

SUB-COMMITTEE ON SHIP DESIGN AND  
CONSTRUCTION  
10th session  
Agenda item 12

SDC 10/12  
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**GUIDELINES FOR USE OF FIBRE-REINFORCED PLASTICS (FRP)  
WITHIN SHIP STRUCTURES**

**Important considerations regarding the use of  
fibre-reinforced plastics (FRP) within ship structures**

**Submitted by Germany and CESA**

**SUMMARY**

*Executive summary:* This submission proposes a number of considerations for the review of the current Interim guidelines and timelines for the finalization of this review. Importantly, the Sub-Committee is invited to discuss whether requirements stemming from SOLAS would conflict with the updated FRP Guidelines.

*Strategic direction, if applicable:* 2

*Output:* 2.6

*Action to be taken:* Paragraph 13

*Related documents:* SDC 8/18; MSC 105/20; MSC 100/19/3; SDC 9/15/2, SDC 9/16 and MSC 107/20

**Introduction and background**

1 The Maritime Safety Committee (MSC), at its ninety-eighth session, adopted the *Interim guidelines for use of Fibre Reinforced Plastic (FRP) elements within ship structures: Fire safety issues* (MSC.1/Circ.1574) (Interim guidelines), which now have been in use for six years. MSC.1/Circ.1574, paragraph 5, states that the Interim guidelines should be reviewed four years after their approval in order to make any necessary amendments based on experience gained.

2 For that purpose, the output on the review of the Interim guidelines was kept on the post-biennial agenda and interested Member States and international organizations were invited to consider the need to review them and to submit any proposals to the SDC Sub-Committee.

3 In 2022, CESA made the submission *Experience gained with larger FRP structures in ship construction* (SDC 9/15/2) to SDC 9, proposing the review of the Interim guidelines with a view to the wider application of FRP beyond their current limitation as structures that may be removed without compromising the safety of the ship. Consequently, the Sub-Committee agreed to invite MSC to move the output 'Guidelines for use of fibre-reinforced plastics (FRP) within ship structures' from its post-biennial agenda to the 2024-2025 biennial agenda of SDC, as well as to place it on the provisional agenda of SDC 10. MSC 107 agreed to the proposal of SDC 9 to include the post-biennial output on the revision of the 'Guidelines for use of fibre-reinforced plastics (FRP) within ship structures' in the provisional agenda of SDC 10 (MSC 107/20/Add.1, annex 41) and set the target completion year to 2025.

4 Furthermore, SDC 9 agreed that any work undertaken on the review of the Interim guidelines would need to take into account and address the concerns raised during the meeting regarding the potential challenges with using FRP, in particular concerning its recycling and its combustibility with respect to fire safety.

### Discussion

5 With this submission CESA and Germany would like to bring to the attention of the Organization the experience gained in the application of FRP with a view to facilitating the review and potential amendment of the Interim guidelines and to improve the uptake of new technologies for greener shipping.

6 The annex highlights new results from R&D projects, as well as an overview of the expected contributions of various projects which should be considered. Moreover, it provides an overview of advancements made in the development of applications for FRP elements in ship structures through R&D projects, ships in use built according to IMO instruments other than SOLAS and further insights.

7 The co-sponsors emphasize the need to facilitate technical discussions, also in between (sub)committee meetings, to progress the revision of the Interim guidelines. The co-sponsors therefore invite the Sub-Committee to consider establishing an intersessional working group reporting to SDC 11. Noting that discussing this very technical topic by correspondence alone may be challenging, the co-sponsors would also advise considering establishing an intersessional working group to take place after MSC 108 and also reporting to SDC 11.

8 Importantly, the Sub-Committee is invited to discuss whether requirements stemming from the existing SOLAS regulation II-2/11 as well as class "A" steel requirements in SOLAS would conflict with the updated FRP Guidelines that would permit the use of FRP in structures. In such a case, MSC 108 should be informed accordingly and a corresponding proposal for a new output should be submitted.

9 The following timelines are therefore foreseen:

IMO meeting	SDC 10 decides that SOLAS would not conflict	SDC 10 decides that SOLAS would conflict
IMO SDC 10 (2024)	Establish IMO CG on the FRP Guidelines to report to SDC 11.	
	Establish an intersessional working group to meet between SDC 10 and SDC 11 and after MSC 108.	
		Invite submissions to MSC 108 for a new output amending SOLAS to allow the use of FRP structures in accordance with the reviewed FRP

IMO meeting	SDC 10 decides that SOLAS would not conflict	SDC 10 decides that SOLAS would conflict
		Guidelines and with SDC as its Associated organ and target year 2025.
	SDC 10 to invite submissions to MSC 108 and promote information exchange.	
Intersessional Working Group	Progress work on the FRP Guidelines, reporting to SDC.	Progress work on the FRP Guidelines and amendments to SOLAS, reporting to SDC.
IMO MSC 109 (2024)	SDC 10 to invite submissions to MSC 109 and promote information exchange	
IMO SDC 11 (2025)	Dedicated WG for preparation of the FRP Guidelines	Dedicated WG for preparation of the FRP Guidelines and amendments to SOLAS.
IMO MSC 110 (2025)	Approval of the FRP Guidelines	

10 The application of the Interim guidelines is currently limited to FRP elements only, which are defined as a structure that may be removed without compromising the safety of the ship. This limitation hampers a broader utilization of lightweight structures in ship construction, which is a significant design aspect in order to increase the energy efficiency and climate friendliness of shipping (SDC 9/15/2, paragraph 5).

11 The Interim guidelines still cannot be utilized for ships constructed entirely of FRP materials or FRP composite structures contributing to the global strength of the ship because the Interim guidelines currently do not fully address the risks of progressive structural collapse or global loss of structural integrity due to fire (SDC 9/15/2, paragraph 6).

## Proposals

12 The submitters therefore invite the Sub-Committee to:

- .1 consider whether a consequential amendment of SOLAS is required to enable the use of FRP in structures and advise MSC 108 accordingly;
- .2 establish a correspondence group preparing the revision of the current Interim guidelines taking into consideration information contained in this submission;
- .3 establish an intersessional working group between SDC 10 and SDC 11;
- .4 establish a working group during SDC 11 to finalize the draft Guidelines for use of fibre-reinforced plastics (FRP) within ship structures in order to submit these to the following meeting of MSC for approval; and
- .5 to encourage interested delegations to submit proposals to the next MSC and SDC meetings and work intersessionally.

## Action requested of the Sub-Committee

13 The Sub-Committee is invited to consider the information provided in paragraphs 5 to 11 and proposals for the way forward provided in paragraph 12 and take action, as appropriate.

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## ANNEX

### CONSIDERATIONS

- A. Extend the scope of the Guidelines to ship structures, beyond "elements"  
For instance, Chapter 1, Section 1.3 should therefore be deleted.
- B. Definitions of (non-)combustible material in Chapter 1, Section 1.1 and SOLAS II-2  
Section 1.1 clarifies that *"any element that can comply with the prescriptive requirements is outside the scope of these guidelines"* and therefore that *"in these guidelines combustible FRP elements are implied"*.
- SOLAS regulation II-2/11.2 requires *"The hull, superstructures, structural bulkheads, decks and deckhouses shall be constructed of steel or other equivalent material. For the purpose of applying the definition of steel or other equivalent material as given in regulation 3.43"*.
- SOLAS regulation II-2/3.34 defines *"Steel or other equivalent material means any non-combustible material [...]"* Since FRP is considered combustible, it cannot be used.
- C. Acceptable safety level demonstrated for ships with FRP composites that go beyond the definition of an 'element'  
A key experience from the RAMSSES project's study *Custom Made Hull for Offshore Vessel* was that an acceptable safety level, including fire safety, can be demonstrated even for ships with FRP composites that go beyond the definition of an 'element' as per chapter 1.3 of the annex to the Interim guidelines (IG) (*'a structure which may be removed without compromising the safety of the ship'*). Hence, it should be considered to abandon the exclusion of FRP composite structures from the IG which are part of the ship's global load bearing structure.
- D. Update reference in SOLAS regulation II-2/17.3  
The footnote in the engineering analysis for alternative design refers to IMO MSC/Circ.1002, but should refer to its update IMO MSC.1/Circ.1455.
- E. Develop an allocation scheme for room types which translates the different nomenclatures used in IMO instruments  
For example, in the alternative design process, it is difficult to use the insulation table for HSC with some additions based on the risk assessment as it was not always straightforward how to translate the room types.
- F. Allow use of combustible material for the fire divisions (A-/B-/C-) according to SOLAS, if proper insulation is provided (Establish separation of combustibility and load bearing capacity)  
FRP cannot be used in these divisions due to the combustibility of the material (see annex A). The Naval Shipcode and construction industry separate the requirements for loadbearing capacity from the thermal insulation, as proposed in RAMSSES (Deliverable D06.3, 4.4. Design, Definitions of "REI" requirements), which would replace the need for incombustible materials in A-/B-/ or C-class regulations.
- G. Structural Integrity Requirements for FRM bulkheads (E.G. FRD-10).

The FTP Code Part 10 does not include structural/loadbearing requirements. In a risk assessment it is not possible to assess what will happen with these panels in case of fire.

It is proposed to add an additional division (FRD-10), enabling testing of the structure for integrity for a period of 10 minutes.

H. Requirements for external surfaces: SOLAS does not specify any requirements for external spaces or voids.

There are spaces with almost no ignition sources or flammable content, but it is difficult to conclude that this should not be protected by insulation.

Fire spreading to the external surfaces is a large risk (for larger vessels) yet there is no FTP standard, suited for composites, that can demonstrate the improved performance.

I. The following suggestions regarding fire tests are made:

i. The FTP part 5 regulations are not well suited for composites. Therefore, a regulation between FTP part 5 and part 10 should be put in place, since currently there is a lack of suitable IMO tests if 'lower flame spread surfaces for composites' are to be applied, e.g. decks and outer surfaces.

ii. Add a structural performance requirement for FRM bulkheads (e.g. FRD-10). (See annex F).

iii. Add a separate requirement for fire reaction (time to fire reaction)

iv. Create a requirement and feasible test for the ignitability of exposed composites on outer surfaces

v. Add a risk-based table for composite structures, or to add the possibility to create a risk-based table such as in the naval ship code, solution 2.

vi. Consideration 'goal based testing' approach to fire test

Standard test set-up may not correspond to the loads in a realistic fire scenario, as the normally protected core materials would be directly exposed to flames and heat.

J. Cradle to cradle ship material circularity passport

CirclesOfLife is an EU funded project (duration January 2024 - December 2026) which will address issues of assessing the overall environmental footprint of ships, including non-operational processes. One goal is to develop a cradle to cradle ship material circularity passport to provide a transparent, understandable, comprehensive and trustworthy methodology to rate the sustainability of ships. When reviewing the IG, it is suggested to make use of the material passport approach and to compare the advantages and disadvantages of different materials over the life cycle in a fair manner, such as steel (good recyclability vs. high weight), aluminum (low weight vs. high energy demand during production), and FRP composites (low weight vs. – currently – little experience with recycling). It is intended that CirclesOfLife will interact with various international stakeholders to enhance acceptance of sustainable materials.

K. Potential basis for fire assessments

In August 2023, the EU funded project LASH FIRE<sup>1</sup> was finalized. Within the project, fire requirements of non-regulated materials were assessed, including composite

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<sup>1</sup> <https://lashfire.eu>

materials and intumescent systems. 30 different material layouts were developed<sup>2</sup> and fire tests according IMO FTP Code Part 2 and Part 5 were performed. Finally, a proposal for fire property requirements for surfaces in ro-ro spaces was developed. More than 200 fire tests have been performed and the data, as well as RAMSSES results, are available in two databases, the RISE Fire database and at E-LASS Material database. The related report is public and available online<sup>3</sup>. This data may be used as reference to the discussion and can be used as a basis for fire assessments, including assessments according SOLAS chapter II-2, regulation 17.

L. Holistic FRP study regarding electric passenger ferries

The German-funded project E2MUT<sup>4</sup> (ongoing) studies electric passenger ferries. The application showcases that new design principles and FRP materials, in combination with alternative propulsion concepts, can significantly extend the range and reduce emissions. Aspects of this project include the development of fire protected FRP ship structures, methods of structural design and health monitoring for FRP parts, joining methods for multi-material combinations as well as examinations on the recyclability and life cycle of FRP parts in marine applications. The results of this project will be a valuable input for the revision of the IG.

M. Ships with FRP as a main building material (hull and structure) built according to other IMO instruments

The increasing number of ships with FRP as a main building material (hull and structure) built according to other IMO instruments, such as the HSC Code, provides a growing knowledge and experience base with structural parts built of FRP materials.<sup>5</sup>

N. Military and authority vehicles with FRP

Furthermore, there are a growing number of military and authority vehicles with FRP as a main building material<sup>6</sup>. Experiences gained in this area and to the extent applicable to seagoing ships could be taken into account for the review of the IG.

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<sup>2</sup> [https://e-lass.eu/media/2017/10/E-LASS-Pula-carrier\\_v2\\_final\\_1.pdf](https://e-lass.eu/media/2017/10/E-LASS-Pula-carrier_v2_final_1.pdf)

<sup>3</sup> [https://lashfire.eu/media/2023/10/LASH-FIRE\\_D08.14\\_Fire-risk-assessment-and-establishment-of-requirements-for-combustible-surfaces-in-ro-ro-spacese.pdf](https://lashfire.eu/media/2023/10/LASH-FIRE_D08.14_Fire-risk-assessment-and-establishment-of-requirements-for-combustible-surfaces-in-ro-ro-spacese.pdf)

<sup>4</sup> <https://ar-engineers.de/en/e2mut-research-on-resistance-reduction-through-lightweight-design-concepts-foiling-technology/>

<sup>5</sup> BRØDRENE AA AS; <https://www.braa.no/fast-ferries>

<sup>6</sup> e.g. Visby Class by Kockums