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Ships and marine technology — Marine evacuation systems — Load calculations and testing

National foreword

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Contents

Page

Foreword

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The committee responsible for this document is ISO/TC 8, *Ships and marine technology*, Subcommittee SC 1, *Lifesaving and fire protection*.

Introduction

The International Convention for the Safety of Life at Sea (SOLAS), 1974 requires all life-saving appliances and arrangements to comply with the requirements of the LSA Code and to be tested in accordance with the recommendations of the IMO. The revised recommendation on testing of life-saving appliances, as adopted by IMO Resolution MSC.81(70), prescribes in paragraph 12.2.2 and 12.3.2.2 the execution of a static load test to the structural attachment to the ship of a marine evacuation system. However, this resolution does not refer to any specific calculation method for this test. This document is intended to provide specifications for an appropriate calculation method for this test in order to facilitate consistent implementation by maritime administrations when approving marine evacuation systems.

Ships and marine technology — Marine evacuation systems — Load calculations and testing

1 Scope

This document specifies a calculation method for the application of a static load test to the structural attachment of marine evacuation systems to ships.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

International Maritime Organization, *The International Convention for the Safety of Life at Sea (SOLAS)*, 1974, as amended

International Maritime Organization, *The International Life-Saving Appliance (LSA) Code*, as adopted by IMO Resolution MSC 48(66) as amended

International Maritime Organization, *The Revised recommendation on testing of life-saving appliances*, as adopted by IMO Resolution MSC.81(70) as amended

International Maritime Organization, *International Code on Intact Stability, 2008 (2008 IS Code)*, as adopted by IMO Resolution MSC.267(85) as amended

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
marine evacuation system
MES
appliance for the rapid transfer of persons from the embarkation deck of a ship to a *floating platform (3.3)* or survival craft by means of a *passage* (3.2)

3.2
passage
integral component of a *marine evacuation system* (3.1) to provide safe descent of persons from the embarkation station to the *floating platform* (3.3) or survival craft

Note 1 to entry: The passage can be an inflatable or rigid slide, a vertical passage or any other arrangement providing the same function.

3.3
floating platform
inflatable structure which may be fitted to the bottom of the *passage* (3.2) to hold evacuees awaiting entry to survival craft

3.4
stowage container
arrangement providing means for stowing a *marine evacuation system* (3.1) and so constructed as to withstand heavy conditions encountered at sea

3.5
structural attachment
attachment of a *marine evacuation system* (3.1) to the ship structure designed to withstand loads calculated in accordance with this document

Note 1 to entry: Such attachments may include blocks, falls, pad eyes, links, fastenings and all other fittings used for restraining the *floating platform* (3.3), if fitted, and survival craft(s) to the ships side during evacuation.

4 Load calculations

4.1 Load calculation

The load imposed by the maximum number and size of fully loaded liferafts for which the system is designed, attached to the loaded floating platform, if fitted, with the ship moving through the water at 3 kn against a head wind of force 10 on the Beaufort scale shall be calculated in accordance with the method in Annex A.

4.2 Additional loads

Where significant gravitational and moment loads of the passage, floating platform, if fitted, or survival craft(s) are imposed to the structural attachments in the fully deployed condition of the marine evacuation system, these loads shall be added when performing the static load tests required.

4.3 Load distribution

Where the loads calculated in 4.1 and 4.2 are shared by more than one structural attachment, the calculated load for load testing of individual structural attachments may be reduced, taking into consideration the distribution of loads in the scenario described in 4.1.

5 Load testing

5.1 Static load testing

All structural attachments of the MES shall be subjected to a static load of 2,2 times the maximum load calculated in accordance with Clause 4. The load shall be applied to the structural attachments for a period of no less than 30 min and in the same direction as the load is applied during service. The structural attachments may be tested with or without the MES in place.

5.2 Load test acceptance criteria

On completion of this test, there shall be no evidence of significant deformation, signs of any fracture, stranding to its connections or any other damage as a result of this factory test.

Annex A
(normative)

Calculation method of maximum load

A.1 Maximum calculated load formula

$$F = F_W + R \quad \text{(A.1)}$$

where

F is the maximum calculated load (N);

F_W is the sum of wind forces on the slide or passage, floating platform and fully loaded liferafts with the maximum specification or quantity at a wind of force 10 on the Beaufort scale (N);

R is the drag on the floating platform and fully loaded liferafts with the maximum specification or quantity when they are dragged in water at a speed of 3 kn (N).

A.2 Calculation of wind force

A.2.1 General

The sum of wind forces, F_W, shall be calculated as the wind pressure, P, multiplied by the sum of exposed areas, A, of the marine evacuation system in the fully deployed condition.

$$F_W = P \cdot A \quad \text{(A.2)}$$

where

P is the wind pressure;

A is the exposed area.

A.2.2 Wind pressure

As specified in the 2008 IS Code, the unit calculated wind pressure shall be taken as 504 N/m^2 as equivalent to the maximum wind speed of 28,4 m/s for a wind force of 10 on the Beaufort scale.

For the floating platform, if fitted, and survival craft(s) alternatively, the values of wind pressure may be taken from Table A.1:

Table A.1 — Alternative wind pressures

6	h (m)	**7**	1	**8**	2	**9**	3	**10**	4	**11**	5	**12**	6 and over
13	P (N/m^2)	**14**	316	**15**	386	**16**	429	**17**	460	**18**	485	**19**	504

where

h is the vertical distance from the centre of the projected vertical area of the floating platform and/or survival craft(s) above the waterline, to the waterline;

P is the wind pressure associated with the height, h.

A.2.3 Calculation of wind area

$$A = (A1 \cdot \alpha) + (A2 \cdot \beta) + (A3 \cdot \theta) + (A4 \cdot \theta) + (A5 \cdot \theta) \quad \text{(A.3)}$$

where

A is the sum of the above wind areas (m^2);

$A1$ is the projected slide or passage area (aft) (m^2);

$A2$ is the projected area of the part of a floating platform above water (aft) (m^2);

$A3$ is the projected area of the part of a fully loaded liferaft above water (aft) (m^2);

$A4$ is the projected area of the part of the second fully loaded liferaft above water(m^2);

$A5$ is the projected area of the part of the third fully loaded liferaft above water(m^2);

α is the drag coefficient of the projected slide or passage area;

β is the drag coefficient of the projected area of the part of a floating platform above water;

θ is the drag coefficient of the projected area of the part of a full-load liferaft above water.

NOTE α, β, θ are generally taken as 0,8 to 1,0, dependent on different products.

A.3 Calculation of drag

A.3.1 General

The total drag, R, shall be calculated as follows:

$$R = R_p + R_f \quad \text{(A.4)}$$

where

R_p is the pressure drag;

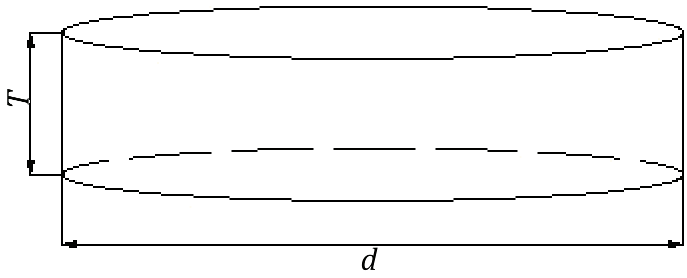
R_f is the friction drag.

A.3.2 Drag composition model

Based on the estimation formula of cylinder drag coefficient proposed by Kirkman,[1] the drag on a round section liferaft with draught, T, and diameter, d, under the impact of flow at 90° angle of attack is analysed as follows.

a) The drag mainly consists of pressure drag, R_p, which accounts for the majority, and friction drag, R_f.

b) The part of a fully loaded liferaft below water is simplified as the model in Figure A.1.



Key

d maximum diameter of a floating platform or liferaft

T draught of a fully loaded liferaft

Figure A.1 — Composition of drag — simplified model

A.3.3 Reynolds number

Reynolds number, Rn, shall be calculated as:

$$Rn = \frac{v}{\upsilon} \cdot d \tag{A.5}$$

where

v is the relative flow velocity of 3 kn equal to 1,543 m/s;

υ is the dynamic viscosity equal to 1,189 2 × 10^{-6} m^2/s at 15 °C;[2]

$$Rn = \frac{1{,}543\ \text{m/s}}{1{,}189\,2 \cdot 10^{-6}\ \text{m}^2/\text{s}} \cdot d \approx 1{,}3 \cdot 10^{6}\ \text{m}^{-1} \cdot d\,.$$

A.3.4 Pressure drag

Pressure drag, R_p, shall be calculated as:

$$R_p = A \cdot C_p \cdot \frac{1}{2} \cdot \rho \cdot v^2 \tag{A.6}$$

where

A is the projected area, i.e. $A = T \cdot d$;

T is the draught of a fully loaded liferaft;

ρ is the density of the seawater equal to 1,03 × 10^3 kg/m^3;

C_p is the pressure drag coefficient equal to 0,60.

For values of d within the range of liferaft dimensions, Reynolds number > 5 × 10^5, for which the pressure drag coefficient, C_p, may be estimated as C_p = 0,60 according to the Kirkman[1] estimation.

A.3.5 Friction drag

Friction drag, R_f, may be calculated as:

$$R_f = S \cdot C_f \cdot \frac{1}{2} \cdot \rho \cdot v^2 \tag{A.7}$$

where

S is the wetted surface, i.e. $S = T \cdot d \cdot \pi + d^2 \cdot 0{,}25 \cdot \pi$;

C_f is the friction drag coefficient.

According to the Kirkman[1] estimation formula, when $Rn > 5 \times 10^5$, then the friction drag coefficient, C_f, may be calculated as follows:

$$C_f = \frac{1}{\left(3{,}46 \cdot \log_{10} Rn - 5{,}6\right)^2} - \frac{1\,700}{Rn} \tag{A.8}$$

where

Rn is Reynolds number as calculated in A.3.3.

Bibliography

[1] Kirkman K.L., & Klötzli J.W. Scaling Problems of Model Appendages. In: *Proceedings of the 19th General Meeting of the American Tank Towing Conference 1980.* Volume I. Ann Arbor Science Publishers, Inc. 1981

[2] ITTC – Recommended Procedures No. 7.5-02-01-03, *Fresh Water and Seawater Properties*, Revision 02. 2011

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BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK