



MARITIME SAFETY COMMITTEE
75th session
Agenda item 23

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ANY OTHER BUSINESS

Micro climate in totally enclosed survival craft

Submitted by Germany

SUMMARY

Executive summary: This document aims at revising both the LSA-Code and resolution MSC.81(70) with regards to setting minimum standards for breathing air quality in future totally enclosed survival craft. It is submitted in accordance with the “Guidelines on the Organization and Method of Work of the Maritime Safety Committee and the Maritime Environment Protection Committee and their subsidiary bodies” (MSC/Circ.931-MEPC/Circ.366).

Action to be taken: Paragraph 7

Related documents: DE 45/INF.11, LSA Code and resolution MSC.81(70)

1 Inclusion of a new work programme item:

- This Document aims at revising both the LSA-Code and resolution MSC.81(70) with regard to setting minimum standards for breathing air quality in future totally enclosed survival craft.
- The compelling need has been demonstrated by extensive qualified research and is discussed further down.
- Costs for the maritime industry are very limited. The associated legislative and administrative burdens are negligible at global level.
- The probability of safe stay and of survival in totally enclosed survival craft will be enhanced considerably.
- [Consideration at DE 46, subsequent approval and adoption by MSC]

1.1 The proposed subject is within the objectives of the Organization, adequate industry standards do exist, and the benefits do justify the proposed action.

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1.2 In the Life-Saving Appliances Code (LSA Code), chapter 4, general requirements are laid down with regard to the construction of survival craft. These requirements serve the purpose of safeguarding an adequate and safe refuge for shipwrecked persons at sea, very often in adverse weather and harsh climatic conditions. These requirements deal, inter *alia*, also with structural precautions to provide for a sound climate in the interior of such craft, mainly in the way of sufficient ventilation.

2 Research

2.1 Germany had informed the Sub-Committee on Ship Design and Equipment, at its forty-first session, about the results of research and field studies by a specialised German Institute www.schiffssicherheit.de >Aktuelles/News< under sea conditions with internationally approved totally enclosed survival craft (boats and rafts) to assess, from the medical point of view, the conditions of stay in such craft. Special emphasis had been put on the microclimate in such totally enclosed survival craft. That 1995 research had disclosed severe deficiencies of the quality of that climate under realistic emergency conditions at sea. The main results of these studies had revealed that severe climatic conditions inside the enclosed craft and other stress factors would, under certain conditions, endanger the life/impair the health of the occupants, mainly through rapidly worsening breathing air quality. For major results of that study see annex 2 of this document.

2.2 Further research carried out in Germany has underlined the 1995 research results. Under emergency conditions with the entrances and the outlook openings of fully loaded liferafts (crew and/or passengers) the condition of the interior air ensuing from these measures was investigated in detail with 4 to 16 person liferafts used on leisure boats and in professional seafaring. The trials were performed in cool, calm weather under laboratory and sea conditions. Further information is available in the Internet www.uke.uni-hamburg.de/institute/arbeitsmedizin >Publikationen<. The results, as presented in annex 1 to this document, in underlining the 1995 research results (annex 2), show a great decline in oxygen as well as a big rise in carbon dioxide even within only one hour's time. Some results are demonstrated in the reference curves of annex 1 (all colours with the exception of green and blue). This situation endangers a person's health, especially the rise of CO₂ up to values of 5 vol.-% (lethal value for long time exposure). The blue curves stem from liferafts with permanent ventilation and the green ones from liferafts with a new canopy material.

3 Proven cases of lethal accidents due to insufficient oxygen or an increase of CO₂ inside liferafts or totally enclosed lifeboats do hitherto not exist because, when corpses are found in liferafts and/or lifeboats, it is (universally) declared that their death was caused by an accident, without however thoroughly investigating the exact reasons behind.

4 When the normal volume percentage of CO₂ in the ambient air in closed liferafts increases it has the following adverse effects: generally a CO₂ rise from 0 to 3% shows no detectable respiratory or other discomfort, between 4 and 6% breathing frequency increases and general arousal occurs. Lack of breath and mental deterioration are noticed between 7 and 10% CO₂. If CO₂ rises to higher levels than 10%, progressive lack of breath, violent respiratory distress, unconsciousness, spasmodic neuromuscular twitching and convulsions occur. In addition to the above mentioned symptoms hunger, thirst, increased urine production, fatigue and sleepiness may be noticed with increasing CO₂ concentrations.

When CO₂ rises, the O₂ percentage will fall with consequences for the occupants: At first breathing frequency as well as heart rate and blood pressure gradually increase when O₂ falls below 17%. Discomfort, uneasiness and lack of breath are present at 15%. Mental function begins to be impaired between 13,3 and 10,5% O₂. The symptoms are similar to alcohol intoxication. The will to survive declines. Changes in mood occur, mistakes are made where skill or intelligence is necessary. Confusion and disorientation are noticed due to lack of oxygen in the brain. Unconsciousness and eventually death can/will occur when O₂ in the closed life raft decreases to less than 10%.

5 For the reasons set out in paragraphs 2 to 4 above, it is deemed necessary that in fully occupied survival craft with sealed entrances and sealed outlook openings the oxygen level should never drop below 18% and the carbon dioxide level never increase to more than 3%. This can be achieved by either:

- inclusion of a sufficiently dimensioned permanent ventilation. (which is not supported because watertightness and seaworthiness of survival craft will be unduly impaired); or
- construction of protective canopies/entrances from completely or partially gas permeable material.

6 As waterproof material which, at the same time, is permeable for gases is obtainable on the market in SOLAS quality Germany proposes minimum standards for climatic conditions in future totally enclosed survival craft to be set both in the LSA Code and in resolution MSC.81(70) – Revised Recommendation on Testing of Life-Saving Appliances – as set out in annex 3 to this document.

Action requested of the Committee

7 The Committee is invited to consider the above results of the research activities and the proposals for amending the LSA Code and resolution MSC.81(70) in annex 3 in order to draw the necessary consequences and to decide, as it deems appropriate.

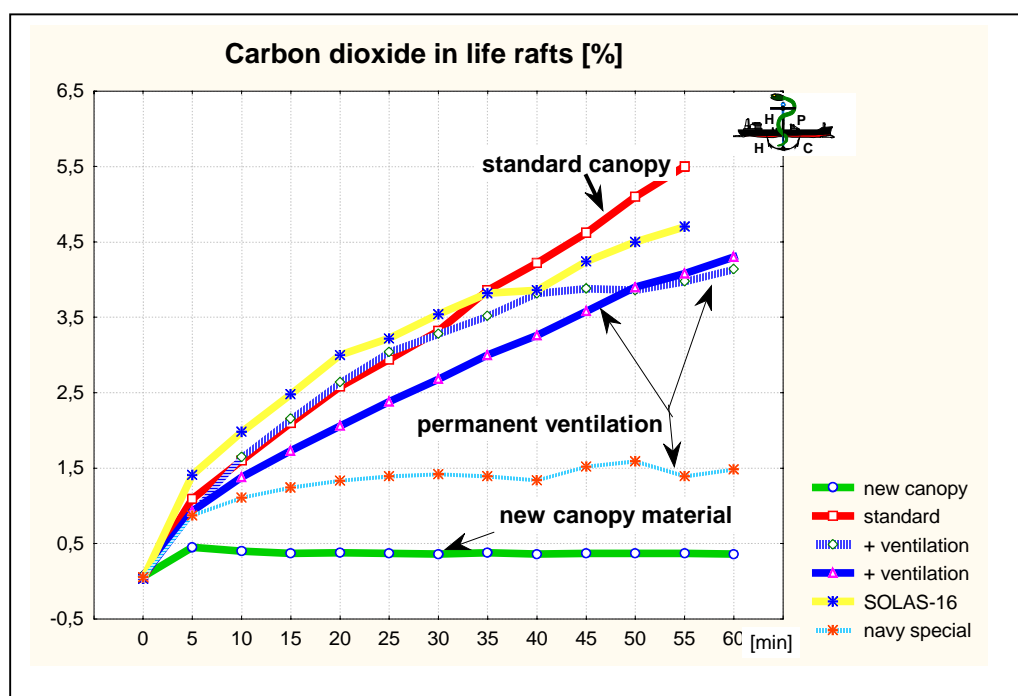
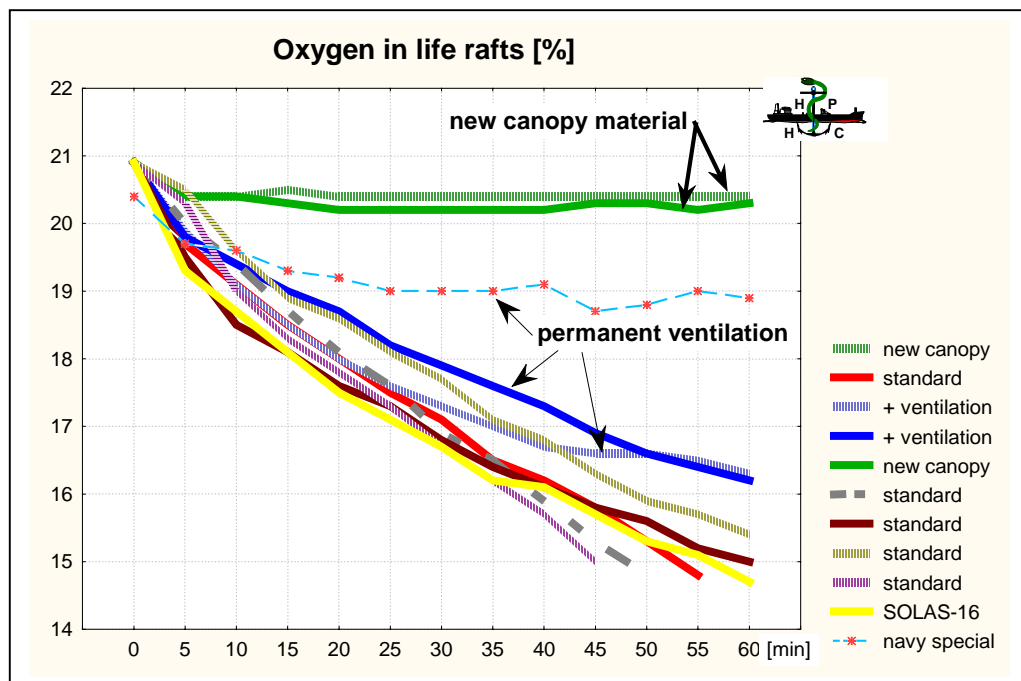
ANNEX 1

Latest research results

Explanation

ad 1.

So far, sufficient forced ventilation was only found in a Navy liferaft in which, in comparison, the number of occupants were only half as many as those found in merchant marine liferafts. In all the other liferafts, forced ventilation was insufficient. In addition, we found insufficient - ventilation caused - watertightness in all the life rafts with ventilation (blue curves marked with "permanent ventilation").



ad 2.

If the canopy or parts thereof are made of gas permeable material, problems occur neither through insufficient breathing gas exchange nor through water-tightness. The liferafts can be completely closed (green curves marked with "new canopy material").

These green curves show liferafts with a new type of canopy material made of PTFE, which leads to a perfect, well breathable atmosphere.

In every type of tested liferaft, the inside temperatures climbed to sufficiently high levels, thus excluding the danger of hypothermia.

Liferafts with standard canopies very rapidly became wet inside due to condensation water. However, the liferafts with the new canopy material remained dry during the whole trial time.

ANNEX 2

RESULTS OF THE 1995 GERMAN RESEARCH INTO THE MICRO CLIMATE IN TOTALLY ENCLOSED SURVIVAL CRAFT¹ AS NOTIFIED TO DE 41

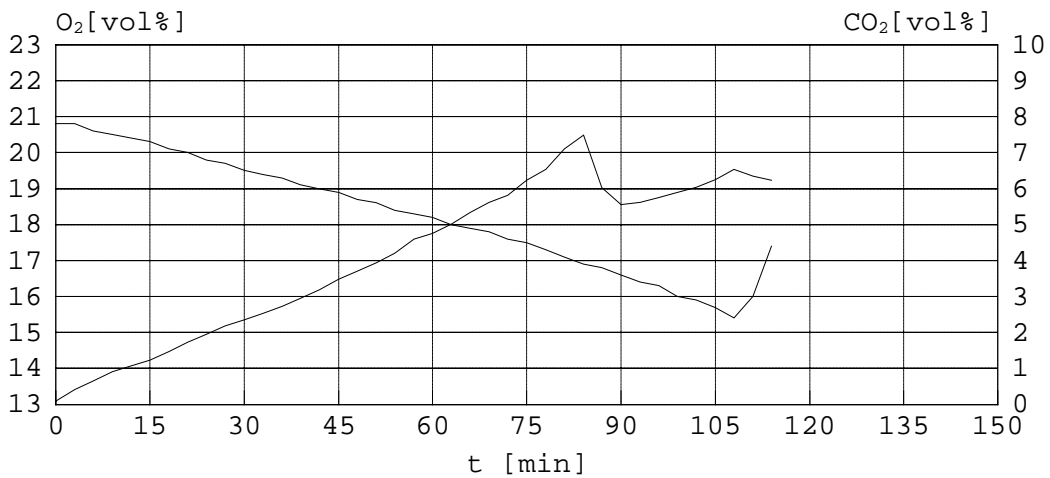


Figure 1

Concentration of oxygen (O₂) and carbon dioxide (CO₂) as a function of time, place of measurement stern, for the field test in TSL-T 5.7 type lifeboat on 7 June 1995, occupied by 15 probationers under functionally given closed state, floating.

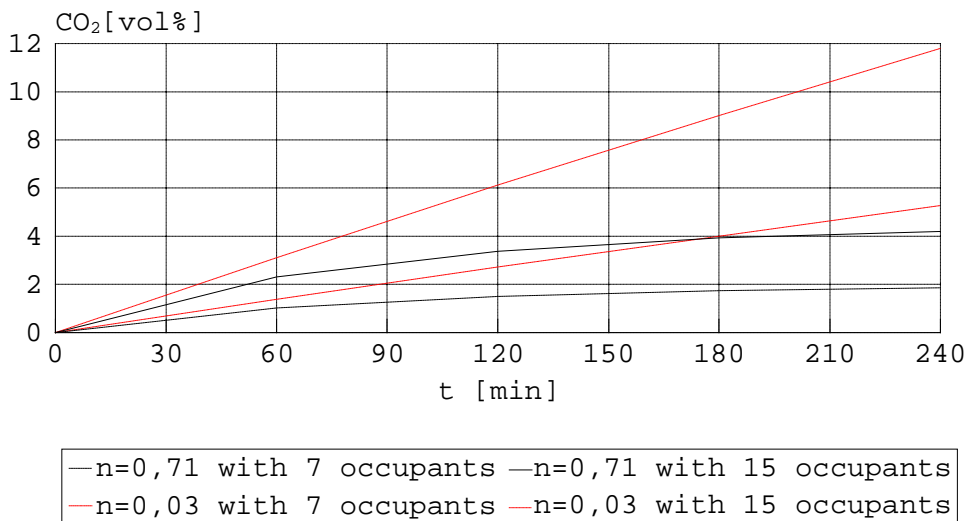


Figure 2

Concentration of carbon dioxide (CO₂) as a function of time under variation of the parameters ventilation rate and number of persons for GSL-T 5.7 type lifeboat

¹ Federal Institute for Occupational Safety and Health (FIOSH), Fb 742, J. Hahne, G. Baaske, S. Hein, H. Tober, E. Dörp, B. Hortian, D. Lorenz, H. Künstner, 'Development and assessment of requirements for using of closed life-saving appliances in case of distress at sea - demands on microclimate and statements on the acceleration behaviour in closed life-saving appliances', Dortmund 1996

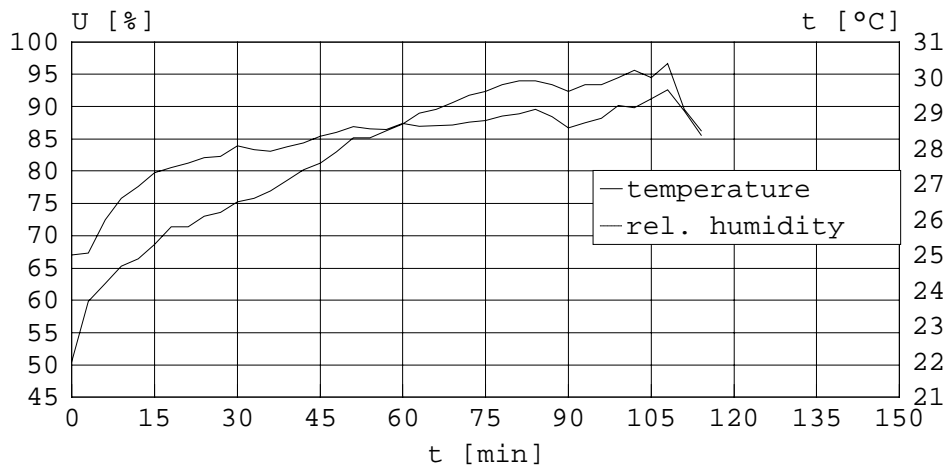


Figure 3

Temperature and relative humidity of air for floating state as a function of time in the lifeboat for the field-test on 7 June 1995. Occupied by 15 probationers in functionally given closed state.

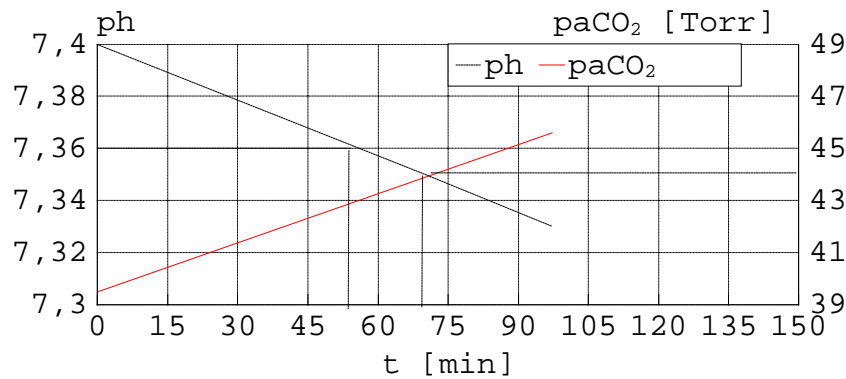


Figure 4

Ph-value (ph) and carbon dioxide (CO₂) partial pressure (pa) as a function of time for the tests carried out in a closed lifeboat on 7 June 1995, giving exact time of exceeding limiting values (pa CO₂ = 44 torr, pH = 7.36)

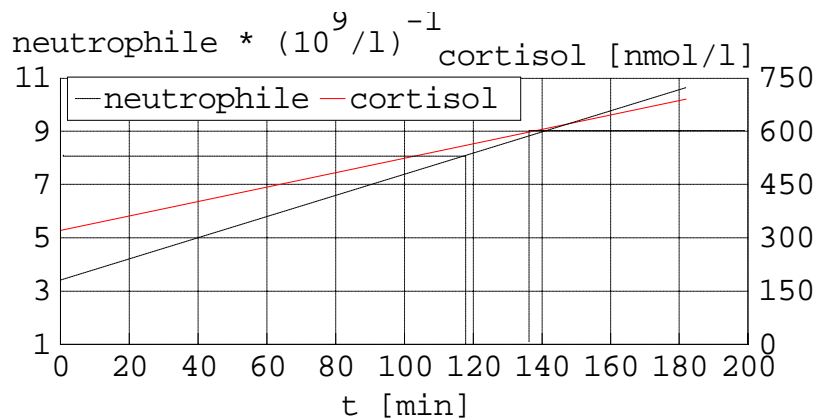


Figure 5

Neutrophile (test on 30 May 1995) and cortisol (test on 7 June 1995) as a function of time in a closed lifeboat giving exact time of exceeding limiting values (Neutrophile = $8 * (10^9 / l)$, cortisol = 600 nmol/l)

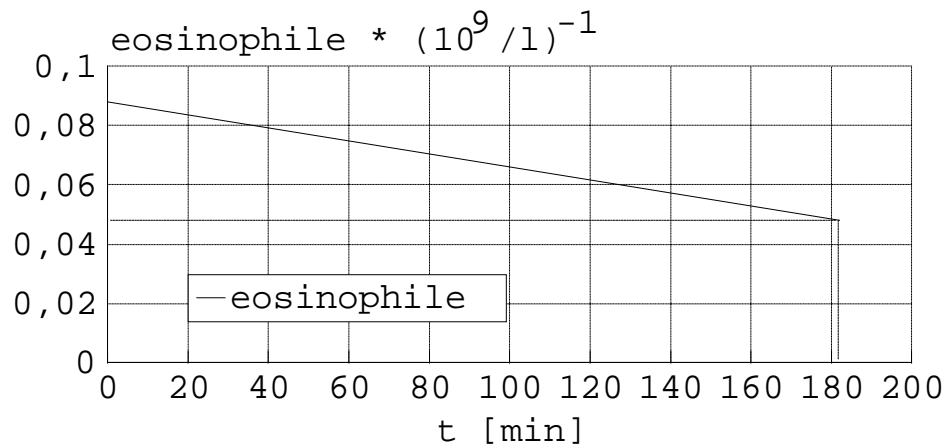


Figure 6

Eosinophiles (on 30 May 1995) as a function of time in a closed lifeboat giving exact time of exceeding limiting values (eosinophile = $0,05 * (10^9 / l)$)

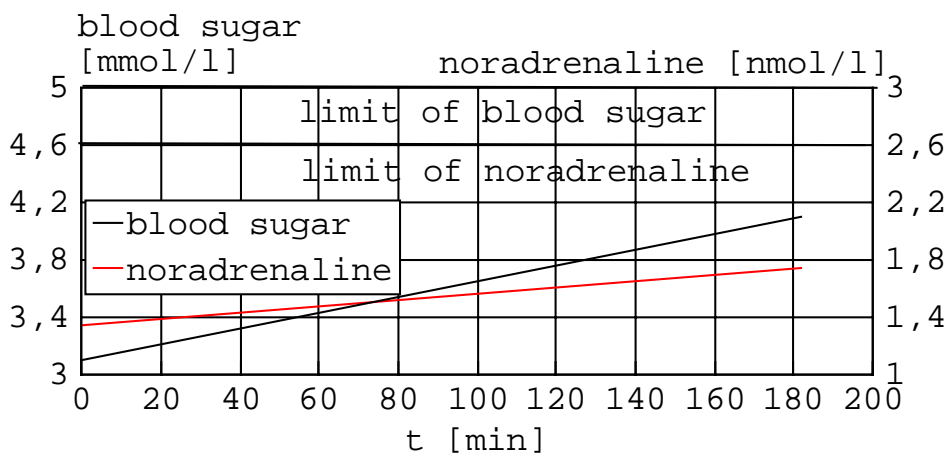


Figure 7

Blood sugar and noradrenaline as a function of time in a closed lifeboat for the test carried out on 30 May 1995. Statement of limiting values (sugar = 5 mmol/l, noradrenaline = 2.5 nmol/l).

ANNEX 3**1 Proposals for amendments of the LSA Code, Chapter IV (Survival Craft):**1.1 Item 4.1.1.5.4 (Liferafts):

(The canopy shall comply with the following:)

"it shall admit sufficient air for the occupants at all times, even with the entrances closed (the oxygen level should never drop below 18% and the carbon dioxide level never increase to more than 3%);"

1.2 Item 4.5.2.6: (Partially enclosed lifeboats)

(The canopy shall be so arranged that:)

"with the entrances closed, it admits sufficient air for the occupants at all times (the oxygen level should never drop below 18% and the carbon dioxide level never increase to more than 3%);"

1.3 Add a new item 4.6.2.12 (Totally enclosed lifeboats):

(The enclosure shall be so arranged that...)

"it shall admit sufficient air for the occupants at all times, even with the entrances closed (the oxygen level should never drop below 18% and the carbon dioxide level never increase to more than 3%);"

2 Proposals for amendment of resolution MSC.81(70):2.1 Add a new item 5.23 (Rigid and inflatable liferafts):

"5.23 Air supply test

It shall be demonstrated that inside of the fully manned liferaft with closed entrances the oxygen level will never drop below 18% and the carbon dioxide level never increase to more than 3% within a test period of not less than 60 minutes during normal weather conditions."

2.2 Add a new item 6.18 (Lifeboats):

"6.18 Air supply test

It shall be demonstrated that inside of the fully manned lifeboat with closed entrances the oxygen level will never drop below 18% and the carbon dioxide level never increase to more than 3% within a test period of not less than 60 minutes during normal weather conditions."