Appendix 1 – HOLD MASS CURVES

Symbols

h : Vertical distance from the top of inner bottom plating to upper deck plating at the ship's centreline, in m.

M_H : As defined in Ch 4, Sec 7

M_{Full} : As defined in Ch 4, Sec 7

M_{HD} : As defined in Ch 4, Sec 7

M_D : The maximum cargo mass given for each cargo hold, in t

M_{blk} : The maximum cargo mass in a cargo hold according to the block loading condition in the loading manual, in t

T_{HB} : As defined in Ch 4, Sec 7

T_i : Draught in loading condition No. i, at mid-hold position of cargo hold length ℓ_H, in m

V_H : As defined in Ch 4, Sec 6

V_f and V_a: Volume of the forward and after cargo hold excluding volume of the hatchway part, in m^3.

Σ : The sum of mass in forward and after holds

1. General

1.1 Application

1.1.1

The requirements of this Appendix apply to ships of 150 m in length L and above.

1.1.2

This Appendix describes the procedure to be used for determination of:

- the maximum and minimum mass of cargo in each cargo hold as a function of the draught at mid-hold position of cargo hold
- the maximum and minimum mass of cargo in any two adjacent holds as a function of the mean draught in way of these holds.

1.1.3

Results of these calculations are to be included in the reviewed loading manual which has also to indicate the maximum permissible mass of cargo at scantling draught in each hold or in any two adjacent holds, as obtained from the design review.

1.1.4

The following notice on referring to the maximum permissible and the minimum required mass of cargo is to be described in loading manual.

Where ship engages in a service to carry such hot coils or heavy cargoes that have some adverse effect on the local strength of the double bottom and that the loading is not described as cargo in loading manual, the maximum permissible and the minimum required mass of cargo are to be considered specially.

2. Maximum and minimum masses of cargo in each hold

2.1 Maximum permissible mass and minimum required masses of single cargo hold in seagoing condition

2.1.1 General

The cargo mass curves of single cargo hold in seagoing condition are defined in [2.1.2] to [2.1.5]. However if the ship structure is checked for more severe loading conditions than the ones considered in Ch 4, Sec 7, [3.7.1], the minimum required cargo mass and the maximum allowable cargo mass can be based on those corresponding loading conditions.

2.1.2 BC-A ship

- For loaded holds

  The maximum permissible mass ($W_{\max}(T_i)$) at various draughts (T_i) is obtained, in t, by the following formulae:

  $$W_{\max}(T_S) = M_{HD} + 0.1M_H$$

  $$W_{\max}(T_i) = M_{HD} + 0.1M_H - 1.025V_H \frac{(T_S - T_i)}{h}$$

  However, $W_{\max}(T_i)$ is no case to be greater than $M_{HD.}$

  The minimum required cargo mass ($W_{\min}(T_i)$) at various draughts (T_i) is obtained, in t, by the following formulae:

  $$W_{\min}(T_i) = 0 \qquad \text{for } T_i \le 0.83T_S$$

  $$W_{\min}(T_i) = 1.025V_H \frac{(T_i - 0.83T_S)}{h} \qquad \text{for } T_S \ge T_i > 0.83T_S$$

  The maximum permissible mass ($W_{\max}(T_i)$) at various draughts (T_i) in harbor condition should also be checked by the following formulae in addition to the requirements in [2.2.2]:

  $$W_{\max}(T_i) = M_{HD} \qquad \text{for } T_i \ge 0.67T_S$$

  $$W_{\max}(T_i) = M_{HD} - 1.025V_H \frac{(0.67T_S - T_i)}{h} \qquad \text{for } T_i < 0.67T_S$$

- For empty holds which can be empty at the maximum draught

  The maximum permissible mass ($W_{\min}(T_i)$) at various draughts (T_i) is obtained, in t, by the following formulae:

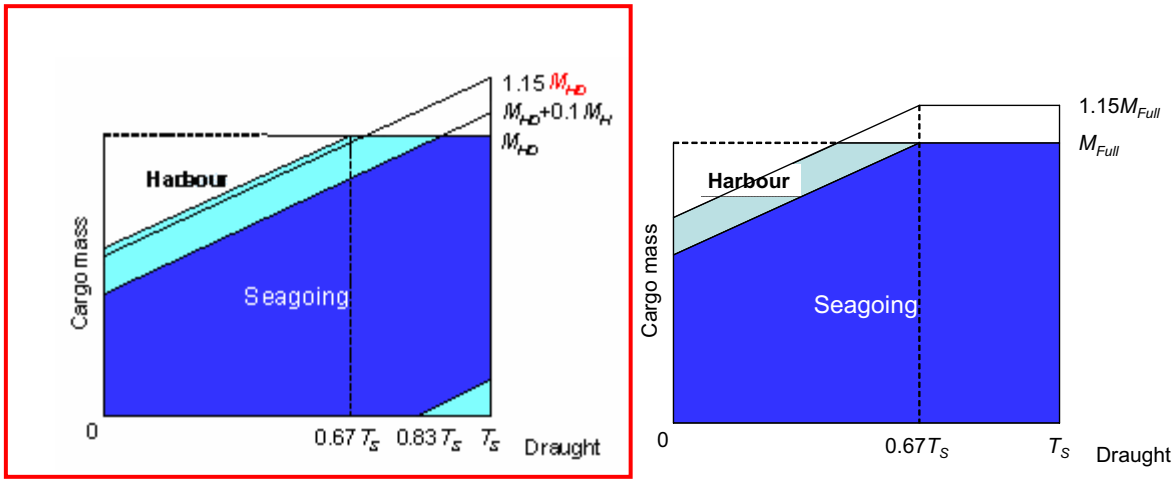
  $$W_{\max}(T_i) = M_{Full} \qquad \text{for } T_S \ge T_i \ge 0.67T_S$$

  $$W_{\max}(T_i) = M_{Full} - 1.025V_H \frac{(0.67T_S - T_i)}{h} \qquad \text{for } T_i < 0.67T_S$$

  The minimum required mass ($W_{\min}(T_i)$) is obtained, in t, by the following formula:

  $$W_{\min}(T_i) = 0 \qquad \text{for } T_i \le T_S$$

Examples for mass curve of loaded cargo hold and cargo hold which can be empty at the maximum draught for **BC-A** ships are shown in Fig 1.



(a) Loaded hold (b) Cargo hold which can be empty at the maximum draught

Figure 1: Example of mass curve for BC-A ships, without {No MP}

2.1.3 BC-A ship with {No MP}

- For loaded holds

  The maximum permissible mass ($W_{\max}(T_i)$) at various draughts (T_i) is the same specified in [2.1.2].

  The minimum required mass ($W_{\min}(T_i)$) is obtained, in t, by the lesser of the following formulae:

  $$W_{\min}(T_i) = 0 \qquad \text{for } T_i \le T_{HB}$$

  $$W_{\min}(T_i) = 1.025 V_H \frac{(T_i - T_{HB})}{h} \quad \text{for } T_S \ge T_i > T_{HB}$$

  or

  $$W_{\min}(T_i) = 0.5 M_H - 1.025 V_H \frac{(T_S - T_i)}{h} \quad \text{for } T_S \ge T_i$$

  $$W_{\min}(T_i) \ge 0$$

- For empty hold which can be empty at the maximum draught

  The maximum permissible mass ($W_{\max}(T_i)$) at various draughts (T_i) is obtained, in t, by the following formula:

  $$W_{\max}(T_i) = M_{Full} - 1.025 V_H \frac{(T_S - T_i)}{h}$$

  The minimum required mass ($W_{\min}(T_i)$) at various draughts (T_i) is obtained, in t, by the following formula:

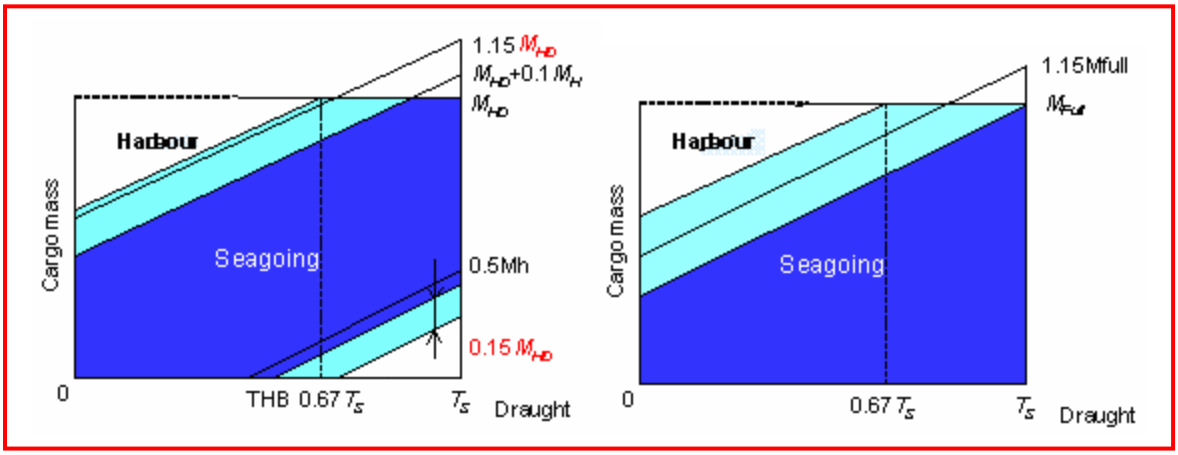
  $$W_{\min}(T_i) = 0 \qquad \text{for } T_i \le T_S$$

  The maximum permissible mass ($W_{\max}(T_i)$) at various draughts (T_i) in harbor condition should also be checked by the following formulae in addition to the requirements in [2.2.2]:

  $$W_{\max}(T_i) = M_{Full} \qquad \text{for } T_S \ge T_i \ge 0.67 T_S$$

  $$W_{\max}(T_i) = M_{Full} - 1.025 V_H \frac{(0.67 T_S - T_i)}{h} \qquad \text{for } T_i < 0.67 T_S$$

Examples for mass curve of cargo hold for **BC-A,** {No MP} ships are shown in Fig 2.



(a) Loaded hold (b) Cargo hold which can be empty at the maximum draught

Figure 2: Example of mass curve for BC-A ships, {No MP}

2.1.4 BC-B and BC-C ships

The maximum permissible mass ($W_{\max}(T_i)$) at various draughts (T_i) is obtained, in t, by the following formulae:

$$W_{\max}(T_i) = M_{Full} \qquad \text{for } T_S \geq T_i \geq 0.67T_S$$

$$W_{\max}(T_i) = M_{Full} - 1.025V_H \frac{(0.67T_S - T_i)}{h} \qquad \text{for } T_i < 0.67T_S$$

The minimum required cargo mass ($W_{\min}(T_i)$) at various draughts (T_i) is obtained, in t, by the following formulae:

$$W_{\min}(T_i) = 0 \qquad \text{for } T_i \leq 0.83T_S$$

$$W_{\min}(T_i) = 1.025V_H \frac{(T_i - 0.83T_S)}{h} \qquad \text{for } T_S \geq T_i > 0.83T_S$$

2.1.5 BC-B and BC-C ships with {No MP}

The maximum permissible mass ($W_{\max}(T_i)$) at various draughts (T_i) is obtained, in t, by the following formula:

$$W_{\max}(T_i) = M_{Full} - 1.025V_H \frac{(T_S - T_i)}{h}$$

The minimum required mass ($W_{\min}(T_i)$) is obtained, in t, by the lesser of the following formulae:

$$W_{\min}(T_i) = 0 \qquad \text{for } T_i \leq T_{HB}$$

$$W_{\min}(T_i) = 1.025V_H \frac{(T_i - T_{HB})}{h} \qquad \text{for } T_S \geq T_i > T_{HB}$$

or

$$W_{\min}(T_i) = 0.5M_H - 1.025V_H \frac{(T_S - T_i)}{h} \qquad \text{for } T_S \geq T_i$$

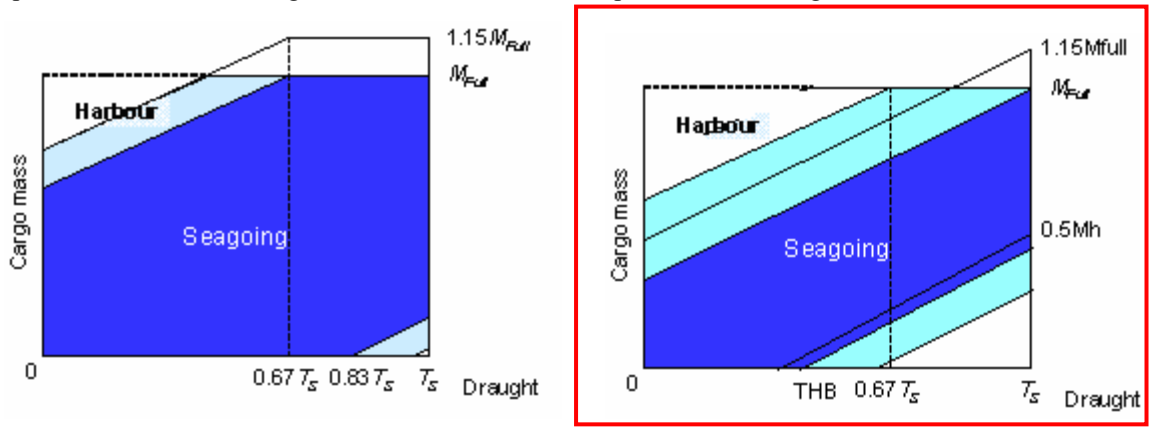
$$W_{\min}(T_i) \geq 0$$

The maximum permissible mass ($W_{\max}(T_i)$) at various draughts (T_i) in harbor condition should also be checked by the following formulae in addition to the requirements in [2.2.2]:

$$W_{\max}(T_i) = M_{Full} \quad \text{for } T_S \geq T_i \geq 0.67T_S$$

$$W_{\max}(T_i) = M_{Full} - 1.025V_H \frac{(0.67T_S - T_i)}{h} \quad \text{for } T_i < 0.67T_S$$

Examples for mass curve of cargo hold for **BC-B** or **BC-C** ships are shown in Fig 3.



(a) Without {No MP} (b) With {No MP}

Figure 3: Example of mass curve for BC-B or BC-C ships

2.2 Maximum permissible mass and minimum required masses of single cargo hold in harbour condition

2.2.1 General

The cargo mass curves of single cargo hold in harbour condition are defined in [2.2.2]. However if the ship structure is checked for more severe loading conditions than ones considered in Ch 4, Sec 7, [3.7.1], the minimum required cargo mass can be based on those corresponding loading conditions.

2.2.2 All ships

The maximum permissible cargo mass and the minimum required cargo mass corresponding to draught for loading/unloading conditions in harbour may be increased or decreased by 15% of the maximum permissible mass at the maximum draught for the cargo hold in seagoing condition. However, maximum permissible mass is in no case to be greater than the maximum permissible cargo mass at designed maximum load draught for each cargo hold.

3. Maximum and minimum masses of cargo of two adjacent holds

3.1 Maximum permissible mass and minimum required masses of two adjacent holds in seagoing condition

3.1.1 General

The cargo mass curves of two adjacent cargo holds in seagoing condition are defined in [3.1.2] and [3.1.3]. However if the ship structure is checked for more severe loading conditions than ones considered in Ch 4, Sec 7, [3.7.1], the minimum required cargo mass and the maximum allowable cargo mass can be based on those corresponding loading conditions.

3.1.2 BC-A ships with "Block loading"

The maximum permissible cargo mass ($W_{\max}(T_i)$) and the minimum required cargo mass ($W_{\min}(T_i)$) for the adjacent two holds at various draughts (T_i) are determined, in t, by the following formulae:

without {No MP},

The maximum permissible mass ($W_{\max}(T_i)$) at various draughts (T_i) is obtained, in t, by the greater of the following formulae:

$$W_{\max}(T_i) = \sum(M_{blk} + 0.1M_H) - 1.025(V_f + V_a)\frac{(T_S - T_i)}{h}$$

or

$$W_{\max}(T_i) = \sum M_{Full} - 1.025(V_f + V_a)\frac{(0.67T_s - T_i)}{h}$$

However, $W_{\max}(T_i)$ is no case to be greater than Σ Mblk.

The minimum required mass ($W_{\min}(T_i)$) at various draughts (T_i) is obtained, in t, by the lesser of the following formulae:

$$W_{\min}(T_i) = 0 \qquad \text{for } T_i < 0.75T_S$$

$$W_{\min}(T_i) = 1.025(V_f + V_a)\frac{T_i - 0.75T_S}{h} \qquad \text{for } T_S \geq T_i > 0.75T_S$$

with {No MP},

The maximum permissible mass ($W_{\max}(T_i)$) at various draughts (T_i) is obtained, in t, by the following formula:

$$W_{\max}(T_i) = \sum(M_{blk} + 0.1M_H) - 1.025(V_f + V_a)\frac{(T_S - T_i)}{h}$$

However, $W_{\max}(T_i)$ is no case to be greater than Σ Mblk.

The minimum required mass ($W_{\min}(T_i)$) at various draughts (T_i) is obtained, in t, by the lesser of the following formulae:

$$W_{\min}(T_i) = 0 \qquad \text{for } T_i \leq T_{HB}$$

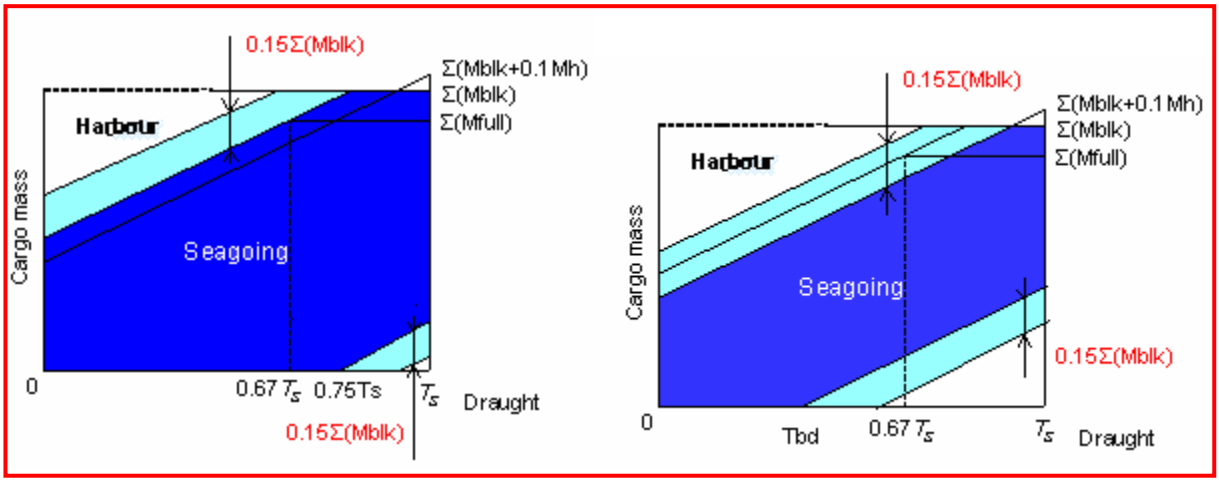
$$W_{\min}(T_i) = 1.025(V_f + V_a)\frac{(T_i - T_{HB})}{h} \qquad \text{for } T_S \geq T_i > T_{HB}$$

The maximum permissible mass ($W_{\max}(T_i)$) at various draughts (T_i) in harbor condition should also be checked by the following formulae in addition to the requirements in [3.2.2]:

$$W_{\max}(T_i) = \sum M_{Full} - 1.025(V_f + V_a)\frac{(0.67T_s - T_i)}{h}$$

$$W_{\max}(T_i) \leq \sum M_{blk}$$

Examples for mass curve of cargo hold for **BC-A,** block loading ships are shown in Fig 4.



(a) Without {No MP} (b) With {No MP}

Figure 4: Example of mass curve for BC-A ships, block loading

3.1.3 BC-A ships without "Block loading" and BC-B, BC-C ships

The maximum permissible cargo mass ($W_{\max}(T_i)$) and the minimum required cargo mass ($W_{\min}(T_i)$) for the adjacent two holds at various draughts (T_i) are determined, in t, by the following formulae:

without {No MP},

The maximum permissible mass ($W_{\max}(T_i)$) at various draughts (T_i) is obtained, in t, by the following formulae:

$$W_{\max}(T_i) = \sum M_{Full} \qquad \text{for } T_S \geq T_i \geq 0.67T_S$$

$$W_{\max}(T_i) = \sum M_{Full} - 1.025(V_f + V_a)\frac{(0.67T_S - T_i)}{h} \qquad \text{for } T_i < 0.67T_S$$

The minimum required mass ($W_{\min}(T_i)$) at various draughts (T_i) is obtained, in t, by the lesser of the following formulae:

$$W_{\min}(T_i) = 0 \qquad \text{for } T_i < 0.75T_S$$

$$W_{\min}(T_i) = 1.025(V_f + V_a)\frac{T_i - 0.75T_S}{h} \qquad \text{for } T_S \geq T_i > 0.75T_S$$

with {No MP},

The maximum permissible mass ($W_{\max}(T_i)$) at various draughts (T_i) is obtained, in t, by the following formula:

$$W_{\max}(T_i) = \sum M_{Full} - 1.025(V_f + V_a)\frac{(T_S - T_i)}{h} \qquad \text{for } T_i < T_S$$

The minimum required mass ($W_{\min}(T_i)$) at various draughts (T_i) is obtained, in t, by the lesser of the following formulae:

$$W_{\min}(T_i) = 0 \qquad \text{for } T_i \leq T_{HB}$$

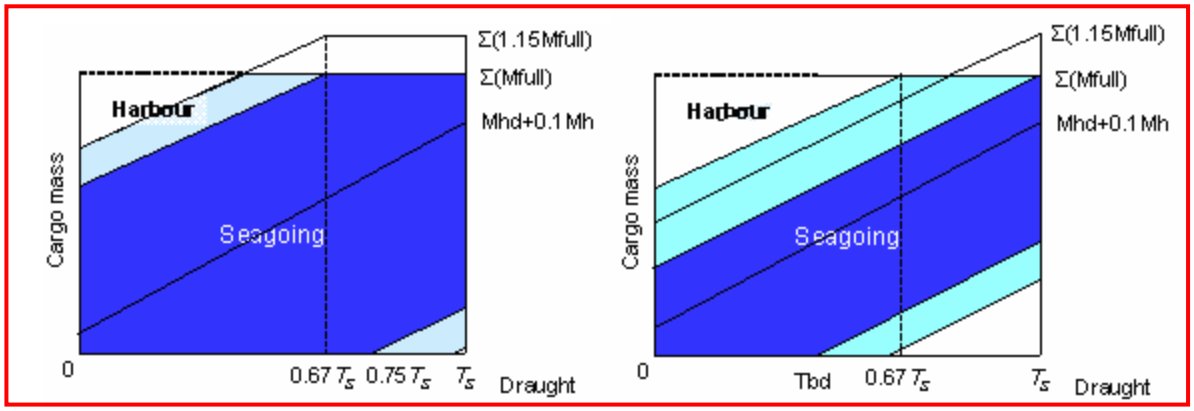
$$W_{\min}(T_i) = 1.025(V_f + V_a)\frac{(T_i - T_{HB})}{h} \qquad \text{for } T_S \geq T_i > T_{HB}$$

The maximum permissible mass ($W_{\max}(T_i)$) at various draughts (T_i) in harbor condition should also be checked by the following formulae in addition to the requirements in [3.2.2]:

$$W_{\max}(T_i) = \sum M_{Full} \qquad \text{for } T_S > T_i > 0.67T_S$$

$$W_{\max}(T_i) = \sum M_{Full} - 1.025(V_f + V_a)\frac{(0.67T_S - T_i)}{h} \qquad \text{for } T_i < 0.67T_S$$

Examples for mass curve of cargo hold for **BC-A,** NO block loading ships and **BC-B, BC-C** are shown in Fig 5.



(a) Without {No MP} (b) With {No MP}

Figure 5: Example of mass curve for BC-A ships, NO block loading and for BC-B and BC-C ships

3.2 Maximum permissible mass and minimum required masses of two adjacent cargo holds in harbour condition

3.2.1 General

The cargo mass curves of two adjacent cargo holds in harbour condition are defined in [3.2.2]. However if the ship structure is checked for more severe loading conditions than ones considered in Ch 4, Sec 7, [3.7.1], the minimum required cargo mass can be based on those corresponding loading conditions.

3.2.2 All ships

The maximum permissible cargo mass and minimum required cargo mass corresponding to draught for loading/unloading conditions in harbour may be increased or decreased by 15% of the maximum permissible mass at the maximum draught for the cargo hold in seagoing condition. However, maximum permissible mass is in no case to be greater than the maximum permissible cargo mass at designed maximum load draught for each cargo hold.