MARINE SAFETY AGENCY

MERCHANT SHIPPING NOTICE

No. 1643/MARPOL 1

Notice to Shipowners, Masters, Certifying Authorities and Surveyors

Schedules attached to this Notice and the regulations referred to in the Schedules are those referred to in the Merchant Shipping (Prevention of Oil Pollution) Regulations 1996

Schedule 1:	Protective location of ballast spaces
Schedule 2:	Standard dimension of flanges for discharge connections
Schedule 3:	Specifications in the design, installation and operation of a part-flow system for control of overboard discharges
Schedule 4:	Definitions of "side and bottom damage" and "hypothetical outflow of oil"
Schedule 5:	Subdivision and stability
Schedule 6:	Protection of cargo spaces by ballast tanks or spaces other than cargo and fuel oil
Schedule 7:	Calculation of hydrostatic water pressure
Schedule 8:	Height of double bottoms in tankers of less than 500 tons deadweight

In this Merchant Shipping Notice –

1. a reference to a numbered paragraph is, unless otherwise stated, a reference to the paragraph of that number in that Schedule;

2. a reference to a numbered Schedule is, unless otherwise stated, a reference to the Schedule of that number, in this Merchant Shipping Notice.

In this Notice, except where the context otherwise requires –

"amidships" means at the middle of the length (L);

"area" in relation to a ship shall be calculated in all cases to moulded lines;

"breadth" (B) means the maximum breadth of the ship, measured amidships to the moulded line of the frame in a ship with a metal shell and to the outer surface of the hull in a ship with a shell of any other material, measured in metres;

"centre tank" means any tank inboard of a longitudinal bulkhead;

"Certifying Authority" means the Secretary of State or any person authorised by the Secretary of State and includes in particular (if so authorised) Lloyd's Register of Shipping, the British Committee of Bureau Veritas, the British Committee of Det Norske Veritas, the British Committee of Germanischer Lloyd, and the British Technical Committee of the American Bureau of Shipping;

"clean ballast" means the ballast in a tank which, since oil was last carried therein, has been so cleaned that the effluent there from, if it were discharged from a ship which is stationary into clean calm water on a clear day would not produce visible traces of oil on the surface of the water or on adjoining shorelines or cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines. If the ballast is discharged through an approved oil discharge monitoring and control system, evidence based on such a system that the oil content of the effluent did not exceed 15 ppm shall be determinative that the ballast was clean, notwithstanding the presence of visible traces referred to above;

"crude oil" means any liquid hydrocarbon mixture occurring naturally in the earth, whether or not treated to render it suitable for transportation, and includes –

- **(a)** crude oil from which certain distillate fractions may have been removed; and
- **(b)** crude oil to which certain distillate fractions may have been added;

"crude oil tanker" means an oil tanker engaged in the trade of carrying crude oil;

"deadweight" (DW) means the difference in metric tons between the displacement of a ship in water of a specific gravity of 1.025 at the load waterline corresponding to the assigned summer freeboard and the lightweight of the ship;

"forward and after perpendiculars" shall be taken at the forward and after ends of the length (L). The forward perpendicular shall coincide with the foreside of the stem on the waterline on which the length is measured;

"length" (L) means 96 percent of the total length on a waterline at 85 per cent of the least moulded depth measured from the top of the keel, or the length from the foreside of the stem to the axis of the rudder stock on that waterline, if that be greater. In ships designed with a rake of keel the waterline on which this length is measured shall be parallel to the designed waterline. The length (L) shall be measured in metres;

"lightweight" means the displacement of a ship in metric tons without cargo, fuel, lubricating oil, ballast water, fresh water and feed water in tanks, consumable stores, and passengers and crew and their effects;

"new ship", except as provided in regulation 17(1), means a ship –

- **(a)** for which the building contract was placed after 31 December 1975; or
- **(b)** in the absence of a building contract, the keel of which was laid or which was at a similar stage of construction after 30 June 1976; or
- **(c)** the delivery of which is after 31 December 1979; or
- **(d)** which has undergone a major conversion –
  - **(i)** for which the contract was placed after 31 December 1975; or
  - **(ii)** in the absence of a contract, the construction work of which was begun after 30 June 1976; or
  - **(iii)** which is or was completed after 31 December 1979;

"oil tanker" means a ship constructed or adapted primarily to carry oil in bulk in its cargo spaces and includes a combination carrier or a chemical tanker when it is carrying a cargo or part cargo of oil in bulk;

"oily mixture" means a mixture with any oil content;

"permeability" of a space means the ratio of the volume within that space which is assumed to be occupied by water to the total volume of that space;

"segregated ballast" means the ballast water introduced into a tank which is completely separated from the cargo oil and oil fuel system and which is permanently allocated to the carriage of ballast or to the carriage of ballast or cargoes other than oil or noxious liquid substances;

"ship" means a vessel of any type whatsoever operating in the marine environment including waters navigable by sea-going vessels and includes submersible craft, floating craft and a structure which is a fixed or floating platform but excludes hovercraft;

"slop tank" means a tank specifically designed for the collection of tank drainings, tank washings and other oily mixtures;

"tank" means an enclosed space which is formed by the permanent structure of a ship and which is designed for the carriage of liquid in bulk;

"volume" in relation to a ship shall be calculated in all cases to moulded lines;

"wing tank" means any tank adjacent to the side shell plating.

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September 1996

SCHEDULE 1 *Regulation 19*

PROTECTIVE LOCATION OF BALLAST SPACES

1. In every new crude oil tanker of 20,000 tons deadweight and above, and every new product carrier of 30,000 tons deadweight and above the segregated ballast tanks and spaces other than oil tanks within the cargo tank length (L_t) shall be so arranged as to comply with the following requirement –

$$\sum PA_c + \sum PA_s \geq J[L_t(B+2D)]$$

where -

PA_C = the side shell area in square metres for each segregated ballast tank or space other than an oil tank based on projected moulded dimensions;

PA_s = the bottom shell area in square metres for each such tank or space based on projected moulded dimensions;

L_t = the length in metres between the forward and after extremities of the cargo tanks;

B = the maximum breadth of the ship in metres as defined;

D = the maximum moulded depth in metres measured vertically from the top of the keel to the top of the freeboard deck beam at the side at amidships. In ships having rounded gunwhales, the moulded depth shall be measured to the point of intersection of the moulded lines of the deck and side shell plating, the lines extending as though the gunwhale were of angular design;

J = 0.45 for oil tankers of 20,000 tons deadweight and 0.30 for oil tankers of 20,000 tons deadweight and above, subject to the provisions of paragraph (2). For intermediate values of the deadweight the value of "J" shall be determined by linear interpolation.

2. For tankers of 200,000 tons deadweight and above the value of "J" may be reduced as follows –

$$J_{reduced} = \left[J - \left(a - \frac{O_c + O_s}{4 \times O_A} \right) \right]$$

or 0.2 whichever is greater

where –

a = 0.25 for oil tankers of 200,000 tons deadweight;

a = 0.40 for oil tankers of 300,000 tons deadweight;

a = 0.50 for oil tankers of 420,000 tons deadweight and above;

(For intermediate values of deadweight the value of "a" shall be determined by linear interpolation.)

O_c = has the same meaning as in Schedule 4;

O_s = has the same meaning as in Schedule 4;

O_A = the allowable oil outflow as required by regulation 28(2) of the Merchant Shipping (Prevention of Oil Pollution) Regulations 1996.

3. In calculating the value of "PA_c" and PA_s" for segregated ballast tanks and spaces other than oil tanks –

3.1 where the width of any wing tank or space which extends for the full depth of the ship's side or from the deck to the top of the double bottom is less than 2 metres measured inboard from the ship's side at right angles to the centre line, that wing tank or space shall not be taken into account when calculating the protecting area "PA_c"; and

3.2 where the depth of any double bottom tank or space is less than $\frac{B}{15}$ or 2 metres, that double bottom tank or space shall not be taken into account when calculating the protecting area "PA_s".

The width and depth of wing tanks and double bottom tanks shall be measured clear of the bilge area and, in the case of width, shall be measured clear of any rounded gunwhale area.

SCHEDULE 2 *Regulation 25*

STANDARD DIMENSIONS OF FLANGES FOR DISCHARGE CONNECTIONS

Every ship shall be provided with piping to enable residues from machinery spaces and machinery space bilges to be pumped to a reception facility. This piping is to be led to the open deck and fitted there with a flange of the following dimensions –

Description	Dimension
Outside diameter	215 mm
Inner diameter	According to pipe outside diameter
Bolt circle diameter	183 mm
Slots in flange	6 holes, 22 mm in diameter, equidistantly placed on a bolt circle of 183 mm diameter, slotted to the flange periphery, the slot width to be 22 mm
Flange thickness	20 mm
Bolts and nuts quantity, diameter	6 each of 20 mm in diameter and of suitable length
The flange shall be designed to accept pipes up to a maximum diameter of 125 mm and shall be of steel or other equivalent material having a flat face. This flange, together with a gasket of oil proof material, shall be suitable for a service pressure of 6kg / cm^2.	

SCHEDULE 3 *Regulation 26*

SPECIFICATIONS FOR THE DESIGN, INSTALLATION AND OPERATION OF A PART-FLOW SYSTEM FOR CONTROL OF OVERBOARD DISCHARGES

1. ***Purpose***

The purpose of these Specifications is to provide specific design criteria and installation and operational requirements for the part-flow system referred to in regulation 26(6)(e) of the Merchant Shipping (Prevention of Oil Pollution) Regulations 1996.

2. ***Application***

2.1 Existing oil tankers may discharge dirty ballast water and oil contaminated water from cargo tank areas below the waterline, provided that part of the flow is led through permanent piping to a readily accessible location on the upper deck or above where it may be visually observed during the discharge operation and provided that the arrangements comply with the requirements of this Schedule.

2.2 The part-flow concept is based on the principle that the observation of a representative part of the overboard effluent is equivalent to observing the entire effluent stream. These specifications provide the details of the design installation, and operation of a part-flow system.

3. ***General Provisions***

3.1 The part-flow system shall be so fitted that it can effectively provide a representative sample of the overboard effluent for visual display under all normal operating conditions.

3.2 The part-flow system is in many respects similar to the sampling system for an oil discharge monitoring and control system but shall have pumping and piping arrangements separate from such a system. However other combined equivalent arrangements may be acceptable.

3.3 The display of the part-flow shall be arranged in a sheltered and readily accessible location on the upper deck or above, (eg the entrance to the pump room). There shall be effective communication between the location of the part-flow display and the discharge control position.

3.4 Samples shall be taken from relevant sections of the overboard discharge piping and be passed to the display arrangement through a permanent piping system.

3.5 The part-flow system shall include the following components–

3.5.1 sampling probes;

3.5.2 sample water piping system;

3.5.3 sample feed pump(s);

3.5.4 display arrangement;

3.5.5 sample discharge arrangement;

and, subject to the diameter of the sample piping –

3.5.6 flushing arrangement.

3.6 The part-flow system shall comply with the appropriate safety requirements.

4. *System Arrangement*

4.1 *Sampling points location*

4.1.1 Sampling points shall be so located that relevant samples can be obtained of the effluent being discharged through outlets below the waterline which are used for operational discharges.

4.1.2 Sampling points shall, as far as practicable, be located in pipe sections where a turbulent flow is not normally encountered.

4.1.3 Sampling points shall, as far as practicable be arranged in accessible locations in vertical sections of the discharge piping.

4.2 *Sampling probes*

4.2.1 Sampling probes shall be arranged to protrude into the pipe a distance of about one fourth of the pipe diameter.

4.2.2 Sampling probes shall be arranged for easy withdrawal for cleaning.

4.2.3 A stop valve shall be fitted adjacent to each probe, except that where the probe is mounted in a cargo line, two stop valves shall be fitted in series, in the sample line.

4.2.4 Sampling probes shall be of corrosion-resistant and oil-resistant material, of adequate strength, properly jointed and supported.

4.2.5 Sampling probes shall have a shape that is not prone to becoming clogged by particle contaminants and shall not generate high hydrodynamic pressures at the sampling probe tip. Figure 1 is an example of one suitable shape of a sampling probe.

4.2.6 Sampling probes shall have the same nominal bore as the sample piping.

4.2 *Sample piping*

4.2.1 The sample piping shall be arranged as straight as possible between the sampling points and the display arrangement. Sharp bends and pockets where settled oil or sediment may accumulate shall be avoided.

4.2.2 The sample piping shall be so arranged that sample water is conveyed to the display arrangement within 20 seconds. The flow velocity in the piping shall not be less than 2 metres per second.

4.2.3 The diameter of the piping shall not be less than 40 millimetres if no fixed flushing arrangement is provided and shall not be less than 25 millimetres if a pressurised flushing arrangement as detailed in paragraph 4.4 is stalled.

4.2.4 The sample piping shall be of corrosion-resistant and oil-resistant material, of adequate strength, properly jointed and supported.

4.2.5 Where several sampling points are installed the piping shall be connected to a valve chest at the suction side of the sample feed pump

4.3 *Sample feed pump*

4.3.1 The sample feed pump capacity shall be suitable to allow the flow rate of the sample water to comply with paragraph 4.2.2.

4.4 *Flushing arrangement*

4.4.1 If the diameter of sample piping is less than 40 millimetres, a fixed connection from pressurised sea or fresh water piping system shall be installed to enable flushing of the sample piping system.

4.5 *Display arrangement*

4.5.1 The display arrangement shall consist of a display chamber provided with a sight glass. The chamber should be of a size that will allow a free fall stream of the sample water to be clearly visible over a length of at least 200 millimetres or such equivalent arrangement as may be approved.

4.5.2 The display arrangement shall incorporate valves and piping in order to allow part of the sample water to bypass the display chamber to obtain a laminar flow for display in the chamber.

4.5.3 The display arrangement shall be designed to be easily opened and cleaned.

4.5.4 The internal surfaces of the display chamber shall be white except for the background wall which shall be so coloured as to facilitate the observation of any change in the quality of the sample water.

4.5.5 The lower part of the display chamber shall be shaped as a funnel for collection of the sample water.

4.5.6 A test cock for taking a grab sample shall be provided in order that a sample of the water can be examined independently of that in the display chamber.

4.5.7 The display arrangement shall be adequately lighted to facilitate visual observation of the sample water.

4.6 *Sample discharge arrangement*

4.6.1 The sample water leaving the display chamber shall be routed to the sea or to a slop tank through fixed piping of adequate diameter.

5. *Operation*

5.1 When a discharge of dirty ballast water or other oil contaminated water from the cargo tank area is taking place through an outlet below the waterline, the part-flow system shall provide sample water from the relevant discharge outlet at all times.

5.2 The sample water shall be observed particularly during those phases of the discharge operation when the greatest possibility of oil contamination occurs. The discharge shall be stopped whenever any traces of oil are visible in the flow and when the oil content meter reading indicates that the oil content exceeds permissible limits.

5.3 On those systems that are fitted with flushing arrangements, the sample piping shall be flushed after contamination has been observed and the sample piping shall be flushed after each period of usage.

5.4 The ship's cargo and ballast handling manuals and, where applicable, those manuals required for crude oil washing systems or dedicated clean ballast tanks operation shall clearly describe the use of the part-flow system in conjunction with the ballast discharge and the slop tank decanting procedures.

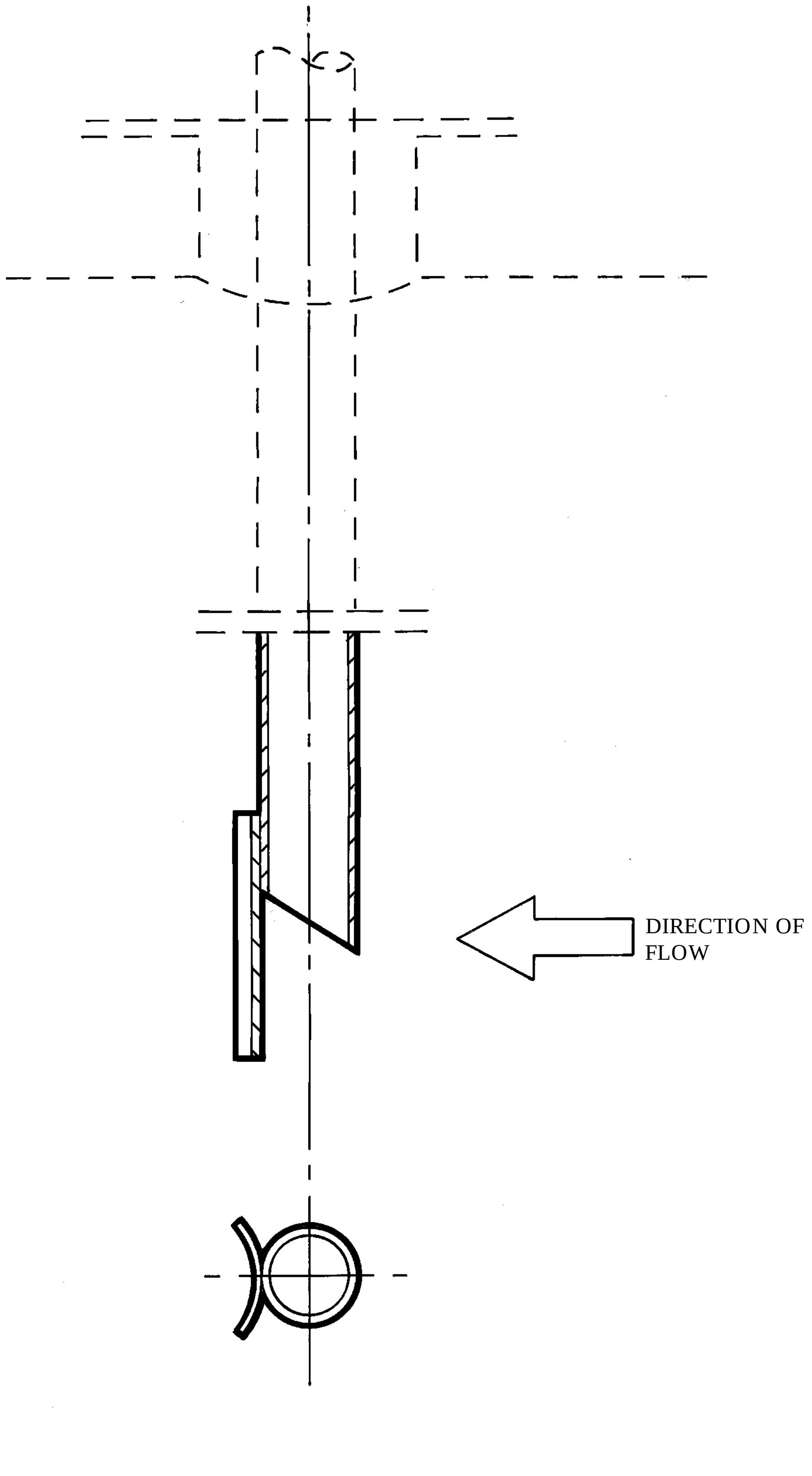


FIGURE 1

SAMPLING PROBE FOR PART-FLOW DISPLAY SYSTEM

DEFINITIONS OF "SIDE AND BOTTOM DAMAGE" AND "HYPOTHETICAL OUTFLOW OF OIL"

The definitions below are necessary to determine the permissible size and arrangements of cargo tanks and for assessing the standard of subdivision of oil tankers.

Side and Bottom Damage

1. Side and bottom damage shall be assumed to be damage having the dimensions described in this Schedule caused to the side or bottom of the ship. In the case of bottom damage the dimensions to be assumed are those which relate to the position of damage, as described in this Schedule.

1.1 ***Side damage***

Longitudinal extent (l_c):	$\frac{1}{3}L^{\frac{2}{3}}$ or 14.5 metres, whichever is less
Transverse extent (t_c): (inboard from the ship's side at right angles to the centreline at the level corresponding to the assigned summer freeboard)	$\frac{B}{5}$ or 11.5 metres, whichever is less
Vertical extent (v_c)	from the base line upwards without limit

1.2 ***Bottom damage***

	For 0.3L from the forward perpendicular of the ship	**Any other part of the ship**
Longitudinal extent (l_s)	$\frac{L}{10}$	$\frac{L}{10}$ or 5 metres, whichever is less
Transverse extent (l_s)	$\frac{B}{6}$ or 10 metres, whichever is less but not less than 5 metres	5 metres
Vertical extent from the base line (v_s):	$\frac{B}{15}$ or 6 metres, whichever is less	

Hypothetical Oil Outflow

2. The hypothetical outflow of oil in the case of side damage (0_c) and bottom damage (O_s) shall be calculated by the following formulae with respect to compartments breached by damage at all conceivable locations along the length of the ship to the extent as described in paragraph 1.1 and 1.2.

2.1 ***for side damage:***

$$O_c = \sum W_i + \sum K_i C_i \quad \textbf{(I)}$$

2.2 ***for bottom damage:***

$$O_s = \frac{1}{3}\left(\Sigma Z_i W_i + \sum Z_i C_i\right) \qquad \textbf{(II)}$$

where:

W_i = volume in cubic metres of a wing tank assumed to be breached by the damage as described in paragraph 1.1 and 1.2. W_i for a segregated ballast tank may be taken as equal to zero.

C_i = volume in cubic metres of a centre tank assumed to be breached by the damage as described in paragraph 1.1 and 1.2. C_i for a segregated ballast tank may be taken as equal to zero.

K_i = $1-\frac{b_i}{t_c}$ when b_i is equal to or greater than T_c, K_i shall be taken as equal to zero.

Z_i = $1-\frac{h_i}{v_s}$ when h_i is equal to or greater than v_s, Z_i shall be taken as equal to zero.

b_i = minimum width in metres of the wing tank under consideration, measured inboard from the ship's side at right angles to the centreline at the level corresponding to the assigned summer freeboard.

h_i = minimum depth in metres of the double bottom under consideration; where no double bottom is fitted h_i shall be taken as equal to zero.

3. Where a void space or segregated ballast tank of a length less than l_c as defined in paragraph 1.1 is located between wing oil tanks, 0_c in formula (I) set out in paragraph 2.1 may be calculated on the basis of volume W_i being the actual volume of one such tank (where they are of equal capacity) or the smaller of the two tanks (if they differ in capacity), adjacent to such space, multiplied by S_i as defined below and taking for all other wing tanks involved in such a collision the value of the actual full volume of those tanks.

$$s_i = 1-\frac{l_i}{l_c}$$

where –

1_i = length in metres of void space or segregated ballast tank under consideration.

4.1 For the purpose of paragraph 2.1 account shall be taken of double bottom tanks which are either empty or carrying clean water only when cargo is carried in the tanks above.

4.2 Where the double bottom does not extend for the full length and width of the tank involved, the double bottom shall be considered non existent and the volume of the tanks above the area of the bottom damage shall be included in formula (II) set out in paragraph 2.2 even if the tank is not considered breached because of the installation of such a partial double bottom.

4.3 Suction wells may be neglected in the determination of the value of hi provided such wells are not excessive in area and extend below the tank in no case more than half the height of the double bottom. If the depth of such a well exceeds half the height of the double bottom, h; shall be taken to be equal to the double bottom height minus the well height.

4.4 Piping serving suction wells if installed within the double bottom shall be fitted with valves or other closing arrangements located at the point of connection to the tank served so as to prevent oil outflow in the event of damage to the piping. Such piping shall be installed as high from the bottom shell as possible. These valves shall be kept closed at sea whenever the tank contains oil cargo, except that they may be opened only to transfer cargo for trimming the ship.

5. In the case where the bottom damage simultaneously involves four centre tanks, the valve of 0_s may be calculated according to the formula -

$$O_s = \frac{1}{4}\left(\sum Z_i W_i + \sum Z_i C_i\right) \quad \textbf{(III)}$$

6. In the case of bottom damage, a reduced amount of oil outflow may be assumed where a cargo transfer system is installed which has an emergency high suction in each cargo tank capable of transferring from a breached tank or tanks to segregated ballast tanks or to cargo tanks, if such tanks have sufficient ullage, and if the cargo transfer system complies with the following requirements –

6.1 in two hours of operation it is capable of transferring oil equal to one half of the largest of the breached tanks involved;

6.2 the ballast or cargo tanks are available and capable of receiving such quantity; and

6.3 the pipes for such suction are installed at a height of not less than the vertical extent of the bottom damage.

7. Where those requirements are satisfied, the calculation of O_s shall be in accordance with formula (III) set out in paragraph 5.

SCHEDULE 5 *Regulation 29*

SUBDIVISION AND STABILITY

Subdivision and stability

1. Every new oil tanker shall comply with the subdivision and damage stability criteria as specified in this Schedule, assuming side or bottom damage specified in paragraph 2, for any operating draught reflecting actual, partial or full load conditions consistent with the trim and strength of the ship as well as the specific gravities of the cargo. Such damage shall be assumed to have occurred at all conceivable locations along the length of the ship as follows –

1.1 in tankers of more than 225 metres in length, anywhere in the ship's length;

1.2 in tankers of more than 150 metres, but not exceeding 225 metres in length, anywhere in the ship's length except locations involving either after or forward bulkheads bounding the machinery space located aft. This machinery space shall be treated as a single floodable compartment;

1.3 in tankers not exceeding 150 metres in length, anywhere in the ship's length between adjacent transverse bulkheads with the exception of the machinery space. Any tanker of 100 metres or less in length which cannot fulfil all the requirements of paragraph 3 without materially impairing the operational qualities of the ship shall comply with such lesser requirements as the Secretary of State may impose.

Ballast conditions, where the tanker is not carrying oil in cargo tanks excluding any oil residues, shall not be taken into account.

2. The following provisions regarding the extent and the character of the assumed damage shall apply

2.1 ***Side damage***

2.1.1 Longitudinal extent (l_c): $\frac{1}{3}L^{\frac{2}{3}}$ or 14.5 metres, whichever is less

2.1.2 Transverse extent $\frac{B}{5}$ or 11.5 metres, whichever is the less

(inboard from the ship's side at right angle to the centreline at the level of the summer load line)

2.1.3 Vertical extent — From the moulded line of the bottom shell plating at centre line, upwards without limit

2.2 ***Bottom damage***

	For 0.3L from the forward perpendicular of the ship	Any other part of the ship
2.2.1 Longitudinal extent	$\frac{1}{3}L^{\frac{2}{3}}$ or 14.5 metres, whichever is less	$\frac{1}{3}L^{\frac{2}{3}}$ or 5 metres, whichever is less
2.2.2 Transverse extent	$\frac{B}{6}$ or 10 metres, whichever is less	$\frac{B}{6}$ or 5 metres, whichever is less
2.2.3 Vertical extent	$\frac{B}{15}$ or 6 metres, whichever is less measured from the moulded line of the bottom shell plating at centre line	$\frac{B}{15}$ or 6 metres, whichever is less measured from the moulded line of the shell plating at centre line

2.3 If any damage of a lesser extent than the maximum extent of damage specified in subparagraphs 2.1 and 2.2 would result in a more severe condition in relation to the ship's stability, such damage shall be assumed.

2.4 Where the damage envisaged in subparagraph 1.1 or 1.2 would involve transverse watertight bulkheads, such bulkheads shall not be considered effective unless they are spaced at a distance at least equal to the longitudinal extent of the assumed damage specified in subparagraphs 2.1 and 2.2. Where such bulkheads are spaced a lesser distance, one or more of these bulkheads within such extent of damage shall be assumed to be non-existent for the purpose of determining which compartments are flooded.

2.5 Where the damage envisaged in subparagraph 1.3 occurs between adjacent transverse watertight bulkheads no main transverse bulkhead or transverse bulkhead bounding side tanks or double bottom tanks shall be assumed damaged unless –

2.5.1 the spacing between the adjacent bulkheads is less than the longitudinal extent of the assumed damage specified in subparagraphs 2.1 and 2.2; or

2.5.2 there is a step or recess in the transverse bulkhead of more than 3.05 metres in length, located within the extent of penetration of the assumed damage. The step formed by the after peak bulkhead and after peak tank top shall not be regarded as a step.

2.6 If pipes, ducts or tunnels are situated within the assumed extent of damage, arrangements shall be made so that progressive flooding cannot thereby extend to compartments other than those assumed to be floodable for each case of damage.

3. Oil tankers shall be regarded as complying with the damage stability criteria if the following requirements are met –

3.1 the final waterline, taking into account sinkage, heel and trim, shall be below the lower edge of any opening through which progressive flooding may take place. Such openings shall include air pipes and those openings which are closed by means of weathertight doors or hatch covers, but may exclude those openings which are closed by means of watertight manhole covers and flush scuttles, small watertight cargo tank hatchcovers which maintain the high integrity of the deck, remote operated watertight sliding doors, and side scuttles of the non-opening type.

3.2 in the final stage of flooding, the angle of heel due to unsymmetrical flooding shall not exceed 25 degrees, provided that this angle may be increased up to 3 degrees if no deck edge immersion occurs as a result of such increase.

3.3 the stability in the final stage of flooding shall be investigated and may be regarded as sufficient if the righting lever curve has a range; of at least 20 degrees beyond the condition of equilibrium in association with a maximum residual righting lever of at least 0.1 metre within the 20 degree range, the area under the curve within this range shall not be less than 0.0175 metre radian. Unprotected openings shall not be immersed within this range unless the space concerned is assumed to be flooded. Within this range, the immersion of any of the openings listed in sub-paragraph 3.1 and other openings capable of being closed weathertight may be permitted.

3.4 equalisation arrangements requiring mechanical aids such as valves or cross-levelling pipes, if fitted, shall not be taken into account for the purpose of reducing an angle of heel or attaining the minimum range of residual stability to meet the requirements of subparagraphs 3.1, 3.2 and 3.3 and sufficient residual stability shall be maintained during all stages where equalisation is used. Spaces which are linked by ducts of large cross-sectional area may be considered to be as one.

3.5 The stability of the ship shall be sufficient during intermediate stages of flooding.

4. The requirements of paragraph 1 shall be deemed not to have been complied with unless compliance is confirmed by calculations which take into consideration the design characteristics of the ship, the arrangements, configuration and contents of the damaged compartments; and the distribution, specific gravities and free surface effect of liquids. The calculations shall be based on the following –

4.1 account shall be taken of any empty or partially filled tank, the specific gravity of the cargo carried, and any outflow of liquids from the damaged compartments;

4.2 the permeabilities assumed for spaces flooded as a result of damage of shall be as follows:

Spaces	Permeability
Appropriate to stores	0.60
Occupied as crew accommodation	0.95
Occupied by machinery	0.85
Voids	0.95
Intended for consumable liquids	0 to 0.95*
Intended for other liquids	0 to 0.95*

* the permeability of partially filled compartments shall be consistent with the amount of liquid carried in the compartment. Whenever damage penetrates a tank containing liquid, it shall be assumed that the contents are completely lost from that compartment and replaced by salt water up to the level of the of the final plane of equilibrium;

4.3 the buoyancy of any superstructure directly above the side damage shall not be taken into account. The unflooded parts of superstructure beyond the extent of damage may be taken into account provided that they are separated from the damaged space by watertight bulkheads and that the requirements of subparagraph 3.1 in respect of these intact spaces are complied with. Hinged watertight doors may be fitted in watertight bulkheads in the superstructure;

4.4 the free surface effect shall be calculated at an angle of heel of 5 degrees for each individual compartment. The Marine Safety Agency may require, or allow, the free surface corrections to be calculated at any angle of heel greater than 5 degrees for partially filled tanks;

4.5 in calculating the effect of free surfaces of consumable liquids it shall be assumed that, for each type of liquid at least one transverse pair of tanks or a centreline tank has a free surface and the tank, or combination of tanks, to be taken into account shall be those where the effect of the free surface is the greatest.

SCHEDULE 6 *Regulations 30 and 31*

PROTECTION OF CARGO SPACES BY BALLAST TANKS OR SPACES OTHER THAN CARGO AND FUEL OIL

Oil tankers built after 5th July 1993

1. In the event of collision or grounding the entire cargo length shall be protected by ballast tanks, or spaces other than cargo and fuel oil tanks, as follows:

1.1 ***Wing tanks or spaces***

Wing tanks or spaces shall extend either for the full depth of the ship's side or from the top of the double bottom to the uppermost deck, disregarding a rounded gunwale where fitted. They shall be arranged in such a way that the cargo tanks are located inboard of the moulded line of the side shell plating, nowhere less than the distance which, as shown in the figure at the end of this Schedule is measured at any cross-section at right angles to the side shell, as specified below-

$$w = 0.5 + \frac{DW}{20,000}(m);$$

or w = 2.0m;

whichever is the lesser, but with a minimum value of 1.0 m.

1.2 ***Double bottom tanks or spaces***

At any cross-section the depth of each double bottom tank or space shall be such that the distance h between the bottom of the cargo tanks and the moulded line of the bottom shell plating measured at right angles to the bottom shell plating as shown in the said figure 1 is not less than specified below –

h = B / 15 (m);

or h = 2.0m;

whichever is the lesser, but with a minimum value of 1.0 m.

1.3 ***Turn of the bilge area or at locations without a clearly defined turn of the bilge***

When the distances h and w are different, the distance w shall have preference at levels exceeding 1.5 h above the baseline as shown in the figure at the end of this Schedule.

1.4 ***The aggregate capacity of ballast tanks***

On crude oil tankers of 20,000 tons deadweight and above and product carriers of 30,000 tons deadweight and above, the aggregate capacity of wing tanks, double bottom tanks, forepeak tanks and afterpeak tanks shall not be less than the capacity of segregated ballast tanks necessary to meet the requirements of regulation 18 of the Merchant Shipping (Prevention of Oil Pollution) Regulations 1996.

Wing tanks or spaces and double bottom tanks used to meet the requirements this regulation shall be located as uniformly as practicable along the cargo tank length. Additional segregated ballast capacity provided for reducing longitudinal hull girder bending stress, trim, etc., may be located anywhere within the ship.

1.5 ***Suction wells in cargo tanks***

Suction wells in cargo tanks may protrude into the double bottom below the boundary line defined by the distance h provided that such wells are as small as practicable and the distance between the well bottom and bottom shell plating is not less than 0.5 h.

1.6 ***Ballast and cargo piping***

Ballast piping and other piping such as sounding and vent piping to ballast tanks shall not pass through cargo tanks. Cargo piping and similar piping to cargo tanks shall not pass through ballast tanks. The Marine Safety Agency may grant exemption from these requirements for short lengths of piping, provided that they are completely welded or equivalent.

1.7 ***Raking damage***

In the case of an oil tanker of 20,000 tons deadweight and above, the provisions regarding the extent and the character of the assumed damage shall be supplemented by the following assumed bottom raking damage –

(a) longitudinal extent

(i) if the oil tanker is of 75,000 tons deadweight and above 0.6L measured from the forward perpendicular;

(ii) if the oil tanker is less than 75,000 tons deadweight 0.4L measured from the forward perpendicular;

(b) transverse extent

B/3 anywhere in the bottom;

(c) vertical extent

breach of the outer hull.

1.8 Every oil tanker of less than 5,000 tons deadweight

(a) be fitted with double bottom tanks or spaces having such a depth, that the distance h specified in paragraph 1.2 of Schedule 6 in Merchant Shipping Notice MARPOL 1 complies with the following

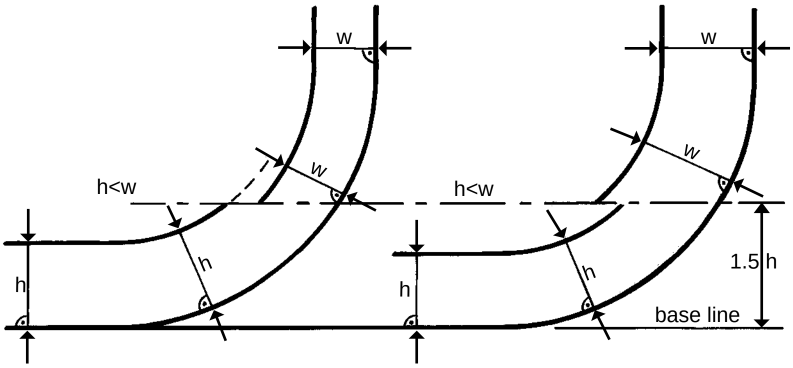
h = B/15,
with a minimum value of 0.76m;

(b) in the turn of the bilge area and at locations without a clearly defined turn of the bilge the cargo tank boundary line running parallel to the line of the mid-ship flat bottom as shown in Schedule 8 in Merchant Shipping Notice No. 1643/MARPOL 1; and

(c) be provided with cargo tanks so arranged that the capacity of each cargo tank does not exceed $700m^3$ unless wing tanks or spaces are arranged in accordance with paragraph, but with the distance w computed as follows –

$$w = 0.4 + \frac{2.4DW}{20,000}$$

with a minimum value of w = 0.76m.



Cargo tank boundary lines

SCHEDULE 7 ***Regulations 30 and 3***

CALCULATION OF HYDROSTATIC PRESSURE

All tankers built after 5th July 1993

1. Double bottom tanks or spaces may be dispensed with, provided that the design of the tanker is such that the cargo and vapour presure exerted on the bottom shell plating forming a single boundary between the cargo and the sea does not exceed the hydrostatic water pressure as expressed by the following formula

$f \times h_c \times p_c \times g + 100\ \Delta p \leq d_n \times p_s \times g$

where:

h_c = height of cargo in contact with the bottom shell plating in metres;

P_c = maximum cargo density in t/m^3;

d_n = minimum operating draught under any expected loading condition in metres;

p_s = density of sea water in t/m^3;

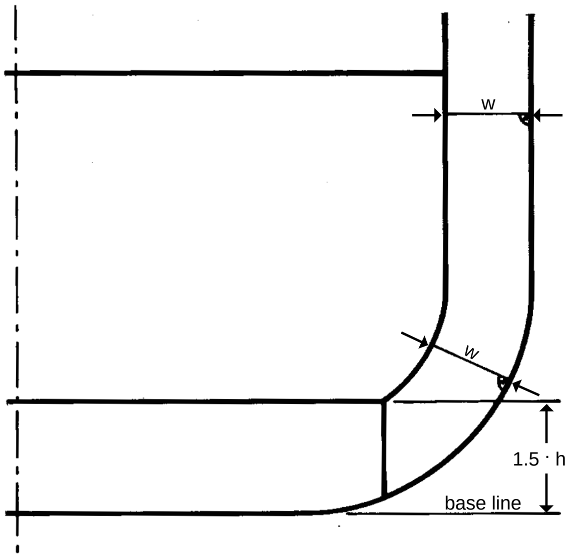
Δp = maximum set pressure of pressure/vacuum valve provided for the cargo tank in bars;

f= safety factor= 1.1;

g = standard acceleration of gravity (9.81 m/s^2).

2. Any horizontal partition necessary to fulfil the requirements of paragraph 1 shall be located at a height of not less than B/6 or 6 metres, whichever is the lesser, but not more than 0.6D, above the baseline (where D is the moulded depth amidships).

3. Where the double bottom tanks or spaces are dispensed with pursuant to paragraph 1, the location of wing tanks or spaces shall be in accordance with paragraph 1.1 of Schedule 6 except that, below a level 1.5 h above the baseline (where h is as defined in paragraph 1.2 of that Schedule), the cargo tank boundary line may be vertical down to the bottom plating as shown in the figure.

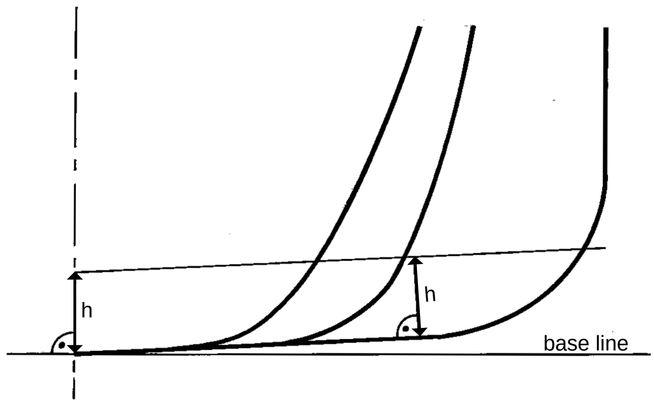


Cargo tank boundary lines

SCHEDULE 8 ***Paragraph 1.8 of Schedule 7***

Height of double bottoms in tankers of less than 5000 tons deadweight

1. The height of the double bottom tanks or spaces in oil tankers of less than 5,000 tons deadweight shall be measured so that in the turn of the bilge area and at locations without a clearly defined turn of the bilge, the cargo tank boudnary line shall run parallel of the mid-ship flat bottom as shown in the following figure.



Cargo tank boundary lines