Intermaritime Certification Services

ICS Class

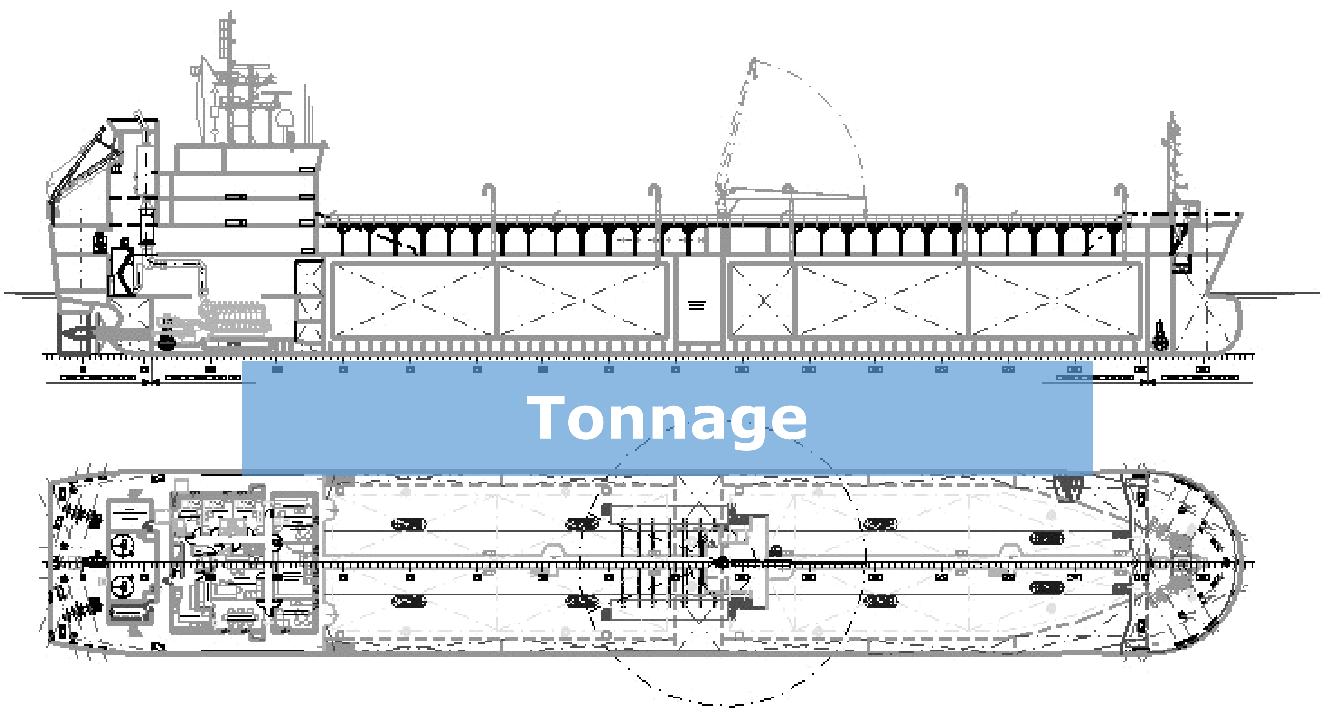
This training/examination module is covering the following item:

2E: Tonnage

In compliance with the IMO resolution MSC.349(92) and MEPC.237(65), RO Code, Appendix 2.

CONTENTS

Module 2E



Tonnage

1. Tonnage

Learning Outcomes
After successful completion of this chapter, you will:

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1.1 Origins

2E-001 'Tonnage' has been used for centuries to indicate the relative magnitude of ships. The term 'tonnage' originated during the days of wooden sailing vessels, when the costs for protection from incessant war and piracy were recovered from ships, and based on the number of wine-barrels, or tuns, it carried.

2E-002 This parameter was termed 'tunnage', which later became 'tonnage' and was mainly used as the basis for collecting ship's dues. Over a period of time, tonnage was found to be a convenient basis for various other purposes, such as shipping statistics, regulatory applications, manning and insurance.

2E-003 As previously explained, historically, tonnage was the tax on tuns (casks) of wine that held 954 litres (252 gallons) of wine and weighed 1016 kilograms (2,240 pounds). This suggests that the unit of weight measurement, the long ton (1,016 kg or 2,240 lb), and tonnage share the same etymology. The confusion between weight-based terms (deadweight and displacement) stems from this common source and the eventual decision to assess dues based on a ship's deadweight rather than counting the tuns of wine. In 1720 the Builder's Old Measurement Rule was adopted to estimate deadweight from the length of keel and maximum breadth or beam of a ship. This overly simplistic system was replaced by the Moorsom System in 1854 and calculated internal volume, not weight. This system evolved into the current set of internationally accepted rules and regulations.

2E-004 When steamships came into being, they could carry less cargo, size for size, than could sailing ships. In addition to spaces taken up by boilers and steam engines, steamships carried extra fresh water for the boilers and coal for the engines. Thus, to move the same volume of cargo as a sailing ship, a steamship would be considerably larger than a sailing ship.

Harbour dues are based on tonnage. In order to prevent steamships operating at a disadvantage, various tonnage calculations were established to minimise the disadvantage presented by the extra space requirements of steamships. Rather than charging by length, displacement, or the like, charges were calculated based on the viable cargo space. As commercial cargo sailing ships are now largely extinct, gross tonnage is becoming the universal method of calculating ships' dues, and is also a more straightforward and transparent method of assessment.

FIGURE - AMPHORA WHERE THE WINE WAS CARRIED

1.2 Type of tonnage and differences

2E-005 It is necessary to understand and differentiate between the following terms used to express the relative magnitude of ships for various purposes, both past and present.

1) Freight tonnage;
2) Displacement tonnage;
3) Deadweight tonnage;
4) Measured tonnage;
5) Registered tonnage;
6) Gross Register Tonnage(GRT);
7) Net Register Tonnage(NRT);
8) Panama Canal tonnage;
9) Suez Canal tonnage;
10) Gross Tonnage(GT);
11) Net Tonnage(NT);
12) Compensated gross tonnage; and
13) Maritime real estate.

1.2.1 Freight Tonnage

2E-006 In ancient and medieval times, wine was the most important cargo and the capacity of a ship was mentioned in terms of the wine casks, or 'tuns', carried by it. A 100 'tun' vessel meant that it could load 100 casks. The volume of a cask (approximately 40 cubic-feet) was related to one 'tun' (or ton) and freight rates for all other cargoes were fixed using this as a base. The volume occupied by other cargoes, was divided by 40 to obtain the equivalent 'ton' called 'freight tonnage'. 40 cubic-feet of space was allotted when payment was made for one 'ton'. George Moorsom4 called the freight tonnage the "measurement cargo at 40 ft^3 to a ton which a ship can carry"(Lane,1964).

Freight tonnage is dependant on the cargo volume, not the weight (tonneau d'affretement, tonnellata di nolo). For easy comparison, it can be considered analogous to current cubic capacity terms such as bale capacity or grain capacity.

1.2.2 Displacement Tonnage

2E-007 Displacement tonnage is the weight of seawater displaced by a vessel at a particular draft. Two kinds of displacement tonnage were in use, 'light displacement tonnage' (deplacement lege, dislocamento leggiero) and 'displacement tonnage loaded' (deplacement en charge, dislocamento a pieno carico). The displacement tonnage was used mainly for construction estimates of battle ships, and apparently not used before the 19th century (Lane,1964;Kendall,1948). The term 'displacement' in current terminology is comparable to the 'displacement tonnage' (Rawson&Tupper,2001).

1.2.3 Deadweight tonnage

2E-008 The difference between 'light displacement tonnage' and the 'displacement tonnage loaded' is called 'deadweight tonnage', i.e., the weight of additional water displaced due to cargo weight. In older days, the weight of cargo was determined by weighing and counting the loaded units individually.
For ordinary wooden vessels, deadweight tonnage was about 50% of its 'displacement tonnage loaded' (Lane,1964;Salisbury,1968). This term is comparable to 'deadweight' in current terminology (Taggart,1980).

'Burthen' or 'Burden' was also used to indicate the cargo capacity (Keene,1978). According to Davis (1962), the term 'tons burden' was used in the 18th century to denote 'the number of tons which would lade an empty ship down to her minimum safe freeboard or loadline'.

1.2.4 Measured Tonnage (or "Old Registered Tonnage)

2E-009 In medieval times, ships were 'rated' for a particular voyage. The 'rating' depended on the cargo capacity, ship's age, length and circumstances of intended voyage (i.e., expected weather conditions and operating sea area), space allotted for stores and arms (piracy was prevalent those days), and in addition, on the judgement of shipwrights, masters and officials based on the above factors. Hence, there was plenty of room for arguments and negotiations between ship-owners, charterers and tax authorities, and a ship could have entirely different 'rating' for different voyages or different purposes or by different persons.

2E-010 This practice created confusion and difficulties, since the ship had to be 'rated' each time it sailed. Gradually, official estimate of the ship's 'rating' was determined from the principal dimensions5 (French,1973;McCusker,1997). The 'rating' so determined from measurement of dimensions, is called 'measured tonnage'.

2E-011 In French and Italian terminology, they were termed ton 'de jauge' or 'di stazza'. The 'measured tonnage' is also termed 'old registered tonnage', after the introduction of 'registered tonnage' in 17866 (French,1973;Lane,1964).

1.2.5 Registered Tonnage (RT)

2E-012 The formula for 'measured tonnage' was not widely enforced until 1786. Since the taxes and dues were based on tonnage, a lower tonnage was declared by ship-owners during registration, though the higher 'measured tonnage' was used for

building, buying and selling of vessels. The tonnage indicated on the ship's registration documents is called 'registered tonnage'. The 'registered tonnage' was roughly two-third of the 'measured tonnage', rounded down to the nearest whole number (McCusker,1966).
In 1786, the law required all vessels to indicate the 'measured tonnage' during registration. Thereafter the 'measured tonnage' is same as the 'registered tonnage' (French,1973).

1.2.6 Gross Registered Tonnage (GRT)

2E-012 The 'registered tonnage' was intended as an indicator of total 'weight' of a ship (Moorsom,1855a). The weight of cargo was assumed to be 50% of the 'registered tonnage'. As the carriage of lighter cargoes such as cotton became more frequent, more space was needed for stowage. Spaces other than cargo space were also utilised for cargo, and ships with higher volume had higher earning potential. Further, the formula-based method for 'registered tonnage' led to the construction of ill-formed vessels with low tonnage, and the 'registered tonnage' did not realistically represent the actual 'weight' of the ship.

2E-013 Due to these reasons, a new term 'Gross register tonnage (GRT)' was introduced in the 1854 British Act7. GRT is determined from the total volume of enclosed spaces. Each 100 ft3 (or 2.83 m3) is counted as one ton, and GRT is obtained by dividing the total enclosed volume in ft3 by 100 (or by 2.83 if in m3). The GRT could have decimal values (Lane,1964;Moorsom, 1855c).

2E-014 The changes in design, transition from wood to iron hull, and changes in propulsion method meant that the GRT alone could not signify the cargo capacity. Some part of the cargo space was allocated for propulsion machinery in steamships (Hughes&Reiter,1958). The traditional desire to relate tonnage to income yielding cargo capacity, led to the development of another registered tonnage, called the 'net register tonnage' (NRT).

1.2.7 Net Registered Tonnage (NRT)

2E-015 'Net register tonnage' was intended to represent the earning capacity. It is obtained by deducting the volume of spaces not available for cargo (such as space for propulsion machinery and crew's quarters), from the volume for GRT, and dividing the resultant volume in ft3 by 100 (or by 2.83 if in m3). The NRT also could have decimal value (Lane,1964;Moorsom,1855c).

1.2.8 Suez Canal Net Tonnage (SC-NT)

2E-016 This tonnage is used only for charging toll for ships transiting the Suez Canal. Special rules, recommended at an international conference held at Constantinople on 18th December, 1873, are used for determining SC-NT. Though these rules are based on Moorsom's System, they differ in some aspects such as deductions and exemptions. The 1873 rules are still followed for SC-NT (Abu-el-hassan,1974;Corkhill,1980).

1.2.9 Panama Canal Net Tonnage (PC-NT)

2E-017 This tonnage is used only for charging toll for ships navigating through the Panama Canal. Separate rules, based on Moorsom's System and Suez Canal rules, were developed for PC-NT in 1913. The principles of ITC-69 were incorporated into the rules in 1994, and now it is called 'Panama Canal Universal Measurement System' net tonnage, PC/UMS-NT (Barnett&Ruben, 2005; Corkhill,1980).

1.2.10 Gross Tonnage (GT)

2E-018 Gross tonnage is determined according to Regulation-3 of ITC-69. The calculation of GT is much easier than earlier methods. GT is determined by a mathematical formula from the total enclosed volume of the ship, including superstructure and deck houses. The final figure is rounded down without decimals to get GT (IMO,1983a;IMO,1994).

1.2.11 Net Tonnage (NT)

2E-019 Net tonnage is determined according to Regulation-4 of ITC-69. It is dependent on the total volume of cargo spaces, number of passengers, depth, draft, and the GT of the vessel. It is also calculated by a formula and the final figure is rounded down without decimals to get NT (IMO,1983a;IMO,1994).

1.2.12 Compensated Gross Tonnage (CGT)

2E-020 CGT is not an indicator of ship's size. It is a statistical tool developed in 1968, for economic evaluation of shipbuilding output worldwide. CGT reflects the work content and complexity in building different types and sizes of ships.

2E-021 For example, one GT of a passenger ship with its sophisticated accommodation and public spaces requires a significantly higher level of work content than one GT of a bulk carrier. One CGT of either ship roughly reflects the equivalent work content, and is hence recognized as a superior tool to GT for comparison of shipyard workload and output. CGT is determined from the GT by using two internationally agreed correction factors, A and B, depending on type and size of ship.

1.2.13 Maritime Real Estate (MRE)

2E-022 This is the latest term proposed to be used as the basis for vessel based charges. In 2005, Australia mooted the concept of 'Maritime Real Estate,(MRE)' as a third tonnage measurement, in addition to GT and NT (IMO,2005b;IMO,2005c). MRE is proposed as the product of length, breadth and draft, with a suitable scaling factor. This is one of the topics currently being studied by the 'Tonnage Correspondence Group' under the SLF subcommittee at IMO (IMO,2009a;IMO,2010).

1.3 Why different methods? – An Analysis

2E-023 The evolution of various measurement methods before ITC-69, briefly discussed are analysed here to provide a background to the forthcoming discussions on ITC-69. The primary reasons leading to the developments in different measurement systems in the past are discussed for this purpose.

An analysis of the various tonnage measurement methods used from the 13th century shows that different methods evolved due to:

i. Technological changes,
ii. Response from disadvantaged stakeholders,
iii. Delay in timely action to change the regulations,
iv. Dominance of some maritime nations and ship-owners, and
v. Concerns about safety and crew living conditions.

1.3.1 Technological Changes

2E-024 The technological developments in ship construction have resulted in adoption of new measurement methods. Steam was used at sea for the first time in the early 19th century, and by the end of 19th century steel ships were increasingly constructed. The machinery space on steam ships occupied a part of the cargo space and the lightship weight was higher due to propulsion machinery. Due to these technological changes and to give fair treatment to new generation vessels, internal volume was considered a better choice than weight to assess the earning capacity. The internal measurement also gave a much lower tonnage (Henderson,1854). While framing Moorsom's System, heavy or deadweight cargoes were not the predominant cargoes of commerce, and it was also feared that external measurement would lead to building of weak and thin-sided vessels (Butts,1865). This shift in approach meant that the GRT did not any more signify the cargo weight and a new measure NRT was needed to meet changing demands.

1.3.2 Response from disadvantaged stakeholders

2E-025 The basis for assessing the tonnage of a ship, was either its total volume or its displacement. The measurement of volume could be done externally or internally, i.e., measuring the moulded dimensions or the dimensions between the inside of the frames. The latter would provide a lower volume than external measurement. The internal measurement was beneficial to wooden ships, as the frames were deeper. But the scantlings were much less for steel ships, and steel ships had about 13% higher tonnage than wooden ships of the 26 same displacement (Bates,1858). This anomaly was corrected by introducing NRT, by allowing certain deductions from GRT, and using NRT as a basis for charging.

2E-026 According to Johnson (1913), the net tonnages of British ships were less than those under other national rules. The ship-owners benefitted from this by saving on port dues. This prompted other nations to also adopt rules beneficial to their ships. In the case of the Suez Canal, when the revenue from NRT-based toll system was inadequate to meet expenses, a GRT-based system was adopted. But opposition from British ship-owners, who controlled 80% of the ships passing through the Suez Canal persuaded authorities to adopt separate rules for the Suez Canal, and the Suez Canal tonnage rules were adopted in 1873 at Constantinople (Wilson,1935). In 1871, the Danube rules were formulated in a similar manner since the propelling power allowance of 32% (instead of the actual tonnage) was considered too high, thereby treating sailing vessels unfavourably. Panama Canal framed separate rules in 1913, after finding that larger modern ships were not treated equally under other measurement rules. The decision by the House of Lords in 1875, in the case of S.S. Bear, legitimised the shelter-deck concept. The purpose of tonnage as an indicator was conveniently discarded, and 'monster' ships without any proportionate increase in tonnage were constructed. The ports and canals were the losers, as they had to handle bigger ships without extra earnings. The tonnage mark scheme introduced in the 1960's had the same fate, since the owner could choose the tonnage for paying dues and the ports were not earning revenue proportionate to their expenses. The IAPH made a resolution indicating the unsuitability of the tonnage mark scheme for charging purposes and it was an important consideration during the ITC-69 Conference.

It can be seen that in many cases different measurement systems evolved out of compulsion and disadvantages to stakeholders. To a certain extent, this was also responsible for the failure to achieve worldwide uniformity.

1.3.3 Delay in timely action to change the regulations

2E-027 During the mid-1800's, long and deep ships were built to reduce tonnage, since the 'measured tonnage' was not dependant on all principal parameters equally.

2E-028 This shows how the loopholes in regulations were exploited at the expense of safety, and highlights the need to formulate measurement methods carefully. The propelling power allowance in Moorsom's System was higher than the actual machinery volume. Repeated attempts to amend this provision failed in the British parliament due to objection from ship-owners, as it would result in a higher NRT. But the inability to amend the law led to the development of the Danube rules, Suez Canal Rules and Panama Canal rules (Johnson,1913). The canal tonnages are greater than national tonnages due to limited exemptions under their separate rules (Pearson,1969). Similarly, commercial interests prevailed over commonsense for amending the definition of shelter-deck, and ships of larger size without proportionate increase in tonnage could be built, after the S.S.Bear judgement (Lyman,1945). Consequently, the determination of tonnage became a complicated calculation and needed expertise (Comstock,1967). The British rules did not permit carriage of cargo on deck, and hence the tonnage rules did not include deck cargo. Later on, ships were specifically designed for carrying deck cargo, but rules were not amended and ships operated without any increase in tonnage. The Panama and Suez Canal authorities benefited from having their own rules because they could amend the rules according to changes in the industry.

These examples show how the inadequate regulatory provisions and the delay in making timely amendments to the regulations contributed to the development of different measurement methods.

1.3.4 Dominance of some maritime nations and shipowners

2E-029 In the 18th century, the tonnage declared during registration was on average 32% less than the 'measured tonnage' to save on tonnage based expenses (French,1973). This led to the development of 'registered tonnage' in 1773. In the late 1880's, Britain owned 80% of world tonnage (Fletcher,1958) and maritime trade was growing rapidly(Davis,1956, North,1958).

2E-030 Though the 1849 Commission led by George Moorsom recommended a 'highly scientific' external measurement system in 1850, the shipping industry was so powerful that neither they nor the government accepted the recommendation.
Subsequently the same commission had to formulate a volume-based internal measurement method, as desired by the industry, which was implemented through Moorsom's System (Moorsom,1855b). The choice of 100 as the divisor23, was merely coincidental, as seen earlier, based on the volume and tonnage of British ships alone. The inclusion of American or German or the world's shipping tonnage while establishing divisor may have resulted an entirely different divisor.

2E-031 The Moorsom's System was beneficial to the British ships which constituted 75% of the Suez Canal traffic, especially for steamships which accounted for 96% of the traffic (Fletcher,1958;Lindsay,1876). The 'artificialities' of measurement system were such that there was little correlation between carrying capacity and NRT which benefited the British ships and other nations allowed similar exemption to their ships to avoid commercial disadvantages(McIntyre,1960). NRT was the basis for charging dues and a liberal propelling power allowance under the British rules, resulting in a lower NRT, encouraged a transition from sailing ships to steamships (Comstock,1967). The practice of declaring a lower tonnage during registration was operative in the late 18th century, and the 'registered tonnage' of colonial-owned vessels was about one-third less than 'computed tonnage' (French,1973;McCusker,1967). But these measures resulted in revenue loss to the ports and canal authorities, and the Suez Canal adopted separate rules in 1873 (Wilson,1935). Though Britain was present in the European Commission of Danube for framing the Danube rules, corresponding amendments could not be incorporated into the Moorsom's System. When the US adopted Moorsom's System, passenger spaces above the first deck were exempted from measurement to reduce the impact of the new system on passenger vessels. Hence, a foreign passenger vessel had a much lower tonnage under the US measurement system. According to Kendall (1948), the threshold of 500 GRT originated in Britain as a measure to exclude small coasting vessels and non-trading vessels, which was later included for application of major maritime conventions. Other thresholds (such as 1600GRT and 3000GRT) were originally made to distinguish between geographical areas of employment of British ships. The manning scale depending on a ship's tonnage was introduced in 1835 in Britain (Clapham,1910). These are some of the examples related to tonnage aspects where the maritime powers took measures to protect their commercial interests, which later became internationally accepted standards.

1.3.5 Concerns on safety and crew living conditions

2E-0032 The changes to measurement systems were prompted by safety concerns and crew aspects. One of the reasons for opting the internal measurement, (i.e., between the inside of frames) was that it would encourage the owners to provide deeper floors, stronger frames and thicker wooden planks, since they would not be penalised for constructing a safer and stronger vessel (Butts,1865;Eriksson, as cited in Wilson,1970). Sailing ships did not have propulsion machinery and had only one tonnage, i.e., GRT. In order to promote the living conditions for crew, the NRT was introduced for the sailing vessels also, by allowing deduction proportionate to the crew spaces from the GRT (Graham,1956). Since the 'measured tonnage' was dependant only on length and breadth, it led to construction of deep and narrow vessels which were unsafe with poor seakeeping qualities (Henderson,1854). Due to this reason, the tonnage rules were modified subsequently to avoid undue influence of any single parameter on tonnage (French,1973;Graham.1956). After safety issues (such as the inability to prevent spread of fire or progressive flooding) due to the presence of tonnage openings were identified, the tonnage mark scheme was introduced in 1963 (Corkhill,1981; Wilson,1970).

The negative influence of safety and crew living conditions on tonnage measurement is clear from the above developments.

1.3.6 Summary

2E-033 It can be seen from discussion that there are a number of factors which contributed to the evolution of new measurement methods, from time to time. Some of these factors contributed to the lack of worldwide uniformity in measurement systems. This brief analysis is intended to provide a background while evaluating various options to resolve the current issues of ITC-69, in Chapters 7 and 8.

2. International Convention on Tonnage Measurement of Ships

2E-034 The Convention, adopted by IMO in 1969, was the first successful attempt to introduce a universal tonnage measurement system.

2E-035 Previously, various systems were used to calculate the tonnage of merchant ships. Although all went back to the method devised by George Moorsom of the British Board of Trade in 1854, there were considerable differences between them and it was recognized that there was a great need for one single international system.

2E-035 The Convention provides for gross and net tonnages, both of which are calculated independently.

2E-036 The rules apply to all ships built on or after 18 July 1982 - the date of entry into force - while ships built before that date were allowed to retain their existing tonnage for 12 years after entry into force, or until 18 July 1994.

2E-036 This phase-in period was intended to ensure that ships were given reasonable economic safeguards, since port and other dues are charged according to ship tonnage. At the same time, and as far as possible, the Convention was drafted to ensure that gross and net tonnages calculated under the new system did not differ too greatly from those calculated under previous methods.

2E-037 *Gross tonnage and net tonnage*

The Convention meant a transition from the traditionally used terms gross register tons (grt) and net register tons (nrt) to gross tonnage(GT) and net tonnage (NT).

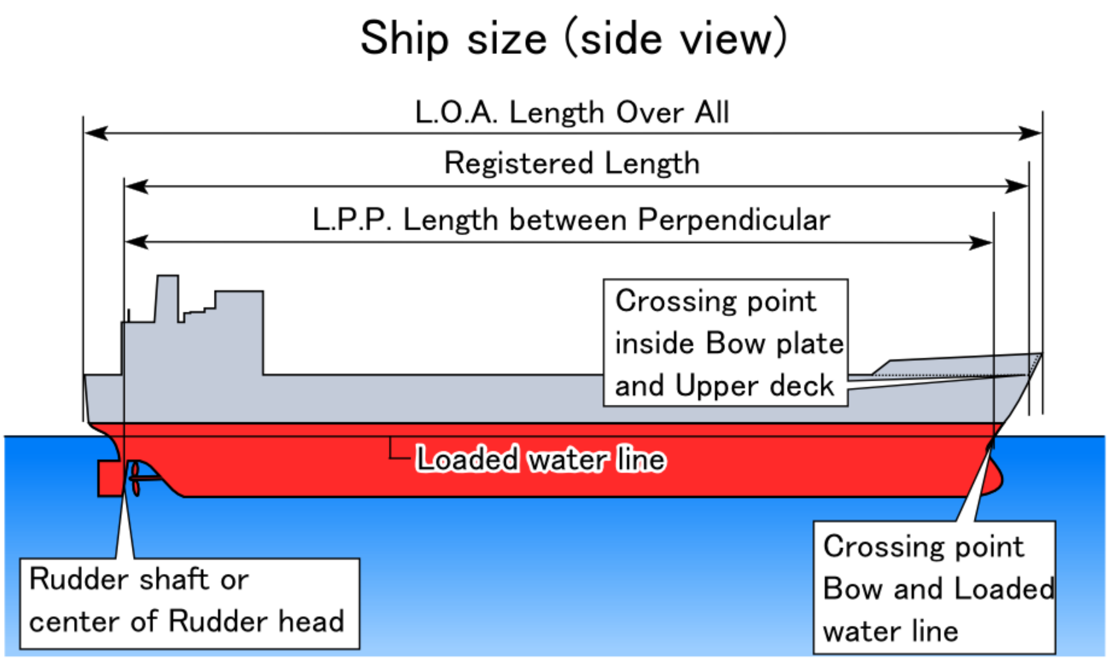
Gross tonnage forms the basis for manning regulations, safety rules and registration fees. Both gross and net tonnages are used to calculate port dues.

The gross tonnage is a function of the moulded volume of all enclosed spaces of the ship. The net tonnage is produced by a formula which is a function of the moulded volume of all cargo spaces of the ship. The net tonnage shall not be taken as less than 30 per cent of the gross tonnage.

2.1 ITC-69 - Definitions

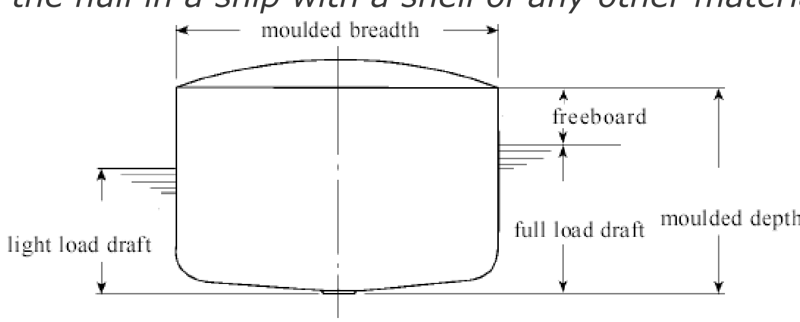
2.1.1 Length (Article 2.8)

2E-038 *"length" means 96 per cent 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 fore side 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;*



2.1.2 Breadth (Regulation 2.3)

2E-039 *The breadth is 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.*

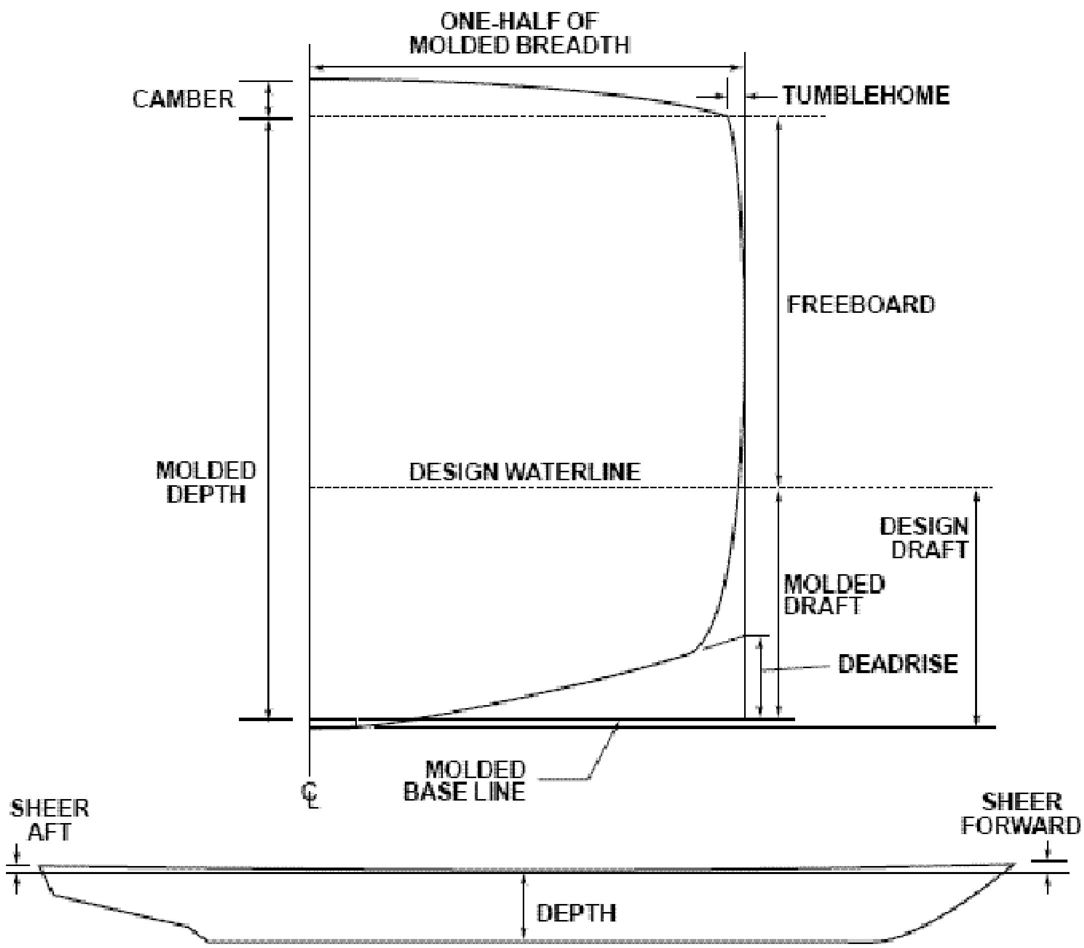


2.1.3 Moulded Depth (Regulation 2.2)

2E-040 *(a) The moulded depth is the vertical distance measured from the top of the keel to the underside of the upper deck at side. In wood and composite ships the distance is measured from the lower edge of the keel rabbet. Where the form at the lower part of the midship section is of a hollow character, or where thick garboards are fitted, the distance is measured from the point where the line of the flat of the bottom continued inwards cuts the side of the keel.*

(b) In ships having rounded gunwales, 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 gunwales were of angular design.

(c) Where the upper deck is stepped and the raised part of the deck extends over the point at which the moulded depth is to be determined, the moulded depth shall be measured to a line of reference extending from the lower part of the deck along a line parallel with the raised part.

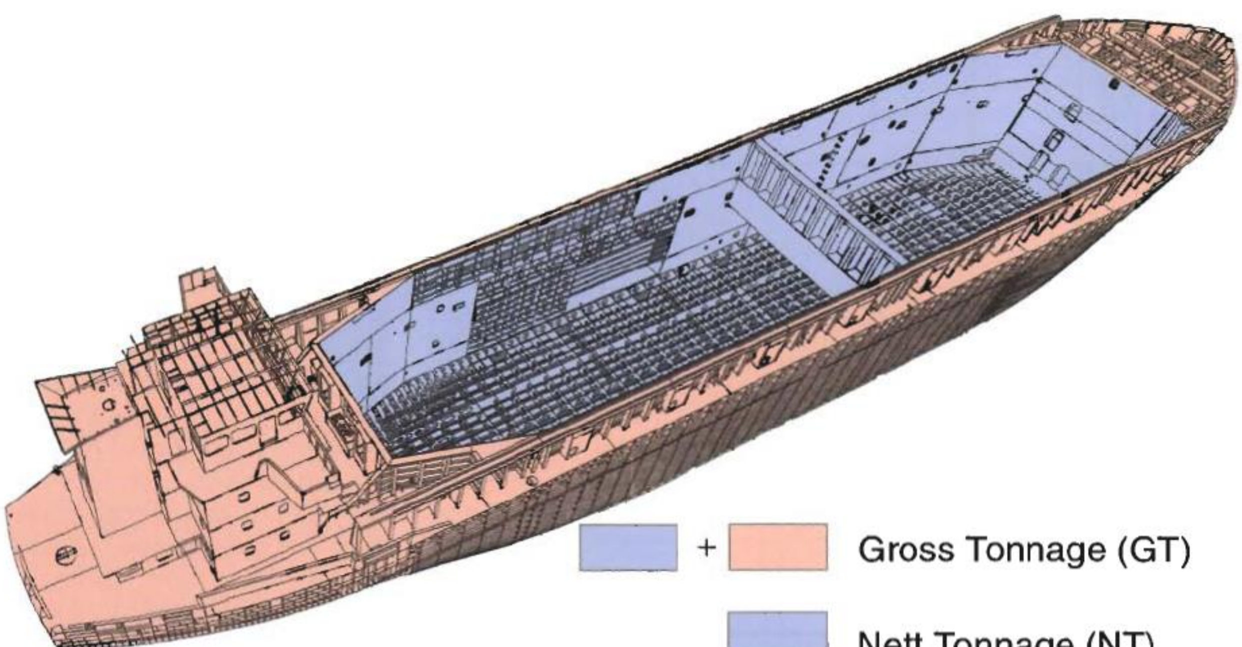


2.1.4 Gross Tonnage (Article 2.4)

2E-041 *"gross tonnage" means the measure of the overall size of a ship determined in accordance with the provisions of the present Convention.*

Gross tonnage (often abbreviated as GT, G.T. or gt) is a unitless index related to a ship's overall internal volume. Gross tonnage is different from gross register tonnage. Neither gross tonnage nor gross register tonnage is a measure of the ship's displacement (mass) and should not be confused with terms such as deadweight tonnage or displacement.

Gross tonnage, along with net tonnage, was defined by The International Convention on Tonnage Measurement of Ships, 1969, adopted by the International Maritime Organization in 1969, and came into force on July 18, 1982. These two measurements replaced gross register tonnage (GRT) and net register tonnage (NRT). *Gross tonnage is calculated based on "the moulded volume of all enclosed spaces of the ship"* and is used to determine things such as a ship's manning regulations, safety rules, registration fees, and port dues, whereas the older gross register tonnage is a measure of the volume of certain enclosed spaces.



2.1.4.1 Gross Tonnage – Calculation (Regulation 3)

2E-042 The gross tonnage calculation is defined in Regulation 3 of Annex 1 of The International Convention on Tonnage Measurement of Ships, 1969. It is based on two variables, and ultimately a one-to-one function of ship volume:

- V, the ship's total volume in cubic meters (m3), and
- K, a multiplier based on the ship volume.

The value of the multiplier K varies in accordance with a ship's total volume (in cubic metres) and is applied as a kind of reduction factor in determining the gross tonnage value - which does not have a unit such as cubic metres or tons. For smaller ships, K is smaller, for larger ships, K is larger. K ranges from 0.22 to 0.32 and is calculated with a formula which uses the common or base-10 logarithm:

The gross tonnage (GT) of a ship shall be determined by the following formula:

$$GT = K_1V$$

Where:

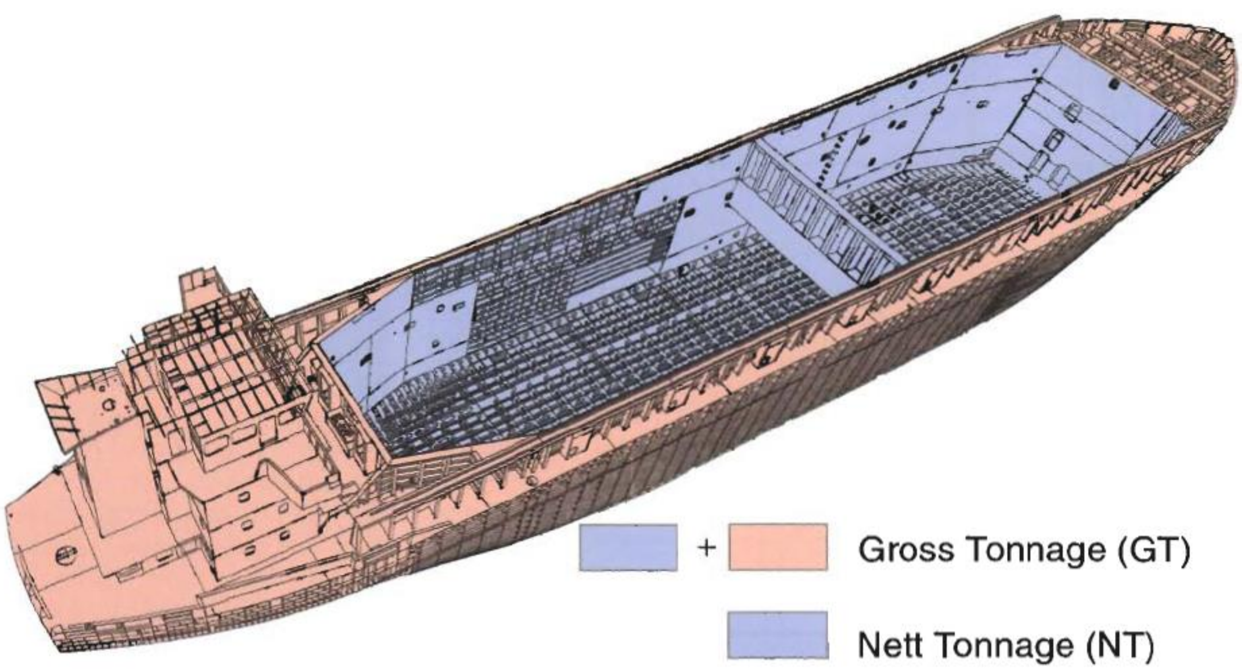
V = Total volume of all enclosed spaces of the ship in cubic metres

$$K_1 = 0.2 + 0.02 \text{ Log}_{10}V$$

2.1.5 Net Tonnage (Article 2.5)

2E-043 "net tonnage" means the measure of the useful capacity of a ship determined in accordance with the provisions of the present Convention;

Net tonnage (often abbreviated as NT, N.T. or nt) is a dimensionless index calculated from the total moulded volume of the ship's cargo spaces by using a mathematical formula. Defined in *The International Convention on Tonnage Measurement of Ships* that was adopted by the *International Maritime Organization* in 1969, the net tonnage replaced the earlier net register tonnage (NRT) which denoted the volume of the ship's revenue-earning spaces in "register tons", units of volume equal to 100 cubic feet (2.83 m3). Net tonnage is used to calculate the port duties and should not be taken as less than 30 per cent of the ship's gross tonnage.
Net tonnage is not a measure of the weight of the ship or its cargo, and should not be confused with terms such as deadweight tonnage or displacement. Also, unlike the net register tonnage, the net tonnage is unitless and thus cannot be defined as "tons" or "net tons".



2.1.5.1 Net Tonnage – Calculation (Regulation 4)

2E-044 The net tonnage calculation is based on a number of factors, one of which is the moulded draft d. The choice of the value to use for d can be complicated. For ships subject to the International Convention on Load Lines, the Summer Load Line draft is used, with the exception of cases where that is a timber load line. For passenger ships, the draft used is the deepest subdivision load line assigned in accordance with the International Convention for the Safety of Life at Sea. Otherwise, if a ship has been assigned a load line by its national government, the draft for that summer load line is used. If the ship has no load line, instead, a maximum draft assigned by its national government, that value is used, if it has been assigned a maximum. Finally, for a ship to which none of the above applies, the value of d is taken as 75 per cent of the moulded depth amidships.

The net tonnage (NT) of a ship shall be determined by the following formula:

$$NT = K_2 V_C \left(\frac{4d}{3D}\right)^2 + K_3 \left(N_1 + \frac{N_2}{10}\right)$$

in which formula:

(a) The factor $\left(\frac{4d}{3D}\right)^2$ shall not be taken as greater than unity;

(b) The term $K_2 V_C \left(\frac{4d}{3D}\right)^2$ shall not be taken as less than 0.25 GT; and

(c) NT shall not be taken as less than 0.30 GT,

and in which:

V_c	=	total volume of cargo spaces in cubic meters,
K_2	=	$0.2 + 0.02 \; log_{10} V_C$ (or as tabulated in Appendix 2 of the Convention),
K_3	=	$1.25 \dfrac{GT + 10000}{10000}$
D	=	moulded depth amidships in meters as defined in Regulation 2 (2),
D	=	moulded draught amidships in meters as defined in paragraph (2) of the Regulation 3,
N_1	=	number of passengers in cabins with not more than 8 berths,
N_2	=	number of other passengers,
$N_1 + N_2$	=	total number of passengers the ship is permitted to carry as indicated in the ship's passenger certificate; when $N_1 + N_2$ is less than 13, N_1, and N_2 shall be taken as zero,
GT	=	gross tonnage of the ship as determined in accordance with the provisions of Regulation 3,

(2) The moulded draught (d) referred to in paragraph (1) of the Regulation 4 shall be one of the following draughts:

(a) for ships to which the International Convention on Load Lines in force applies, the draught corresponding to the Summer Load Line (other than timber load lines) assigned in accordance with that Convention;

(b) for passenger ships, the draught corresponding to the deepest sub-division load line assigned in accordance with the International Convention for the Safety of Life at Sea in force or other international agreement where applicable;

(c) for ships to which the International Convention on Load Lines does not apply but which have been assigned a load line in compliance with national requirements, the draught corresponding to the summer load line so assigned;

(d) for ships to which no load line has been assigned but the draught of which is restricted in compliance with national requirements, the maximum permitted draught;

(e) for other ships, 75 per cent of the moulded depth amidships as defined in Regulation 2 (2).

2.1.6 Gross Tonnage and Net Tonnage – Calculation Example

Tonnage Calculation

1. Gross Tonnage (Regulation 3)

According to International Convention on Tonnage Measures of Ship, 1969, the Gross Tonnage (GT) of a ship shall be determined by the following formula:

$GT = K_1 V$

V= Total volume of all enclosed spaces of the ship in cubic meters;

$K_1 = 0.2 + 0.02 \log_{10} V$

Where

$V = 19397.72$ m^3

$K_1 = 0.2 + 0.02 \log_{10} V$

$K_1 = 0.286$

$GT = K_1 V$

GT= 5543

2. Net Tonnage (Regulation 4)

The net tonnage (NT) of a ship shall be determined by the following formula:

$NT = K_2 V_c (4d/3D)^2 + K_3 (N_1 + N_2/10)$

Moulded Draft: $d = 8.500$

Moulded Depth: $D = 12.900$

Cargo Space: $V_c = 13739.700$

$K_2 = 0.2 + 0.02 \log_{10} V_c$

$K_2 = 0.28$

$K_3 = [1.25(GT+10000)]/10000$

$K_3 = 1.943$

N_1= number of passengers in cabins with not more than 8 berths,

N_1= NIL

N_2= number of other passengers.

N_2= NIL

$(4d/3D)^2 = 0.772$ → Shall not be taken as greater than unity; "1(one)"

so $(4d/3D)^2 = 0.772$

$K_2 V_c (4d/3D)^2 = 2998.682108$ → Shall not be taken as less than 0.25GT;

$0.25GT = 1385.75$

$K_2 V_c (4d/3D)^2 = 2998.68$

$K_3 (N_1 + N_2/10)$= NIL

$NT = 2999$ → NT must not be taken as less than 0.30GT

$0.30GT = 1662.9$

NT= 2999

2.1.7 Enclosed Spaces (Regulation 2.4)

2E-045 *Enclosed spaces* are all those spaces which are bounded by the ship's hull, by fixed or portable partitions or bulkheads, by decks or coverings other than permanent or movable awnings. No break in a deck, nor any opening in the ship's hull, in a deck or in a covering of a space, or in the partitions or bulkheads of a space, nor the absence of a partition or bulkhead, shall preclude a space from being included in the enclosed space.

2.1.8 Excluded Spaces (Regulation 2.5)

2E-046 *Notwithstanding the provisions of paragraph (4) of this Regulation, the spaces referred to in subparagraphs (a) to (e) inclusive of this paragraph shall be called excluded spaces and shall not be included in the volume of enclosed spaces, except that any such space which fulfils at least one of the following three conditions shall be treated as an enclosed space:*

- *the space is fitted with shelves or other means for securing cargo or stores;*
- *the openings are fitted with any means of closure;*
- *the construction provides any possibility of such openings being closed:*

(a)

i. *A space within an erection opposite an end opening extending from deck to deck except for a curtain plate of a depth not exceeding by more than 25 millimetres (one inch) the depth of the adjoining deck beams, such opening having a breadth equal to or greater than 90 per cent of the breadth of the deck at the line of the opening of the space. This provision shall be applied so as to exclude from the enclosed spaces only the space between the actual end opening and a line drawn parallel to the line or face of the opening at a distance from the opening equal to one half of the width of the deck at the line of the opening (Figure 1 in Appendix 1).*
ii. *Should the width of the space because of any arrangement except by convergence of the outside plating, become less than 90 per cent of the breadth of the deck, only the space between the line of the opening and a parallel line drawn through the point where the athwartships width of the space becomes equal to, or less than, 90 per cent of the breadth of the deck shall be excluded from the volume of enclosed spaces (Figures 2, 3 and 4 in Appendix 1).*
iii. *Where an interval which is completely open except for bulwarks or open rails separates any two spaces, the exclusion of one or both of which is permitted under sub-paragraphs (a) (i) and/or (a) (ii), such exclusion shall not apply if the separation between the two spaces is less than the*

least half breadth of the deck in way of the separation (Figures 5 and 6 in Appendix 1).

(b) A space under an overhead deck covering open to the sea and weather, having no other connexion on the exposed sides with the body of the ship than the stanchions necessary for its support. In such a space, open rails or a bulwark and curtain plate may be fitted or stanchions fitted at the ship's side, provided that the distance between the top of the rails or the bulwark and the curtain plate is not less than 0.75 metres (2.5 feet) or one-third of the height of the space, whichever is the greater (Figure 7 in Appendix 1).

(c) A space in a side-to-side erection directly in way of opposite side openings not less in height than 0.75 metres (2.5 feet) or one-third of the height of the erection, whichever is the greater. If the opening in such an erection is provided on one side only, the space to be excluded from the volume of enclosed spaces shall be limited inboard from the opening to a maximum of one-half of the breadth of the deck in way of the opening (Figure 8 in Appendix 1).

(d) A space in an erection immediately below an uncovered opening in the deck overhead, provided that such an opening is exposed to the weather and the space excluded from enclosed spaces is limited to the area of the opening (Figure 9 in Appendix 1)

(e) A recess in the boundary bulkhead of an erection which is exposed to the weather and the opening of which extends from deck to deck without means of closing, provided that the interior width is not greater than the width at the entrance and its extension into the erection is not greater than twice the width of its entrance (Figure 10 in Appendix 1).

2.1.9 Appendix 1 – Figures referred to in Regulation 2.5

2E-047 In the following figures:

O = Excluded Space
C = Enclosed Space
I = Space to be considered as an Enclosed Space

Hatched in parts to be included as enclosed spaces.

B = Breadth of the deck in way of the opening. In ships with rounded gunwales the breadth is measured as indicated in Figure 11.

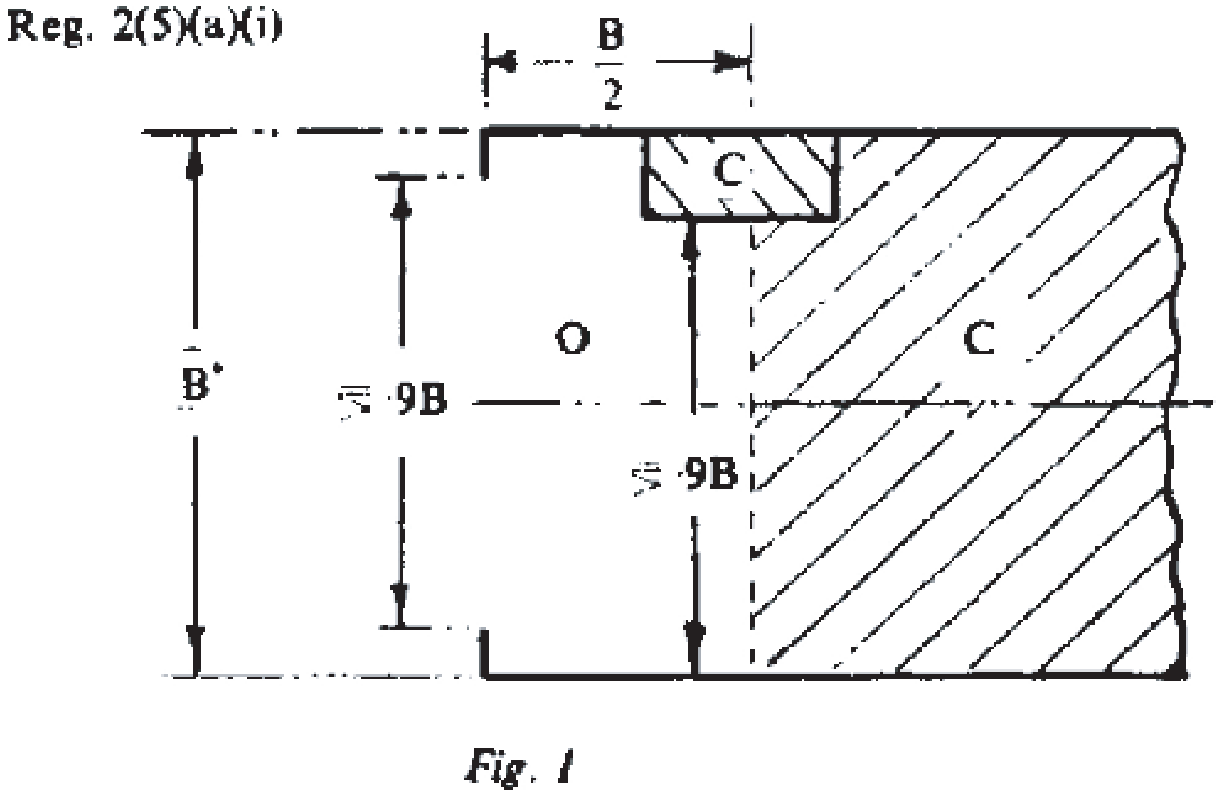


FIGURE 1

In the following figures:

O	=	Excluded Space
C	=	Enclosed Space
I	=	Space to be considered as an Enclosed Space

Hatched in parts to be included as enclosed spaces.

B = Breadth of the deck in way of the opening. In ships with rounded gunwales the breadth is measured as indicated in Figure 11.

Reg. 2(5)(a)(ii)

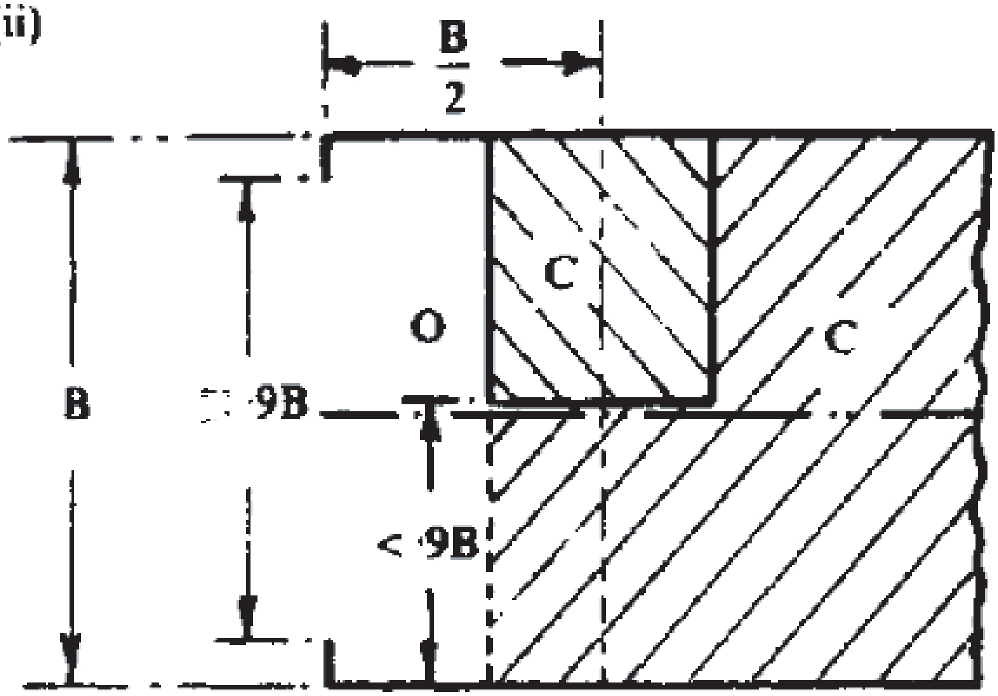


Fig. 2

FIGURE 3

In the following figures:

O = Excluded Space
C = Enclosed Space
I = Space to be considered as an Enclosed Space

Hatched in parts to be included as enclosed spaces.

B = Breadth of the deck in way of the opening. In ships with rounded gunwales the breadth is measured as indicated in Figure 11.

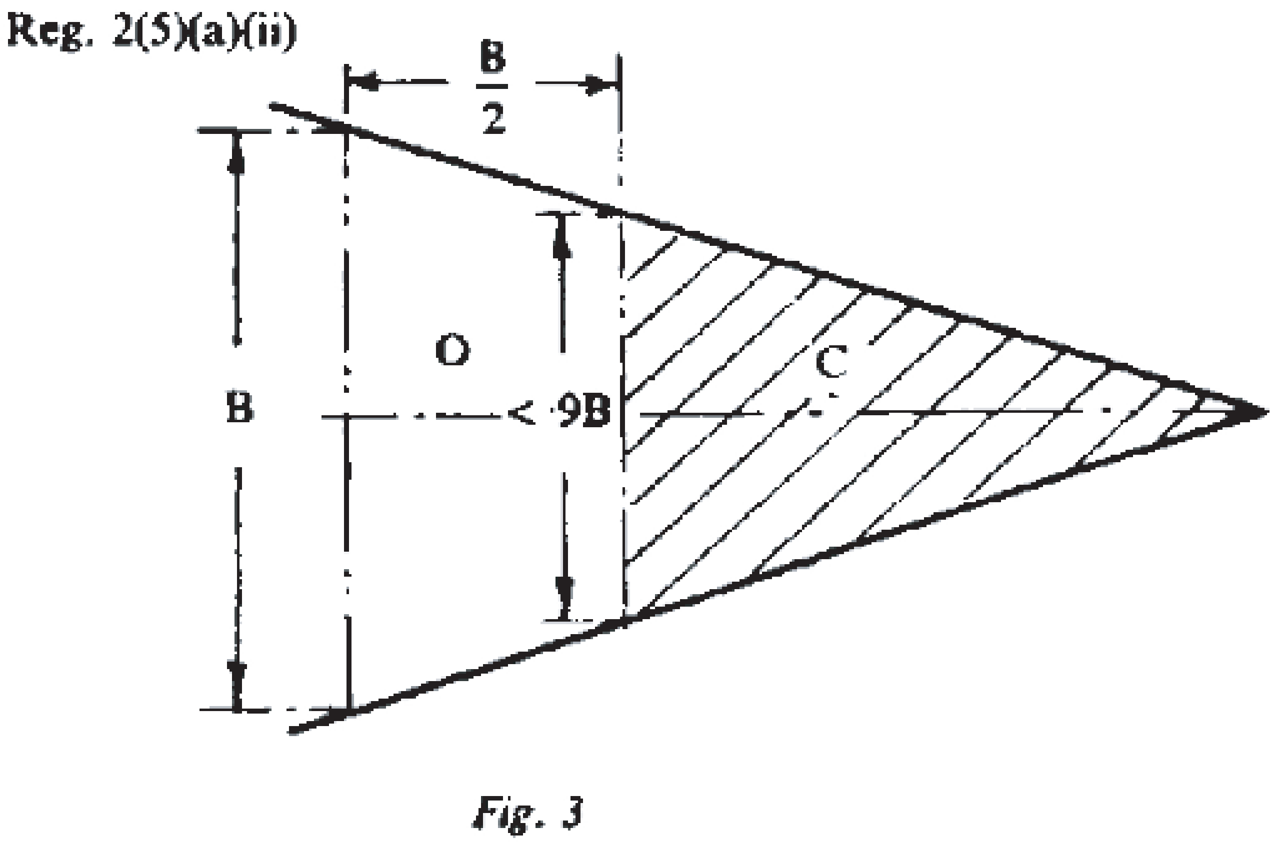


FIGURE 3

In the following figures:

O	=	Excluded Space
C	=	Enclosed Space
I	=	Space to be considered as an Enclosed Space

Hatched in parts to be included as enclosed spaces.

B = Breadth of the deck in way of the opening. In ships with rounded gunwales the breadth is measured as indicated in Figure 11.

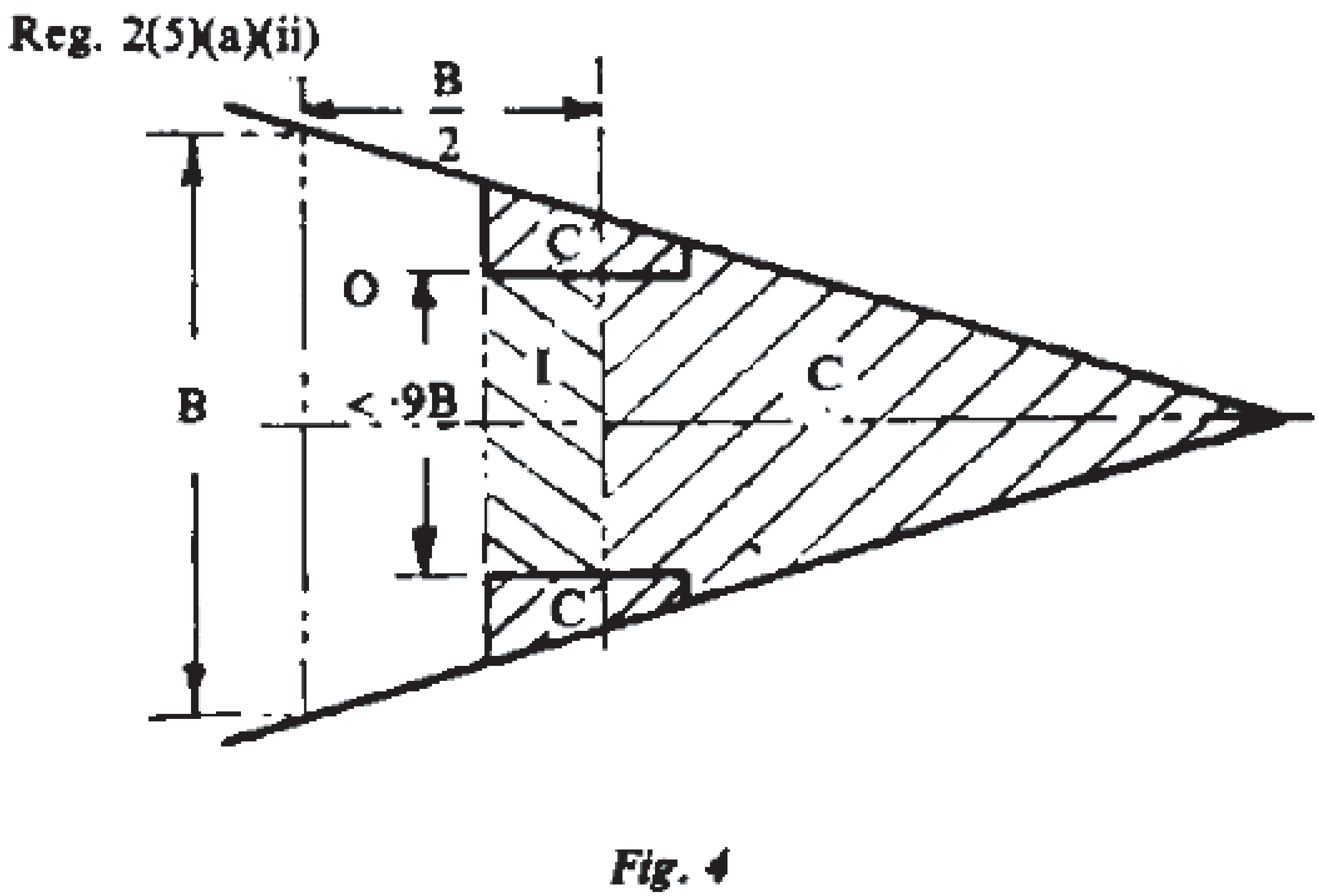


FIGURE 4

In the following figures:

O	=	Excluded Space
C	=	Enclosed Space
I	=	Space to be considered as an Enclosed Space

Hatched in parts to be included as enclosed spaces.

B	=	Breadth of the deck in way of the opening. In ships with rounded gunwales the breadth is measured as indicated in Figure 11.

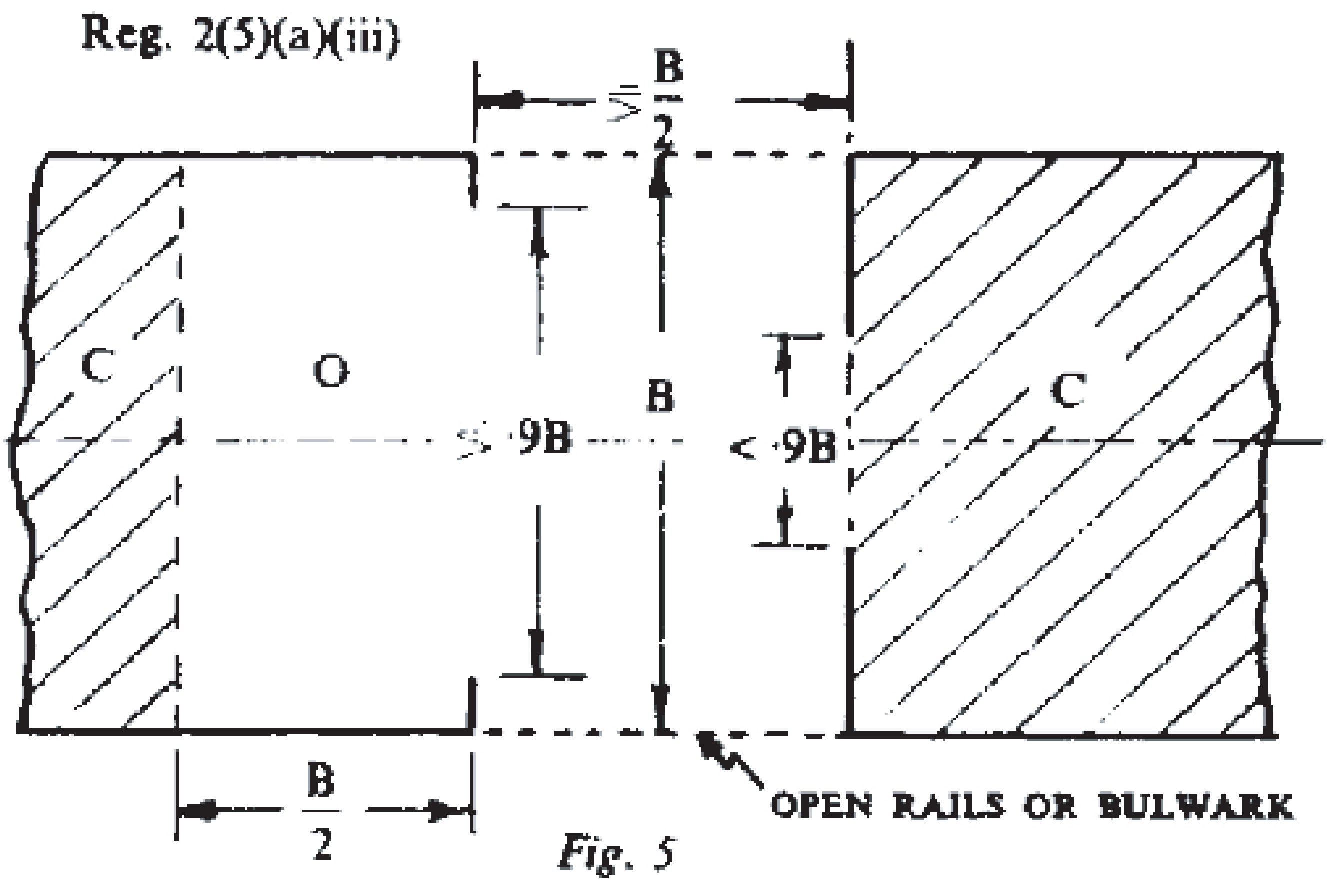


FIGURE 5

In the following figures:

O	=	Excluded Space
C	=	Enclosed Space
I	=	Space to be considered as an Enclosed Space

Hatched in parts to be included as enclosed spaces.

B = Breadth of the deck in way of the opening. In ships with rounded gunwales the breadth is measured as indicated in Figure 11.

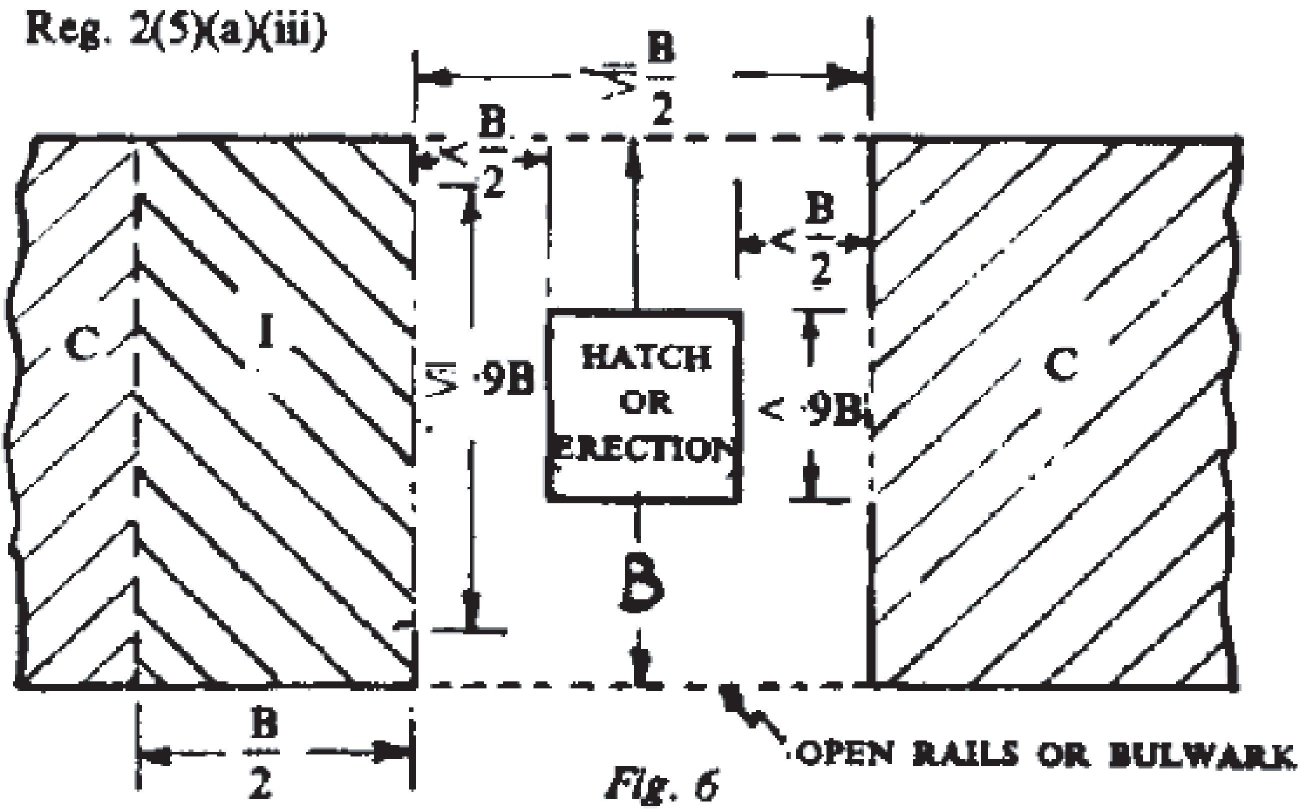


FIGURE 6

In the following figures:

O	=	Excluded Space
C	=	Enclosed Space
I	=	Space to be considered as an Enclosed Space

Hatched in parts to be included as enclosed spaces.

B = Breadth of the deck in way of the opening. In ships with rounded gunwales the breadth is measured as indicated in Figure 11.

Reg. 2(5)(b)

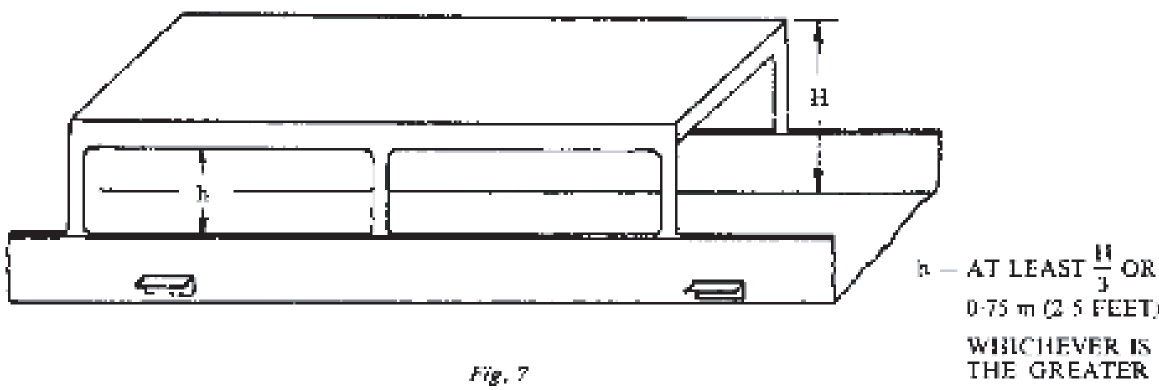


Fig. 7

In the following figures:

O	=	Excluded Space
C	=	Enclosed Space
I	=	Space to be considered as an Enclosed Space

Hatched in parts to be included as enclosed spaces.

B = Breadth of the deck in way of the opening. In ships with rounded gunwales the breadth is measured as indicated in Figure 11.

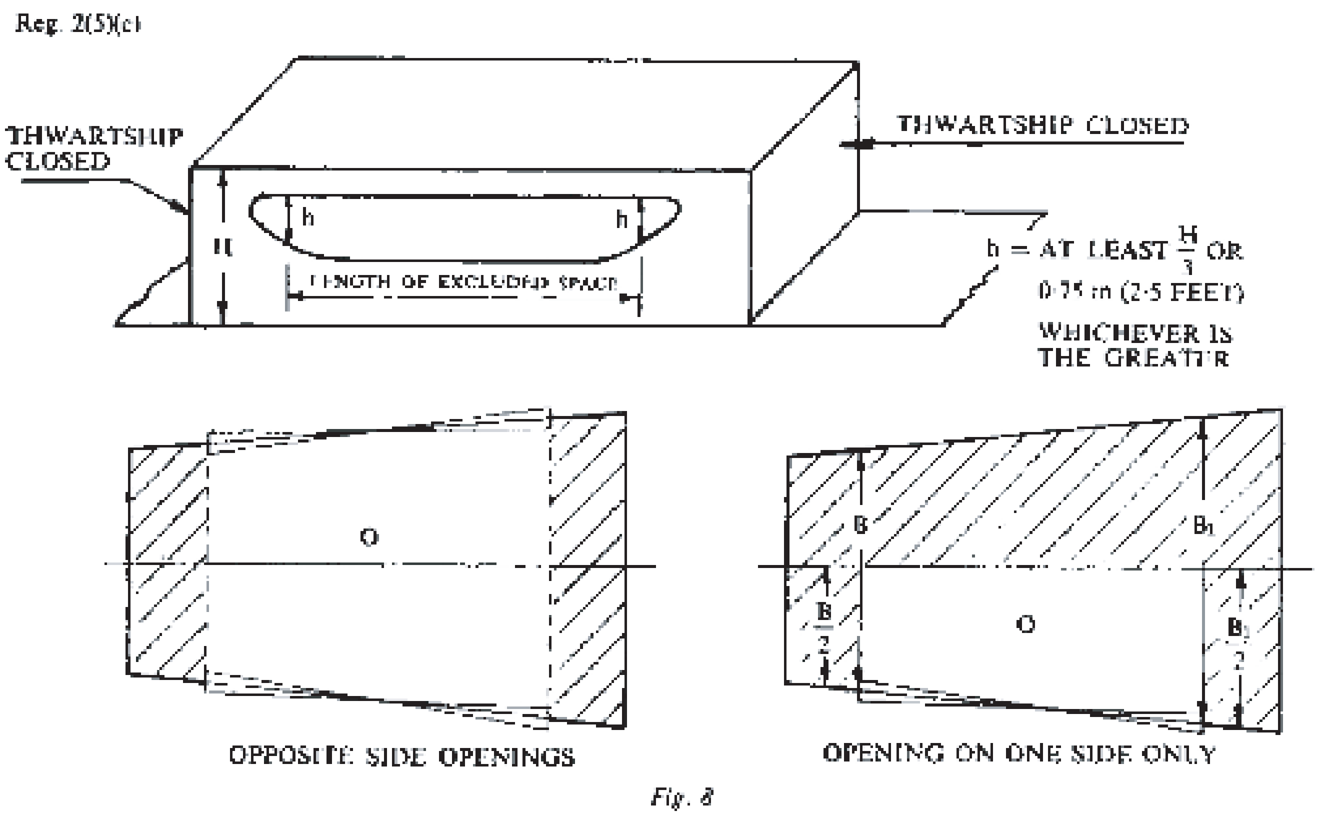


FIGURE 8

In the following figures:

O = Excluded Space
C = Enclosed Space
I = Space to be considered as an Enclosed Space

Hatched in parts to be included as enclosed spaces.

B = Breadth of the deck in way of the opening. In ships with rounded gunwales the breadth is measured as indicated in Figure 11.

Reg. 2(5)(e)

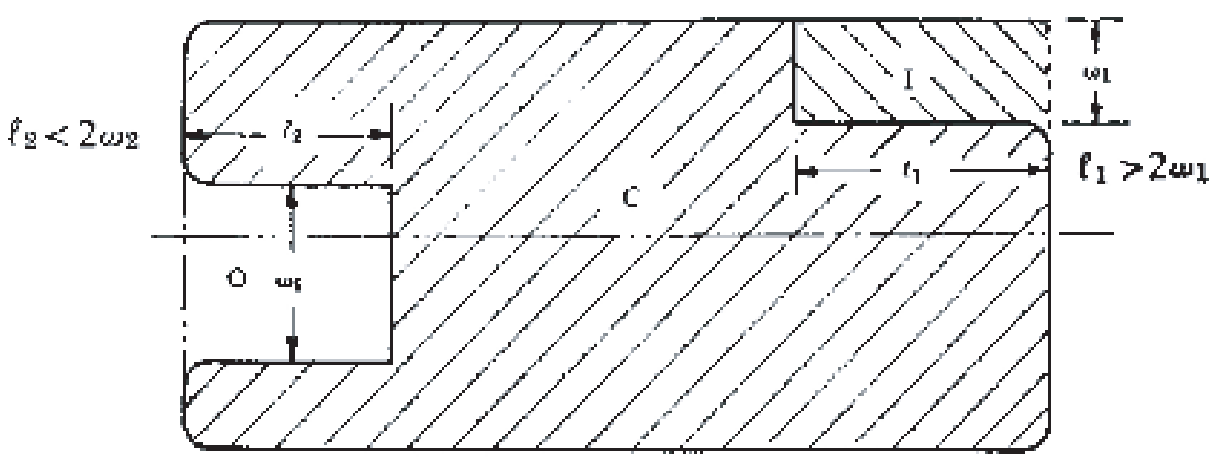


Fig. 10

FIGURE 10

In the following figures:

O	=	Excluded Space
C	=	Enclosed Space
I	=	Space to be considered as an Enclosed Space

Hatched in parts to be included as enclosed spaces.

B	=	Breadth of the deck in way of the opening. In ships with rounded gunwales the breadth is measured as indicated in Figure 11.

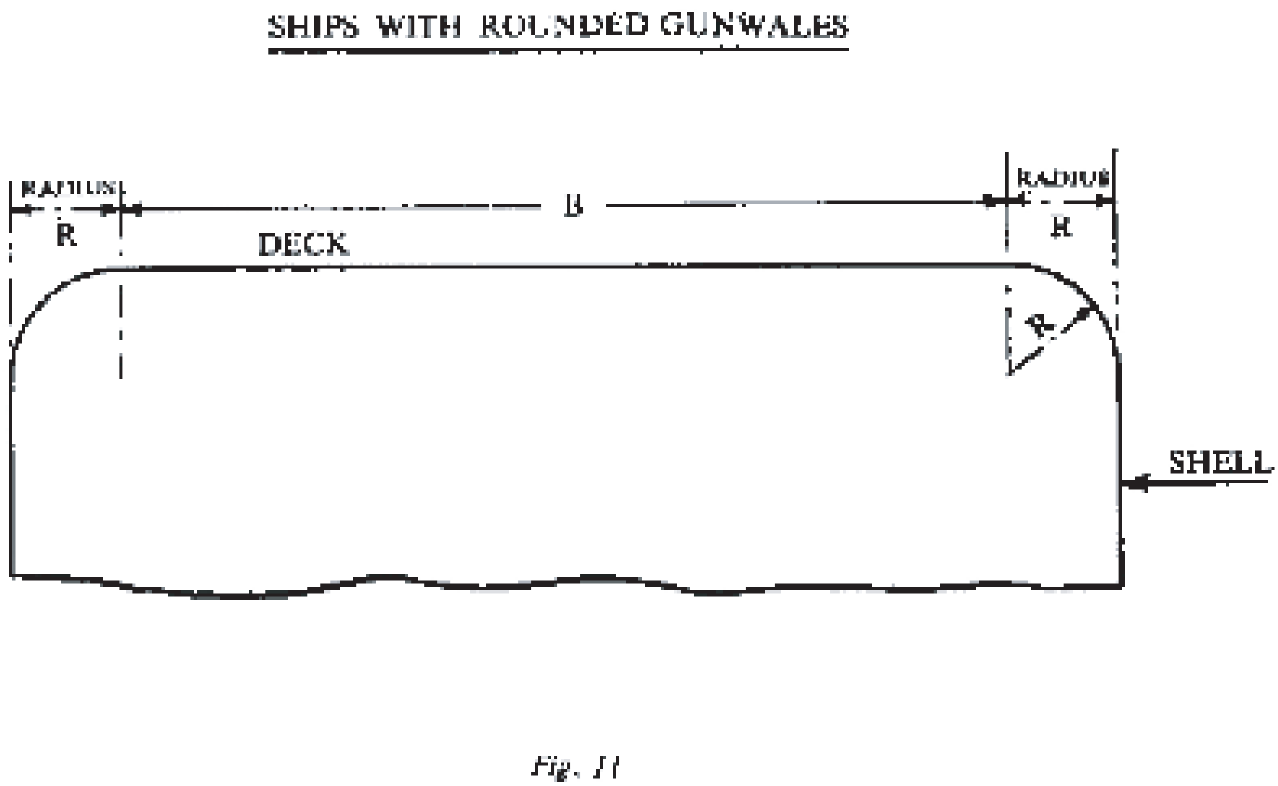


FIGURE 11

2.1.10 Appendix 2 – Coefficients K_1 and K_2 referred to in Reg. 3 and 4.1

V or V_c = Volume in cubic metres							
V or V_c	K_1 or K_2	V or V_c	K_1 or K_2	V or V_c	K_1 or K_2	V or V_c	K_1 or K_2
10	0.2200	45000	0.2931	330000	0.3104	670000	0.3165
20	0.2260	50000	0.2940	340000	0.3106	680000	0.3166
30	0.2295	55000	0.2948	350000	0.3109	690000	0.3168
40	0.2320	60000	0.2959	360000	0.3111	700000	0.3169
50	0.2340	65000	0.2963	370000	0.3114	710000	0.3170
60	0.2356	70000	0.2969	380000	0.3116	720000	0.3171
70	0.2369	75000	0.2975	390000	0.3118	730000	0.3173
80	0.2381	80000	0.2981	400000	0.3120	740000	0.3174
90	0.2391	85000	0.2986	410000	0.3123	750000	0.3175
100	0.2400	90000	0.2991	420000	0.3125	760000	0.3176
200	0.2460	95000	0.2996	430000	0.3127	770000	0.3177
300	0.2495	100000	0.3000	440000	0.3129	780000	0.3178
400	0.2520	110000	0.3008	450000	0.3131	790000	0.3180
500	0.2540	120000	0.3016	460000	0.3133	800000	0.3181
600	0.2556	130000	0.3023	470000	0.3134	810000	0.3182
700	0.2569	140000	0.3029	480000	0.3136	820000	0.3183
800	0.2581	150000	0.3035	490000	0.3138	830000	0.3184
900	0.2591	160000	0.3041	500000	0.3140	840000	0.3185
1000	0.2600	170000	0.3046	510000	0.3142	850000	0.3186
2000	0.2660	180000	0.3051	520000	0.3143	860000	0.3187
3000	0.2695	190000	0.3056	530000	0.3145	870000	0.3188
4000	0.2720	200000	0.3060	540000	0.3146	880000	0.3189
5000	0.2740	210000	0.3064	550000	0.3148	890000	0.3190
6000	0.2756	220000	0.3068	560000	0.3150	900000	0.3191
7000	0.2769	230000	0.3072	570000	0.3151	910000	0.3192
8000	0.2781	240000	0.3076	580000	0.3153	920000	0.3193
9000	0.2791	250000	0.3080	590000	0.3154	930000	0.3194
10000	0.2800	260000	0.3083	600000	0.3156	940000	0.3195
15000	0.2835	270000	0.3086	610000	0.3157	950000	0.3196
20000	0.2860	280000	0.3089	620000	0.3158	960000	0.3196
25000	0.2880	290000	0.3092	630000	0.3160	970000	0.3197
30000	0.2895	300000	0.3095	640000	0.3161	980000	0.3198
35000	0.2909	310000	0.3098	650000	0.3163	990000	0.3199
40000	0.2920	320000	0.3101	660000	0.3164	1000000	0.3200
Coefficients K_1 or K_2 at intermediate values of V or V_c shall be obtained by linear interpolation.							

2.1.11 Moulded Draught (Regulation 4.2)

2E-048 *The moulded draught (d) referred to in paragraph (1) of the Regulation 4 shall be one of the following draughts:*

a) for ships to which the International Convention on Load Lines in force applies, the draught corresponding to the Summer Load Line (other than timber load lines) assigned in accordance with that Convention;
b) for passenger ships, the draught corresponding to the deepest sub-division load line assigned in accordance with the International Convention for the Safety of Life at Sea in force or other international agreement where applicable;
c) for ships to which the International Convention on Load Lines does not apply but which have been assigned a load line in compliance with national requirements, the draught corresponding to the summer load line so assigned;
d) for ships to which no load line has been assigned but the draught of which is restricted in compliance with national requirements, the maximum permitted draught;

(e) for other ships, 75 per cent of the moulded depth amidships as defined in Regulation 2 (2).