Nordic Boat Standard

Commercial Boats less than 15 metres

1990

Denmark –

Finland –

Iceland

Norway –

Sweden –

Secretary

PREAMBLE

Nordic Boat Standard for Commercial Boats has been developed in co-operation between the Maritime Administrations in Denmark, Finland, Iceland, Norway, Sweden and Det norske Veritas, in the following called "the Authorities". The Authorities consider that this Standard contain safety /requirements which are equivalent to valid national provisions for commercial vessels which are subject to survey in the Nordic countries.

In order to achieve a rational approval procedure for new commercial boats subject to survey within the Nordic countries, the Standard is based on a Nordic reciprocal acceptance of boats with "Nordic Approval" and that such approval thereby also can be the base for a final national approval and certification for commercial vessels subject to survey in the individual countries.

In respect of areas not covered by the Standard the boats shall be surveyed in accordance with provisions issued by the Maritime Administration in the country where the boat shall be registered.

A National Maritime Administration may, based on accidents and other safety considerations, in exceptional cases, adopt additional requirements in areas covered by the Standard. When such additional requirements are applied in an individual country the Administration concerned shall communicate to the Authorities particulars thereof.

A presumption for a reciprocal acceptance of "Nordic Approvals" is that the Authorities shall have reciprocal right to insight into the documentations, surveys and tests on which approvals are based. This right should, however, normally not mean that the Authorities will request full documentation or undertake detailed surveys and tests in respect of each individual boat in areas covered by the approval.

In case of boats with "Nordic Approval" subject to requirements issued by an Administration the documentation in respect of areas not covered by the Standard shall be submitted to the Administration in accordance with the national requirements of the country concerned. In respect of areas covered by the Standard the following documentation shall be submitted

- Copy of documents for "Nordic Approval"
- General Arrangement drawing.

When the national provisions provide for Operation Certificates, such certificates shall be issued by the Administration in the country concerned. Operation Certificates are required in the Nordic countries for the following boats:

Boat type	Denmark	Finland	Iceland	Norway	Sweden
Passenger boat	Number of passenger >12	All	Loa >6 m	All	Number of passenger >12
Fishing boat	Gross tonnage >5	Loa >8.5 m	Loa >6 m	Loa >10.67 m	Gross tonnage >20
Work boat and tug	Gross >5 m	All	Loa >6 m	-	Gross >20 m

Without request for issue of "Operation Certificates" the Standard is fully or partly applied as Administration requirements for the following boat types

Iceland - All boats imported to Iceland

Norway - Fishing boats with Loa between 5.5 and 10.67 m

Translation from the original languages by Per Eriksson, former Maritime Safety Director of the National Maritime Administration of Sweden.

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NORDIC APPROVAL C1

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1 NORDIC APPROVAL

1.1 For boats being built in accordance with the Standard an approval can be issued upon request when it after control as described in this Chapter is established that the requirements of the Standard are complied with.

1.2 The approval is called "NORDIC APPROVAL", which means that the Nordic co-operating authorities are satisfied that the requirements of the Standard are complied with.

1.3 NORDIC APPROVAL can be issued by the Maritime Administrations in Denmark, Finland, Iceland, Norway, Sweden and by Det norske Veritas.

1.4 The approvals do not include periodical controls after the boat has been put in service.

1.5 Nordic approval procedures are not undertaken in respect of existing boats or boats where the control procedures described in paragraphs 3 and 5 of this chapter are not complied with during the building of the boat.

1.6 For boats which have been put in service and which are provided with a Nordic Approval, the approval will cease to be valid when damages, modifications or alterations have the effect that these Standards no longer are complied with.

2 CONTENT OF THE STANDARD

2.1 The Nordic Boat Standard for Commercial Boats contains joint Nordic Standards for commercial boats with a length less than 15 metres.

2.2 The Standard contains primarily direct requirements related to safety but also requirements related to quality, lifetime, fitness for user, etc when such items are of major importance for safety.

2.3 The same importance is, however, not attached to requirement related to quality, lifetime and fitness for the user when these items are not normally of importance for safety.

2.4 Boats built under other production conditions, using other materials, using other methods, with other design or with other installations than those provided for in the Standard may be approved on condition that the alternative arrangements are at least as effective as those required by the Standard.

2.5 Additional requirements may be applied when found necessary to achieve that the purpose of the Standard is complied with.

2.6 The Standard does not contain requirements in respect of:

- portable safety equipment;
- portable navigational equipment;
- communication equipment;
- portable fire extinguishers;
- electrical installations above 50 V;
- special restrictions concerning operation which have to be decided nationally;
- tankers and other types of ship for carriage of dangerous goods.

2.7 For requirements which are mandatory the expression "shall" or "must not" are used. When the expressions "shall normally" or "shall normally not" are used the intention of the requirements of the Standard shall be complied with.

2.8 The Standard is based on the following conditions for use of boats:

- that the boat is not loaded with a weight greater than that for which it is approved;
- that the boat is handled in a seamanlike manner in particular with regard to weather and sea conditions;
- that the use of propulsion power is adapted to the conditions;
- that open boats are used in waters where it is possible to search an emergency port before the weather becomes too bad;
- that operational restrictions are applied so as to avoid ice accretion;
- that operation in ice waters only takes place when the requirements of C33 are complied with, and in that case only in waters with thin ice, or with

moderate concentration of drifting ice.

3 APPLICATION FOR NORDIC APPROVAL

3.1 Application for Nordic Approval shall be made by the manufacturer of the boat or by his agent. It shall be in writing.

3.2 The one who applies for Nordic Approval undertakes to make possible the control and to submit the information required by the Standard.

4 DOCUMENTATION

4.1 The documentation which shall be available before approval shall be such that it constitutes basis for a total control of that all requirements of the Standards related to construction, scantlings, arrangement, stability and loading, etc are complied with. The documentation shall be made available as a collective documentation.

4.2 With the exemptions referred to in paragraph 4.3, the manufacturer shall for each boat submit the following drawings and specifications in three copies:

(a) general arrangement drawing;
(b) information on the building workshop;
(c) information on which building and dimension requirements are used (cf. C18 - C20 or C21 - C29);
(d) drawing of the hull arrangement indicating material used, scantlings and stiffening system;
(e) lines drawing and body plan;
(f) hydrostatic data for stability;
(g) loading conditions with calculations for loading capacity, trim and maximum draught;
(h) specification or drawings of machinery and tank installation, bilge pumping arrangement, rudder and steering gear, drainage of decks or soles (floorings), closing arrangements for external doors, hatchways, windows, emergency escapes, wheelhouse arrangement, ventilation and electrical installations;
(i) documentation for lifting gears referred to in C15.

4.3 For boats which are built in series with identical main dimension, construction and hull form it will normally be sufficient that documentation and information in respect of paragraphs (b), (c), (d), (e) and (f) are submitted only for the first boat in the series.

5 SURVEYS AND TESTING

5.1 For boats which are built and given scantlings in accordance with C18 to C20 it shall be arranged for a so rational survey that it normally will be sufficient with a final survey which is mandatory for each boat. Where because of insulation and lack of accessibility, etc it is not possible to carry out a complete examination during the final survey the producer shall apply for additional examination during the building period.

5.2 For boats which are given scantlings in accordance with C21 to C25 or which are built of other material or combination of materials other than those referred to in the Standard, it will – in addition to the final survey – normally be required a more extensive examination, material testing, control of the workmanship and other proceedings during the building which will ensure that the requirements of the Standards in C26 to C29 are complied with.

5.3 Generally the final survey and testing shall be so comprehensive that it together with the documentation satisfies that the requirements and the intentions of the Standard, as appropriate, are complied with.

5.4 A trial trip shall be made when the following shall be controlled:

- steering properties to both sides at low speed and at normal speed;
- going astern;
- steering and course stability at low speed;
- stopping properties;

5.5 The result of survey and tests in accordance with 5.3 and 5.4 shall be recorded in a final report which shall be prepared for each individual boat.

6 APPROVAL DOCUMENTS AND IDENTIFICATION MARKING

6.1 The Authority which has given a "Nordic Approval" in accordance with these Standards shall issue a document which certifies that for each individual boat.

6.2 Each individual boat shall be marked for identification by the manufacturer. The marking shall be permanent and contain the name of the manufacturer or builder and the production number or build number of the boat.

6.3 The form for the document referred to in 6.1 is given below.

NORDIC APPROVAL

I, the undersigned certify that this boat with:

Production number/build number.....
Producer/builder.....
.....
complies with the requirements of the Nordic Boat Standard for commercial boats and is given a Nordic Approval as
.....

The hull is built of .....
.....
and is given dimensions in accordance with C .....

Information on the boat

Description/type.....
Loa..... m B ..... m D..... m
Total loading capacity ..... kp2)
Maximum deck load..... kp2)
Maximum number of passengers .....
Freeboard amidships .....mm3)

Place..... Surveyor
Date..... ....

1) The approval does not cover portable safety equipment, communication equipment, and portable navigational equipment, electrical installations with a voltage higher than 50 and operational restrictions in accordance with national requirements, etc. The approval will be invalid in case of damages, modifications or alterations which lead to that the requirements in the Nordic Boat Standard no longer are complied with. In such cases no new Nordic Approval will be given.

2) Load includes weight of persons, provision, equipment, tank content, portable safety equipment, etc.

3) The boat must not be loaded in such a way that, because of trim, healing, the speed of the boat at sea, etc in any condition a permanent water accumulation on deck/sole (flooring) takes place.

DEFINITIONS AND SYMBOLS C2

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1 DEFINITIONS OF BOATS

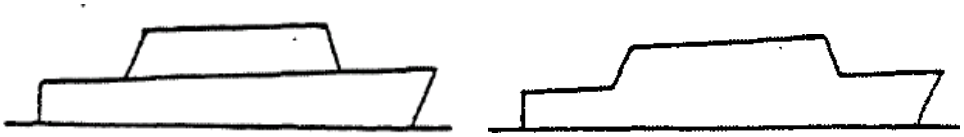
1.1 "Boat" is any craft which is used as a transport means by sea. For the purpose of the Standard the definition of a boat covers also craft which nationally are defined as a ship, vessel, etc.

1.2 "Boat types"

Fishing boat	-	Boat used for commercial fishing.
Passenger boat	-	Boat used for conveying passengers.
Tug	-	Boat used for towing, see also C32.
Work boat	-	Boat for other professional duties.
Commercial boat	-	Joint term for all commercial boats.

1.3 Closed boat

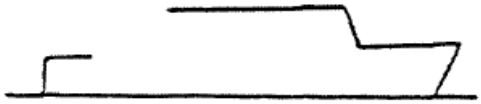
A boat which is intended for use in unsheltered waters and which can be decked or covered. "Covered boat" means a boat where the superstructure is weathertight closed in accordance with the Standard and given strength for shipping seawater.



Decked boat Covered boat

1.4 Open boat

A boat which is intended for use in sheltered waters. It can be partly covered or open. Partly covered boat means also a boat which is totally covered but where the superstructure is not weathertight.



Partly covered boat

Open boat

2 MAIN DIMENSIONS

2.1 As a principle for measuring the main dimensions all rigid permanent parts of the hull construction including fender lists shall be included. On the other hand, parts which can be disassembled, e.g. hung-on rudders, loose fenders, details which can be dismantled or exchanged, cleats, rails, keels, etc shall not be included.

Loa Length overall in metres including fender lists and rigid permanent parts of the hull construction excluding any hung-on rudder.

Bmax Breadth overall in metres including fender lists.

B Greatest breadth of the hull measured outside the laminate. Fender lists, overhanging covering board, chain plates, etc are not included in the breadth.

D Depth in metres amidships measured from top edge of gunwale or deckline to lower edge of the hull on or at the side of a pronounced keel, at Loa/2.

d Greatest draught in metres including keel.

F Freeboard amidships.

3 MEASURING OF FREEBOARD

3.1 For closed boats the freeboard is measured to the upper side of the deck at side excluding any bulwark. Except in case of passenger boats and tugs, the permitted freeboard shall be marked amidships at both sides of the boat with a contrast-coloured load line mark which shall have a length of about 250 mm and a width of 20 mm.

3.2 For open boats the freeboard is measured to the point where water can penetrate into the boat. The freeboard shall, however, not be limited by openings with a diameter of less than 20 mm where these are located at least 0.5 F above the deepest waterline or provided with a non-return valve. Load line marks are not required for

open boats.

3.3 The permitted freeboard amidships shall be recorded in the approval document.

4 LOADING CAPACITY

4.1 The maximum load of a boat (P) includes the weight the boat can carry in addition to its lightweight having regard to its minimum freeboard, strength and stability according to the Standard. The maximum load includes the following weights:

- the weight of the maximum number of persons permitted at 75 kg each;
- the weight of personal belongings which as an average can be taken as 30 kg per person;
- the weight of the maximum content of the tanks;
- the weight of tools, provision, portable safety equipment and any other portable equipment and fittings; and
- the payload.

4.2 For closed boats the maximum load shall be established hydrostatically taking into account the trim with cargo in the holds and deckload which is considered evenly distributed over those areas/ decks where it is possible to place cargo.

4.3 For open boats the maximum load shall be established in connection with control and, when carried out, calculations of the stability, trim and freeboard in accordance with C3. The trim with cargo evenly distributed over the areas in the boat where cargo can be placed shall be taken into account.

4.4 The maximum load of the boat and the deckload shall be recorded in the approval document.

5 LIGHTWEIGHT AND DISPLACEMENT

5.1 The lightweight of the boat (G) in kg shall include:

- the weight of the ready-made boat with accommodation and equipment which are permanent parts of the boat;
- the weight of machinery, winches and other permanent systems including the weight of hydraulic and lubricating oil, cooling water and other system liquids;
- anchors and mooring equipment.

5.2 The lightweight of the boat is established through hydrostatics or weighing.

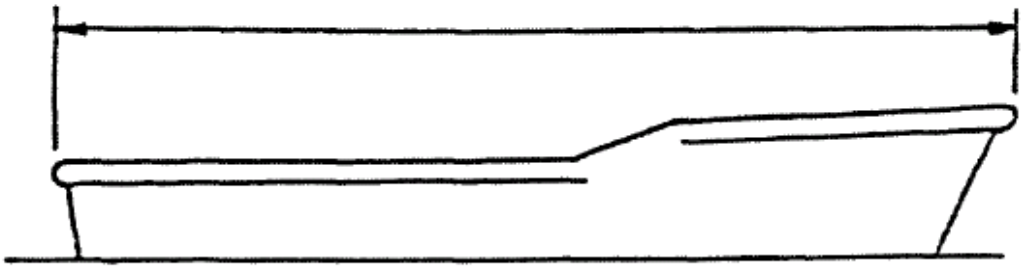
5.3 The displacement fully loaded is:

$\Delta = P + G$

6 SKETCHES SHOWING HOW TO MEASURE THE MAIN DIMENSIONS AND FREEBOARD

6.1 The measuring of length overall is shown in the sketches below.

Loa



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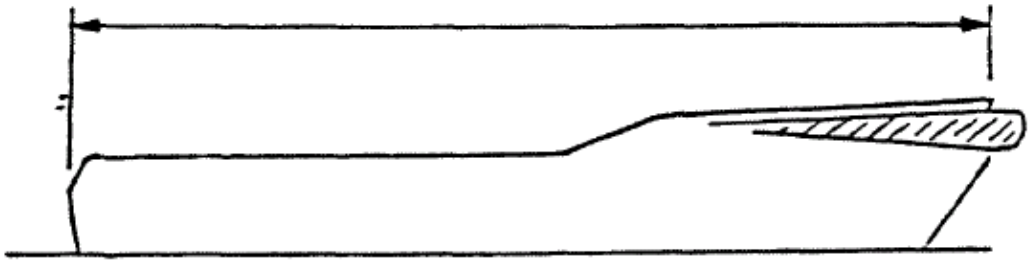

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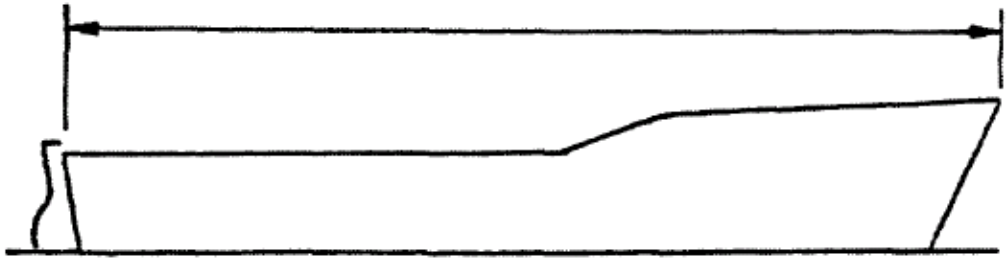

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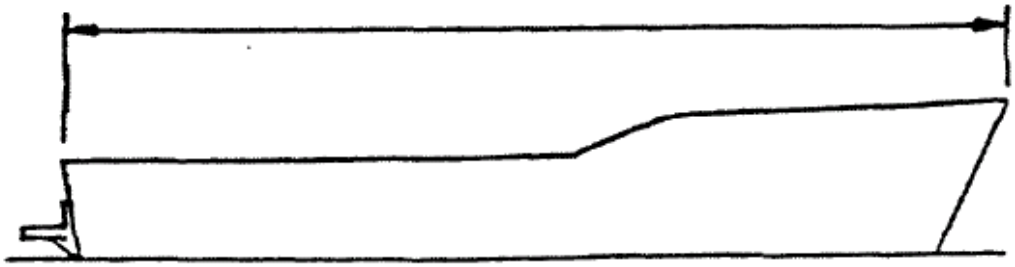

6.2 The measuring of breadths is shown in the sketches below.

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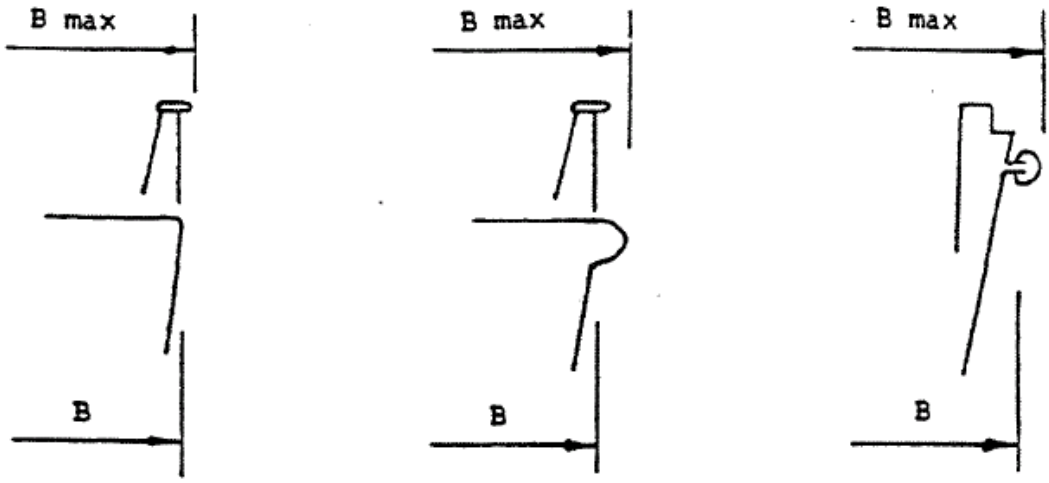
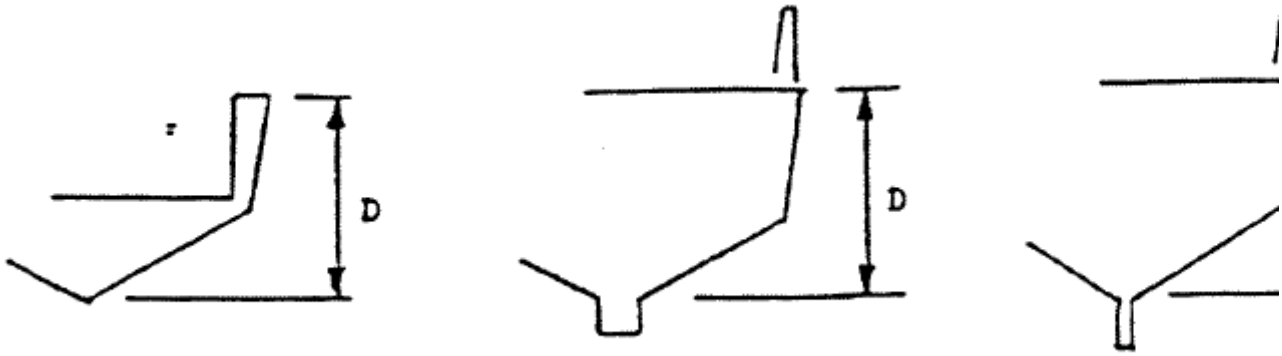
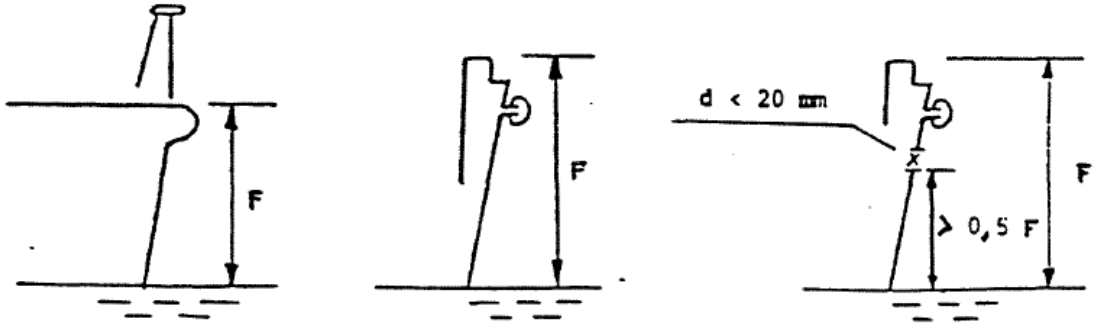


6.3 The measuring of the depth (D) is shown in the sketches below.

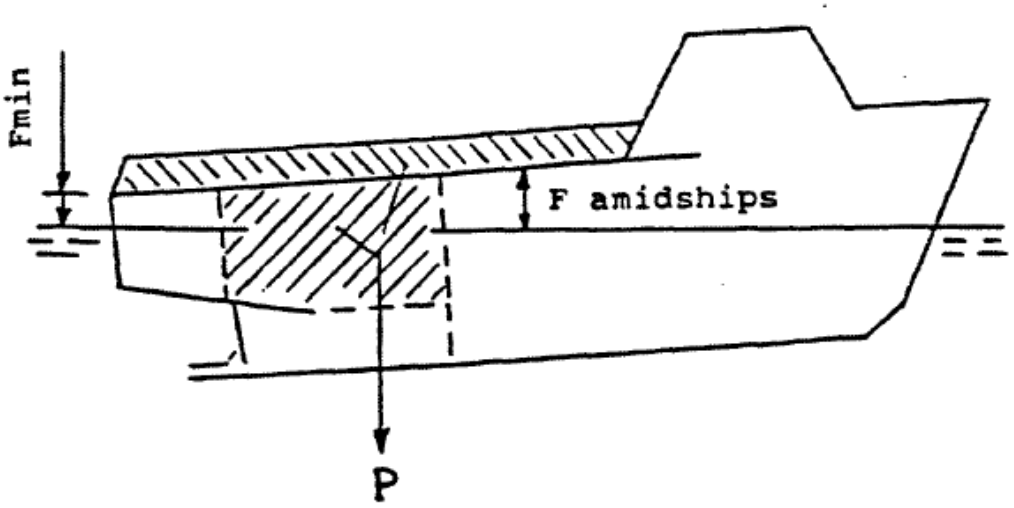


6.4 The measuring of the freeboard is shown in the sketches below.

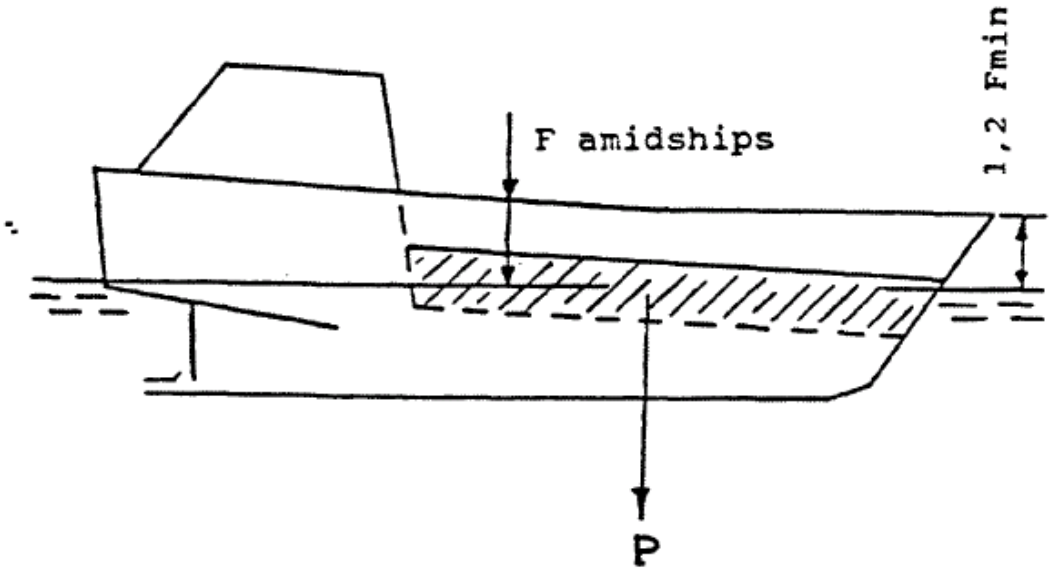


Closed boat Open boat Open boat

6.5 Example of influence of the location of the cargo and the trim on the calculation of the freeboard amidships compared to the minimum freeboard in accordance with C3.



closed boat



open boat

7. SYMBOLS AND UNITS

7.1 Symbols

Symbol	Unit	Equivalence
A	m2	area
A	A	ampere
a	cm2	area
B	m	breadth
b	cm	- " -
C	m3 /	volume
c	c	centi
D	m	depth
d	m	draught
d	mm	diameter
E	N/mm2	modulus of elasticity
F	m	freeboard
G	kg	lightweight displacement
H	m	height
h	m	- " -
I	cm 4	moment of inertia
J	J, Nm	joule
K	N, kp	force
k	k	correction factor
k	k	Kilo
L	m	length
Loa	m	length overall
l	mm	length of span
M	Nm	moment
m	m	meter
m	m	milli
N	N	Newton
n	number	number, number of persons
o	degrees	degrees Celsius
P	Kp, N	force, weight, load
p	N/mm2	pressure
p	kW	motor effect (engine power)
Q	m3/min	capacity
R	cm	radius
r	revolution/sec	revolution
S	cm, mm	moment arm
s	mm	frame/stiffener spacing
t	mm	thickness
V	knots	speed
v	kg/m3	density
W, Z	cm3	section modulus
W	W	Watt
	degree	angle degree
	N/mm2	mechanical stress
	kg	displacement

7.2 Units

BASIC SI UNITS:

Quantity		Name
Length	m	metre
	cm	centimetre
	mm	millimetre
Mass	kg	kilogram
Time	s	second
Electrical Current	A	ampere

DERIVED SI UNITS:

Quantity		Name/definition
Frequency	Hz	hertz = /s
Force	N	newton = kg * m/s2
	kN	kilonewton
Pressure	kN/m2	= kPa, kilopascal
	bar	= 105 Pa
Bending moment		
	N * m	newton-metres
Torsional moment		
	kN * m	kilonewton-metres
Work, energy	J	joule = Nm
Heat	kJ	kilojoule
Power	kW	kilowatt
Temperature	° C	degrees Celsius

SI/TS CONVERTION RELATION

Si-unit	TS-conversion relation	Other
1 N	0.1020 kp	
1 kN/m2 1kPa, 0.01 bar	0.0102 kp/cm2	0.1 m H20
1 N/mm2, 1 MPa, 10 bar	10.20 kp/cm2	100 m H20
1 N.m, 1 J	0.1020 kp.m	
1 kJ	0.2388 kcal	
l kW	1.36 Hp	
l w	0.860 kcal/h	

FREEBOARD AND STABILITY C3

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1 FREEBOARD FOR CLOSED BOATS

1.1 The freeboard amidships is decided having regard to stability, trim and hull strength, etc, but shall not in any case and condition be less than 200 mm measured from the upper side of the deck at side to the waterline.

1.2 The forecastle deck or the freeboard deck forward shall in any load condition have a height above the waterline of at least 17 * Loa + 700 mm. The height of forecastle/freeboard deck forward may be reduced to the minimum freeboard gradually over a length of 0.3 Loa from the stem.

2 FREEBOARD FOR OPEN BOATS

2.1 The freeboard is decided having regard to stability, trim and hull strength, etc, but shall amidships not be less than the greater of:

(a) $F = 3.2 * \Delta (1000 * Loa * B)$ m
(b) $F = 0.5$ m

2.2 Forward the freeboard shall not be less than 1.2 F. Aft the freeboard shall not be less than 0.8 F.

3 STABILITY FOR CLOSED BOATS

3.1 Inclination tests shall be carried out with each individual boat. The tests shall be carried out with a ready-made boat with all permanent equipment installed. Particulars of the inclination tests shall be recorded in a report form and lightweight and location of centre of gravity shall be calculated.

3.2 When boats are built in series with identical main dimensions, construction, hull form, weight and location of permanent equipment, the requirement may be dispensed with provided that it by calculation or weighing can be established that the lightweight of the boat is the same as that calculated at the inclination

test of a previous boat. An inclination test shall always be carried out with the two first boats in a series.

3.3 The righting arm (GZ) with free trim shall be calculated for the following conditions:

(a) Lightweight condition with the minimum amount of fuel, water, equipment and persons on board. The total weights other than the lightweight (G) shall not be greater than 10 per cent of the maximum load of the boat (P);

(b) Loaded condition with maximum cargo in the hold, fuel tanks and other tanks totally full and maximum deck load. The total weight of cargo, equipment, persons, fuel and water must not be less than the total loading capacity (P);

(c) Arrival condition with 10 per cent content in fuel and other tanks, empty holds and maximum deck load;

(d) Other conditions which will give a less favourable result than (a), (b) and (c).

The centre of gravity in each of the conditions referred to in (a) to (d) shall be calculated as follows:

- For cargo holds including volumes in hatchway coamings, fuel tanks and other tanks the volumetric centre of gravity is calculated;
- For deckload except passengers and heavy items with a relatively high centre of gravity, the centre of gravity is calculated with an evenly distributed deckload with a density of 1.0 tons/m^3, however, not less than 0.10 m above deck;
- Passengers are calculated as evenly distributed deckload with the centre of gravity 1.0 m above deck/flooring;
- For boats intended for the carriage of deckload in the form of heavy items such as vehicles with a relatively high centre of gravity the most relevant centre of gravity shall be assumed having regard to type of cargo in question.

3.4 Closed boats shall in all conditions have:

- a righting arm at 30 degrees heeling of at least GZ30 = 0.20 m;
- the greatest value of the GZ curve shall be at an angle of heel greater than 25 degrees;
- the GZ curve shall be positive up to heeling angle of 40 degrees; and
- the GZ curve shall be terminated at the heeling angle where a filling opening will come below water.

3.5 Openings which are not provided with weathertight closing arrangements shall be considered as filling openings where water will flood the boat when such an opening is submerged.

3.6 For the calculation of GZ curves, small penetration openings for wires, chains, etc in deckhouses or superstructures may be considered as tight. Small openings with a diameter of less than 20 mm which are located more than 380 mm above the freeboard deck need not be considered as filling openings when they will come into the water at a heeling angle of more than 30 degrees.

3.7 For boats with lifting gears, such gear shall not in the most unfavourable condition give a heeling of more than 10 degrees in the lightweight condition.

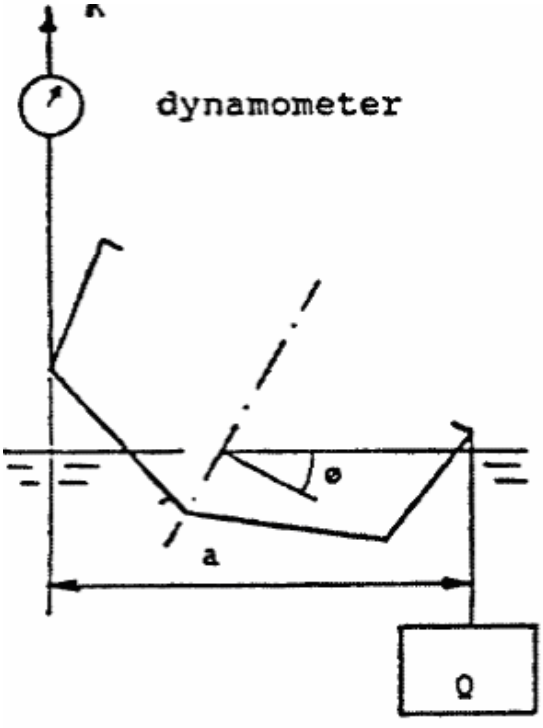
3.8 Special additional requirements apply to the stability for fishing boats, passenger boats and tugs, see C30 to C32.

4. STABILITY FOR OPEN BOATS

4.1 Normally an inclination test shall be carried out to establish the metacentric height (GM) for the boat in lightweight condition. The metacentric height shall normally not be less than, GM = 0.35 m.

4.2 The weight displacement of the boat shall be established through weighing or by a hydrostatic calculation.

4.3 A metacentric height less than that required in 4.1 may be accepted only if a calculation shows that the GZ curve for the boat in the lightweight condition satisfies the requirements for closed boats up to a heeling angle of 30 degrees. As an alternative to calculations the GZ30 = 0.20 m in the lightweight condition may be established through the following method where G215 and GZ25 shall indicate a natural form of the GZ curve.



Requirements:

GZ30 = 0.20 m

$Q = \Delta * 0.20 / a$

where
a is measured with Ø = 30°
Q is measured with the weight submerged

15°	25°	30°
K = kp	K = kp	K = kp

Requirement for K at
Ø = 30°: K > 0

In order to avoid lift of the boat during the measuring, the dynamometer and the weight shall be placed longitudinally so that the trim of the boat will not change during the test.

4.4 Where the height of the sole (flooring) and other areas for cargo is such that the cargo mainly will be located above the waterline in fully loaded condition, a stability test with a load (weights) which is half the loading capacity of the boat (0.5 P) placed on one side of the centreline at 0.25 B at the cargo area shall be carried out. This must not result in:

- a heeling angle greater than 15 degrees;
- a freeboard of less than 200 mm at the place where water first will flood the boat.

Such a stability test is not required for passenger boats.

5 BALLAST

5.1 Ballast shall be secured in the boat in such a way that it will not move even if the boat is inclined to 90 degrees.

DOORS, HATCHWAYS AND WINDOWS C4

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1 WEATHERTIGHT HATCHWAYS ON CLOSED BOATS

1.1 Coamings of hatchways on exposed freeboard decks shall have a height above the deck of at least 380 mm. Similar hatchways on first deck above freeboard deck shall have a coaming height of at least 300 mm.

1.2 Coaming heights as for hatchways in paragraph 1.1 may never the less be reduced to 230 mm and 150 mm as the case may be, on condition that minimum freeboards are increased accordingly.

1.3 Hatchways which may be opened at sea shall be hinged or attached with chains and be capable of being secured when open.

1.4 Coamings of small hatchways (companionway hatchways, etc) which are not normally opened when the boat is at sea may be minimum 230 mm on the free-board deck and 100 mm on the first deck above freeboard deck.

1.5 Heights of hatchway coamings may further be reduced or omitted for

- machinery space hatchways which are used only in connection with maintenance and repair of machinery and other hatchways which similarly are not necessary for the normal operation of the boat;

- small hatchways with an area of not more than 0.1 m^2.

This applies on condition that the covers have gaskets and securing means with small spacing and which cannot be opened without special measures.

1.6 In order to ensure that the hatchways are weathertight it is required that

- the hatchway covers are fitted so that they are not pressed out;
- battening down devices are fitted at distances of not more than 600 mm.

2. DOORS ON CLOSED BOATS

2.1 Openings which from an exposed freeboard deck lead to a space below deck or a superstructure which is part of the buoyancy of the boat for stability shall have doors which cannot be opened inwards. The door shall be stiffened and constructed in such a way that the whole construction is of equal strength as the bulkhead otherwise. Devices for weathertight closing of such doors shall be gaskets and at least two securing devices in addition to the hinges.

2.2 Doors shall be capable of being opened and closed from both sides of the bulkhead.

2.3 The sill height of such doors on the freeboard deck shall be at least 380 mm. Similar doors on the first deck above freeboard deck shall have a sill height of at least 300 mm.

2.4 The sill heights as for doors in paragraph 2.3 may nevertheless be reduced to 230 mm and 150 mm as the case may be, on condition that minimum freeboards are increased accordingly.

3. HATCHWAYS AND DOORS ON OPEN BOATS

3.1 Hatchways to machinery spaces and hatchways and doors to covered accommodation spaces shall be provided with closing devices.

4 WINDOWS

4.1 Windows shall be given pane thickness as indicated in the following table which applies to panes of tempered glass, carbonate glass, acrylic glass and laminated glass.

Thickness in mm required for panes with height (h) and breadth (b) in mm:

h	**200**			**300**			**400**			**500**			**600**			**700**		
col	**3**	**2**	**1**	**3**	**2**	**1**	**3**	**2**	**1**	**3**	**2**	**1**	**3**	**2**	**1**	**3**	**2**	**1**
b																		
200	4	5	5	4	5	5	4	5	5	4	5	5	4	5	5	4	5	5
300	4	5	5	4	5	5	4	5	6	4	5	6	4	5	6	4	5	6
400	4	5	5	4	5	6	4	5	6	4	6	6	4	6	8	5	6	8
500	4	5	5	4	5	6	4	6	6	4	6	8	5	6	10	5	8	10
600	4	5	5	4	5	6	4	6	8	5	6	10	5	8	10	5	8	10
700	4	5	6	4	6	8	5	6	8	5	8	10	5	8	10	5	8	10
800	4	5	-	4	6	-	5	6	-	5	8	-	5	8	-	6	10	-
900	4	5	-	4	6	-	5	6	-	5	8	-	6	10	-	6	10	-
1000	4	5	-	5	6	-	5	8	-	5	8	-	6	10	-	6	10	-
1100	4	5	-	5	6	-	5	8	-	6	10	-	6	10	-	6	12	-
1200	4	5	-	5	6	-	5	8	-	6	10	-	6	10	-	6	12	-
1300	4	5	-	5	6	-	6	8	-	6	10	-	6	12	-	6	12	-
1400	4	5	-	5	6	-	6	8	-	6	10	-	6	12	-	6	12	-

4.2 The application of column 1, 2 or 3 depends on window location and closed/open boat as follows.

Column 1

(a) Windows from 0.5 m to a height of

$$3.2 * \Delta /(1000 * Loa * B)$$

above the load waterline. In displacement boats the windows/port holes in this location shall be provided with hinged deadlights.

b) Horizontal hatchways/windows which can be exposed to local loads in deck- or super structure tops on closed boats and which are located higher than

$$3.2 * \Delta /(1000 * Loa * B)$$

above the load waterline. Such hatchways/ windows with lower location shall be considered separately.

Column 2

(a) Windows in a superstructure, wheelhouse, etc on closed boats where the window location is higher than

$3.2 * \Delta /(1000 * Loa * B)$

Column 3

(a) Windows in superstructures on open boats (partly covered boats) where the window location above the load waterline is higher than F for the boat.

(b) Windows in the second superstructure on closed boats, except in the front bulkhead of the wheelhouse, in which case column 2 shall be applied.

4.3 Windows in the hull side shall never be placed lower than 500 mm above the load waterline and shall be placed at least 10 mm inside the hull side. A window frame which is arranged outside the glass must not project more than 5 mm outside the hull side.

4.4 Coloured glass or window of a material which is susceptible to scratching must not be used in the front of and at the sides of the operator's place.

4.5 Windows shall be satisfactorily fastened taking into account particularly the risk for being pressed in. When the risk for that the glass is pressed out of the frame because of the size of the window, the bending properties of the glass, the location of the window near the waterline, etc, special measures shall be taken to prevent the pressing in of the glass by increasing the contact surface between glass and frame or by fixing the glass to the frame.

4.6 Windows in spaces which shall be included in the buoyancy for stability shall be fastened in a fixed frame which is mechanically attached.

4.7 Where rubber profiles are used the glass shall be mounted in a way that is safe in respect of pressing in and the thickness of the glass in column 1 and 2 shall be increased with 20 percent. If glass other than tempered glass is used the thickness shall be adapted to the stiffness and strength of the material.

4.8 If windows with greater length or breadth than those in the table are used, equivalent strength and stiffness shall be demonstrated.

5 PORTS IN THE HULL

5.1 Ports in the hull constituting the freeboard on open boats shall be so constructed that they are watertight. Ports and coamings shall have at least the same strength as the hull otherwise. Ports at sides, stem and stern on closed boats must not be fitted below the freeboard deck.

5.2 The lowest point of a port opening on open boats must not be lower than 200 mm above the load waterline.

5.3 For ports with the lowest point of the opening lower than 500 mm above the load waterline solid gaskets and battening down devices with a distance of not more than 300 mm are required. Ports located higher than 500 mm above the load water line shall be so arranged that significant amounts of water will not penetrate into the boat and shall be fitted with satisfactory closing arrangement.

5.4 Ports which can be folded down shall be fitted with stopping arrangements in the lowest position.

FREEING PORTS AND HULL PENETRATIONS C5

Table of contents

1 DRAINAGE OF DECKS ON CLOSED BOATS

1.1 Freeing ports shall be distributed along the deck in such a way that the locations are concentrated to the areas where the collection of water on deck will be the greatest having regard to sheer, probable trim, etc.

1.2 On boats where the bulwark, end bulkheads of closed superstructures, deckhouses, etc constitute wells, the minimum effective freeing port area at each side of the boat shall be:

$$A = 0.02 * V \quad m^2$$

where V is the volume of well in cubic metres.

1.3 The volume of the well is calculated as deck area times bulwark height minus volume of hatchways, deckhouses, etc up to the bulwark height.

1.4 Flaps or external rubber claps in freeing ports, if fitted, shall be fastened with hinges at the upper edge. Such devices shall have sufficient clearance to prevent jamming. The hinges shall be made of non-corroding material. Arrangements for locking of freeing port flaps are not permitted.

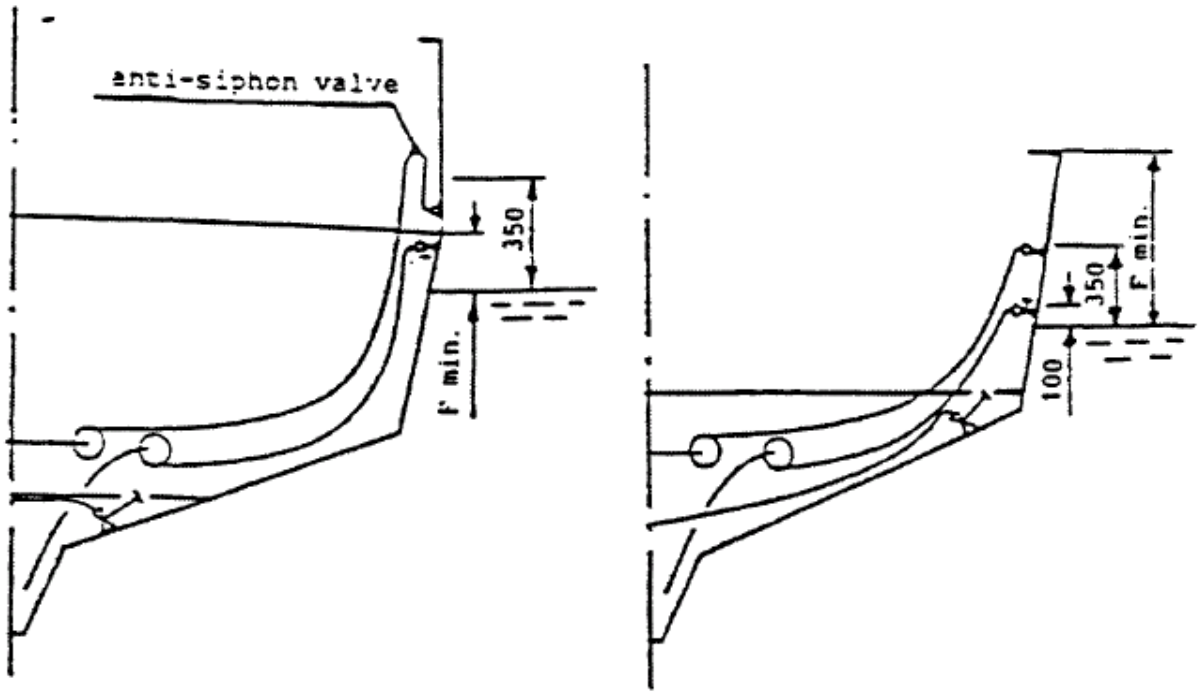
1.5 Large freeing ports shall be fitted with bars, spaced with a maximum distance of 330 mm apart, the distance below the lowest bar shall, however, not be greater than 230 mm.

2 HULL PENETRATIONS

2.1 Hull penetrations with the opening less than 100 mm above the load waterline or below the sole (flooring) on open boats shall be provided with a closing arrangement.

2.2 Valves on hull penetrations shall be suitable for use in boats and be installed in such a way that they are easily accessible under all conditions, i.e. valves must not be placed in cargo holds or below the flooring if the manoeuvring device is not extended to above the flooring. Valves with screw-on covers shall be constructed in such a way that the cover cannot loosen when the valve is being opened or closed.

2.3 Openings in the hull above the waterline at the lightweight of the boat (G) and less than 350 mm above the load waterline as well as hose systems with an inside open end shall have a non-return valve which prevents water penetration if the entire system is lower than 350 mm above the load waterline.



2.4 Pipe systems connected to a hull penetration shall be so arranged that water will not enter the boat if valves are open.

2.5 Pipe systems connected to a hull penetration located lower than 350 mm above the load water line shall have double hose clamps in both ends. The pipe system is carried above the 350 mm, double hose clamps are required only at the hull penetration.

3 VENTILATION OPENINGS

3.1 On closed boats the ventilation openings shall have a height of at least 450 mm above deck and shall be such that they because of their arrangement and location will not cause water filling of the boat in breaking seas. Height and location of vents shall be such that the ventilation openings will not come below water at a heeling of up to 30 degrees on open boats and 4 0 degrees on closed boats.

4 AIR PIPES

4.1 Air pipes shall have a height to the upper edge of the bulwark, however, at least 450 mm above the deck and shall be so located that they are protected against damages in connection with work on deck.

4.2 The air pipes shall be so arranged, e.g. with a non-return valve or a goose-neck, that a sea shipped will not penetrate into a tank, battery room, etc.

4.3 The air pipes to fuel tanks shall terminate outside the boat on open boats and above deck on covered boats.

WATERTIGHT SUBDIVISION AND BILGE PUMPING C6

Table of contents

1 WATERTIGHT SUBDIVISION

1.1 Engine compartments, cargo holds and accommodation spaces in closed boats shall from bottom to deck be subdivided by watertight bulkheads. In open boats the machinery space shall have a watertight bulkhead up to the waterline in loaded condition.

1.2 Hatchways and door openings in watertight bulk heads shall be provided with closing arrangements and have the same strength as the bulkhead where they are arranged.

1.3 Where pipes and electrical wires are carried through a watertight subdivision bulkhead, the penetration arrangements shall be made to ensure the watertight integrity of the bulkheads.

2 COLLECTION OF OIL SPILLS

2.1 The bottom space in the engine compartment shall preferably be capable of being drained with the aid of a fixed bilge pumping system to a bilge water tank. The system must not have connection to the bilge system otherwise or a connection for discharge into the sea.

2.2 The bilge water tank shall be a permanently installed tank. Alternatively several portable tanks with a capacity of not more than 25 litres each may be used. Such tanks shall be suitable for taking ashore.

2.3 A permanently installed bilge water tank shall have air pipes to the open deck. The content of the tank shall be capable of being discharged to a reception facility ashore via a connection on deck.

3. MAIN BILGE SYSTEM

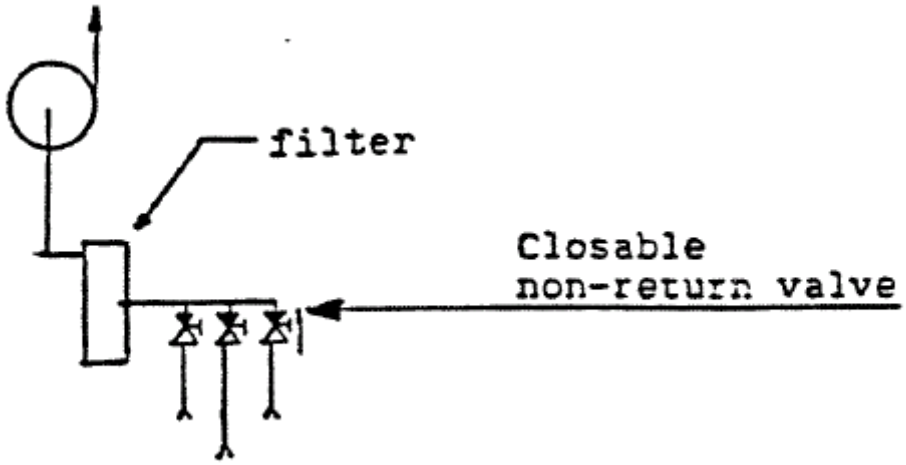
3.1 The main bilge system shall be capable of pumping from and draining of all watertight compartments. Watertight compartments of limited size may be drained to an adjacent space. The drainage hole shall in such cases be tightened with a firmly fitted plug.

3.2 A fixed motor driven or electrically driven bilge pump shall be installed which via a fixed piping system with a non-return-valve mounted to each suction pipeline is capable of draining all watertight compartments. Alternatively each compartment can be drained with a separate pump. Each pump shall be capable of being operated from the steering place.

3.3 Each pump shall have at least the following capacity:

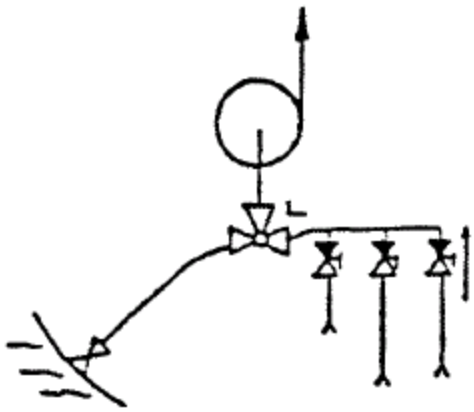
Loa	Litres per minute
5.50 - 8.00	60
8.00 - 9.99	80
10.00 - 11.99	120
12.00 -	180

3.4 The arrangement of the bilge pumping system shall be such that water cannot flow from one watertight compartment to another via the bilge pumping system.



3.5 If the bilge pumping system is arranged with electrically driven pumps, the pumps must not be connected to the starting accumulator of the motor. If the bilge pump is located in the cargo hold, it shall be easily accessible for cleaning under all conditions or alternatively a stand-by pump shall be available in the cargo hold.

3.6 The bilge pumping system shall normally not be used for any other purpose than draining. A sea chest may, however, be connected to the bilge pumping system provided that the boat is fitted with at least two power driven pumps. The pipelines shall be connected in such a way that sea water cannot flow into the boat via the bilge pumping system. A system as the one shown in the sketch below can be accepted.



3.7 The parts of the system must not be combined in such a way that galvanic corrosion can arise.

4 EMERGENCY BILGE PUMPING SYSTEM

4.1 It shall be possible to drain engine rooms by a fixed permanent manual bilge pump fitted outside the room.

4.2 The capacity of the pump shall normally not be less than that shown in the table below.

Loa	Litres per stroke cycle	
	diaphragm pump	piston pump
5.50 – 8.00	0.5	0.7
8.00 – 10.00	0.7	1.0
10.00 -	0.9	1.25

4.3 If the boat has two engines installed, or an auxiliary engine is installed, the manual pump may be substituted by a pump direct or indirectly driven by the auxiliary engine or driven by the other than the main engine mentioned in 3.2.

5 WATER LEVEL ALARM

5.1 Closed boats shall be fitted with an alarm for a high water level in the motor room.

6 DRAINAGE PIPES AND HOSES

6.1 The bilge water pumping system in the motor room shall be of non-combustible material or flexible hoses which shall be approved in accordance with section MC11.

6.2 Bilge piping systems are to be properly installed in the entire length.

RUDDER AND STEERING ARRANGEMENTS C7

Table of contents

1 INSTALLATION

1.1 The steering gear shall ensure a steady and safe manoeuvring of the boat at the maximum engine power for which the boat is certified. The steering devices and wheel, if fitted, shall comply with chapters MC12 and MC14. The steering devices shall be protected so that they do not come in contact with cargo or the like which can block or make difficult the steering.

1.2 Rudder stops are required in case of remote control of the steering.

1.3 Boats approved for outboard motors with a higher power than 15 kW shall be fitted with a permanent wheel steering.

1.4 A steering console or similar arrangement in the steering system shall be built, stiffened and secured in such a way that it can absorb the forces to which it will be exposed taking into account also the forces the operator of the boat will transfer to the wheel at heeling and other movements of the boat. At specially exposed places be bolt connections shall be made of stainless steel. All bolt connections which are part of the steering system installation in the boat shall be locked.

1.5 All penetrations in a motor well such as holes for a steering cable shall be effectively sealed by means of a sleeve or similar device.

1.6 Hydraulic hoses and pipes shall be protected from contact with hot parts and from mechanical wear and be clamped at intervals of 300 mm. The oil fill opening and air bleeders shall be easily accessible.

1.7 Emergency steering shall be possible on all rudderstocks in case of remotely controlled steering. Emergency steering below deck may be accepted provided that communication to the open deck is arranged.

Emergency steering is not required in boats with two propellers provided that it from the results of the manoeuvring tests is evident that the boat can be steered safely with the propellers.

Emergency steering is not required in boats where two independent steering systems are installed and where a hydraulic system does not contain flexible hoses.

2. FORCES ACTING UPON STEERING SYSTEMS

2.1 Unless otherwise stated, the following symbols shall be used:

- K steering force in Newton;
- P rudder force in N ; $P = 110 * A * V^2$
- A rudder area in m^2
- V the maximum speed of the boat in knots
- Sa length in mm of the steering arm
- Sb distance in mm from the centre of pressure (Tc) to the nearest rudder shaft bearing above the rudder
- Sv perpendicular distance in mm from the centre of pressure to the centre of rotation of the rudder. Plate rudders have the centre of pressure at a point situated 40 per cent aft of the leading edge of the rudder
- U maximum motor power in kW
- M moment in N mm
- d_v diameter in mm of massive rudderstock
- σ_2 yield stress in N/mm^2.

2.2 The steering force in boats with outboard motors or I/O drives is:

$K = 10 * U \quad N$

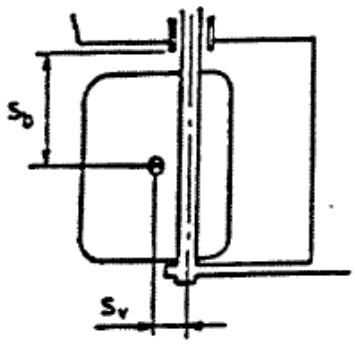
2.3 The steering force in boats with rudder is:

$K = P * Sv/Sa \quad N$

3 RUDDER STOCKS

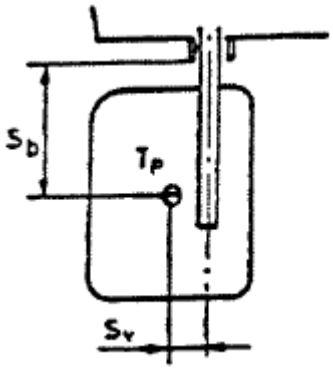
3.1 If the rudder has a lower bearing point (heel pintle) with at least the same stiffness sidewise as the rudderstock, the moment is calculated as follows:

$M = 1.15 (0.25 * P * Sb + 0.5 * P \sqrt{(Sb + 2 * Sv^2)})$



3.2 A rudder stock of a spade-rudder shall be considered to have a combined torque and bending moment of:

$$M = 1.15\ (0.5*P*Sb + 0.5*P\ \sqrt{(Sb + 2*Sv^2)})$$



3.3 The diameter of the rudder stock must not be less than:

$$d_v = 2.2\ \sqrt[3]{(M/\sigma_{0.2})}\quad mm$$

3.4 Tubular rudder stocks shall have dimensions in accordance with the following formula:

$$d_v = \sqrt[3]{(d_1 4 - d_2 4/d_1)} \qquad mm$$

where

d_v diameter of solid rudderstock in mm
d, external tube diameter in mm
d_2 internal tube diameter in mm

3.5 The bearings of the rudder stock and their fastenings shall be dimensioned for the rudder force (P). The length of the bearings shall be at least d_v. The pintle shall have a diameter of at least $d = 5 + 0.6*d_v$ mm. For spade-rudders an upper bearing point shall normally be arranged at a distance of at least (Sb) above the lower bearing.

3.6 The diameter of the bolts in a rudder coupling must not be less than:

$$d_b = 0.65 * d_v / \sqrt{n} \qquad mm$$

where

d_b bolt diameter in mm
n number of bolts, not less than four.

The pitch circle radius for the coupling bolts must not be less than the diameter of the rudder stock. The thickness of the coupling flange and the width of the flange outside the bolt holes must not be less than d_b.

3.7 The top packing box of the rudder stock housing shall have a height of at least 350 mm above the load waterline and be provided with a sealing. Where this is not practically possible, a grease filled packing box shall be arranged.

4. RUDDERS

4.1 Rudders of steel, aluminium, and glass fibre reinforced polyester shall have an all through rudder stock from the rudder coupling down to the pintle. The diameter of the rudder stock must not be less than the diameter of the pintle in accordance with 3.5. In case of spade-rudders the diameter may, however, be reduced linearly down from the rudder-coupling.

4.2 Rudders of steel and aluminium constructed as plate rudders or profile rudders shall have at least two reinforcements across the rudder stock with a distance of maximum 600 mm. The thickness of the reinforcements must not be less than the thickness of the plate in the profile rudder according to 4.4.

4.3 Plate-rudders shall have a thickness of at least:

$$t = 3 + 0.125 * d^v \text{ mm}$$

4.4 The plating in a profile rudder shall have a thickness of at least:

$$t_d = k * t_e \text{ sun}$$

where

k = 0.46 for steel or aluminium
k 0.33 for stainless steel
t_e thickness of plate-rudder according to 4.3.

4.5 Rudders made of glass fibre reinforced polyester shall be profile rudders and have steel reinforcements welded to the rudder stock with maximum distance of 200 mm. The thickness of the steel reinforcements shall at least the same as the thickness of a plate rudder according to 4.3, the breadth at least ten times the thickness and the length not less than 75 per cent of the distance from the rudder stock to the trailing edge or leading edge of the rudder.

4.6 A rudder made of glass fibre reinforced polyester which is laminated in two parts shall be filled with reinforced polyester or equivalent material and the parts shall be effectively glued together on flanges and at the edges. The thickness of the side

parts shall not be less than the thickness of the plate in a profile rudder of steel or aluminium according to 4.4.

4.7 Wooden rudders shall be made of oak and be attached to the rudder stock and the pintle with steel forks with a thickness of a plate-rudder according to 4.3. The steel forks shall be welded with continuous welds to the rudder stock and the pintle and bolted to the rudder with at least three upper bolts and two lower bolts which shall have the same diameter as bolts in a rudder coupling according to 3.6.

4.8 Rudders of oak shall have a thickness of at least:

$$t_t = 7.3 * t_e \quad \text{mm}$$

where t_e is the thickness of a plate-rudder according to 4.3.

ENGINE INSTALLATIONS C 8

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1 ENGINES

1.1 Commercial boats shall be provided with diesel engines. Commercial boats other than passenger boats may, however, have gasoline outboard motors provided that Loa * B is less than 20.

1.2 Inboard propulsion engine with power greater than 100 kW shall be type approved for marine use. Individual survey certificates are not required.

1.3 Where elastic mounting of a propulsion engine is used, the propeller shaft shall be longer than 40 times the diameter of the shaft when an elastic shaft coupling is not arranged.

2 ENGINE SPACES

2.1 The engine space shall be arranged so that it cannot be used for other purposes. The normal service points of the engine shall be easily accessible. Stowage spaces shall be separated from the engine space by bulkheads or similar arrangements. In order to simplify big service work on the engine the divisions may be detachable if acceptable having regard to the division requirements.

2.2 Windows or other types of lighting glass must not be fitted in the boat side, engine casing or the deck above the engine space. The room shall be equipped with electrical light.

3 INSTALLATION

3.1 Flexible hoses shall be accessible and visible for inspection. They shall comply with chapters MC9, MC10 and MC11 and be fitted with double acid resistant hose clamps.

4 EXHAUST SYSTEMS

4.1 Material in the seawater cooling system shall be corrosion resistant. The parts of the system must not be combined in such a way that galvanic corrosion will arise.

4.2 In the case of a multiple engine installation each motor shall have its separate exhaust system.

4.3 Exhaust pipes shall be mounted so that mechanical wear is avoided. Moulding in of an exhaust line is, however, not permitted. Drainage is not permitted at a part of the line which passes through enclosed accommodation spaces.

4.4 Exhaust outlets shall be at least 100 mm above the load waterline or connected to a fixed pipeline which is drawn up to at least 100 mm above the load waterline. An exhaust line shall always be drawn so that a part of it is at least 350 mm above the load waterline with a slope downwards to the outlet.

5 ENGINE CONTROL

The propulsion engine shall be capable of easy manoeuvring from the steering place and the control devices for inboard engines shall be arranged so that the following information is available at the steering place:

- the revolution of the propulsion machinery;
- lubrication oil pressure of the propulsion engine;
- lubrication oil pressure of the gear and hydraulic pressure, if applicable;
- cooling water temperature;
- cooling water failure in the exhaust system.

The control instruments shall be marked with abnormal operational conditions and fitted with adjustable lighting. The functions listed above except the revolution of the propulsion machinery shall be fitted with alarms.

6 INSTALLATION OF OUTBOARD MOTORS

6.1 The transom shall be fitted with a well attached plate as a protection for the fastening bolts for the engine. The upper part of the plate shall have a marked ridge of at least 5 mm. A suitable protection plate shall be mounted at the outer side of the transom.

6.2 Outboard motors with a power greater than 15 kW shall be fastened to the stern using through bolts with nuts.

6.3 Boats with motors having a power greater than 15 kW shall have a motor well drained to the sea through at least one hole with a diameter of at least 15 mm.

6.4 Holes for the control cable and fuel pipe in the engine well shall be tightened with sleeves or the like.

6.5 The well shall have such a size that the motor can be easily manoeuvred and tilted.

7 SEAWATER COOLING SYSTEM

7.1 Materials in a seawater cooling system shall be corrosion resistant. The parts of the system must not be combined in such a way that galvanic corrosion arises.

7.2 Seawater intake shall be provided either with a strainer or a filter.

7.3 External cooling water line shall be protected at the forward end.

7.4 If a filter is part of a seawater cooling system for the cooling of the engine, the filter shall be mounted so that it can be cleaned without tools and when the engine is running.

7.5 Pipes and filters in the engine space must not be made of thermoplastics. Small hose sections may be accepted.

8 VENTILATION OF ENGINE AND TANK SPACES

8.1 The air intake for the engine space shall be arranged so that the air needed for the engine in accordance with the engine manufacturer's guide lines, but at least 7 cm/kW, is satisfied. The air intake for the engine space shall be placed in the opposite side to the air intake for the engine.

8.2 The ventilation openings shall be provided with closing devices which are operated from a place outside the engine space and which can be secured in both open and closed position.

8.3 Fuel filling opening and tank vent fitting shall be arranged and mounted so that any spill at over filling or gas from the vent fitting will not penetrate into the boat.

FUEL INSTALLATIONS C9

Table of contents

1. GENERAL

1.1 Fuel lines to the engine shall be fixed mounted and shall be fitted with a filter and a water separating system which both shall be capable of being drained and cleaned without use of tools.

Filters must not be located in fuel tanks.

1.2 The return fuel line shall end near the bottom of the tank.

1.3 Fuel tank shall be mounted on and be attached to a strong bed. A fuel tank shall not be located adjacent to other parts in such a way that the air circulation is obstructed.

2 FUEL TANKS

2.1 For diesel oil tanks a fuel line with a shut-off valve in the bottom of the tank is accepted.

Drainage valve with tightening plug (tätnings plugg) is also accepted in the tank bottom. Connection piping between diesel oil tanks may be accepted. A shut-off valve shall than be fitted at each tank connection.

2.2 Boats with outboard motor shall have an appropriate fastening arrangement for a portable gasoline tank when a permanently mounted tank is not arranged. The arrangement shall be such that the tank can easily be put into place.

2.3 A fixed installed gasoline tank shall be made of stainless steel or aluminium and be located in a space which is gas-tightly separated from the rest of the boat and which has natural ventilation to the open air.

2.4 A tank with a volume of more than 50 litres shall have the necessary wash bulkheads. The wash bulkhead shall have openings between the sections both at top and bottom.

All parts of the tank shall be accessible for cleaning through a manhole which shall be located so that it is easily accessible.

Tanks with a volume of more than 1 500 litres shall be fitted with an inspection hatch with a size of at least 450 x 350 mm.

2.5 Each tank shall have a mechanical device for indication of level or be fitted with an electrical level indicator. In case of external indicating pipes a self-closing valve is required.

2.6 Fuel tank made of glass fibre reinforced polyester (GRP) shall be made of polyester of grade 1 and be internally coated with gelcoat or topcoat.

2.7 Non-integral fuel tanks of steel, stainless steel or aluminium shall be manufactured as a fully welded construction, i.e. an edge welding cannot be accepted.

2.8 Fuel tanks shall be given dimensions having regard to stiffening but shall have material thickness according to the following table.

Volume in litres	50 mm	50-99 mm	100-199 mm	200-499 mm	500-999 mm	1000- mm
Steel 37-2	1.5	2.0	3.0	4.0	5.0	6.0
Stainless steel AISI 316L	1.25	1.25	2.0	3.0	3.0	4.0
Seawater resistant Aluminium	2.0	3.0	4.0	5.0	5.0	6.0
GRP	4.0	4.0	4.0	5.0	5.0	6.0
Polyetylen	5.0	7.0	9.0	—	—	—

3 FUEL LINES

3.1 Fuel lines shall normally be pipes made of steel or copper. Short hose sections may be used provided that they comply with the requirements in chapter MC8 or ISO/DIS 84 69 (Small Craft-Non-Fire Resistant Fuel Hoses) and be marked accordingly.

3.2 Each permanently mounted tank shall have separate filling and ventilation lines. The outlet of the ventilation line shall have flame arresters and be so arranged that water normally cannot flow into the tank. The filling line shall have an internal diameter of at least 38 mm and the ventilation line at least 12 mm.

3.3 A shut-off valve shall be fitted in the fuel line as close as possible to the tank. The valve shall be possible to close from an accessible place above deck. The valve shall be fire resistant.

3.4 A fuel line shall be properly clamped and protected so that it is not exposed to mechanical damage or wear. Pipes and hoses shall be arranged with sufficient expansion bends. Metallic components in a fuel line must not be combined so that they give rise to a damaging corrosion.

Details assembled in a piping system shall be of the same standard.

3.5 Connections of hoses shall be arranged in an appropriate way. If hose clamps are used, double clamps shall be fitted at each coupling. Hose fittings shall be of sufficient length and shall be ribbed.

Hose clamps shall be made of acid resistant material.

3.6 After final installation the whole fuel system shall be subjected to a test for tightness with an overpressure of at least 0.02 N/mm. The tightness test may be carried out with air and soapy water.

PROPELLER SHAFTS AND PROPELLERS C10

Table of contents

1 PROPELLER SHAFTS

1.1 The shaft diameter shall comply with the engine manufacturer's requirements but shall be at least

$$d = \sqrt[3]{p/r} \quad mm$$

where

p is the maximum continuous power in kW
r propeller revolutions per second
k = 30 for carbon steel
23 for AISI 316 austenitic stainless steel
22 for AISI Y31 martensitic stainless steel
18 for Hickal-Copper alloy K 500
21 for AISI 429

1.2 Other shaft material shall be specially considered having regard to the seawater fatigue properties of the material.

1.3 Shaft penetrations in a watertight bulkhead shall be arranged so that the watertight integrity and strength of the bulkhead is maintained.

2 SHAFT BRACKETS

2.1 The wall thickness of a shaft bearing shall be at least:

$$t = d + 230/32 \quad mm$$

where d is the shaft diameter in mm.

The length of the shaft bearing shall be at least 3 d for bearings in stern tubes and 2 d for other brackets.

2.2 One-armed shaft brackets shall have a minimum moment of resistance (section modulus) (W) at the bottom of the boat calculated according to the following formula:

$$W = l * d^2/(112 * \sigma_B)$$

where

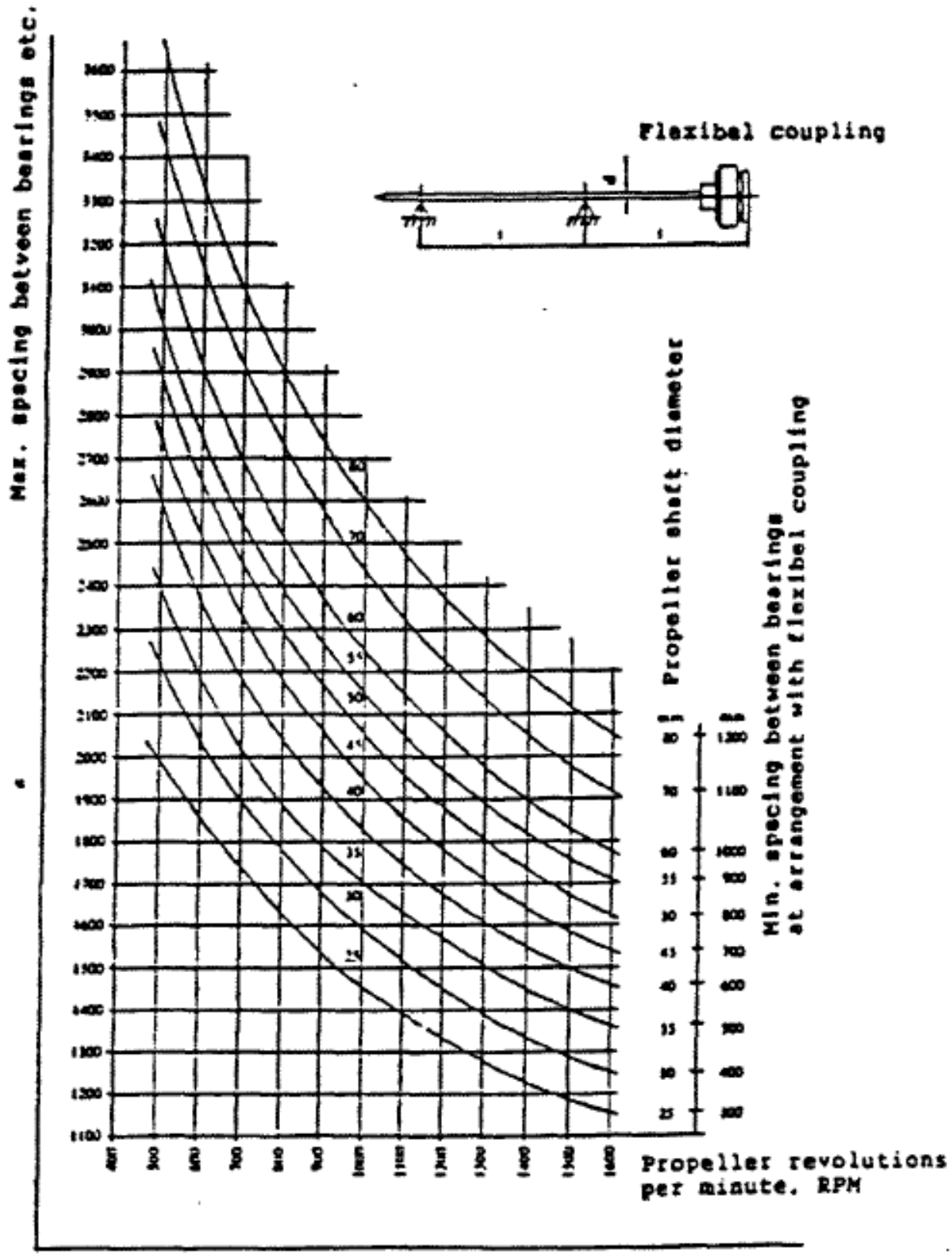
l is the length of the shaft bracket in mm

σ_B the tensile strength of the material.

At the propeller shaft the section modulus of the shaft bracket shall be at least 60 per cent of the-above requirement.

3 FREE PROPELLER SHAFT LENGTHS

3.1 The distance between the shaft supports (bearings) must not be greater than that specified by the diagram.


Max. spacing between bearings etc.
Flexibel coupling
Propeller shaft diameter
Min. spacing between bearings
at arrangement with flexibel coupling
Propeller revolutions
per minute. RPM

ELECTRICAL INSTALLATIONS C11

Table of contents

1 SCOPE

1.1 These requirements apply to direct current installations with a rated voltage up to 50 V. For other installations reference is made to the requirements of the national administration.

1.2 The Standard does not cover electrical components installed in propulsion engines or auxiliary engines or equipment in apparatus such as radio apparatus, electrical motors, signal horns, instruments, etc. If, however, it can be established that such apparatus are defective from a safety point of view, improvement or replacement may be required.

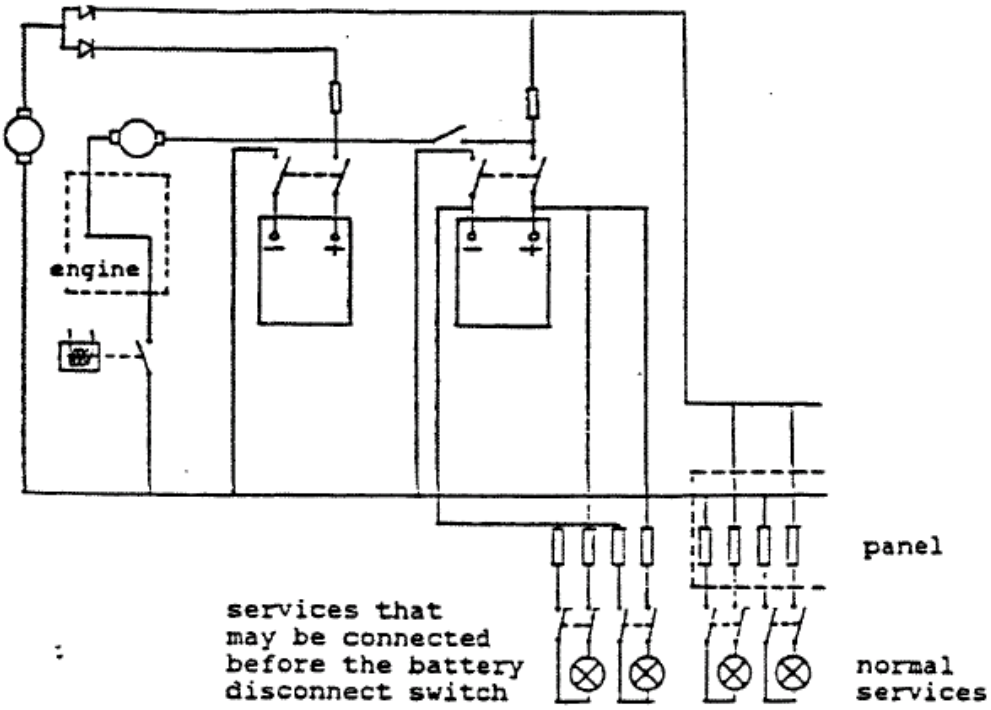
1.3 The Standard does not cover protective measures against electromagnetic influence on persons from apparatus such as radars and viewing screens.

2 SYSTEM REQUIREMENTS

2.1 Systems shall normally be installed as insulated two conductor systems.

2.2 For propulsion engines with a power less than 100 kW it is permitted that the engine be used as conductor during start.

The figure below shows an example where the engine is used as conductor during start and where either of the batteries can be used to start the engine.



2.3 Supply from a battery installation to other consumers than those on the boat's engine is to be led to one or more centrally located distribution and fuse panels via overload protected main cable and disconnect switch near the battery. Gas and burglar alarms, heating equipment and automatic bilge pumps may, however, be connected before the battery disconnect switch but must have separate fuses. A cable to a machine which is used only for short periods, e.g. anchor gears, may be connected to a battery without fuse but shall comply with the requirements of 7.3. The voltage drop in the cables from the central to the consumers must not at full load be more than 6 per cent of the voltage at the main central.

3. GROUP CONNECTION AND CONTROL CIRCUITS

3.1 Each navigation light shall have its own separate fuse.

3.2 Each navigation light, where supervision from the steering position is not possible, shall be provided with either an optical indicator at the steering pulpit which shows if the light works or a joint audible alarm indicating malfunction. Malfunction of the indicator must not affect the light.

3.3 The ordinary lighting on board should be divided into at least two groups.

3.4 Safety equipment, such as radio, signal horn, searchlight, etc, as well as consumers larger than 5 A shall have separate fuses.

4 ACCESSIBILITY AND MARKING

4.1 Batteries, cables and other electrical components shall be located so that they can be supervised and maintained also when the boat is in operation. A wiring diagram for the installation shall be supplied with the boat.

4.2 All markings shall be made with permanent marking signs with durable text.

4.3 Connected equipment and rated current shall be stated at each fuse. The circuit number given in the wiring diagram shall correspond to the circuit number marking on the fuse base. A wiring diagram shall be posted in the central on the inside of the door or hatch. Each group shall be accessible for insulation measurement.

4.4 Measuring instruments, switches, signal lamps, etc in apparatus cabinets shall be fitted with clear marking.

4.5 Socket outlets shall have marking signs indicating voltage and type of current. In boats with only 12 or 24 V direct current socket outlets without marking are accepted.

4.6 Conductors and multiconductors shall have a durable marking e.g. with colours, so that they can be identified with the aid of the wiring diagram.

4.7 Marking shall indicate the use of each battery and how a possible transfer between batteries is made.

5 OVERLOAD PROTECTION

5.1 Cables shall be so dimensioned that they under normal operation conditions, will not reach a hazardous temperature or be damaged by thermal or mechanical loads at short circuit. A connection between battery and starting motor shall not be provided with a fuse. For connection battery starting motor and generator-battery the motor manufacturer's recommendations instructions concerning cable area should be complied with, the voltage drop must, however, not be more than 8 per cent.

5.2 Overload protection shall protect the cables against overload and at short circuit break the current within a period of not more than five seconds in accordance with the table below. The overload protection shall be placed in the central and near the battery respectively. Each group shall be protected at both poles. Cables which only transfer signals to instruments or the like may have a smaller cross section than the smallest in the table.

Cable cross section	dimensioning continuous load	max fuse against overload	max fuse short-circuit in series with overload protect.
mm^2	**A**	**A**	A
1.5	**9**	**10**	**20**
2.5	**12**	**16**	**35**
4	**16**	**20**	**35**
6	**21**	**25**	**63**
10	**28**	**35**	**100**
16	**37**	**50**	**160**
25	**49**	**63**	**200**
35	**60**	**80**	**315**
50	**76**	**100**	**400**

5.3 Fuses of type neozed, diazed and those complying with DIN 72581 part 3 rated according to the table column "maximum fuse against overload" shall be considered as complying also with the requirements for short circuit protection. Circuit breakers must be of the manually reset trip free type and shall be able to break short circuit currents of at least 100 A.

6 BATTERY ARRANGEMENT

6.1 There shall be arrangements for charging the batteries continuously under way.

6.2 The electric starter of the propulsion engine shall be possible to connect to two independent batteries or groups of batteries. One group of batteries shall be the normal starting group which must not be the normal power source for other consumers. The other group may be the lighting battery group provided it has sufficient capacity to start the propulsion engine.

6.3 Each group of batteries shall have a two pole disconnector.

6.4 Batteries positioned in the watertight engine compartment shall be arranged so as not to short circuit when the compartment is flooded up to the load waterline. As an alternative an emergency battery supplying power for emergency lighting and radio may be installed on deck or in the wheelhouse for operation of emergency lighting, navigational equipment and radio.

6.5 Batteries shall be securely fastened so that they cannot come loose. Batteries

constructed so that they may leak under heavy heeling shall be placed in a liquid tight case of a material which is resistant to the electrolyte.

6.6 Battery installations of more than 5 kWh, equivalent to 208 Ah at 24 V and 416 Ah at 12 V shall be placed in a separate compartment with ventilation to the open air. The arrangement shall be such that the air circulation is not blocked.

7 CABLE DRAWING AND PLACING OF COMPONENTS

7.1 Cables shall be securely clamped or run in conduits. The conduits shall either be properly fastened by clamps or be matted in. Direct embedding of cables in GRP laminates is not accepted. Cables must not be fastened direct to tanks, oil pipes or water pipes, etc.

7.2 Cables shall be located in such a way that they are protected against heat. Cables which can be subjected to mechanical wear shall be armoured or placed in tubing. The pipes shall either be properly clamped or protected by tubing. Cables positioned below machinery or flooring shall be protected by tubing or equivalent. Tubing for cables shall be positioned so that possible water or condensation will flow out of the tube. Cable penetrations of decks or watertight bulkheads shall be watertight. Cable entrances should be from below or from the side.

7.3 The following cables shall be separate insulated single conductors which shall be located so that they are well protected against mechanical damage:

generator – battery;
battery – starting motor;
battery – central.

Where these cables are fastened to an electrically conductive material they shall be single conductor cables or insulated single conductors in separate sheaths of insulating material.

7.4 Cable ends shall be securely connected in such a way that the conductors are not damaged. Cable sheaths shall reach into the entrance to the connection. Cables which shall comply with the requirements of 7.3 should be connected with pressed on cable-thimbles with lock washer and nut. Other connections shall be made on terminals or with fixed clips.

7.5 Fuses or batteries must not be located in the same compartment as gasoline tanks or space with containers for substances which can emit explosive gases. Fuses must also not be located in a closed battery space. Switches and lighting fittings in such spaces shall be of explosion proof construction.

8 ENCLOSURE PROTECTION

8.1 The minimum requirements concerning enclosure class for equipment in the indicated spaces are given in the following table. The first number represents the maximum permissible opening for risk of touching and penetration of foreign objects into a piece of equipment. The second number represents the protection against penetration of liquids. Where the table does not indicate enclosure class the installation is not permitted.

First Number	Touching Protection	Second number	Liquid protection	Symbol
0	No requirement	0	Normal design	
1	Openings < 50 mm	1	Protection against dripping water	
2	Openings < 12 mm	2	Protection against dripping water when tilted up to 15 degrees	
3	Openings < 2.5 mm	3	Spraying proof	
4	Openings < 1.0 mm	4	Splashing proof	
5	Dust protecting	5	Washing proof	
6	Dust proof	6	Protected against immersion	

Detailed requirements are given in the IEC publication 529.

location	engines	panels, displays	lighting fittings	heaters	cooker, refrigerator	other installation material
accommodation	IP20	IP20	IP20	IP20	IP20	IP20
wheelhouse	IP20	IP20	IP20	IP20	IP20	IP20
control station	IP22	IP22	IP22	IP22	IP22	IP22
engine space	IP22	IP22	IP44	IP44	-	IP4 4
steering gear space	IP22	-	IP44	IP44	-	IP44

cargo hold	-	-	IP56	IP56	-	IP56
pantry	-	IP44	IP22 -	IP22	IP44	IP22
wet spaces	IP44	-	IP44	IP44	-	IP55
refriger chamber	IP44	-	IP44	-	-	IP55
below soles	IP44	-	IP55	-	-	-
open deck	IP56	IP56	IP55	-	-	IP56

9 CABLES AND FITTINGS

9.1 Cables shall have a voltage class of at least 60 volt. Cables in accommodation and on deck shall have a temperature rating of minimum 60° C. Cables in engine spaces and cables to fire and bilge pumps shall have a temperature rating of minimum 85° C.

9.2 Fixed cables shall be multi-stranded conductors. Cables which will be subjected to movements shall have multi-stranded conductors.

9.3 Switches shall be arranged for breaking the current and voltage concerned.

9.4 Lighting fitting shall be provided with a protective lattice over the glass if the glass otherwise can be easily damaged.

9.5 Fluorescent tube fitting shall be of an approved type and marked in accordance with established standard.

ACCOMMODATION C12

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1 TOILETS

1.1 Closed boats with a length overall of more than 8 metres shall be provided with at least one toilet.

1.2 All toilet spaces shall have a lockable door and be well lightened up. Each space shall be provided with a wash basin with water and drain.

2 VENTILATION

2.1 Accommodation spaces shall be so ventilated as to ensure sufficient supply and exhaust of air when doors, sidescuttles, windows and similar apertures are closed.

2.2 The ventilation apertures for inlet and outlet of air shall be so located as to obtain best possible ventilation.

2.3 Cowl for fresh air supply shall be located so that there is no danger of inlet of harmful combustion products. By natural ventilation the channels shall be as short as possible with a minimum of bend.

2.4 By natural ventilation the sectional area of flow of supply and exhaust channels shall be a minimum of 7.5 square centimetres per seat in the room or equivalent.

2.5 A cowl with exhaust into the open air shall be mounted above any cooking place. The channel shall be provided with a ventilation fan.

2.6 Toilet spaces shall be provided with separate exhaust to the open air.

3 FRESH WATER SYSTEMS

3.1 Fresh water tanks shall be readily accessible for cleaning.

3.2 Tanks shall have an inspection hatch with a diameter of at least 150 mm.

3.3 Fresh water tanks shall be capable of being drained through a valve at the lowest point of the tank or through a suction line. The suction line shall end in a well in the bottom of the tank.

PROTECTION OF PERSONNEL C13

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1 NON-SLIP ARRANGEMENTS ON DECK

1.1 Open decks, the space around winches and windlasses and spaces where persons can be expected to walk or stay shall be provided with non-slip surfaces in order to get a safe foothold.

2 RAILS AND HAND HOLDS

2.1 Open decks intended to be used by persons shall be equipped with a bulwark or fixed rail. The rail may be portable if necessary for the operation of the boat.

2.2 The height of bulwark and rail shall be at least 750 mm. A rail must not have an opening greater than 230 mm below the lowest bar. The distance between the bars otherwise must not be more than 330 mm.

2.3 All boats shall be provided with the necessary hand holds or other arrangements for persons to keep a firm hold to protect themselves from being injured.

3 SHARP EDGES

3.1 Sharp edges which can cause injuries to persons are not permitted at places where persons shall move or stay.

4 NON-SLIP ARRANGEMENTS IN ENGINE SPACES

4.1 Surfaces where persons can walk shall be non-slip and must not absorb oil. Soles (floorings) shall be firmly mounted.

5 SAFETY AT MOVING AND HOT ITEMS

5.1 If persons stay or move near machines and apparatus with hot or moving parts, these shall be arranged so that risk for injuries is avoided. Exhaust pipes with a surface temperature of more than 80° C must not be easily accessible for touching.

Rotating parts shall be shielded so that clothes or the like are not entrapped.

5.2 Wire reels shall be so arranged that the wire end does not strike up against the person who serves at the reel.

6 EMERGENCY ESCAPES

6.1 All spaces in which persons can be present shall have two exits. Only one exit can, however, be accepted for small rooms provided that it will not be blocked by a fire in the engine room, pantry or the like.

6.2 The exits shall be as far as possible from each other and suitable for use in an emergency. Ladders, steps and hand holds are required if the exit otherwise is not easily accessible.

6.3 The opening of exits shall be at least 450 x 450 mm or have a diameter of at least 450 mm.

6.4 The exits shall easily be capable of being opened from the inside without use of tools. Sliding covers shall be provided with hand hold on the inside.

The exit shall also be capable of being opened from the outside. The use of a loose handle, fire axe or equivalent for opening is, however, accepted if such devices are available at the central place in the boat, e.g. in the wheelhouse.

6.5 If access to an exit passes through another enclosed room, doors to such rooms may be lockable only if they have a kick-plate which can be removed in the direction of escape.

7 BOARDING ARRANGEMENTS

7.1 All boats shall have a permanently mounted rescue ladder or equivalent suitable arrangements which will enable a person who has fallen overboard to get on board again. Convertible rope ladders are not regarded as permanently mounted. The lowest step shall be arranged at least 300 mm below the waterline.

FIRE SAFETY C14

Table of contents

1 INSTALLATION OF COOKER

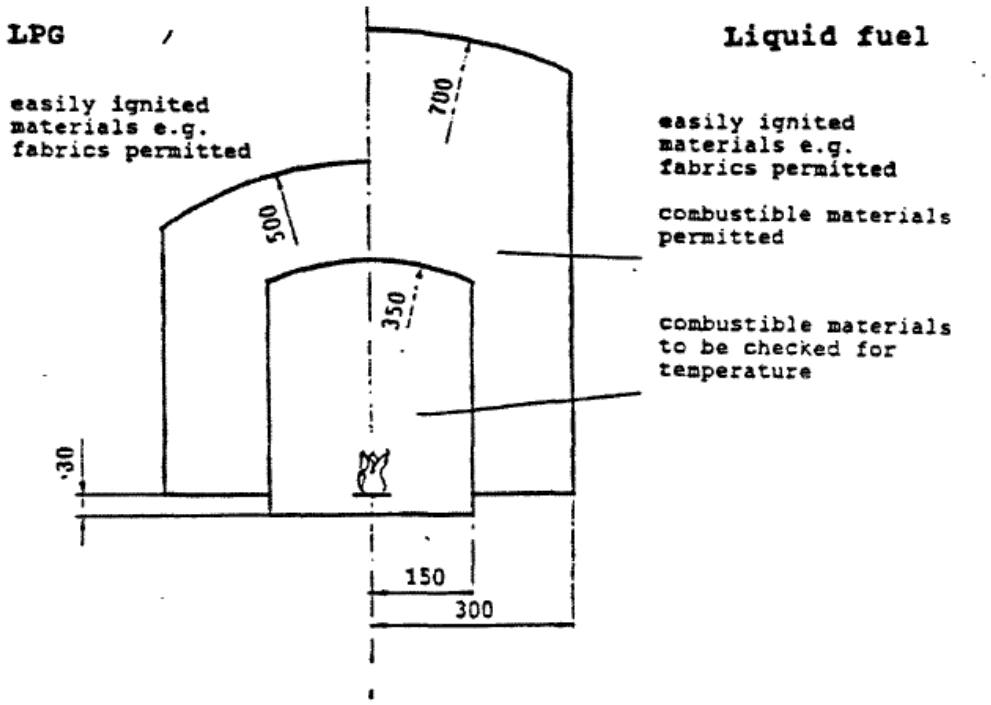
1.1 Cooler constructed so that fuel can be spilled during filling or so that fuel can leak if the flame goes out shall be placed in or over a liquid tight case. The sides of the case shall have a height of at least 20 mm.

1.2 Oil fired heaters with an open burning shall be provided with a valve which automatically close the oil supply if a fire arises in the apparatus.

1.3 LPG fired apparatus shall be provided with a shut-off valve. The valve shall be accessible near the apparatus and be capable of being manoeuvred in case of a fire in the apparatus. If the valve on the bottle is easily accessible near the apparatus the shut-off valve is not required.

1.4 LPG fired combustion apparatus other than ovens shall be of the sealed combustion chamber type and be installed so that the combustion system is completely separated from the air in the boat. Spaces in which a gas fired combustion apparatus is installed shall be ventilated.

1.5 Combustion apparatus shall be installed so that the surrounding parts will not be subjected to hazardous heating. Combustion material must not be subjected to a higher temperature than 80° C. The figure below shows the distances from an open flame which are permitted and when control of heating of combustible material shall be carried out. Protection against heating of combustible material may be achieved through shielding with non combustible material which is thermally insulated from the combustible material.



1.6 A safety barrier shall be arranged in front of a gimbaled stove. The oven shall be possible to lock in horizontal position.

1.7 Combustion apparatus shall be fastened in such a way that they cannot come loose because of the movements of the boat at sea.

2 LPG INSTALLATIONS

2.1 These requirements apply to permanently installed LPG systems except those used in connection with propulsion engines and those with a pressure of not more than 35 mbar.

2.2 Components of a LPG system shall comply with the requirements in MC15.

2.3 Pipelines shall not have more joints than necessary. Pipelines shall not be drawn through the engine compartment.

2.4 Pipelines shall be fastened with clamps or equivalent so that wearing and vibration are avoided. Clamps and other devices shall be made of corrosive resistant material and shall not damage the pipeline with sharp edges or by wear and must also not damage the pipeline material in any other way.

2.5 Flexible hoses shall not have a length of more than one metre except when the distance between the bottle and the apparatus is not more than 1.5 metres and only

one apparatus is connected to the bottle. Rubber hoses, if used, shall be accessible for inspection.

2.6 The space for the bottle shall have arrangements for securing the bottle against movement. A regulator which is not designed for mounting direct on the bottle shall be fixed mounted in the same space. It shall not be possible to use the bottle space for storage of other equipment. Spaces for spare bottles, both filled and empty, shall comply with the same requirements as those for bottles. Safety devices shall be mounted in such a way that they can withstand the movements which normally can be expected at sea. Systems with two connected bottles shall have a valve for changing over from one bottle to the other. This valve will not substitute the bottle shut-off valve.

2.7 The space for LPG bottles, regulator and safety devices on open deck, on the top of a superstructure, outside the cockpit well or an enclosed space shall be a case with direct ventilation to the open air.

2.8 A space for an LPG bottle, gas regulator and safety devices below deck and in the cockpit shall be gas-tightly separated from the accommodation and capable of being opened only from above and arranged so that gas cannot flow into the boat. The space shall be positioned above the waterline and shall, if covered, be rapidly accessible and capable of being opened without tools so that the bottle valve can be manoeuvred and so that the system can be pressure tested for tightness and a pressure gauge be read, if fitted.

The space shall have a ventilation opening in the bottom with an inner diameter of at least 12.5 mm which leads to the outside of the boat without pockets through the hull to a point lower than the bottom of the space but above the waterline. The opening must be located at least 500 mm from other hull openings which lead into the boat.

2.9 The system shall after final completion be controlled in respect of leakage, using soapy water or a detergent solution at all couplings and at possible leakage warning devices. Leakage must not exist. The pipeline shall before it is connected to the gas regulator or to the leakage warning device, if fitted, be pressure tested with air at at least 35 kPa. Leakages must not exist.

3. STRUCTURAL FIRE PROTECTION

3.1 Insulation materials which are used and their surfaces shall have an oxygen index of at least 21.

3.2 Insulation materials in engine rooms shall be covered by a surface layer impermeable to oil and oil mist.

3.3 Oil tanks and bilge water tanks located totally or partly above the flooring in the

engine room shall be insulated with a hard mineral wool block with a thickness of at least 15 mm or with expanding, fire protecting paint with equivalent insulation effect. The sides which are protected by the hull need not be insulated.

4. FIXED FIRE EXTINGUISHING SYSTEM

4.1 Boats with a length overall greater than 8 metres shall have a fixed fire extinguishing system in the engine room. In closed and partly covered boats a fire alarm system is in addition required for the engine room. The signal device shall be located at the steering place.

4.2 The requirements below apply to an extinguishing system with carbon dioxide as the extinguishing medium. Other extinguishing media which give equivalent safety and function are also accepted.

4.3 The extinguishing system shall be able to be released manually only. The release device shall be centrally positioned in the boat outside the engine room and the tank space and be protected against splash water and risk, for unintentional release. An instruction shall be fitted at the release place.

4.4 The bottles for extinguishing medium shall be positioned in -a space where sea water splash, mechanical damage or temperatures above 50°C are not expected. Bottles must not be placed in the engine room.

4.5 Pipelines and nozzles shall be designed and placed so that an even distribution of the extinguishing medium is achieved. The amount of extinguishing medium and discharge time shall be so adapted that an effective extinction is achieved.

4.6 The amount of carbon dioxide shall be 1.5 kg per cubic metre of the gross volume of the engine room, however, at least 2 kg. At least half the filling ratio shall be achieved in not more than ten seconds.

4.7 Ventilation openings and their closing devices shall be so arranged that a damaging overpressure will not arise at release of the extinguishing system.

4.8 The engine room and spaces for carbon dioxide bottles and other parts of the system where leakage can occur shall be separated in such a way that leaking gas cannot penetrate into spaces for personnel which can be closed. Spaces for bottles shall have ventilation direct to the open air.

LIFTING GEARS C15

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1 SCOPE

1.1 These requirements apply to power driven lifting gears.

2 MEASURES AGAINST OVERLOAD

2.1 Lifting gears shall be so arranged that they without engagement with tools make it impossible

- to lift a bigger load than that for which the gear is constructed; and
- to expose the boat to a greater heeling moment than that permitted by the stability requirements.

A lifting gear which is lifting the load with a wire shall be designed so that the wire cannot be overloaded when the hook reaches its innermost position.

2.2 The greatest permitted load shall be marked at a clearly visible place on the lifting gear. At least three different loads with the corresponding reach-outs which in the most unfavourable position give a permitted heeling angle shall be indicated. The marking may in case of automatic load limitation indicate different greatest permitted load for different crane positions. Other markings which can be mixed up with that required are not allowed.

3 DOCUMENTATION OF STRENGTH

3.1 For each lifting gear documentation showing for which load it has been appr-oved by the authorized testing body shall be provided.

3.2 Calculations which prove that the safety factor for metal is at least 5 and for glass reinforced polyester at least 7 is required for the lifting gear fastening and the part of the boat which is affected.

MOORING AND ANCHORING EQUIPMENT C16

Table of contents

1 BOLLARDS AND FAIRLEADS

1.1 The boat shall be provided with approved bollards according to chapter MC16 and hawsepipes arranged so that the boat can be anchored, tow other ships, be towed and moored satisfactorily.

1.2 All boats shall have at least one mooring cleat forward and one aft. When two cleats are fitted forward or aft they shall be located as near as possible to boat sides. For larger boats additional mooring cleats may be required.

1.3 One cleat forward and one aft shall be placed in such a way that towing is possible. If a towing cleat mounted on the stern is easily accessible it can be approved also as a mooring cleat in open boats without a deck forward.

1.4 Mooring cleats and their mountings shall be strongly designed and mounted. The cleats and their mountings shall be strongly designed and mounted. The cleats and their mountings shall be capable of withstanding a tensile load (P) in the longitudinal direction as follow:

$$P = 50 * \Delta/Loa \quad N$$

where Δ is the displacement fully loaded in kg.

1.5 Appropriate reinforcements shall be provided where the cleats are fastened. Bolts, nuts and other mounting details shall be made of corrosion resistant materials.

1.6 Mooring cleats shall either be welded or mounted with through bolts. Large washers shall be fitted below the nuts and the nuts shall be locked.

2 AHCHORING EQUIPMENT

2.1 The boat shall be provided with anchoring equipment at least according to the following diagrams. The equipment shall be arranged in such a way that it is possible to anchor rapidly and reliably.

2.2 The anchor weight may be distributed on two anchors one of which must have at least 2/3 of the required weight. The required anchor weights are based on

traditional anchor types. If the anchor is of a type with extra high holding capacity, e.g. anchors approved by a recognized classification society with the designation "high holding anchor" the anchor weight may be decreased with up to 25 per cent.

2.3 The boat shall be equipped with at least one short chain-cable of a length and dimension according to the diagram below.

2.4 The boat shall be equipped with at least one anchor rope (anchor cable) and three mooring ropes of a length and minimum breaking strength given in the diagram.

2.5 Boats which shall sail in a particularly wind exposed area shall have measured anchor weight and short chain cable in accordance with national rules (requirements).