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Ships and marine technology — Marine evacuation systems — Determination of capacity

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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

This document is intended to provide means of evaluating and determining the maximum evacuation capacity of marine evacuation systems (MES). As a consequence of MES systems being installed on large passenger ships, there has been an increase in system capacity during recent years. This document provides a uniform test regime while reducing the risk of injury to test personnel by reducing the number of persons required to complete the test. The capacity determined through this document is based on trial conditions as described in referenced IMO instruments and does not take into account factors such as adverse weather conditions, ship-specific installations or arrangements, or the physical capabilities of the passengers to be evacuated.

Ships and marine technology — Marine evacuation systems — Determination of capacity

1 Scope

This document specifies a procedure for the evaluation and determination of the capacity of a marine evacuation system as required by the International Maritime Organization Life-Saving Appliance Code (LSA Code) and as an alternative to the procedure specified in Resolution MSC.81(70) part 1/12.6.1.

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.

IMO Revised recommendation on testing of life-saving appliances [IMO Resolution MSC.81(70) (as amended through IMO Resolution MSC.321(89)]

IMO International Life-Saving Appliance (LSA) Code [IMO Resolution MSC.48(66) (as amended through IMO Resolution MSC.320(89)]

IMO International Convention for the Safety of Life at Sea (SOLAS), 1974 [as amended through Res. MSC.47(66)]

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
available evacuation time
total period allowed for evacuation of the ship

Note 1 to entry: 30 min for SOLAS passenger ships or in 17 min and 40 s for passenger ships subject to the High Speed Craft (HSC) Code.

3.2
approved installation height
maximum installation height for which the *MES* (3.5) is to be approved

3.3
associated survival craft
craft forming part of and used in conjunction with a *marine evacuation system* (3.5) and which are not directly accessible via the *passage* (3.7)

3.4
handling of associated survival craft
deployment, retrieval, inflation, mooring, and other actions necessary to prepare the *survival craft* (3.9) for boarding

3.5
marine evacuation system
MES
appliance for the rapid transfer of persons from the embarkation deck of a ship to a *floating platform* (3.8) or *survival craft* (3.9) by means of a *passage* (3.7)

3.6
MES crew
personnel required for the safe operation of the *MES* (3.5)

Note 1 to entry: These personnel may include the person in overall charge at the evacuation station, platform crew and others as needed.

3.7
passage
integral component of a *marine evacuation system* (3.5) to provide safe descent of persons from the embarkation station to the *floating platform* (3.8) or *survival craft* (3.9)

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

3.8
floating platform
inflatable structure which may be fitted to the bottom of the *passage* (3.7) to hold evacuees awaiting entry to *survival craft* (3.9)

Note 1 to entry: In some system configurations, a survival craft may also serve as a floating platform.

3.9
survival craft
craft capable of sustaining the lives of persons in distress from the time of abandoning the ship

3.10
survival craft unit
multiple pre-connected *survival craft* (3.9) deployed together

3.11
system capacity
total number of evacuees which can be evacuated by a given *MES* (3.5) within the *available evacuation time* (3.1)

4 Test arrangement

4.1 Test rig

As an alternative to testing from a floating ship, a test rig which deploys the MES over water may be used for the determination of MES capacity.

4.2 Position of the test rig

The side of the test rig, simulating a ship's side, shall be parallel to, and in line with, the outer boundary of the pier.

4.3 Installation height of MES

The entrance to the passage shall be positioned at 15 m (±1 m) above the waterline or at least at the height for which the system is to be approved if this is less than 15 m (±1 m) above the waterline.

4.4 MES/ship interface

The MES retaining and connection lines of the test rig shall be arranged and fitted as on a real ship with the same installation height and longitudinal distances as used for the capacity test.

4.5 Associated survival craft

If the capacity test includes the use of associated survival crafts, these shall be positioned on the pier at a distance of at least 15 m from the centreline of the access entrance to the MES passage.

If more than one associated survival craft is used with the system, at least two of the largest associated survival crafts necessary to attain the maximum capacity of the system shall be deployed and handled during the test.

4.6 Access to embarkation area

The test rig should have a dedicated assembly area. However, other arrangements are acceptable if access by the evacuees to the embarkation point, in a safe and constant flow, is ensured.

5 Test persons

5.1 Number of test persons

5.1.1 The number of persons to be selected for the test shall correspond to at least 110 % of the capacity of the largest survival craft used with the MES, except as specified in 5.1.4.

5.1.2 In the case where a survival craft unit or units are used, a number of test persons corresponding to 110 % of the largest individual survival craft shall be used, except as specified in 5.1.4.

5.1.3 In the case where only a single survival craft is used, of which the capacity is less than 165 persons, a number of test persons corresponding to 100 % of the survival craft shall be used.

5.1.4 If the survival craft capacity is larger than 165 persons, only 165 test persons shall be used and the test shall be conducted under the conditions described in 6.8.

5.2 Selection of test persons

5.2.1 Subjects shall

— be able-bodied,

— not have received practical training in the use of a MES, and

— be selected according to the weight distribution given in Table 1 and the following.

5.2.2 Small test subjects, i.e. those persons less than 65 kg, need not be adults.

5.2.3 At least one-third, but not more than one-half of the test subjects, should be females and selected from the three weight categories, except females need not be represented from the highest weight category.

Table 1 — Test subject selection for capacity test of marine evacuation systems

Weight range, kg		
<60	60–90	>90
10 %–20 %	60 %–80 %	10 %–20 %

6 Test procedure

6.1 The test persons, wearing approved lifejackets conforming to the requirements of the LSA Code, shall be lined up in the embarkation area, if space permits, or on the stairway leading to the embarkation area in a way that there shall not be any interruption in the flow of the test persons.

6.2 Prior to initiating the test, the MES crew shall be ready in the embarkation area and awaiting the order to deploy the system.

6.3 When the order to initiate the test is given, the timing is started and the system is activated by the MES crew.

6.4 When the floating platform or the survival craft at the base of the passage is ready for boarding and the access passable, the designated MES crew descends the MES and prepares to receive the test persons.

6.5 For safety reasons, the timing may be temporarily interrupted at this point while the test persons assemble in the embarkation area and shall be resumed when the test persons are lined up as described in 6.1.

6.6 If the MES consists of more than one passage, they shall be used equally.

6.7 When the all-clear signal is given, the test persons descend to the floating platform/survival craft and transfer to the survival craft which is designated as the first to be disengaged from the system.

6.8 If either a single survival craft or survival craft unit is used as described in 5.1.4, the following procedure is used as equivalent to verify operational capabilities in a crowded survival craft.

6.8.1 If a single survival craft is used, the test persons shall assemble in the area closest to the end of the passage closest to vessel connection points to simulate that the operating area for the crew is crowded.

6.8.2 If a survival craft unit is used, the test persons shall assemble in the craft(s) closest to the end of the passage(s) and in such a way that at least one craft is occupied to its full capacity.

6.9 The handling of associated survival craft may be carried out in parallel with the descent of the test persons, provided that the MES crew is available to perform all operations safely.

6.10 When the last survival craft to be used for the test is disengaged, the time is stopped.

7 Test timing

7.1 Timekeepers

7.1.1 The role of the timekeeper(s) shall include, but is not limited to, the following:

a) ensuring all stopwatches to be used to record event timings are synchronized;

b) ensuring all timed operations to be recorded can be viewed;

c) ensuring that if there is more than one timekeeper, each time keeper is aware of their individual task;

d) recording of test times as detailed in Table 2;

e) recording the capacity of the floating platform/primary raft(s) as applicable;

f) recording the capacity and boarding sequence of associated survival craft as applicable;

g) recording the number of MES crew used during the test and the positions of MES crew as relevant.

7.1.2 The use of video cameras appropriately synchronized can be used to assist in recording the timing of the key events of the evacuation, if necessary.

7.2 Sequences to be timed

7.2.1 Prior to the initiation of the test, all stopwatches shall be synchronized and set to 0:00. When the signal to initiate the test is given, the timekeepers shall start their stopwatch(s). The timekeeper(s) shall record the time at which each of the events indicated in Table 2 occur. The time recorded shall be the time shown on the stop watch when the event occurs.

7.2.2 Depending on the design of the MES, and the number of test persons and survival craft used, the events listed in Table 2 may not occur in the sequence indicated.

7.2.3 If the time is stopped for any reason, the start time, stop time, duration and reason should be recorded.

Table 2 — Test times

Event	Time (min:s)	Time elapsed (s)
Order to activate the system given	00:00	A: 00
System ready for lowering		B:
System lowered to the waterline		C:
System ready for descent		D:
Platform crew ready to receive test persons		E:
Time stopped for safety of test persons (see 6.5)		F:
Time resumed		G:
First test person starts descent to floating platform or survival craft		H:
Last test person completes descent to floating platform or survival craft		I:
Handling of first associated survival craft initiated		J:
First person enters the first associated survival craft		K:
Last person enters the first associated survival craft		L:
Second associated survival craft secured and boardable		M:
Disengagement of last survival craft from ship initiated		N:
Disengagement of last survival craft from ship completed		O:

8 Capacity calculation

8.1 Principle

The total evacuation time consists of the time required to deploy the MES and prepare for descent, the time required for passengers to descend and transfer to survival craft and the time required to disengage the survival craft from the ship or passage. The deployment and disengagement times are dependent on the MES design and typically will not vary based on number of test persons. The descent and boarding time are dependent on the number of test persons. This calculation uses the time for the test persons to descend the passage and board survival craft to extrapolate to a full evacuation capacity.

8.2 Formulae and abbreviations

8.2.1 For the purpose of calculating the total capacity of a given MES, the following abbreviations and formulas are used:

a) T_{evac} is the available evacuation time in seconds [e.g. SOLAS passenger ships = 30 min (1 800 s), HSC passenger ships = 17 min 40 s (1 080 s), SOLAS cargo ships = 10 min (600 s)];

b) $T_{congest}$ is the congestion time, the period of time when persons are unable to board survival craft from floating platform;

c) $T_{board\ 1,2,3...}$ is the boarding time for passengers to enter survival craft 1, 2, 3 etc.;

d) $T_{hand\ 1,2,3,...}$ is the handling time to prepare survival craft 1,2, 3, etc. for boarding;

e) S_{cap} is the total person capacity of the marine evacuation system tested;

f) A_{dt} is the average descend time of passage, in seconds, per person;

g) N_{tp} is the number of test persons descended;

h) $Cap_{[1,2,3..]}$ is the person capacity of survival craft 1, 2, 3, ...;

i) $Cap_{Platform}$ is the person capacity of the platform;

j) Cap_{tot} is the total person capacity of all survival craft.

8.2.2 If the MES floating platform is used as a survival craft, use Formula (1):

$$Cap_{tot} = Cap_{Platform} + Cap_1 + Cap_2 + Cap_3 + Cap_4 \quad (1)$$

8.2.3 If the MES floating platform is not used as a survival craft, use Formula (2):

$$Cap_{tot} = Cap_1 + Cap_2 + Cap_3 + Cap_4 \quad (2)$$

8.3 Calculation of average descent time

8.3.1 If the descent of test persons is not interrupted, the average descent time per person is calculated from Table 2 using Formula (3):

$$A_{dt} = \frac{I - H}{N_{tp}} \quad (3)$$

8.3.2 If the descent time is interrupted, the average descent time per person is calculated using Formula (4):

$$A_{\mathrm{dt}} = \frac{(I - H) - (G - F)}{N_{\mathrm{tp}}} \tag{4}$$

8.4 Calculation of survival craft handling time and boarding time

8.4.1 Boarding time of the first survival craft is calculated from Table 2 using Formula (5):

$$T_{\mathrm{board1}} = L - K \tag{5}$$

8.4.2 Boarding time of additional survival craft is calculated based on the ratio of survival craft capacities as follows:

$$T_{\mathrm{board2}} = \left(T_{\mathrm{board1}} / \mathrm{Cap}_1\right) \times \mathrm{Cap}_2 \tag{6}$$

$$T_{\mathrm{boardn}} = \left(T_{\mathrm{board1}} / \mathrm{Cap}_1\right) \times \mathrm{Cap}_{\mathrm{n}} \tag{7}$$

8.4.3 For a MES that delivers persons directly into a single survival craft or a MES that uses multiple pre-connected survival craft with no additional associated survival craft, the handling time is taken to be zero ($T_{\mathrm{hand}} = 0$).

8.4.4 Handling time of the associated survival craft used in the test are calculated from Table 2 as follows.

— Handling time for survival craft 1:

$$T_{\mathrm{hand1}} = K - J \tag{8}$$

— Handling time for survival craft 2:

$$T_{\mathrm{hand2}} = M - L \tag{9}$$

— Handling time for survival craft 3:

$$T_{\mathrm{hand3}} = M - L \tag{10}$$

— Handling time for survival craft 4:

$$T_{\mathrm{hand4}} = M - L \tag{11}$$

8.5 Calculation of congestion time

8.5.1 Delays in evacuation flow will occur if available survival craft capacity is insufficient to accommodate continuously descending evacuees. Possible congestion time is calculated using Formula (12):

$$T_{\text{congest}} = \left(\begin{matrix} T_{\text{hand1}} + T_{\text{board1}} + T_{\text{hand2}} + T_{\text{board2}} + T_{\text{hand3}} + T_{\text{board3}} + \\ T_{\text{hand4}} + T_{\text{board4}} \end{matrix} \right) - \left(A_{\text{dt}} \times \left(\text{Cap}_{\text{Platform}} + \text{Cap}_1 + \text{Cap}_2 + \text{Cap}_3 + \text{Cap}_4 \right) \right) \quad (12)$$

8.5.2 If $T_{\text{congest}} < 0$, it should be taken as 0.

8.6 Calculation of MES capacity

The MES capacity should be calculated using Formula (13):

$$S_{\text{cap}} = \frac{T_{\text{evac}} - (H - A) + (G - F) - (O - N) - T_{\text{congest}}}{A_{\text{dt}}} \quad (13)$$

If S_{cap} exceeds the total survival craft capacity, the MES capacity is taken as the total survival craft capacity.

8.7 Calculation adjustment for increased/reduced height of passage (see 4.3)

Under circumstances where the test uses a passage that is of reduced or increased length than that of the intended installation height, the average descend time, A_{dt}, shall be replaced with an adjusted descend time, A_{dtadj}, throughout the calculation formulae in accordance with Formula (14):

$$A_{\text{dtadj}} = \frac{L_{\text{a}}}{L_{\text{t}}} \times A_{\text{dtj}} \quad (14)$$

where

L_{a} is the length of passage for which the system is to be approved;

L_{t} is the length of passage of test system.

Annex A
(informative)

Capacity calculation examples

A.1 General

The following two calculation examples are based on imaginary evacuation situations and as such only intended to provide guidance in the application of this document.

A.2 MES capacity calculation example with survival craft functioning as floating platform

A.2.1 Table A.1 provides an example of a completed test time form with the survival craft functioning as a floating platform.

Table A.1 — Test timing form completed (Example 1)

Event	Time (min:s)	Time elapsed (s)
Order to activate the system given	0:00	A: 0
System ready for lowering		B:
System lowered to the waterline		C:
System ready for descend	2:15	D: 135
Platform crew ready to receive test persons	3:00	E: 180
Time stopped for safety of test persons		F:
Time resumed		G:
First person starts descent to floating platform or survival craft	3:00	H: 180
Last person completes descent to floating platform or survival craft	9:36	I: 576
Handling of first associated survival craft initiated	3:00	J: 180
First person enters the first associated survival craft	7:00	K: 420
Last person enters the first associated survival craft	13:00	L: 780
Second associated survival craft secured and board able	16:00	M: 960
Disengagement of last survival craft from ship initiated	17:00	N: 1020
Disengagement of last survival craft from ship completed	18:00	O: 1080

A.2.2 Calculation of deployed survival craft capacity

A.2.2.1 Survival craft capacity and deployment order is provided in Table A.2.

Table A.2 — Survival craft capacity and deployment order

Deployment order	1	2	3	4	5	6	7
Prefix	$Cap_{Platform}$	Cap_1	Cap_2	Cap_3	Cap_4	Cap_5	Cap_6
Capacity	150	150	150	150			

A.2.2.2 The total capacity is calculated using Formula (A.1):

$$Cap_{tot} = Cap_{Platform} + Cap_1 + Cap_2 + Cap_3 + Cap_4 \quad (A.1)$$

where

Cap_{tot} is the total survival craft capacity deployed and only including floating platform capacity if that is designated as a survival craft.

A.2.3 Calculation of the total number of deployed associated survival crafts is shown in Table A.3.

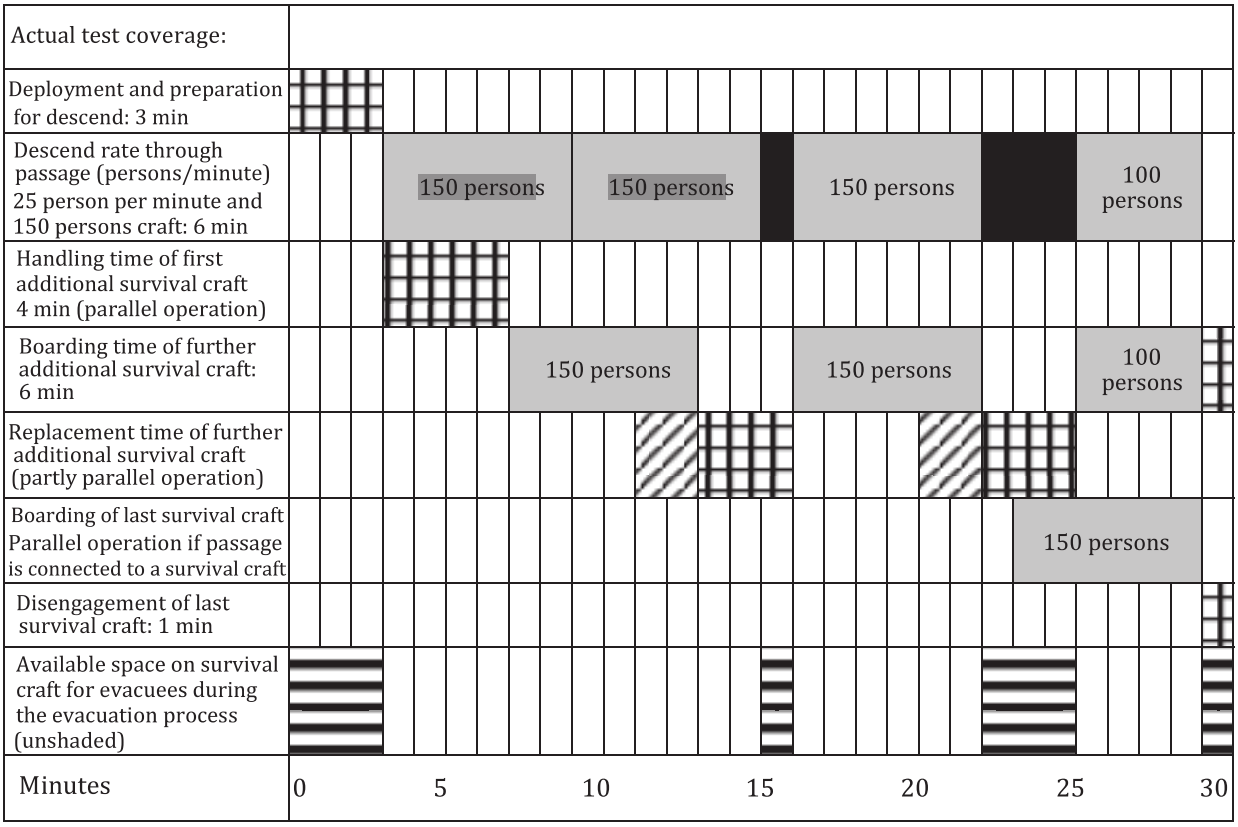
Table A.3 — Calculation of the total number of deployed associated survival crafts

Event	Time (s)	Remaining time	Crafts deployed
Time available for boarding and handling of associated survival crafts: $T_{evac} - (H - A) - (O - N)$	1 560	1 560	Platform/ 150 persons
Handling time for first associated survival craft: $(K - J)$	240	1 320	1/150 persons
Boarding time for first associated survival craft: $(L - K)$	360	960	
Handling time for second associated survival craft: $(M - L)$	180	780	1/150 persons
Boarding time for second associated survival craft: $\frac{L-K}{Cap_1} \times Cap_2$	360	420	
Handling time for third associated survival craft: $(M - L)$	180	240	1/150 persons
Boarding time for third associated survival craft: $\frac{L-K}{Cap_1} \times Cap_3$	360	–120	
Handling time for fourth associated survival craft: $(M - L)$	n/a	n/a	
Boarding time for fourth associated survival craft: $\frac{L-K}{Cap_1} \times Cap_4$	n/a	n/a	

Cap_{tot}: 150 + 150 + 150 + 150 = 600 persons (floating platform capacity included, as the floating platform is a designated survival craft).

A.2.4 Evacuation matrix is provided in Table A.4.

Table A.4 — Evacuation matrix (MES with life raft functioning as floating platform)



A.2.5 Capacity calculation

$$T_{\text{congest}} = \left(\begin{matrix} T_{\text{hand1}} + T_{\text{board1}} + T_{\text{hand2}} + T_{\text{board2}} + T_{\text{hand3}} + T_{\text{board3}} + \\ T_{\text{hand4}} + T_{\text{board4}} \end{matrix} \right) - \left(A_{\text{dt}} \times \left(\text{Cap}_{\text{Platform}} + \text{Cap}_1 + \text{Cap}_2 + \text{Cap}_3 + \text{Cap}_4 \right) \right)$$

$$T_{\text{congest}} = \left(\begin{matrix} \left(K - J \right) + \left(L - K \right) + \left(M - L \right) + \left(\frac{L - K}{\text{Cap}_1} \times \text{Cap}_2 \right) + \left(M - L \right) + \\ \left(\frac{L - K}{\text{Cap}_1} \times \text{Cap}_3 \right) + \left(M - L \right) + \left(\frac{L - K}{\text{Cap}_1} \times \text{Cap}_4 \right) \end{matrix} \right) - \left(A_{\text{dt}} \times \left(\text{Cap}_{\text{Platform}} + \text{Cap}_1 + \text{Cap}_2 + \text{Cap}_3 + \text{Cap}_4 \right) \right) \quad \text{(A.2)}$$

N_{tp} = 165 persons (150 + 10 %)

where

N_{tp} is the number of test persons participating.

$$A_{\text{dt}} = \frac{I - H}{N_{\text{tp}}} \quad \text{(A.3)}$$

$$= \frac{396}{165} = 2,4\,\text{s / person}$$

where

A_{dt} is the average descend time of passage per person (in seconds).

$$T_{congest} = \begin{pmatrix} (420-180)+(780-420)+(960-780)+\left(\frac{780-420}{150}\times 150\right)+ \\ (960-780)+\left(\frac{780-420}{150}\times 150\right)+(n/a)+(n/a)-2,4\times \\ (150+150+150+150) \end{pmatrix}$$

Survival craft no. 4 is not handled, thus not applicable (n/a) to the calculation.

$$T_{congest} = \begin{pmatrix} (240)+(360)+(180)+(360)+(180)+(360)+ \\ (n/a)+(n/a)-2,4(600) \end{pmatrix}$$

$$T_{congest} = 240+360+180+360+180+360-1\,440 = 240\,s$$

$H - A$: time for system deployment and preparation for descend;

O – N: time for disengagement of final survival craft.

$$A_{dt} = \frac{I-H}{N_{tp}} = \frac{396}{165} = 2,4\,s/person$$

Cap_{tot}: 3 × 150 + 1 × 150 = 600 (floating platform capacity included, as the platform is a designated survival craft).

$$S_{cap} = \frac{T_{evac} - (H-A) + (G-F) - (O-N) - T_{congest}}{A_{dt}} \quad (A.4)$$

$$S_{cap} = \frac{1\,800 - 180 + 0 - 60 - 240}{2,4} = 550\,persons < Cap_{tot}$$

A.3 MES capacity calculation example with a non-survival craft functioning as floating platform

A.3.1 Table A.5 provides an example of a completed test time form with a non-survival craft functioning as the floating platform.

Table A.5 — Test timing form completed (Example 2)

Event	Time (min:s)	Time elapsed (s)
Order to activate the system given	0:00	A: 0
System ready for lowering		B:
System lowered to the waterline		C:
System ready for descent	2:15	D: 135
Platform crew ready	3:00	E: 180
Time stopped for safety of test persons		F:
Time resumed		G:

Table A.5 *(continued)*

Event	Time (min:s)	Time elapsed (s)
First person starts descent to floating platform or survival craft	3:00	H: 180
Last person completes descent to floating platform or survival craft	9:36	I: 576
Handling of first associated survival craft initiated	3:00	J: 180
First person enters the first associated survival craft	6:00	K: 360
Last person enters the first associated survival craft	12:00	L: 720
Second associated survival craft secured and board able	14:00	M: 900
Disengagement of last survival craft from ship initiated	16:00	N: 960
Disengagement of last survival craft from ship completed	17:00	O: 1020

A.3.2 Calculation of deployed survival craft capacity

A.3.2.1 Survival craft capacity and deployment order is provided in Table A.6.

Table A.6 — Survival craft capacity and deployment order

Deployment order	1	2	3	4	5	6	7
Prefix	$Cap_{platform}$	Cap_1	Cap_2	Cap_3	Cap_4	Cap_5	Cap_6
Capacity	150	150	150	150			

A.3.2.2 The total capacity is calculated using Formula (A.1):

$$Cap_{tot} = Cap_{Platform} + Cap_1 + Cap_2 + Cap_3 + Cap_4$$

where

Cap_{tot} is the total survival craft capacity deployed and only including floating platform capacity if that is designated as a survival craft.

A.3.3 Calculation of total number of deployed associated survival crafts is shown in Table A.7.

Table A.7 — Calculation of total number of deployed associated survival crafts

Event	Time (s)	Remaining time	Crafts deployed
Time available for boarding and handling of associated survival crafts: $T_{evac} - (H - A) - (O - N)$	1 560	1 560	
Handling time for first associated survival craft: $(K - J)$	180	1 380	1/150 persons
Boarding time for first associated survival craft: $(L - K)$	360	1 020	
Handling time for second associated survival craft: $(M - L)$	120	900	1/150 persons
Boarding time for second associated survival craft: $\frac{L - K}{Cap_1} \times Cap_2$	360	540	
Handling time for third associated survival craft: $(M - L)$	120	420	1/150 persons

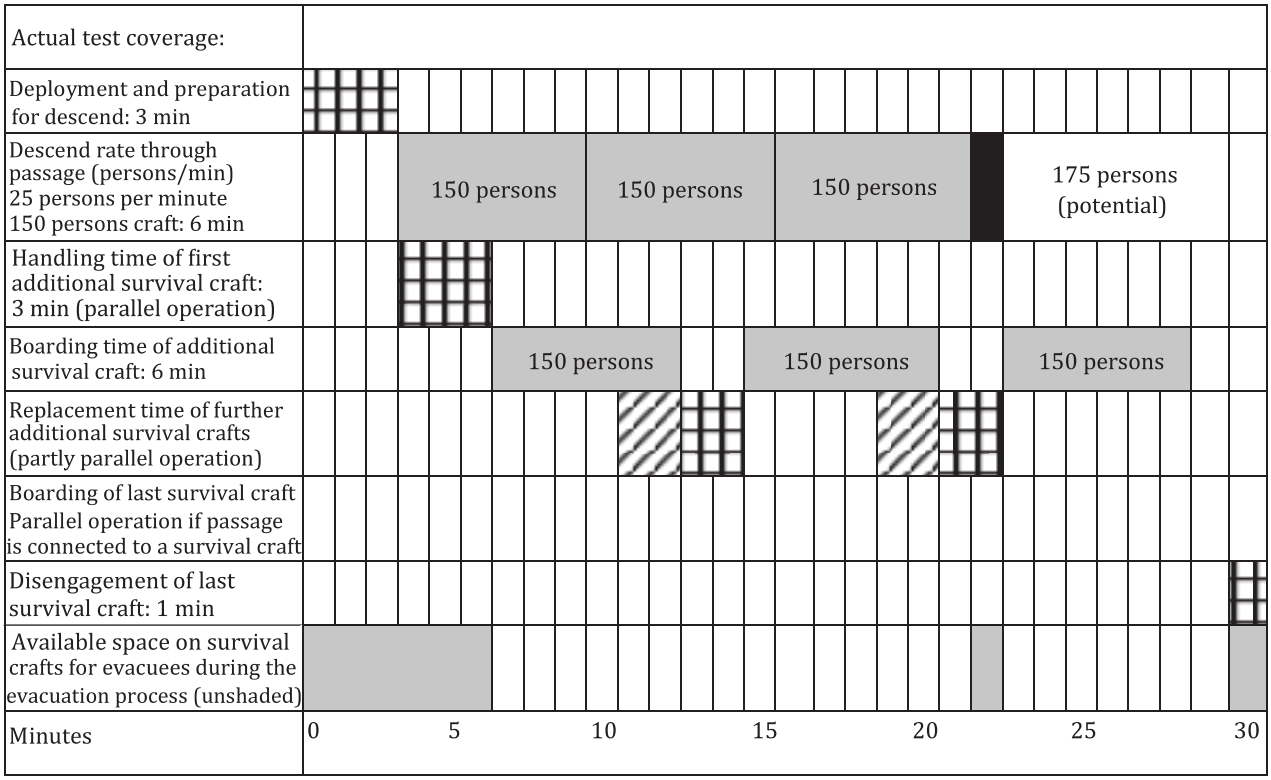
Table A.7 *(continued)*

Event	Time (s)	Remaining time	Crafts deployed
Boarding time for third associated survival craft: $\frac{L-K}{\text{Cap}_1} \times \text{Cap}_3$	360	60	
Handling time for fourth associated survival craft: $(M - L)$	n/a	n/a	
Boarding time for fourth associated survival craft: $\frac{L-K}{\text{Cap}_1} \times \text{Cap}_4$	n/a	n/a	

Cap_{tot}: 150 + 150 + 150 = 450 persons (floating platform capacity not included as the floating platform is not a designated survival craft).

A.3.4 Evacuation matrix is provided in Table A.8.

Table A.8 — Evacuation matrix [MES with floating platform (non-survival craft)]



A.3.5 Capacity calculation

$$T_{\text{congest}} = \left(\begin{matrix} T_{\text{hand1}} + T_{\text{board1}} + T_{\text{hand2}} + T_{\text{board2}} + T_{\text{hand3}} + T_{\text{board3}} + \\ T_{\text{hand4}} + T_{\text{board4}} \end{matrix} \right) - \left(A_{\text{dt}} \times \left(\text{Cap}_{\text{Platform}} + \text{Cap}_1 + \text{Cap}_2 + \text{Cap}_3 + \text{Cap}_4 \right) \right)$$

$$T_{\text{congest}} = \left(\begin{array}{l} \left(K - J\right) + \left(L - K\right) + \left(M - L\right) + \left(\frac{L - K}{\text{Cap}_1} \times \text{Cap}_2 \right) + \left(M - L\right) + \\ \left(\frac{L - K}{\text{Cap}_1} \times \text{Cap}_3 \right) + \left(M - L\right) + \left(\frac{L - K}{\text{Cap}_1} \times \text{Cap}_4 \right) \end{array} \right) - \left(A_{\text{dt}} \times \left(\text{Cap}_{\text{Platform}} + \text{Cap}_1 + \text{Cap}_2 + \text{Cap}_3 + \text{Cap}_4\right)\right)$$

N_{tp} = 165 persons (150 + 10 %)

where

N_{tp} is the number of test persons participating.

$$A_{\text{dt}} = \frac{I - H}{N_{\text{tp}}} = \frac{396}{165} = 2,4\,\text{s / person}$$

where

A_{dt} is the average descend time of passage per person (in seconds).

$$T_{\text{congest}} = \left(\begin{array}{l} \left(360 - 180\right) + \left(720 - 360\right) + \left(840 - 720\right) + \left(\frac{360}{150} \times 150 \right) + \\ \left(840 - 720\right) + \left(\frac{360}{150} \times 150 \right) + \left(\text{n/a}\right) + \left(\text{n/a}\right) \end{array} \right) - 2,4 \times \left(150 + 150 + 150 + 150 + \text{n/a}\right)$$

$$T_{\text{congest}} = \left(\begin{array}{l} \left(180\right) + \left(360\right) + \left(120\right) + \left(360\right) + \left(120\right) + \left(360\right) - \\ 2,4\left(600\right) \end{array} \right)$$

$$T_{\text{congest}} = 180 + 360 + 120 + 360 + 120 + 360 - 1\,440 = 60\,\text{s}$$

H – *A*: time for system deployment and preparation for descend;

O – *N*: time for disengagement of final survival craft.

$$A_{\text{dt}} = \frac{I - H}{N_{\text{tp}}} = \frac{396}{165} = 2,4\,\text{s/person}$$

Cap_{tot}: 3 × 150 = 450 (floating platform capacity not included as the platform is not a designated survival craft)

$$S_{\text{cap}} = \frac{T_{\text{evac}} - (H - A) + (G - F) - (O - N) - T_{\text{congest}}}{A_{\text{dt}}}$$

$$S_{\text{cap}} = \frac{1\,800 - 180 + 0 - 60 - 60}{2,4} = 625\,\text{persons} > \text{Cap}_{\text{tot}}\left(450\,\text{persons}\right) \Rightarrow S_{\text{cap}} = 450\,\text{persons}$$

NOTE If S_{cap} exceeds the total survival craft capacity, the MES capacity is taken as the total survival craft capacity.

A.4 Remarks concerning the above

A.4.1 The worked example in A.2 illustrates a system lacking synchronization between the evacuation passage and the processes of survival craft preparation, boarding and disengagement. Clearly, if one or a combination of these latter processes were to be speeded up, the full potential of the survival craft could be realized.

A.4.2 The worked example in A.3 illustrates a better balanced system using an equivalent passage but which, because the floating platform is not approved as a survival craft, provides a lesser capacity than the example in A.2.

Annex B
(informative)

Test forms

B.1 General

B.1.1 The following test forms are intended as guidance for manufacturers and approving authorities when recording and verifying the results of capacity tests of marine evacuation systems.

B.1.2 The variables used in the test forms are identical to those used throughout this document.

Table B.1 — MES evacuation test form

MES evacuation test form			
Manufacturer		Date	
Type		Surveyor	
Serial number		Organization	
Test data			
Number of persons (N_{tp})			
Installation height/lowering height of system (L1)			
Length of passage (H1)			

Number of test persons (N_{tp})	Distribution of test persons in relation to weight		
Weight range	<60 kg	60–90 kg	>90 kg
Distribution	10 %–20 %	60 %–80 %	10 %–20 %
Test persons			

Deployment order	1	2	3	4	5	6
Prefix	$Cap_{Platform}$	Cap_1	Cap_2	Cap_3	Cap_4	Cap_5
Capacity						

Table B.2 — Calculation of the total number of deployed associated survival crafts

Event	**Time** (s)	**Remaining time**	**Crafts deployed**
Time available for boarding and handling of associated survival crafts: $T_{evac} - (H - A) - (O - N)$			
Handling time for first associated survival craft: $(K - J)$			
Boarding time for first associated survival craft: $(L - K)$			
Handling time for second associated survival craft: $(M - L)$			

Table B.2 *(continued)*

Event	Time (s)	Remaining time	Crafts deployed
Boarding time for second associated survival craft: $\frac{L-K}{\text{Cap}_1} \times \text{Cap}_2$			
Handling time for third associated survival craft: $(M - L)$			
Boarding time for third associated survival craft: $\frac{L-K}{\text{Cap}_1} \times \text{Cap}_3$			
Handling time for fourth associated survival craft: $(M - L)$			
Boarding time for fourth associated survival craft: $\frac{L-K}{\text{Cap}_1} \times \text{Cap}_4$			
Total survival craft capacity deployed			

Table B.3 — Test timings

Event	Time (min:s)	Time elapsed (s)
Order to activate the system given	0:00	A: 0
System ready for lowering		B:
System lowered to the waterline		C:
System ready for descent		D:
Platform crew ready to receive test persons		E:
Time stopped for safety of test persons (see 6.5)		F:
Time resumed		G:
First person starts descent to floating platform or survival craft		H:
Last person completes descent to floating platform or survival craft		I:
Handling of first associated survival craft initiated		J:
First person enters the first associated survival craft		K:
Last person enters the first associated survival craft		L:
Second associated survival craft secured and board able		M:
Disengagement of last survival craft from ship initiated		N:
Disengagement of last survival craft from ship completed		O:

B.2 Possible congestion time

$$T_{\text{congest}} = \left(T_{\text{hand1}} + T_{\text{board1}} + T_{\text{hand2}} + T_{\text{board2}} + T_{\text{hand3}} + T_{\text{board3}} + T_{\text{hand4}} + T_{\text{board4}}\right) - \left(A_{\text{dt}} \times \left(\text{Cap}_{\text{Platform}} + \text{Cap}_1 + \text{Cap}_2 + \text{Cap}_3 + \text{Cap}_4\right)\right) \quad \text{(B.1)}$$

If $T_{\text{congest}} < 0$, it shall be taken as 0.

$$A_{\text{dt}} = \frac{I - H}{N_{\text{tp}}} \quad \text{(B.2)}$$

$$T_{\text{congest}} = \left(\begin{array}{l} \left(K-J\right)+\left(L-K\right)+\left(M-L\right)+\left(\frac{L-K}{\text{Cap}_1}\times\text{Cap}_2\right)+\left(M-L\right)+ \\ \left(\frac{L-K}{\text{Cap}_1}\times\text{Cap}_3\right)+\left(M-L\right)+\left(\frac{L-K}{\text{Cap}_1}\times\text{Cap}_4\right) \end{array} \right) - \_\_\_\_\_ \text{s} \quad \text{(B.3)}$$
$$\left(A_{\text{dt}}\times\left(\text{Cap}_{\text{Platform}}+\text{Cap}_1+\text{Cap}_2+\text{Cap}_3+\text{Cap}_4\right)\right) =$$

B.3 System capacity

$$S_{\text{cap}} = \frac{T_{\text{evac}} - (H-A) + (G-F) - (O-N) - T_{\text{congest}}}{A_{\text{dt}}} = \_\_\_\_\_ \text{ persons} \quad \text{(B.4)}$$

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