Port Walcott, etc.

j) Post Piping Diagram for Ballast Operation

Master should post Piping Diagram for Ballast Operation including Stripping Line at below places;

i) Ship's Office

ii) Gangway Space, and,

iii) Ballast Pump space in Engine Room

3.5 Changes Loadable Quantity, Loading Sequence or Cargo

3.5.1

In cases where changes are required to be made in the loadable quantity, loading sequence or cargo grades upon request from charterer / operators, the review process shall be requested from company again, prior to same being sent to the charterer / operators (Not applicable for vessels that have to change their figures due to changes in the tides, mean sailing drafts etc. after berthing).

3.5.2

The Master continues to be fully responsible for all cargo related matters and shall thoroughly check all calculations and operations carried out onboard his vessel.

3.6 Urgency

3.6.1

In case an urgent reply is required from the office or if messages sent out of office hours which require a reply before the office reopens, etc., the message shall be followed up with a phone call to the concerned company Hachiuma MTG, NYKSM PIC HSEQ / his back-up.

1.2 Voyage Order / Sailing Instruction

(1) The voyage orders will provide for the following :

- Name and address of the charterers
- The charterparty date
- Details of delivery
- Laydays and cancelling dates
- Details of the voyage
- Date and place of redelivery
- Instructions regarding speed of the vessel and fuel consumption

(2) In addition it will :

- Provide details of the intended cargo
- Ask the master to prepare and submit a stowage plan
- State the requirements for ETA and tendering NOR
- Provide details of the charterers agents
- Advise proposed bunkering intentions
- State the authority, if any, to be given by the master to charterers or their agents for the signing of bills of lading.
- Describe the arrangements for using a weather routing service
- State the requirements for reporting noon position, average daily consumption, speed, weather and ETA whilst at sea, and for providing an arrival report on completion of each passage.

(3) In the voyage orders or at some stage in the voyage the charterers will provide :

- A list of discharge ports, maximum permitted drafts at each port and the cargo quantity to be discharged at each
- Details of whether the quantity of cargo loaded and discharged is to be assessed by draft survey or shore scale, to determine bill of lading weight.

❖ Failure to comply with items of the voyage order can prove expensive and the master should consult his documents and principals whenever he is doubt.

(Ref : Abbreviation used in charter party contracts)

1.3 Preparation for Loading Plan

(1) Cargo Planning and Monitoring

The determination of an acceptable safe and proper cargo distribution is vital to effective and efficient cargo handling.

Conventionally, appropriate results are manually obtained through the process of preparing cargo plans. The modern approach is to utilize computerization.

Cargo Plans draw particular attention to the importance of compiling accurate loading or stowage plans, showing the distribution of weight and capacities, for all types of cargoes (if carrying more than two (2) types of cargoes).

The Chief Officer will devise a planned stowage for the cargo once he receives the sailing instructions. Correct cargo stowage of cargo will help to ensure that it reaches its destination undamaged. It is recommended that the OOW makes himself familiar with all the characteristics of the cargo before it is loaded. Prior knowledge of the hazards of spontaneous combustion, self-heating, vapors, fumes, moisture and odors is essential. Ventilation requirements and compatibility with other intended cargoes should be studied. For detailed guidance on individual commodities learners should consult a definitive cargo manual such as *THOMAS STOWAGE* and IMDG Code.

In general terms however, and in some trades, cargo plans are known as stowage plans.

Prior arrival at load/disports, apart from the stability computations being prepared intended for the loading/unloading sequence, Ship and Shore safety checklist should be executed/completed prior loading or unloading. The Chief Officer and the foreman shall fill out the form and affix both their signatures.

(2) Constant Calculation

Each vessel has a constant to show unknown weight composed of materials adhering to the bottom, unmeasured quantity in tanks and stores, and ship weight changes due to repairs. And the value of the constant changes in accordance with a ship's age, before/after dock, and other factors.

On the other hand, the following miscellaneous weights, which are measurable and changeable, are provided together with the constant in some loading booklets:

- Quantity in small tanks
- Washing water tank

- Ballast water in pipes
- Others;

In some cases, the above miscellaneous items are mistakenly handled as if they are part of the constant. It is important that all measurable items be grasped as accurately as possible and used for calculations. Otherwise, correct cargo quantity cannot be found. Handling Constant and Miscellaneous Weights

Items categorized as constant and items categorized as miscellaneous items are not standardized, and itemization/categorization described in the loading booklet varies by shipyard. **Constant as an unknown weight is used as a fixed value for a short period, and it can change as time passes, and so it must be reviewed periodically.** In order to make an accurate calculation of the ship's constant, the following should be done properly:

1) **Confirm each item categorized as a constant**, such as miscellaneous weight, ballast tanks, cargo weight, lightship, etc.
2) **Confirm which items are fixed, which are variable and/or measurable, and which are unknown.**
3) **Measure/get exact values, as accurately as possible, each item that is measurable.**
4) **Minimize items categorized as constants, and recheck constant values at every opportunity, such as draft survey, dry docking**, etc.

   The categorization of a constant and the description of a constant vary according to each shipyard's standard. We recognize that some dockyards provide descriptions that might not clearly provide details and do not deduct some quantities that do not actually exist. However, there are a lot of ships that always use the same constant value including miscellaneous weight even though a different value can easily be determined by using the loading booklet.

In order to grasp accurate ship condition & cargo quantities, we would like you to confirm your constant again and confirm the breakdown of constant and miscellaneous weight, especially by taking into account the existence of ballast line water when the vessel enters or departs from port.

Bad Examples of Calculation of Constant:

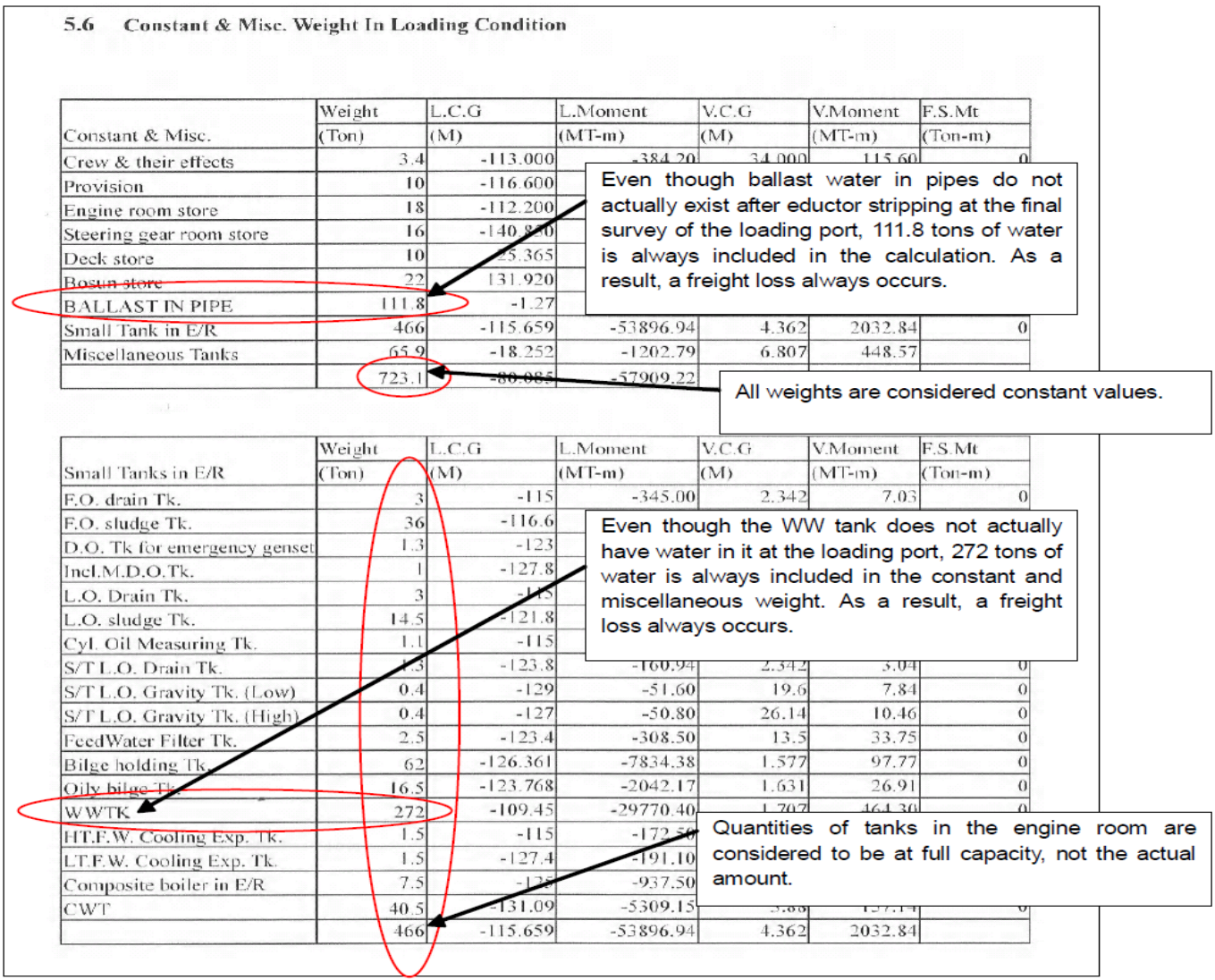
The following is a sample calculation sheet (from a loading booklet) for constants and miscellaneous weights. In this case, the vessel had always used 723.1 MT as its constant.

1) The weight in small tanks in the E/R (466 ton) was calculated based almost on its full capacity.
2) The weight in the WW Tank (Washing Water Tank: 272 ton), where washing water does not normally exist, was calculated based on its full capacity.

   => The vessel lost 272 tons of cargo every voyage.
3) The 111.8 tons of ballast in pipes was not excluded from the final survey even though almost all ballast in pipes does not exist after eductor stripping. Ballast in pipes usually exists when vessels enter port (at initial survey).

   => The vessel lost 111.8 tons of cargo every voyage.

The above-mentioned vessel might have lost approx. 400 MT of cargo every voyage.<Sample calculation sheet (in loading booklet) for constants and miscellaneous weights >



5.6 Constant & Misc. Weight In Loading Condition

Constant & Misc.	Weight (Ton)	L.C.G (M)	L.Moment (MT-m)	V.C.G (M)	V.Moment (MT-m)	F.S.Mt (Ton-m)
Crew & their effects	3.4	-113.000	-384.20	34.000	115.60	0
Provision	10	-116.600				
Engine room store	18	-112.200				
Steering gear room store	16	-140.850				
Deck store	10	25.365				
Bosun store	22	131.920				
BALLAST IN PIPE	111.8	-1.27				
Small Tank in E/R	466	-115.659	-53896.94	4.362	2032.84	0
Miscellaneous Tanks	65.9	-18.252	-1202.79	6.807	448.57	
	723.1	-80.085	-57909.22			

Even though ballast water in pipes do not actually exist after eductor stripping at the final survey of the loading port, 111.8 tons of water is always included in the calculation. As a result, a freight loss always occurs.

All weights are considered constant values.

Small Tanks in E/R	Weight (Ton)	L.C.G (M)	L.Moment (MT-m)	V.C.G (M)	V.Moment (MT-m)	F.S.Mt (Ton-m)
F.O. drain Tk.	3	-115	-345.00	2.342	7.03	0
F.O. sludge Tk.	36	-116.6				
D.O. Tk for emergency genset	1.3	-123				
Incl.M.D.O.Tk.	1	-127.8				
L.O. Drain Tk.	3	-115				
L.O. sludge Tk.	14.5	-121.8				
Cyl. Oil Measuring Tk.	1.1	-115				
S/T L.O. Drain Tk.	1.3	-123.8	-160.94	2.342	3.04	0
S/T L.O. Gravity Tk. (Low)	0.4	-129	-51.60	19.6	7.84	0
S/T L.O. Gravity Tk. (High)	0.4	-127	-50.80	26.14	10.46	0
FeedWater Filter Tk.	2.5	-123.4	-308.50	13.5	33.75	0
Bilge holding Tk.	62	-126.361	-7834.38	1.577	97.77	0
Oily bilge Tk.	16.5	-123.768	-2042.17	1.631	26.91	0
WWTK	272	-109.45	-29770.40	1.707	464.30	0
HT.F.W. Cooling Exp. Tk.	1.5	-115	-172.50			
LT.F.W. Cooling Exp. Tk.	1.5	-127.4	-191.10			
Composite boiler in E/R	7.5	-125	-937.50			
CWT	40.5	-131.09	-5309.15	3.88	157.14	0
	466	-115.659	-53896.94	4.362	2032.84	

Even though the WW tank does not actually have water in it at the loading port, 272 tons of water is always included in the constant and miscellaneous weight. As a result, a freight loss always occurs.

Quantities of tanks in the engine room are considered to be at full capacity, not the actual amount.

2. Cargo Work Planning

2.1 Calculate the Maximum Loadable Cargo

The items mentioned below should be considered when formulating the stowage plan.

(1) Restrictions at loading and discharging port.

- Depth of water (route, berth, anchorage)
- Maximum permissible draft
- Maximum permissible trim
- Maximum permissible deadweight capacity or displacement tonnage
- Maximum air draft
- Maximum dimensions of ship (length overall, breadth overall, depth)
- Which side alongside
- Tide and current restrictions
- Specific gravity of sea water

  Operator will advice SG of special port such as Nagoya, Gulf and River, otherwise confirm SG of seawater to Port Agent.

(2) Draft variation

- Specific Gravity of Seawater

(Ref : DBCH 01-03)
(Ref : DBCH 02-02-5)
(Ref : DBCSR 2007-11)
(Ref : DBCSR 2008-07)

※ Variation of displacement due to Difference in Seawater Specific Gravity

$$\Delta \text{Disp [MT]} = \frac{W \times (P_0 - P_1)}{P_0}$$

W	: Displacement,
P_0	: Standard seawater specific gravity (1.025)
P_1	: The expected seawater specific gravity

※ Variation in Mean Draft due to Difference in Seawater Specific Gravity

$$\text{Mean Draft Variation [cm]} = \frac{W \times (P_0 - P_1)}{P_0 \times T}$$

W	: Displacement,
P_0	: Standard seawater specific gravity (1.025)
P_1	: The expected seawater specific gravity
T	: Tons per centimeter (TPC)

- Discrepancy of Hydrometer *(Ref : DBCH 02-02-4)*

  ※ Apparent loss for differential of hydrometer

$$\text{Apparent Loss [MT]} = \frac{Wc \times (H_0 - H_1)}{H_0}$$

Wc : Maximum Loadable Cargo
H_0 : Standard SG by JIS hydrometer
H_1 : Standard SG by Zeal's hydrometer

- FO, DO, LO, Fresh Water and Drinking Water Consumption
- Generated Fresh Water
- Ballast Amount *(Ref : DGG 008)*
- Constant

Exercise 1: Calculation of Maximum Loadable Quantity (Basic)

(3) Sagging Correction *(Ref : DBCSR 2010-02)*

No correction is required for hogging, but when sagging occurs, and correction for sagging has to be deducted. That is, the draft of the ship calculated using the Loading Calculator is generally indicated without considering hogging/sagging effects. Therefore, if the cargo is loaded on the ship up to the load water line as indicated by calculations, then a tanker in the sagging condition will be completely in the "overdraft" condition.

In such cases, the Sag Correction should be calculated from the deflection (sag) output by the Loading Calculator using the equation given below and deducted from the loadable quantity.

SAG Corr. amount (MT) = TPC × 1/4 × DEFLECTION value (cm)

That is, approximately one-fourth the TPC for 1-cm deflection indicated by the Loading Calculator becomes the value to be deducted from the loadable quantity.

<draft and deflection values output by the Loading Calculator>

The draft values output by the old loading calculation program are calculated based on the displacement and weight distribution, while the

deflection values are output by the hull deflection calculations based on a separate weight distribution. This deflection value is not reflected in the draft calculation. (This has been confirmed from the manufacturer of the calculator. However, the latest calculation program can output calculations that are linked.)

In view of the above, if the output deflection value is merely added to the output draft value at midship, then an unknown weight will be added to the displacement.

That is, let us take the case where the output draft is F=19.200 m, MID=19.200 m, A=19.200 m and the deflection value is 20 cm (sagging). If the deflection value of 20 cm is simply added to the draft MID of 19.200 m, then the draft values become F=19.200 m, MID=19.400 m, and A=19.200 m. In this case, the displacement increases by the amount: 123 MT (TCP) x 3/4 x 20 cm (sagging) = 1,845 MT. In practice, the displacement does not increase.

Theoretically, the effect of sag on the displacement can be explained as follows. The increase in displacement at midship is balanced by the decrease in displacement at the forward and aft ends of the hull. With respect to the draft, the hull at midship sinks by an amount equivalent to the increase in displacement, while the hull forward and aft rise by an amount equivalent to the decrease in displacement.

Accordingly, the deflection value calculated by the Loading Calculator can generally be used to calculate the approximate draft considering the deflection due to the draft correction given below.

<u>The draft should be corrected by value of deflection output by the Loading Calculator based on the assumptions below.</u>

1) Considering that maximum deflection occurs at midship, the hull may be assumed to sink or rise uniformly. The trim is assumed to remain unchanged.

2) The deflection is given by δ = (da + df)/2 – dmid
(Note that sag is taken as negative and hog as positive)
(δ : Deflection value)

df : draft forward
da : draft aft
dmid : draft at midship

3) One-fourth the mean draft is d(1/4 mean) = (da + df)/2 -3/4δ

4) The draft for trim calculation is taken as 1/4th the mean value. The change in draft considering deflection is as given below.

Draft estimated considering hull deflection

(FORWARD) = df+3/4δ
(MIDSHIP) = dmid −1/4δ
(AFT) = da+3/4δ

(4) Navigation zones and load water line *(Ref : DBCH 02-03)*

- **Under any circumstances, the ship should not be loaded or ballasted such that the load water line is exceeded.**
- The "Chart of Zones and Seasonal Areas" should be referred to when deciding the load water line of the ship in navigation areas. (See Fig.1)
- **If the zone or season area changes when the ship is underway, the load water line corresponding to the changed zone or season should be used.**
- If the ship is entering a port that is on the boundary of a zone or a seasonal area, the load water line corresponding to the zone or seasonal area until reaching the said port, or the load water line corresponding to the zone or seasonal area after leaving the said port on its outward voyage should be used.
- Irrespective of the trim, hogging or sagging condition of the ship, the water line indicated by the freeboard mark should be strictly adhered to.
- **Deciding the maximum draft**

  The following points should be considered when deciding the maximum draft:

  - **Draft restrictions of the channel to be navigated**
  - **Load water line to be used when navigating the zone or seasonal area**
  - **If the zone or seasonal area changes when the ship is underway, the quantity of fuel, fresh water and consumables required until the ship reaches the changed zone or seasonal area**
  - **Change in draft due to the difference in specific gravity of sea water.**

- **Heel and Bunker usage**

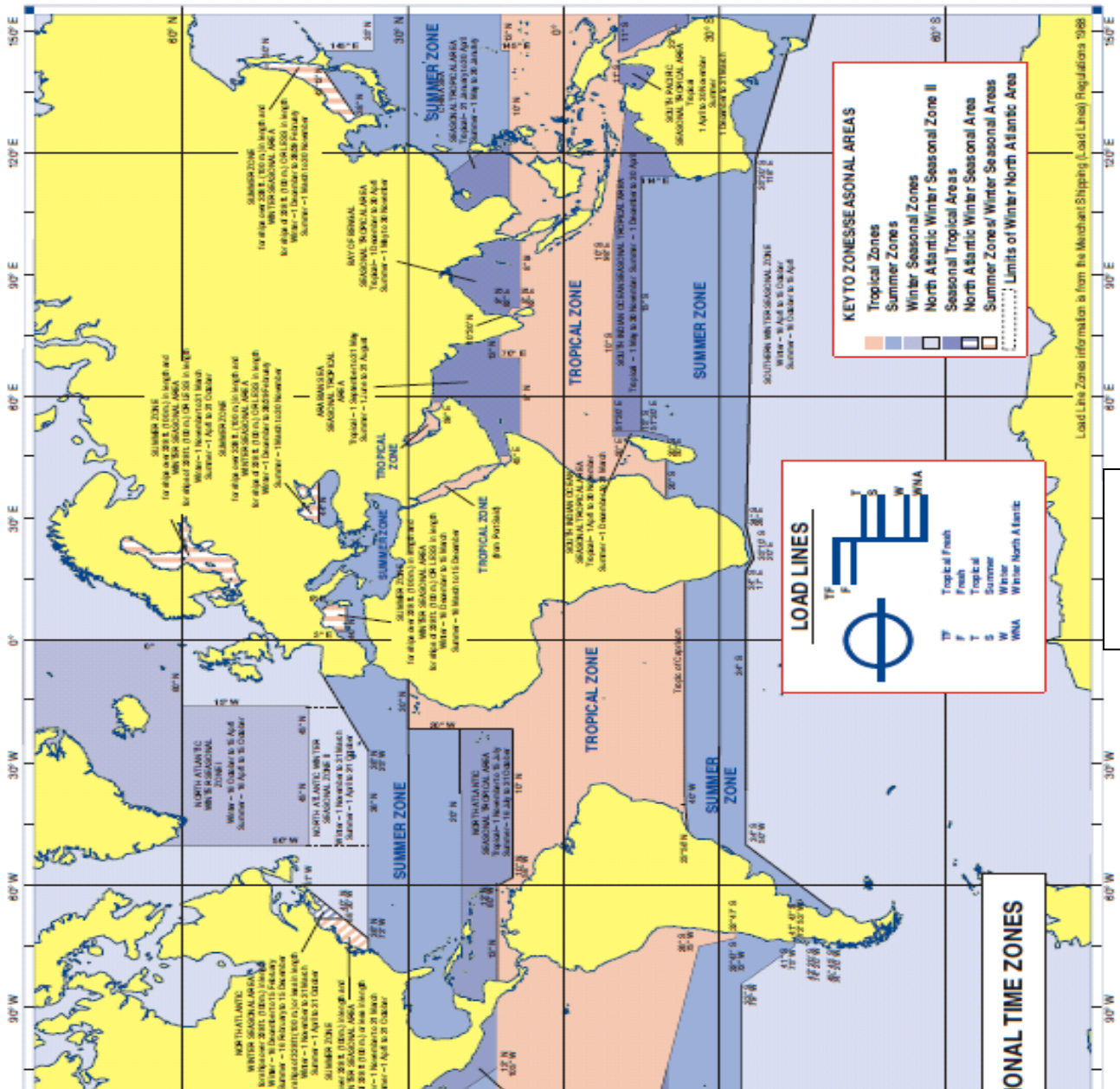
- **Plan of the bunker tank usage is directly affected heel.**
- **C/O must need special precaution about the usage of the bunker tank to avoid the unexpected heel.**
- **If your heel condition is different at loading port from your original plan, you must confirm the arrival condition of heel at discharging port by using the C/E's bunker plan for discharging port on loading computer in advance.**

- **If you need to change the bunker plan at discharging port, you should discuss C/E to avoid the over draft at discharging port.**
- **If C/E cannot change the bunker tank usage plan, please call V/M as soon as possible.**

Exercise 2: Calculation of Maximum Loadable Cargo
(Under Draft Limitation at Discharging Port)

Exercise 2-2: Calculation of Maximum Loadable Cargo
(Under Draft Limitation at Discharging Port)

Exercise 3: Calculation of Maximum Loadable Cargo
(Under navigating with a change of seasonal area)



<Fig.1>

2.2 Making Stowage Plan

After the Total cargo to be loaded has been finalized then we need to decide the amount of Cargo that will be stowed in each hold. The following should be kept in mind.

(1) **Insert the known figures for Bunkers, Fresh water, Constant and Unpumpable Ballast as per the vessels experience**(confirm density of every item is correctly entered).

(2) **Confirm the number of Holds to be loaded.**

(3) **Enter the correct Stowage Factor(SF) for the holds.**

SF will be declared by "DECLARATION BY SHIPPER". As of stage of stowage plan, Operator will advise SF as their experience due to not received yet "DECLARATION BY SHIPPER".

SF is in many cases expressed in cubic feet (CF or FT3)/LT (long ton) [CF/LT]. SF is the number of cubic feet occupied by one long ton of cargo.

1 meter = 3.280840 feet

1 cubic meter = 35.31467 cubic feet

1 metric ton = 0.984206 long ton

1 long ton = 1.016047 metric ton

(4) **Share the total cargo between holds decided.** In doing so the following is to be emphasized upon.

1) Minimize hogging and sagging
2) Keep in mind that fore and aft holds have large broken spaces due to their location and vessels structure (narrowing toward the back of the coaming).
3) In planning cargoes with high Stowage factor, careful attention should be paid for space in trimming holds so as to have some additional space to absorb any undue trim.
4) When carrying more than one grade allocate loads such that one Hold will carry same grade of cargo so far as possible. Also try not to allocate the same grade to adjoining holds (refer ships stability booklet to check restrictions if any).

(5) **Check hull strength and stability for departure Condition.**

(6) **Check SF/BM for departure Condition.**

(7) Check that the tonnage allocated to each hold is within permissible limits. **Allowable mass of cargo in loaded holds should be checked by referring to ALLOWABLE MASS CHART.**

(8) **If Alternate/Block loading is to be carried out then does the loading of individual holds remain within block loading limits.**

(9) **Work the stowage plan through the entire voyage stages reflecting all consumables** so as to ensure that the ships stability, SF/BM are all within permissible limits at every stage up to discharge port arrival.

(10) **After work the loadable, Vessels shall send the Cargo Loadable Quantity Calculation to their ship management company, basis instructions in the Voyage Orders, for approval.**

Do not forget enter the following items.

- Max draft at Load port
- Max air draft at load port
- Density at load port
- No of loaders and loading rate
- Max draft at disport
- Max air draft at Disport
- Density at disport
- Contracted quantity with options (eg. +/-10% MOLOO)
- Stowage factor with units
- Any additional restrictions at the load or disport.
- A brief explanation from the vessel explaining the basis of the calculation if required for easier understanding.
- The loadable calculation excel sheet with all columns filled up accurately.

2.3 Knowledge on Allocating Loads to Hatches

(1) **Allocate loads in holds so as to minimize hogging and sagging if hold space and hull strength permit.** (Load less cargoes in midship holds than in fore and aft holds.)

(2) In planning loads with a high stowage factor (SF) or when it is expected that available space will be full volume-wise, keep in mind that **fore and aft holds have large broken spaces due to the narrowing toward the back of the coaming.**

(3) **If the space is expected to be full volume-wise, pay careful attention to space in the trimming holds**, and allow extra space to absorb any undue trim.

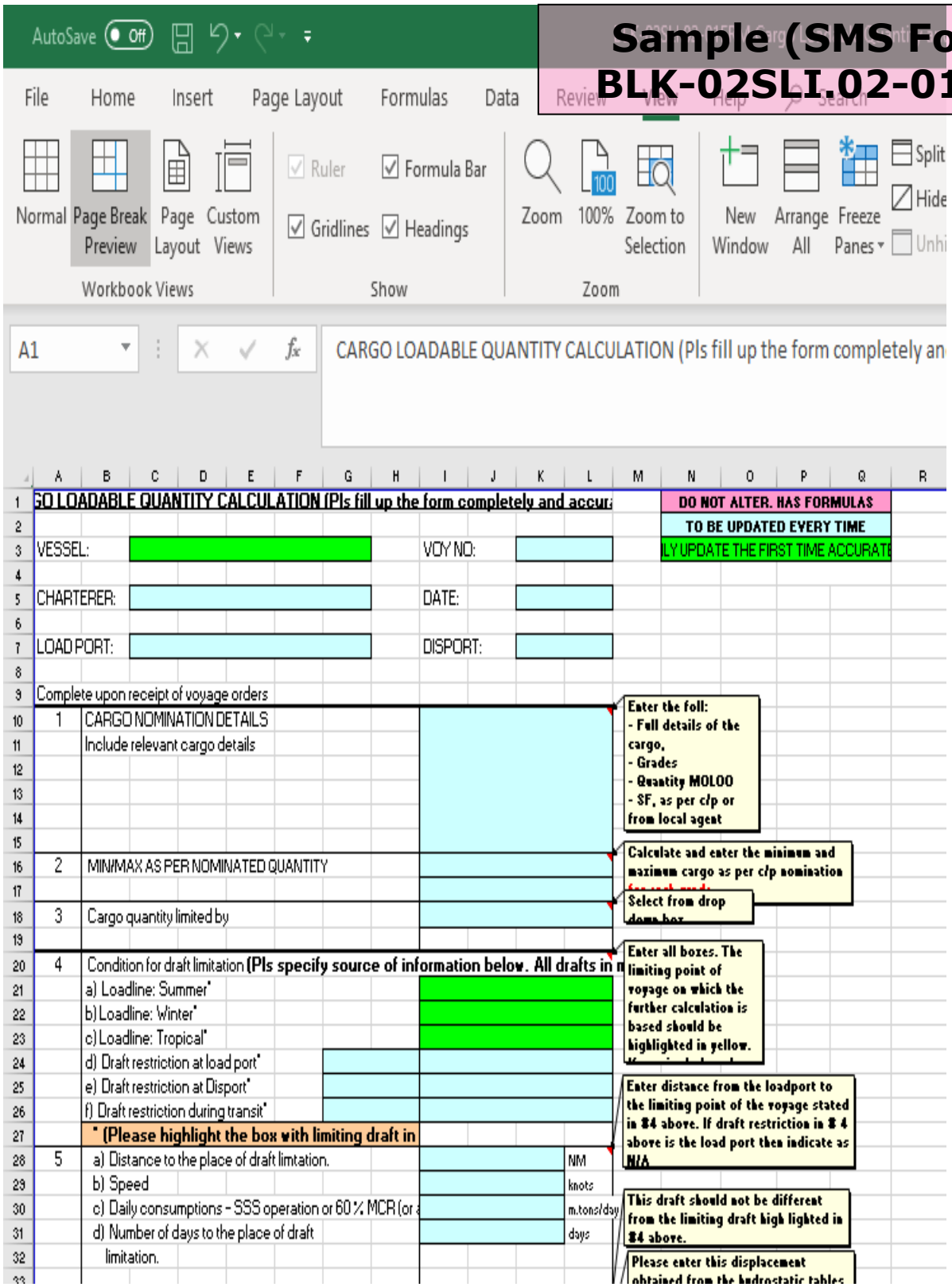
(4) **In case of multi-grades of cargo, allocate to load the hatches so that each hold can be filled with the same grade of cargo, unless absolutely impossible.** Complete loading with same grade without introducing another grade of cargo.

(5) **In case of multi-grade of cargo, try not to allocate the same grade to adjoining holds.** Try to distribute the same grade in the holds at the fore and midship, aft and midship, or fore and aft. (When two loaders are being used for cargo handling at the port, they might not be able to work adjoining holds simultaneously. This separation of holds can also help reduce excessive trim and strength variations.)

Exercise 4: Calculation of the Conversion of Stowage Factor
(CM/MT → CF/LT, CF/MT → CF/LT)

Exercise 5: Calculation of Cargo Loadable Quantity
(Under Single Grade Cargo)

Sample (SMS Form)
BLK-02SLI.02-01FRM



AutoSave Off

File Home Insert Page Layout Formulas Data Review View Help Search

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Workbook Views | Show | Zoom

A1 | CARGO LOADABLE QUANTITY CALCULATION (Pls fill up the form completely an

GO LOADABLE QUANTITY CALCULATION (Pls fill up the form completely and accur

DO NOT ALTER. HAS FORMULAS
TO BE UPDATED EVERY TIME
LY UPDATE THE FIRST TIME ACCURATE

VESSEL: | VOY NO:

CHARTERER: | DATE:

LOAD PORT: | DISPORT:

Complete upon receipt of voyage orders

1 CARGO NOMINATION DETAILS
Include relevant cargo details

Enter the foll:
- Full details of the cargo,
- Grades
- Quantity MOLOO
- SF, as per c/p or from local agent

2 MIN/MAX AS PER NOMINATED QUANTITY

Calculate and enter the minimum and maximum cargo as per c/p nomination

3 Cargo quantity limited by

Select from drop down box

4 Condition for draft limitation (Pls specify source of information below. All drafts in m

Enter all boxes. The limiting point of voyage on which the further calculation is based should be highlighted in yellow.

a) Loadline: Summer*
b) Loadline: Winter*
c) Loadline: Tropical*
d) Draft restriction at load port*
e) Draft restriction at Disport*
f) Draft restriction during transit*

* (Please highlight the box with limiting draft in

5 a) Distance to the place of draft limtation. — NM

Enter distance from the loadport to the limiting point of the voyage stated in #4 above. If draft restriction in # 4 above is the load port then indicate as N/A

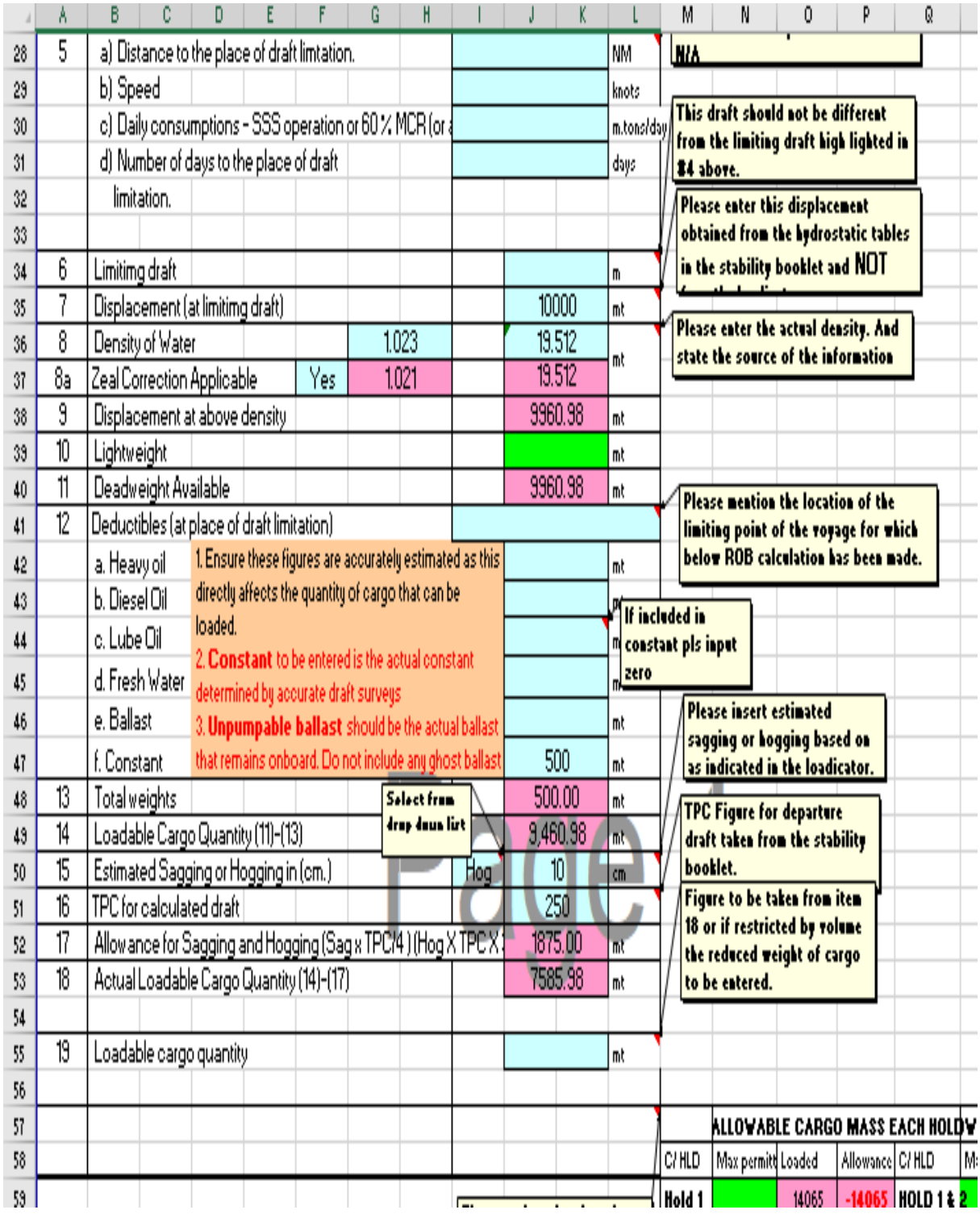
b) Speed — knots

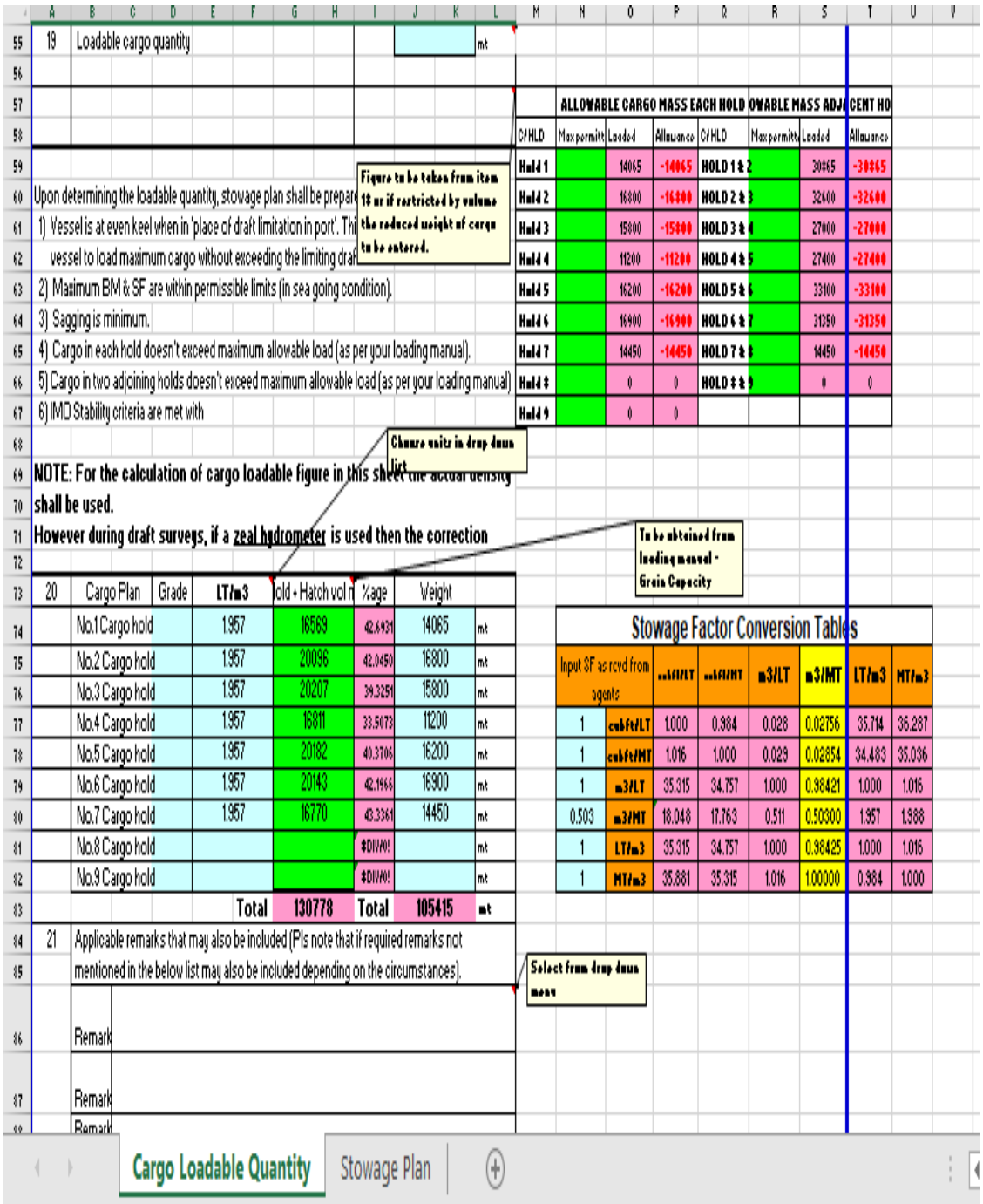
c) Daily consumptions - SSS operation or 60 % MCR (or — m.tons/day

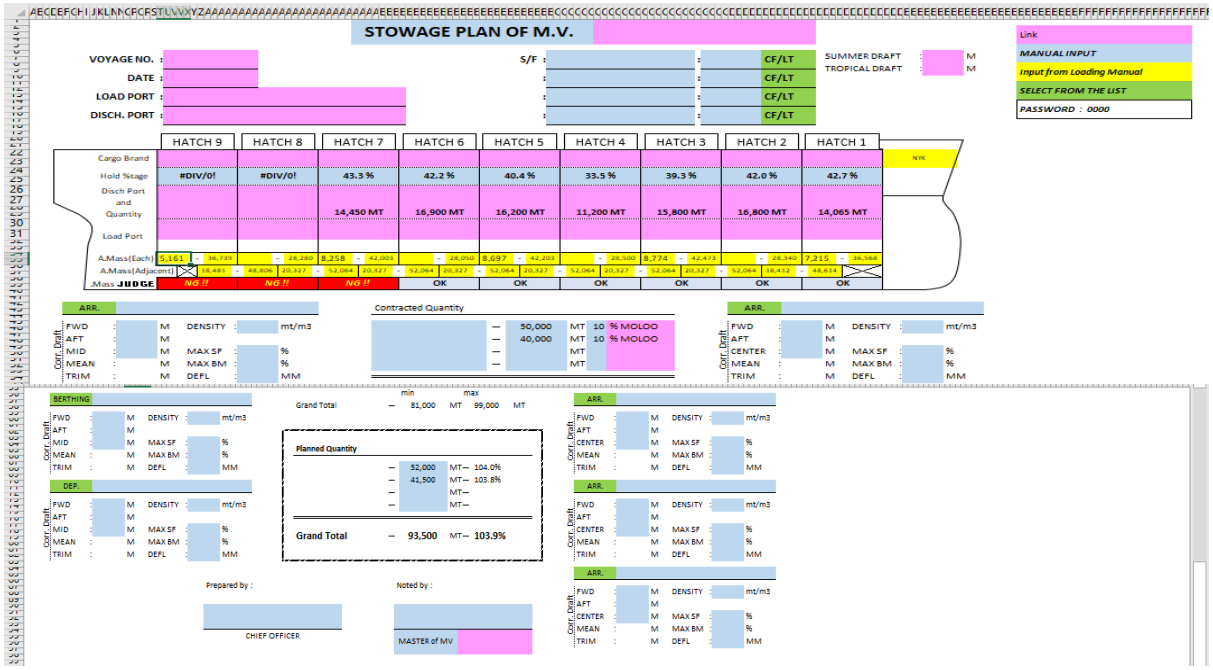
This draft should not be different from the limiting draft high lighted in #4 above.

d) Number of days to the place of draft limitation. — days

Please enter this displacement obtained from the hydrostatic tables

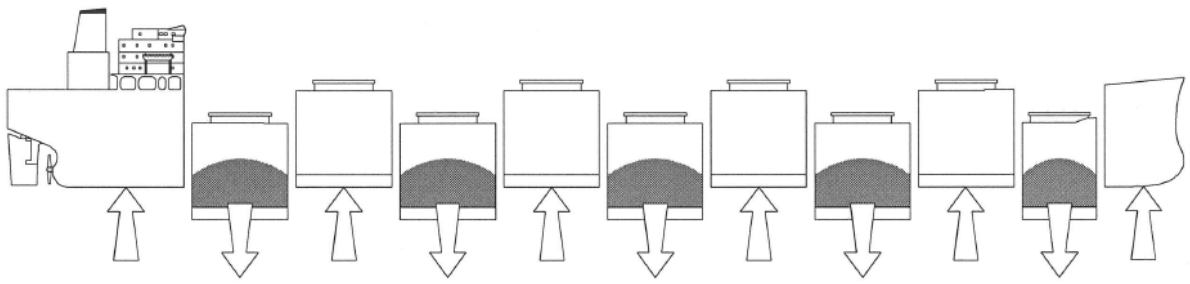

5 a) Distance to the place of draft limtation. NM
b) Speed knots
c) Daily consumptions - SSS operation or 60 % MCR (or
d) Number of days to the place of draft limitation. days
6 Limitimg draft m
7 Displacement (at limitimg draft) 10000 mt
8 Density of Water 1.023 19.512 mt
8a Zeal Correction Applicable Yes 1.021 19.512
9 Displacement at above density 9960.98 mt
10 Lightweight mt
11 Deadweight Available 9960.98 mt
12 Deductibles (at place of draft limitation)
a. Heavy oil
b. Diesel Oil
c. Lube Oil
d. Fresh Water
e. Ballast
f. Constant 500 mt
1. Ensure these figures are accurately estimated as this directly affects the quantity of cargo that can be loaded.
2. Constant to be entered is the actual constant determined by accurate draft surveys
3. Unpumpable ballast should be the actual ballast that remains onboard. Do not include any ghost ballast
13 Total weights 500.00 mt
14 Loadable Cargo Quantity (11)-(13) 9,460.98 mt
15 Estimated Sagging or Hogging in (cm.) Hog 10 cm
16 TPC for calculated draft 250
17 Allowance for Sagging and Hogging (Sag x TPC/4) (Hog X TPC X 1875.00 mt
18 Actual Loadable Cargo Quantity (14)-(17) 7585.98 mt
19 Loadable cargo quantity mt
Select from drop down list
This draft should not be different from the limiting draft high lighted in 84 above.
Please enter this displacement obtained from the hydrostatic tables in the stability booklet and NOT
Please enter the actual density. And state the source of the information
Please mention the location of the limiting point of the voyage for which below ROB calculation has been made.
If included in constant pls input zero
Please insert estimated sagging or hogging based on as indicated in the loadicator.
TPC Figure for departure draft taken from the stability booklet.
Figure to be taken from item 18 or if restricted by volume the reduced weight of cargo to be entered.
N/A
ALLOWABLE CARGO MASS EACH HOLD
C/ HLD
Max permitt
Loaded
Allowance
C/ HLD
Hold 1
14065
-14065
HOLD 1 & 2


19 Loadable cargo quantity mt
ALLOWABLE CARGO MASS EACH HOLD
Upon determining the loadable quantity, stowage plan shall be prepare
1) Vessel is at even keel when in 'place of draft limitation in port'. Thi
vessel to load maximum cargo without exceeding the limiting draf
2) Maximum BM & SF are within permissible limits (in sea going condition).
3) Sagging is minimum.
4) Cargo in each hold doesn't exceed maximum allowable load (as per your loading manual).
5) Cargo in two adjoining holds doesn't exceed maximum allowable load (as per your loading manual)
6) IMO Stability criteria are met with
Figure to be taken from item 18 or if restricted by volume the reduced weight of cargo to be entered.
Change unit in drop down list
NOTE: For the calculation of cargo loadable figure in this sheet the actual density shall be used.
However during draft surveys, if a zeal hydrometer is used then the correction
To be obtained from loading manual - Grain Capacity
20 Cargo Plan Grade LT/m3 Hold + Hatch vol m3 %age Weight
No.1 Cargo hold 1.957 16569 42.6931 14065 mt
No.2 Cargo hold 1.957 20096 42.0450 16800 mt
No.3 Cargo hold 1.957 20207 39.3251 15800 mt
No.4 Cargo hold 1.957 16811 33.5073 11200 mt
No.5 Cargo hold 1.957 20182 40.3706 16200 mt
No.6 Cargo hold 1.957 20143 42.1966 16900 mt
No.7 Cargo hold 1.957 16770 43.3361 14450 mt
No.8 Cargo hold #DIV/0! mt
No.9 Cargo hold #DIV/0! mt
Total 130778 Total 105415 mt
21 Applicable remarks that may also be included (Pls note that if required remarks not mentioned in the below list may also be included depending on the circumstances).
Select from drop down menu
Remark
Remark
Stowage Factor Conversion Tables
Input SF as rcvd from agents
Cargo Loadable Quantity
Stowage Plan



2.4 Shearing Forces(SF) and Bending Moments(BM) in the hull

The seagoing SF and BM limits are not to be exceeded when the ship puts to sea or during any part of a seagoing voyage. In harbor, where the ship is in sheltered water, the hull girder is permitted to carry a higher level of stress imposed by the static loads. **The harbor SF and BM limits are not to be exceeded during any stage of harbor cargo operation.**



Shearing Action of Hull Girder in Still Water

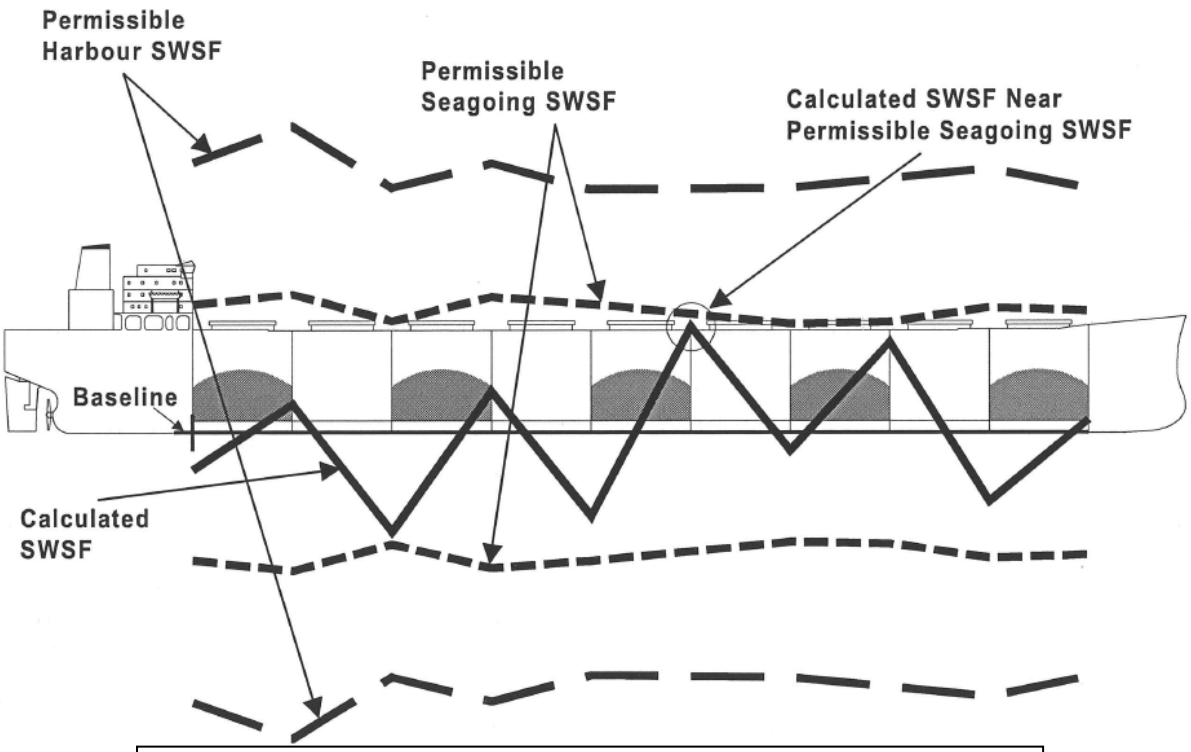
When a ship is floating in still water, the ship's lightweight and deadweight are supported by the global buoyancy up-thrust acting on the exterior of the hull. Along the ship's length there will be local differences in the vertical forces of buoyancy and the ship's weight. These unbalanced net vertical forces acting along the length of ship will cause the hull girder

to shear and tp bend, including a vertical still water SF and BM at each section of hull.

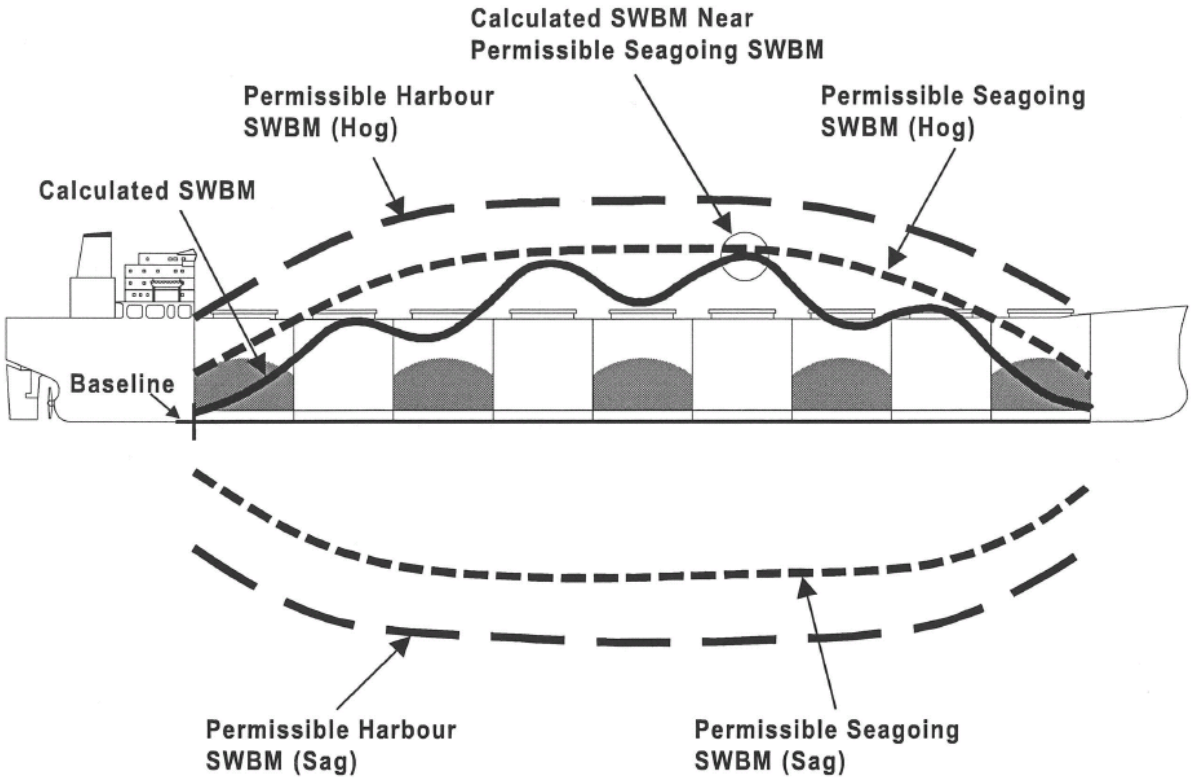
At sea, the ship is subjected to cyclical shearing and bending actions inducted by continuously changing wave pressures acting on the hull. These cyclical shearing and bending actions give rise to an additional component of dynamic, wave induced, SF and BM in the hull girder. At any one time, the hull girder is subjected to combination of still water and wage inducted SF and BM.

The stresses in the hull section caused by these SF and BM are carried by continuous longitudinal structural members. These structural members are the strength deck, side shell and bottom shell plating and longitudinal, inner bottom plating and longitudinal, double bottom girders and topside and hopper tank sloping and longitudinal, which are generally defined as the hull girder.

Examples of permissible and calculated SF and BM are shown bellow respectively.



Relationship of the Permissible SF and Calculated SF



Relationship of the Permissible BM and Calculated BM

2.5 Devising Cargo Loading Sequence *(Ref : DBCH 03-01)*

Once the stowage plan for the cargo has been approved the focus then shifts to Cargo Loading sequence. Efficient management of loading sequence will allow the vessel to load the cargo within least possible time, no undue stress on the cargo and ensure loading of complete parcel of cargo.

Factors that need to be taken into account when planning the loading sequence are as follows.

- Max allowable safe draft at Berth.
- Tidal range.
- Limiting draft as was calculated earlier.
- Air Draft restriction at berth.
- Characteristics/ Limitations of loading equipment.
- Maximum load rate
- Number of Ship loaders.
- Ships Characteristics.
- The ship's draft and trim at the completion of each step in the cargo operation

- The amount of ballast water and assumed de-ballasting rate.

The loading/unloading plan should indicate any allowances for cargo stoppage (which may be necessary to allow the ship to de-ballast when the loading rate is high), shifting ship, bunkering, draft check and cargo trimming.

Other practical aspects which need to be considered are as follows.

(1) **Ballast holds should be loaded as late as is practicable.** Drainage, Cleaning, Preparation and Dry-up may take longer time than expected.

(2) Be sure that the sequence ensures **sufficient trim by the stern when completing deballasting of hold** so that smooth hold preparation can be facilitated.

(3) **Plan the sequence so that no repeated starting and stopping of ballast pumps is required.** Be careful not to let the plan involve alternate deballasting on ballast tanks differing in the water head. Plan the sequence so that **cargo loading starts at a midship hold, while letting the hull sink parallel,** and the ballast is uniformly discharged by gravity (except where the hatch allocation for multiple grades or hull strength limitation forbids it).

(4) **Begin cargo handling from the midship hold, and in parallel with the discharging of hold ballast, maintain safe air draft by letting the hull sink parallel.**

(5) **Save the aftmost ballast tanks until the last so as to secure sufficient trim by the stern.** Give priority to discharge ballast starting from forward ballast tanks toward the stern ballast tanks from the beginning till the middle phase of cargo loading to facilitate efficient deballasting.

(6) **Do not increase unnecessarily the number of loading passes at each hatch.** To reduce cargo handling time, fill every alternate hold in only one pour, unless there is a problem with hull strength or trim, and or cargo cannot be handled without strain, except the holds at fore and aft end, trimming holds, and the second holds from the forward and aft, respectively. (This does not apply to ore carriers.)

(7) **Plan the sequence in order to secure a large trim by the stern during the stripping work (usually 3.5 m to 6.0 m for Capesize, or 3.0 m to 5.0 m for Panamax).** The rest of the cargo handling sequence after achieving this trim by the stern should be such that the state of trim by the stern is maintained by shifting the loading position from the stern to the midship and then to the stern to secure enough time for the stripping work. Therefore, before doing interim

draft survey, **the holds remained to be loaded with cargo should be the fore holds.**

(8) **When carrying multi-grades of cargo, plan the sequence in such a way that the cargo constituting the most volume is stowed last to ensure trim flexibility.** (A plan to last sequence with the grade having smallest-volume might not rectify an error of earlier loaded grade, resulting the need for more volume for trim correction).

(9) **As the trimming hold, do not use the end hold that would invite too great a trim variation. Also, do not use the midship holds whose trim variation is too small. The volume of trimming should be large enough to absorb any error; trimming volume in one attempt should be 3,000 ~ 5,000 tons for a Capesize, or 2,000 ~ 3,000 tons for a Panamax.**

(10) Although the current standard practice is to trim cargo in one round (in two holds) to reduce cargo-operating time, trimming can also be accomplished in two rounds by terminal procedure. In the latter case, **the minimum pour capacity of the loader should be taken into account when determining the trimming quantity.**

3. Cargo Work (Loading-1)

3.1 Pre-Cargo Work Meeting *(Ref : Bulker Operation Manual / BLK-03LOD-01 Loading Cargo Work Operations Deballasting)*

Prior commencement of cargo operations Pre-Cargo Work Meeting shall be conducted on board. **The objective of the meeting shall be to achieve safe and efficient cargo operations.**

The meeting shall be chaired by Chief Officer and attended by all deck officers and ratings. Involvement of other senior officers is highly recommended. It is suggested that this meeting be held in a window period of not less than 24 hours and not more than 72 hours prior to arrival of the port in order to have a meaningful dialogue with maximum amount of information at hand.

The agenda of the meeting should include following.

1) Arr / Dep drafts, Channel/Berth Depth, Local Tide, Water Density
2) Mooring Arrangements, Shore Bits Arrangements, Width of Fenders, etc.
3) Side Alongside, Ship/Shore Access Arrangements
4) Sailing windows for intended departure draft

5) Quantity of Cargo
6) Stowage Plan
7) Loading/Unloading Sequential Plan
8) Number of Loaders, Loading Rate, Minimum Pour Quantity
9) Maximum Outreach of Loader and Travelling Length
10) Hatch Cover Positioning
11) Cargo Information (Characteristic, Loading / Securing Requirements)
12) Allowable Air Draft in conjunction with the Loader Height
13) Ballasting / De-Ballasting Sequential Plan
14) Ventilator Management for Ballasting / De-Ballasting
15) Pump/Valve Operations Procedures
16) Hold Inspections
17) Draft Survey
18) Stevedoring Arrangements

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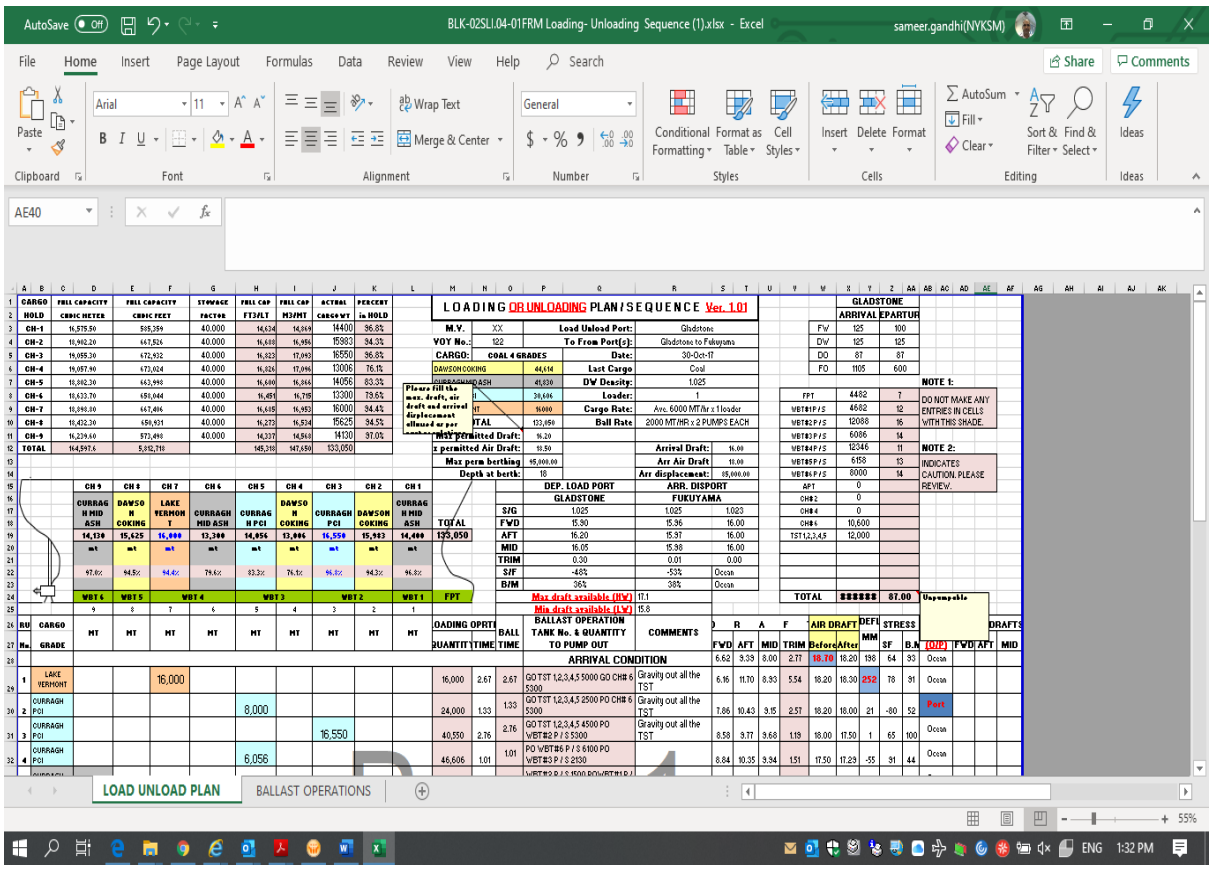


Exercise 6: Devising Cargo Loading Sequence followed by explanation of your loading sequence.

3.2 Discussions before Loading

The chief officer shall discuss the following matters with the shore supervisor in charge of cargo work and submit the agreed matters to the competent authority.

1) Notification to the nearest competent authority about agreed matters concerning the kind and quantity of cargo to be loaded, loading sequence, and de-ballasting plan.
2) Matters pertaining to stowage factors, moisture content, whether or not harmful gases will be generated, nature of the cargoes, etc.
3) Method of loading and loading efficiency.
4) Method of communications between the shore stevedore and the ship.
5) Matters concerning safety and sea pollution prevention regulations of the terminal and the loading port.
6) Restrictions regarding under keel clearance and air draft.
7) Matters pertaining to replenishment of oil, water, ship's supplies, food, etc.
8) The capacities of the ship's cranes (safe working load) (only applicable to those equipped with cranes).

3.3 Monitoring the ship’s Loading Condition

The officer in charge should closely monitor the ship’s condition during cargo operations to ensure that if a significant deviation from the agreed loading plan is detected all cargo and ballast operations must STOP.

The officer in charge should ensure that,

- The cargo operation and intended ballast procedure are synchronized
- Draft surveys are conducted at appropriate steps of loading plan to verify the ship’s loading condition. The draft readings, usually taken at amidships and the fore and aft perpendiculars should be in good agreement with values calculated in the loading plan.
- Ballast tanks are sounded to verify their contents and rate of ballasting/de-ballasting
- The cargo load is in agreement with the figures provided by the terminal

- The SF, BM and, where appropriate, hold cargo weight versus draft calculations are performed at intermediate stages of cargo operation. These results should be logged, for recording purposes, against the appropriate position in the loading plan.

3.4 High Loading Rates

High loading rates may cause significant overloading within a very short space of time. The officer in charge should be prepared to STOP cargo operations if the loading operation deviates from the agreed loading plan.

There are following problems associated with high loading rates which may result in over-stressing the ship's structure.

- The sensitivity of the SF and BM
- Overloading the local structure
- Synchronization of the ballasting operations

4. Ballast Operation

(Ref : DBCSR 2006-08)

(Ref : DBCSR 2013-02)

4.1 Knowledge of Ballasting and Deballasting

(1) Deballasting at Loading Port

1) **Make sure that the ventilation is open** before commencement of deballasting.
2) When discharging the hold ballast, be sure to open the air vents of the hold and escape hatches or hatch covers beforehand.
3) During deballasting operation, **pay attention to the water heads in not only the tank being worked on but also the other tanks** to make sure that the work is done exactly in the planned sequence.
4) When the ballast tanks have sufficient water heads, usually no ballast pump is required for deballasting, because deballasting by gravity is generally faster than deballasting by pump. The line arrangement for deballasting by gravity should have no strainer if possible.
5) Deballasting at the loading port should **always be somewhat faster than the progress of cargo handling**; and be careful not to fall behind the schedule of each sequence even if the loading rate is increased.
6) Plan deballasting so as not to develop trim by the head except when it becomes inevitable due to circumstances of cargo handling. **Keep**

trim by the stern at all times to secure a sufficient suction head.

7) Be careful not to allow a difference in water heads between port and starboard tanks during deballasting work, and **ensure that there is no heel due to uneven deballasting.** If cargo handling causes excessive heel, ask the foreman to adjust the heel by loading cargo accordingly.

8) If both pumps trap air when in parallel operation while stripping, the operation may be hampered. Therefore, keep one of the pumps in standby keeping in circulation, and perform deballasting with the other. Also, **pick up as much of remaining water as possible with the main pump to minimize the time taken for stripping by Eductor.**

9) Give top priority to discharge the hold ballast so that the holds can be ready to receive the cargo. In preparing the stowage plan, **be sure that a sufficient trim by the stern can be secured at the time of stripping the ballast holds, so as to prevent taking extra time for their stripping.**

10) **When tanks with a large difference in water heads are to be deballasted at the same time, equalize the tanks before deballasting;** otherwise, ballast may flow back from the tank with a higher water head to that tank with a lower water head, resulting in deballasting of only the former.

11) Even if any pump begins drawing air at the final stage of deballasting, **don't stop the pump immediately**; make every effort to continue deballasting with the main pump by **priming the pump from another tank** or deballasting the tank on the other side of inclination by utilizing the heel of the hull, and thereby reducing the time taken for deballasting with the eductor.

12) Keep a sufficient trim by the stern when stripping with the main pump, and **make every effort to achieve thorough deballasting with the main pump.**

13) Also while stripping with the eductor, keep a sufficient trim by the stern. Keep close watch on the hull inclination during cargo loading and, **conversely, utilize the hull inclination to strip the tank efficiently taking into account the bellmouth position of the tanks.**

14) Upon completion of the final stripping, **measure the remaining water by maintaining a state in which the trim is kept by the stern. In this case, use a Dipping Table (Wedge Table) for precise measurement of the remaining water.** When there is a trim and the water head is very low, do not measure the ballast

with the Sounding Table, which adjusts the trim correction with the water head, as it would inevitably lead to an error and consequently cause a reduction of the apparent cargo load.

(2) Ballasting at Discharging Port

1) **Make sure that the ventilation is "open"** before commencement of ballasting.
2) Keep a close eye on water levels in the tanks during ballasting; **never allow the ballast water to overflow when vessel at the berth.**
3) In the initial stage of ballasting, no ballast pump is required because filling by gravity is generally faster than pumping. The line arrangement for ballasting by gravity should have strainers to prevent foreign objects from entering ballast tanks and, conversely, the line arrangement for deballasting should have no strainer.
4) Ballasting at the discharging port should **be somewhat slower than the progress of cargo handling** to facilitate adaptation to any sudden change in the discharging plan or any similar unexpected development. Also pay attention to the draft and trim, and make plans always readily adaptable to emergency unberthing.
5) **Plan your ballasting so as not to make trim by the head.**
6) **Pay constant attention to the water head.** When it is necessary to fill the ballast tanks up to the planned water head, disengage the ballast pumps from parallel operation and operate them independently a little before top-off or keep one of them in circulation, and reduce a delivery quantity **to allow for extra time to determine to stop it.** If there is a difference in water heads between the top-off tank and other tanks, ballast may shift or flow back as a consequence of the water head difference, possibly inviting line blockage or an abrupt change in the load on pumps.
7) Equalize the water heads of the ballast tanks on both port/starboard sides to **eliminate heel imbalance due to inappropriate ballasting.** Precaution is particularly required for ballast-attributable heel imbalance, as it would lead unbalanced cargo discharging. If there is an excessive heel due to unbalanced cargo, ask the stevedore to change the cargo discharging side. (Take into account of the consequence of not achieving the planned capacity if the heel and/or the trim are excessive.)
8) **Avoid repeated starting and stopping of the pumps.** When the required ballast capacity varies substantially in a short period, either keep one of the pumps in circulation, top off one of the tanks

and resume parallel operation when ballasting is restarted with the next pump, or fill many of tanks at the same time in the top-off operation to allow extra time for ballasting.

9) If there is a ballast tank topped off in a trim-less or a excessive heel toward the other side, or if cargo handling invites an excessive trim or the heel returns to the upright, **achieve topping-off with some water head allowance in anticipation of a possible overflow of the ballast.** When in port, it is usually advised not to fill any of the ballast tanks to its full capacity.

10) If limitations of the hull's strength require complete filling of every ballast tank to its capacity while the vessel is to be unloaded at multiple ports, pay attention to the progress of cargo handling and subsequent changes in trim, along with other factors, and fill the ballast tanks somewhat behind cargo handling schedule not to let the ballast overflow from the tanks. Also ask the stevedore to keep watch over the impact of cargo handling on the heel.

11) When the ballast holds are to be topped off by operating the ballast pumps in parallel, **keep track of the filling rate and the expected top-off time** to prevent overflow. It is easier to estimate topping-off time by gauging it with ladder rungs to the escape hatch.

12) When ballast is to be replaced after leaving the port, if the hull stresses are within limit and the propeller is immersed in water more than required relative to weather conditions, it is not absolutely necessary to completely fill the ballast tanks. As an increase in remaining ballast volume could invite increased fuel consumption. **Be sure not to keep more ballast than needed.**

13) **Before filling the ballast holds with water, remove all cargo residuals as thoroughly as possible.** It is also necessary to install silk hat strainers to ensure that no cargo residuals enter into the ballast line and damage seat rings or cause any other problems. If any manhole stud has been bent in the course of cargo handling, fit a nut on the stud and lightly hit the nut to straighten the bend. Be careful not to break the bolt thread by accidentally hitting the stud directly.

4.2 Preparation of the ballasting plan

Ballasting work during loading mainly involves de-ballasting.

There are no merits or demerits between discharging and de-ballasting work. If de-ballasting is not performed, the scheduled cargo loading operation cannot be implemented. The points related to de-ballasting mentioned below should be considered when preparing the ballasting plan.

1) Controlling the ship's hydrostatic attitude

   Ballast is mainly used for controlling the ship's attitude and it plays an important role in tankers.

2) Ensuring hull strength

   Hull strength is a very important factor to be considered during the voyage of the ship between loading ports.

3) De-ballasting and delays

   Basically, if there is no trim by the stern, then a large quantity of water remains in the tank after de-ballasting, causing a reduction in the loadable quantity. At ports with draft restrictions, high tides may have to be considered and a considerable delay in departure may occur.

4) Number and construction of ballast tanks

   The number of ballast tanks in double hull ships is approximately two times the number in single hull ships. The quantity of water remaining in the upper and lower parts of the tank structure is considerable in double hull ships, and the time required for stripping is greater compared to that in single hull ships.

5) Trim by stern

   Where possible, the trim by stern should be made 3 m approximately before stripping. If conditions permit, this should be done as early as possible. However, care is necessary since restrictions on trim may be applicable when berthing/mooring at a terminal.

6) Precautions during de-ballasting work

   a) The level of the ballasting tank should be checked before the de-ballasting work to confirm that no oil is present.

   b) The movable range of the loading arm (manifold height) should be checked considering changes in tide.

   c) The ship's attitude (draft, trim, list (heel) should be correctly maintained.

   d) Personnel should be stationed and the sides of the ship should be carefully monitored.

   e) The mooring ropes should be adjusted considering changes in tide and draft.

   f) Terminal regulations should be adhered to.

4.3 Importance of de-ballasting work

If the tank is to be loaded fully up to the estimated level, ballast should be completely stripped. At ports with draft restrictions, the ship cannot sail out of the port with large quantity of ballast remaining in it.

Unnecessary ballast on board must be prohibited. Unnecessary ballast on board caused the loss of cargo to be loaded.

4.4 Stripping work

Stripping work has to be performed in the final stage of the de-ballasting work. The items given below should be considered in the final stage.

1) Selection of bell mouth

The main suction (bell mouth is installed about 5 to 10 cm above the bottom) is mainly used for de-ballasting using the ballast pump. When the eductor is to be used, the stripping bell mouth (installed about 2 to 4 cm from the bottom) is mainly used. For complete stripping, ultimately the stripping bell mouth has to be used. Accordingly, the bell mouth for the remaining oil and water has to be selected.

2) Trim and list (heel)

The points below should be borne in mind for completely stripping the tanks.

a) Appropriate trim

As far as possible, stripping should be carried out with a trim of about 3 m. Since the bottom construction of a ballast tank is complex, the flow of water becomes poor. This point should be considered and after valve lineup, stripping should be carried out about 5 times. An appropriate interval of time should be assigned between strippings depending on the condition of flow of the remaining water.

b) Listing the ship in the direction of the suction bell mouth Stripping should be carried out after adjusting the list of the ship in the direction of the suction bell mouth by cargo oil or other ballast.

Care should be taken because an excessive list will lead to damage to fenders of the berth.

List is generally limited to about 0.5 degrees.

4.5 Cavitation

(1) What is cavitation?

During pump operation, the pressure of the flow near the impeller entrance reduces locally. If the absolute pressure is equal to or less than the saturated vapor pressure of the liquid at that temperature, the liquid in that part starts vaporizing even if no heat is applied, and gas bubbles are created.

The phenomenon of occurrence of gas bubbles in the liquid is called cavitation. When cavitation occurs, the discharge pressure or the suction pressure varies, noise and vibrations increase, and the operation can no longer be continued. Cavitation leads to pump damage such as erosion, and to the shortening of

pump life.

(2) Occurrence of cavitation

The pump should be operated correctly during the discharging operation before cavitation occurs.

Cavitation can be easily detected when it occurs since noise and vibrations increase. It should be borne in mind that if appropriate measures against cavitation are not adopted, continuous operation becomes difficult, and in the worst case, the pump may be damaged.

(3) Measures to be adopted when cavitation occurs

The measures below are required to be adopted when cavitation occurs.

1) Reduce the pump rpm.
2) Throttle the discharge valve.
3) If there is a tank with head, open the suction valve of the tank and reduce the negative pressure. That is, if the eductor can be used, the oil should be collected in the slop tank to develop the head. The suction valve in the slop tank should be opened to some extent (usually about 30%, but this may be changed depending on the condition) to ensure the pump suction pressure.
4) Increase the number of suctions tanks using the stripping line. In this case, oil should have been filled in the stripping line before connect the line to the main line. It is important to have the line used for discharging fully filled with oil during the pump priming work so that it can be readily used whenever required.

4.6 Pressure Surge

For the purpose of prevent pressure surge, method of operating the valve is as follows.

1) **<u>Gradually throttle and adjust the valve carefully</u>** so that the flow is not changed abruptly. Flow rate adjustments of butterfly valves can be performed easily. However, when the flow rate changes abruptly in valves that have been opened by 50%, adequate care should be taken to operate the valve gradually.
2) Change the flow rate by throttling the valve further from 50% to 30%.
3) At the valve opening of about 30%, the oil flows in slowly. At about 20%, the flow of oil is so slow that it appears to have stopped. Accordingly, it is important to keep the valve open to about 30% before the target ullage is reached.
4) In the vicinity of target ullage, open the valve to about 20% and allow the oil to settle.
5) Confirm that oil flows into other tanks correctly and then fully close the valve. If the other tank valve is adequately open and flow rate is less than the permissible flow rate in the piping, no problems will occur even if you quickly close the valve all at once from an opening of 20% or less.
6) **<u>The valve in the final tank to be loaded should be kept fully open until the Loading Master's permission to close the valve is obtained, the loading pump stops and the flow in the pipeline stops completely.</u>**

4.7 Water Hammer

Adopt the measures given below to prevent water hammer before delivery of oil to the cargo pump.

1) Check for negative pressure in the cargo line by observing the suction pressure of the pump.
2) If negative pressure exists, open the gas intake valve installed in the cargo tank, supply gas to the cargo line using the tank pressure to attain positive pressure in the cargo line. The method of opening the air cock at the upper part of the strainer tank or the pump casing for attaining positive pressure is a secondary method presently and is not normally used.

5. Cargo Work (Loading-2)

5.1 Trimming of Ship

Trimming of the vessel needs to be carried out to bring the vessel to her intended drafts- Fwd-midship and aft. Trimming pours are also required to compensate for few of the following factors.

- Inaccurate Quantities loaded
- Failure to load the cargo in exactly the positions intended.
- In accuracies in loading calculations
- Error in assumed position / figure of assumed Constant.
- The most important aspect of laying stress on Trimming is to reduce the possibility of Cargo Shift.

The volume of trimming should be large enough to absorb any error; typical trimming cargo tons are. **As the trimming hold, do not use the end hold that would invite too great a trim variation. Also, do not use the midship holds whose trim variation is too small.**

- **Cape Size:- 3,000 ～5,000 tons**
- **Panamax Size: 2,000～3,000 tons**

Trimming should be accomplished in two passes for better control, although in some cases it is done in one pass to save time. In the latter case, the minimum pour capacity of the loader should be taken into account when determining the trimming quantity.

Once the Trimming holds and trimming quantities are confirmed, then the proportion of trimming amount is to be decided depending upon the trimming moments of the respective holds.

The trimming pours are the incorporated into the loading sequence and checked to ensure that they provide acceptable draft, trim and stress.

Exercise 7: Calculation of Cargo Trimming

5.2 Draft Survey and Displacement Calculation

(Ref : DBCSR 2013-02)

(Ref : DBCSR 2014-02)

Draft surveys are made in order to determine the quantity of cargo loaded, carried and discharged. This is done by measuring the vessels draft and calculating its displacement prior loading a cargo and after loading of this cargo, taking variables such as weight lightship, ballast water, fuel and stores into account.

In order to obtain a reasonable accuracy in this draft survey calculation corrections to the draft readings and it initial corresponding stability values and parameters must be made.

(1) Estimating for Cargo quantity

Each day it is customary on most piers not only to report cargo on hand on the dock and alongside in lighters but also to measure the ship to determine the weight of the cargo to be loaded to fill in the remaining space and put the ship down to its desired marks. The weight remaining is figured from the draft of the ship and its immersion scale.

(2) Precautions to be taken when Reading Draft

1) While staring at the draft mark for a few minutes, the sea surface, which is usually moving up and down, is found to be at a momentary standstill. When this reading is continued for some time, the observer will notice repetition of the same draft reading at the momentary standstill of the sea surface. Use of the reading obtained in this way is recommended.
2) **In a port where a sea tide is present or a port in a river, the draft reading tends to be exaggerated by the flow of the tide or the river.**
3) Misreading the forward or aft draft by 1 cm would have a 1/8 impact on the final value 1/4 M, while misreading the midship draft by 1 cm would have a 3/8 impact on 1/4 M.

$$1/4\ \text{Mean} = \frac{Fc + Ac + 3Mid(P) + 3Mid(S)}{8}$$

4) **When the midship draft on the shore side is to be read from above, the reading tends to exaggerated. Therefore, it is advisable to read from a position slightly away.**
5) **If the draft is to be read under the light of a lamp at night when the sea surface is calm, it is often difficult to read the draft, as the sea surface is not clear. In such a case, reading can be facilitated by throwing a small stone or the like to generate a ripple.**

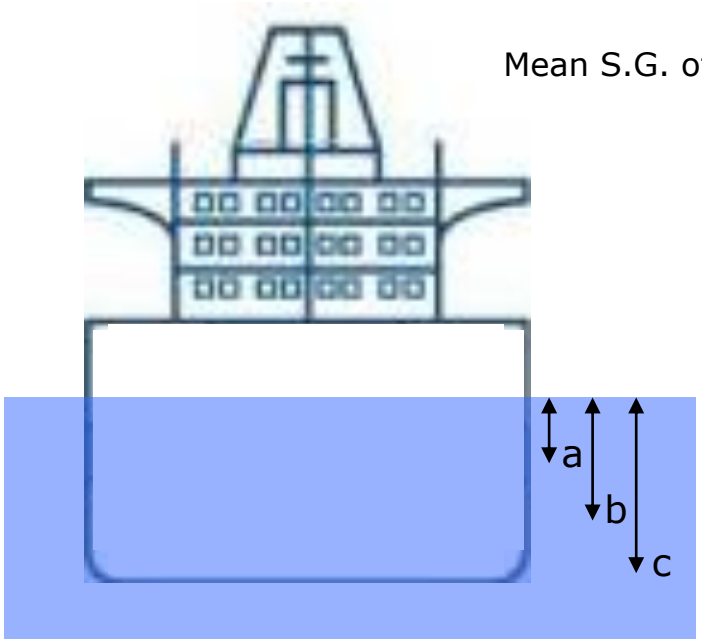
(3) Measurement of Specific Gravity of Seawater

The mean specific gravity of seawater is used as the value of specific gravity of seawater. Thus, **basically, the specific gravity of seawater**

is measured at a total of 18 points comprising three (top, middle and bottom) each at six on the two broadsides (forward, aft and midship), and the 18 values are averaged.

$$\text{Seawater S.G. in the port} = \frac{\text{Each Mean SG of Seawater}}{\dfrac{\text{FP + FS + Mid(P) + Mid(S) +AP + AS}}{6}}$$

$$\text{Mean S.G. of Seawater} = \frac{a + 2b + c}{4}$$



However, as the surveyor permanently assigned to the same port has good knowledge of the specific gravity of seawater in the port, he may simplify the procedure and use the measurement at only one position instead of the mean specific gravity of seawater described above. Confirm what kind of seawater hydrometer is used by the surveyor at the port. In the ports of Newcastle and Abbot Point in Australia, Zeal-manufactured hydrometers (weight in air 15 C/15 C) are used, and they are about 0.002 different from JIS hydrometers (Weight in Vacuum 15 C/4 C) used aboard our ships.

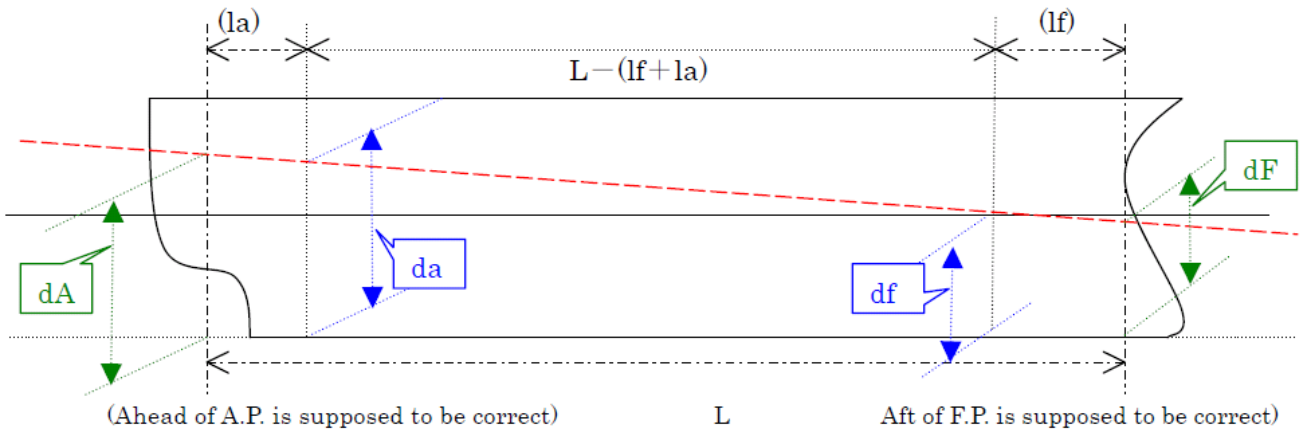
When seawater is to be sampled with a sampler, it is advisable to draw up seawater two or three times with the sampler to adapt it to the seawater temperature.

(4) Trim Correction Procedure

When we obtain actual displacement, following collection should be apply to Q/M displacement.

1) Stem & Stern Correction

Where draft marks are not indicated on perpendiculars, the drafts on the forward and aft perpendiculars are not expressed when there is a trim, and therefore this difference should be corrected.



L : Length between perpendiculars [m]
lf : Length between forward perpendicular and forward draft mark [m]
la : Length between aft perpendicular and aft draft mark [m]
df : Draft measured forward [m]
da : Draft measured aft [m]
dF : Draft at forward perpendicular [m]
dA : Draft on aft perpendicular [m]

① Calculate the Forward and Aft Draft Trim Corrections

Extent of forward draft trim correction

$$\Delta f\ [m] = \frac{(-)lf \times \text{Uncorrected trim [m]}}{L-(lf+la)}$$

Extent of aft draft trim correction

$$\Delta a\ [m] = \frac{(+)la \times \text{Uncorrected trim [m]}}{L-(lf+la)}$$

② Calculate Draft at Forward and Aft Perpendiculars

Draft at Forward Perpendicular (dF) : $dF\ [m] = df \pm \Delta f$

Draft at Aft Perpendicular (dA): $dA\ [m] = da \pm \Delta a$

2) 1/4 Mean (Quarter Mean)

① Calculate the Mean of Mean(M/M)

$$\text{Calculated midship draft (Mc)} = \frac{dF + dA}{2}$$

$$\text{Measured midship mean draft (C)} = \frac{\text{Measured Midship(P)} + \text{Measured Midship(S)}}{2}$$

$$\text{Mean of mean (M/M)} = \frac{Mc + C}{2}$$

② Calculate 1/4 Mean (Quarter Mean)

$$\text{1/4 Mean} = \frac{M/M + C}{2}$$

Alternatively, 1/4 M can also be found with the following equation.

$$\text{1/4 Mean} = \frac{dF + dA + 6\,(C)}{8}$$

3) Obtain Following Values from Hydrostatic Table

- Displacement [tons] : Displacement at Q/M
- LCF [m] : Longitudinal Center of Flotation from midship (Horizontal distance from midship point to center of flotation)
- TPC [t/cm] : Tonnage Per Centimeter Immersion
- MTC (−50) [t-m/cm] : Moment to Change Trim (Trim moment per cm) (1/4 Mean - 50 cm)
- MTC (+50) [t-m/cm] : Trim moment per cm (1/4 Mean + 50 cm)

$$\frac{\text{MTC } (-50)}{\text{MTC } (+50)} \quad (-$$

ΔMTC (The value is always positive)

4) First & Second Trim Correction

As displacement figures listed in the hydrostatic table are calculated on an even keel basis, if the vessel have a trim, the pertinent figure should be corrected.

$$\text{1st Trim Correction (MT)} = \frac{100 \times LCF \times \text{True Trim at Q/M(m)} \times TPC}{Lpp}$$

$$\text{2nd Trim Correction (MT)} = 50 \times \Delta MTC \times (\text{True Trim at Q/M})^2$$

Lpp

5) S.G. Correction

As displacement figures listed in the hydrostatic table are calculated on a basis of a standard specific gravity of seawater (1.025), if the specific gravity of seawater measured in the port differs from the standard, the pertinent figure should be corrected.

$$\text{SG Correction [MT]} = \text{Displacement after Trim Correction} \times \frac{\text{Seawater's S.G. in the port} - 1.025}{1.025}$$

Exercise 8: Calculation of Draft Survey

6. NAABSA CLAUSE

Extract from casualty information no 86 - December 2011, " Norwegian Hull Club"

6.10 What is a "Safe port?"

"A port will not be safe unless, in the relevant period of time, the particular ship can reach it, use it and return from it without, in the absence of some abnormal occurrence, being exposed to danger which cannot be avoided by good navigation and seamanship."

This principle has been clarified further:

"If there is a dangerous obstruction in the port, but with ordinary care and skill the vessel will never be at risk of collision with it, the port is in ordinary parlance safe. On the other hand if the situation in the port is such that even with ordinary care and skill there will still be a risk of collision, the matter is quite different".

6.11 What is "Safely aground"?

The general understanding is that your vessel will rest on flat, soft mud during low tide, while cargo operations continue. This is normal procedure in some English rivers like the Thames and Humber, as well as in the River Plate, in South America. In other words, this clause is routinely accepted in many of the major ports. However, your Owners may also have to accept this clause in lesser ports where Safely aground is not the norm. Problems can arise as a result.

The practice of lying aground while loading is still common in grain trades and remains an important provision for those involved in such trades, but with a separate indemnity provision added.

The parties must agree from the outset of the charter if the ship is capable of lying aground and, if so, the places where it's permitted to lie aground. If the parties do not identify the places in writing in sub-clause 1(d) then the clause will not apply. The provision has been phrased in this way because of the potential class andinsurance implications for owners in agreeing to allow their ship to lie aground at specified places, which they should consider on a case-by-case basis.

6.12 Practical advice for masters:

Contact Ship management company, carry out joint risk assessment with the company

Matters which are included in the RA may be following

• Ensure that all navigation charts are up to date.

• Ensure that the ship has adequate tidal information in the form of tide tables, etc. This information can be obtained from local sources such as agents

if it is not carried on board.

• Obtain as much knowledge about the port as possible,prior to arrival.

• Check soundings of doublebottom tanks at the times of grounding and refloating.

• Engineers to ensure there is no damage to the rudder.This includes checking the bearings distances at the first opportunity.

• Check operation of the rudder and rudder angles visually after refloating. Ensure steering gear is not running when aground.

• Be aware of possibility of listing caused by the seabed being not uniformly level.

• Include pilots and harbour authorities. Information required by the master includes

(but is not limited to):

–– the permitted draft whilst alongside

–– nature of the seabed at the exact berth the ship will be visiting

–– details of any obstructions that may pose a hazard to the ship

–– loading and discharge rates of the facilities that will be visited

–– the strength of the bollards at the berth.

6.13 Action Required (When calling a port where the vessel anticipates this situation),

- *Confirm if the NAABSA clause is included in the charter party*
- *Inform all concerned parties about possible bottom touch*

- *RA to be sent for company approval*
- *An Underwater survey may be arranged after completion(usually on charterer's account)*
-

6.14 Following information to be obtained from agents-:

- Permissible draft, Nature of the seabed
- Vessel's Berth, details of any obstructions that may pose a hazard to the ship
- Loading and discharge rates of the facilities that will be visited
- The strength of the bollards at the berth
- NAABSA checks to be done not only for loading but discharging as well

Do NOT make an assumption that the permissible draft for port or terminal during previous call is still valid. Check permissible drafts prior each call. To be careful about terminal change in the same port , which may affect the permissible draft as well

6.15 Recommendations / Cautions

- To take soundings of DB tank at the time of grounding and refloating(and sounding around vessel using hand lead line)
- Rudder function to be checked after refloating
- Steering gear should not be run when vessel is sitting on her bottom
- Be mindful of possibility that vessel lists to one side after touching bottom ,due to uneven bottom

Exercise 9: Maximum loadable calculation, and making cargo sequence-5 grades, 3 load and 3 discharge ports

7. GRAIN

The term Grain covers wheat, maize(corn),oats, rye, barley, rice, pulses, seeds and processed forms thereof, whose behavior is similar to that of grain in its natural state. Source of definition: Intl Grain Code,

The Master shall ensure that the ship:

a. Before loading, can comply with intact stability criteria at all stages of the voyage.
b. Is upright before proceeding to sea.
c. Has all the paperwork completed and onboard.
(paperwork generally consists of Document of authorization issued by the flag state, a loading certificate issued by the shipper appointed authorized co. , shipper's declaration, fumigation cert, grain stability booklet etc)

7.10 Typical Grain related issues

- Hold cleanliness
- Stability (liable to shift, Free surface effect)
- Dangerous atmosphere in hold and adjoining spaces due to fumigants/lack of O2
- Cargo Care-Ship/Cargo Sweat or sea water ingress-Poor hatch covers, leakage or bilges, Tank top temperatures, contamination with previous cargo, rust or insects
- Self heating

7.11 Weather Precautions:

- - This cargo shall be kept dry as practicable during loading.
- - This cargo cannot be handled during precipitation. Do not load in rain.
- - Do not press up any ballast tanks adjacent to cargo holds. Never overflow ballast tanks.
- - During the loading, non-working hatches must be closed. Only hatches being worked on shall be kept open.
- - To prevent cargo claims due to water ingress, all hatch seals (both longitudinal and transverse), hold access lids and seals around the hatch sides should be chalk marked and water tested using deck wash hoses.
- - Hatch cover drains, including non-return valves, should be proved clean and clear with blanking caps attached and working to ensure water ingress is prevented from coming into the hold.
- When entering the cargo space, the company's enclosed space permit and relevant checklist must be followed.

- - During the loading of grain, dust clouds often develop. These are health hazard and additional safety requirements, such as the wearing of eye protection goggles and dust masks should be observed by all personnel in the vicinity of the dust cloud.

7.12 Gases

- Metabolic processes continue after harvesting the wheat. The wheat absorbs oxygen (O2) and excretes carbon dioxide (CO2).

Respiration may cause life-threatening CO2 concentrations or O2 shortages in the holds. Ventilation and gas measurements must be carried out before anyone enters the hold. It is important to find out what type of grain is about to be carried and if it gives off any dangerous gases.

- Strict rules for entering enclosed spaces on vessels must be followed.

7.13 Odour

- Gasses and aroma substances are readily absorbed by the grains. For this reason, holds must be completely odour-free and deodorization must not be carried out until immediately before loading.

7.14 Insect infestation

- Wheat may be infested by cereal pests during storage and transport. Inadequately cleaned warehouses and holds are usually the root cause of insect infestation. Infestation may result in self-heating which ultimately gives rise to depreciation or even total loss.
- Cargoes will need to be fumigated, and in case significant delays occur at any stage in the voyage thought would have to be given to checking and possibly re-fumigating the cargo as insect populations and other pests can multiply rapidly in a cargo hold of wheat.

7.15 Self Heating

- When a Stored material increases in temperature by generating heat without drawing heat from its surrounding the action is called Self Heating
- The increase in temperature occurs in two phases. Phase one is known as biological heating, which normally occurs up to 55C and exceptionally up to 75 C. Phase 2 is known as chemical heating , which occurs from above 75C to at least 150 C.
- Heating is promoted by high moisture content of the cargo. Especially in freshly harvested grains with average moisture contents of 14%, there is a risk of self-heating, given the differing stages of ripeness of the individual grains; some of them have higher moisture contents. They are the starting points for moist spots which expand continuously and finally encompass the entire cargo of grains with a major rise in temperature

- There has been an increase in claims related to heat damage in soya bean cargoes loaded in South America, particularly Brazil and Uruguay, mostly for discharge in China" , some claims amounting to multi million dollars-Source GARD LP Circular

Prevention of damage due to heating:

- - The main hazard when carrying grain is the risk of self heating and spontaneous combustion. Shipper's declaration regarding the properties of cargo, to be studied carefully prior loading

7.16 Grain cleaning standard

- Usually by combi-gun using SW and rinse by FW, utilizing a 15mtr ladder for reaching areas inaccessible to combigun (Attention- Ladder/working aloft Safety precautions)

7.17 After cleaning there should be

- No remains ,stains or odor of previous cargo
- No insects
- No loose rust scales, flaking paint or wet paint, or fresh paint smell or paint blisters
- No dust on hold surface(&holds to be thoroughly dry)
- - All previous cargo remnants and any loose scale or flaking paint to be totally removed including those from behind beams, ledges, pipe guards and other fittings in the holds. Cargo holds must be clean dry and odorless.
- - To avoid taint problems, fresh paint should not be used in the holds or under the hatch lids at anytime during the hold preparation, unless there is sufficient time for the paint to cure and be free of odor as per manufacturer's instructions.
- - Cargo hold bilges and strums of the ballast hold should be thoroughly cleaned, free from odor and all traces of precious cargo removed.
- - Bilge suction to be tested, confirmed working normally. The bilge spaces containing water to be pumped out. Pls review your bilges lines prior to blanking off in order to ensure pumping out of cargo hold bilges can be carried out any time in case of flooding. Blanking of bilge lines may be carried out inside the engine room.

7.18 Cargo Care

- During cargo operations, close hatches which are not in use(keep track of rain/close hatch covers immediately once loader is out, if rain can be sighted visually).
- Issue LOP to terminal in case of delays in pulling out the loader
- Ship/Cargo Sweat—Monitor hold temp to check for dew point and self heating possibility

- Cargo Sweat is where the air in the hold is hotter that the air outside the hold
  Ships sweat is where the air outside the hold is hotter that the air inside the hold

7.19 Ventilation requirements:

- The holds must not be ventilated until the minimum fumigation period has expired, and care must be taken to ensure that subsequent ventilation does not endanger the crew.
- The decision on whether or not to ventilate will require careful consideration by the Master and officers. The basic principle is to keep the dew point of the air within the hold below the temperature of the hold structure and the cargo to stop the formation of ship and cargo sweat. The vessel should closely monitor the hold air dew point, the atmosphere dew point and the sea temperature, with recordings being taken on a regular basis.

Ventilation

Ventilation of grain depends on the mositure content. Cargo with moisture content under 14% may not need extensive ventilation.Up to a moisture content of 15%, surface ventilation is recommended. Wheat releases water vapour constantly, which needs to be dissipated by ventilation. Special care should be taken on voyages from hot to cold regions. In the case of damage only to a proportion of the cargo, an indicative rule might be that the damaged proportion has been stored in a dead air zone with inadequate ventilation. Ventilation is essential until the cargo has been unloaded from the ship, and should not be turned off while the ship is waiting to berth.

For the purpose of defending against cargo claims, having accurate ventilation records on the vessel will be essential. It is important to record both periods of ventilation and periods when ventilation is not possible or suitable (and why, eg:bad weather).

The three-degree rule:[172] says that a hygroscopic cargo should be ventilated when the temperature of the outside air is at least 3°C below that of the cargo temperature taken at loading. This rule avoids the need to take readings in the holds after the voyage has commenced and relies on the fact that the temperature of hygroscopic cargoes, except at their boundaries, changes very slowly during a voyage. However it should be noted that one authority (see Appendix 19.2) advises that the ventilation of grain cargoes is likely to do more harm than good.

- Tank top temperatures- Monitor & record FO tank temp daily (temp can be checked from FO transfer pump),
- Temp Log SAMPLE
- Monitor atmosphere by draeger tubes, if under fumigation(and if necessary)

- Some of the sources of heat in cargo holds are: 1) Hot fuel tanks under cargo holds/adjacent to the cargo holds; 2) Hot fuel oil pipelines; 3) Engine Room bulkheads
  - Cargo against the Engine room bulkheads in the after most hold or cargo stowed on the Tank top above Fuel Oil DB Tanks is most susceptible to damage to heat and gets discolored (dark brown) and caked due to being overheated. (commonly referred to as Toasting of cargo).
  - To prevent damage to cargo due to heating kindly do as follows: 1) Stop heating of Fuel in Bunker Tanks which are adjacent to or underneath cargo holds; 2) Heating of Fuel shall be undertaken only when it is not possible to take suction from the Tanks without preheating of the Fuel; 3) Management company shall be informed prior starting the heating to the applicable Fuel Tanks.
  - In order to mitigate claims in case of cargo damage, vessel shall maintain a Daily log of Temperatures of the applicable Bunker Tanks. Please also record the times of starting and stopping of Heating to the Bunker Tanks.

7.20 Fumigation requirement

- Charterers and shippers may require the cargo to be fumigated
- If this is to be done during the voyage or before or after loading, full and clear instructions should be received from the charterers and shippers.
- These instructions should refer to product data sheets and the correct procedures and safety advice, application dangers, method of handling, and *requirements for personal protective equipment and monitoring equipment.*
- Refer to IMO Recommendations on the Safe Use of Pesticides on Ships.
- Always carry out a risk assessment
- e) Potential Hazards & Caution:
- - Once the storage space is fumigated, it can be of oxygen deficient or have flammable gases in it. The detailed recommendations contained in the recommendations on the Safe Use of Pesticides in Ships should be followed. Spaces adjacent to fumigated spaces should be treated as if fumigated.
- A qualified fumigator should be engaged by the charterers when fumigation is to be done in port.
- All spaces should be padlocked and sealed to prevent anyone from entering the space.
- No-one should enter a space that has been fumigated until after it has been thoroughly ventilated.
- It is recommended that an expert chemist declares whether the space is safe to enter.

- If the cargo requires ventilation after fumigation, advice should be sought from fumigation experts in respect to crew safety.

7.21 Trimmed and Untrimmed ends

The Code requires all compartments in which grain is stowed to be either "filled" (trimmed or untrimmed) or "partly filled" (trimmed only).

IGC(Intl Grain code) Part A: 2.2: Filled Compartment, trimmed- Any Cargo space in which after loading and trimming as required under A 10.2, the bulk grain is at it's
highest possible level.

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

Filled Compartments, Untrimmed- Any Cargo space which is filled to the maximum extent possible in way of hatch opening but which has not been trimmed outside the periphery of the hatch opening i.e.

- The cargo should be trimmed within the hatchway but may be left at its natural angle of repose on the surrounding area of the hatchway.

7.22 Partly Filled Compartment

As per IGC Code, Partly filled compartment refers to any compartment where bulk grain is not loaded in manner prescribed in IGC part A2.2(filled compartment trimmed) and A2.3(filled compartment untrimmed)
i.e. Slack Holds
The surface of grain cargo in each partly filled compartment is to be evenly distributed and not used to remove a list;(there is no mention of partly filled untrimmed compartment in the code)

- In partly filled compartments, the surface of bulk grain should be secured by over-stowing except in cases where heeling moments due to grain shift have been calculated and taken into consideration for stability of the vessel.

(i.e. if grain stability requirements are met, it is not necessary to carry out overstowing)

- For Grain loading in USA, as per 46 CFR 172.040 , a certificate of loading needs to be issued by an organization recognized by USCG. (NCB is the only organization authorized by USCG to issue DOA and COL)
- NCB requires its Grain stability calculation form filled up prior authorization of loading.

Exercise 10—Grain loading calculations including filling up of the NCB Form

SMS Submission list

3.1.4 BLK-03LOD.01-01FIG Submission List to Company

Checklist/Form	Name of Checklist / Form	Submit to Company?	Tablet Checklist	Smart Form
Checklist	BLK-02SLI.01-01CHK Checklist Upon Receipt of Sailing Instruction	Yes	Yes	Yes
Form	BLK-02SLI.02-01FRM Cargo Loadable Quantity and Stow Plan	Yes	No	Yes
Form	BLK-02SLI.04-01FRM Loading- Unloading Sequence	Yes	No	Yes
Form	BLK-02SLI.04-02FRM Loading Sequence Newcastle 5 hold template	Yes	No	Yes
Checklist	BLK-03LOD.03-01CHK Loading Port Deballasting	No	Yes	No
Checklist	BLK-03LOD.02-01CHK Ship Shore Safety Checklist	No	Yes	No
Form	BLK-03LOD.03-02FRM Loading Operations Log	Yes	No	Yes
Form	BLK-03LOD.03-01FRM Ballast Deballast Operations Log	No	No	Yes
Form	BLK-05DIS.01-01FRM Arrival Draft Calculation	Yes	No	Yes
Checklist	BLK-04VOY.01-01CHK Laden Voyage to Discharging Port	No	Yes	No
Form	BLK-05DIS.05-02FRM Discharging Sequence	No	No	Yes
Form	BLK-04VOY.01-01FRM HFO Daily Temperature Log	No	No	Yes
Form	BLK-04VOY.01-02FRM Record for Gas and Temperature in Cargo Hold	Yes	No	Yes
Checklist	BLK-07BAL.04-01CHK HC Inspection and Maintenance Checklist	No	Yes	No