

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

SDC 10/12/2
1 December 2023
Original: ENGLISH
Pre-session public release:

GUIDELINES FOR USE OF FIBRE-REINFORCED PLASTICS (FRP) WITHIN SHIP STRUCTURES

Comments on document SDC 10/12

Submitted by IACS

SUMMARY

Executive summary: This document comments on the proposals in document SDC 10/12 (Germany et al.), in particular with regard to addressing the fire testing of the FRP structures and informs about the experience of IACS members leading to the conclusion on the need for improvement in the current testing regime for fire performance of composite structures.

Strategic direction, if applicable: 2

Output: 2.6

Action to be taken: Paragraph 16

Related documents: SDC 8/18; MSC 105/20; MSC100/19/3; SDC/9/15/2, SDC 9/16 and SDC 10/12

Introduction

1 This document is submitted in accordance with the provisions of paragraph 6.12.5 of the *Organization and method of work of the Maritime Safety Committee and the Marine Environment Protection Committee and their subsidiary bodies* (MSC-MEPC.1/Circ.5/Rev.5) and provides comments on document SDC 10/12.

Background

2 After the approval by MSC 98 of the *Interim Guidelines for use of fibre reinforced plastic (FRP) elements within ship structures: fire safety* (MSC.1/Circ.1574), the Committee agreed to keep the output "Guidelines for use of fibre-reinforced plastics (FRP) within ship structures" on the post-biennial agenda with a view to making any necessary amendments based on experience gained. MSC 107 agreed to the proposal by SDC 9 (based on document SDC 9/15/2 (CESA)) to place the output "Guidelines for use of fibre-reinforced plastics (FRP) within ship structures" onto the provisional agenda of SDC 10.

3 Paragraph 10 of document SDC 9/15/2 addressed some of the main fire safety aspects which are affected by the introduction of FRP structures, i.e. fire growth potential, fire containment and structural integrity during and after a fire. While document SDC 9/15/2 was generally supported by many delegations, nevertheless concerns were raised regarding the potential challenges associated with the use of FRP, in particular concerning its combustibility with respect to fire safety (SDC 9/16, paragraph 15.10).

4 Document SDC 10/12 outlines a possible way forward for progressing the work under the present agenda item and provides in the annex thereof a list of key topics to be further considered. Specifically, in relation to the issues discussed in paragraph 3 above, IACS notes that paragraph I in the annex to document SDC 10/12 provides further suggestions to improve the fire testing regime for FRP composites within the FTP Code.

Discussion

5 IACS supports further considerations of the main fire safety aspects identified in documents SDC 9/15/2 and SDC 10/12. In addition, IACS believes that considerations should be given also to the following aspects of fire safety when utilizing FRP as structural materials:

- .1 the ignition potential of the FRP material, e.g. by electrical failures: dedicated design principles to reduce any additional risk may be required;
- .2 fire-fighting strategies and equipment: standard maritime strategies may not work efficiently, and;
- .3 the maintenance of protective measures: the insulation to protect the FRP to be maintained over the lifetime of the ship to keep an acceptable safety level.

6 While providing comments on paragraph I in the annex to document SDC 10/12, IACS would also like to draw attention to the annex to document SDC 9/15/2. That annex contains a flow chart which proposes fire resistance test procedures for "A" and "B" class divisions constructed of FRP composite materials, based on the performance requirements of divisions with respect to the load-bearing capacity ("R"), integrity ("E") and insulation ("I"). IACS is supportive of this proposal which may contribute to improved and more function-based requirements for testing of FRP structures and notes the need for further development work in this area.

Improvement in the current testing regime for fire resistance performance of composite structures

7 In the following paragraphs, IACS would like to share the experience of its members leading to the conclusion on the need for improvement in the current testing regime for fire resistance performance of composite structures.

8 Part 3 of annex 1 to the FTP Code contains mandatory fire resistance test procedures for "A" and "B" class divisions. Those procedures assume the use of materials with certain characteristics, e.g. non-combustibility, low flame-spread characteristics, that readily conduct heat. For load-bearing divisions of aluminium alloys, because of their premature softening at elevated temperatures, the methodology also requires the average temperature of the structural core not to exceed a threshold (paragraph 3.3 of part 3 of annex 1 to the FTP Code).

9 One of the main performance criteria during fire testing of "A" and "B" class divisions is related to the temperature of the side facing away from the fire. FRP structures are made of fibres and polymers while the core material is made of, e.g. polymer-based foam, cellulosic

honeycomb or balsa wood. In contrast to metallic materials, FRP materials typically have the benefit of very low heat conductivity (~100 times lower) and thus high surface temperatures on the unexposed side of the fire present no issue. However, due to its material properties, the FRP structure is usually protected on either side by a non-combustible fire-rated insulation, as it will degrade due to the combustion of the organic content material of the FRP or the softening of the resin at elevated temperatures, i.e. it will lose its load bearing capacity.

10 IACS members have witnessed that significant damage may occur to the skin on the fire exposed side of the FRP structure, while the thermocouples on the non-fire exposed side are at, or are close to, ambient temperature, fulfilling the surface temperature criterion of the fire test for steel or equivalent materials, of part 3 of annex 1 to the FTP Code.

11 IACS is of the view that current fire test procedures of part 3 of annex 1 to the FTP Code are not adequate to evaluate the fire performance of composite FRP divisions fitted on ships which are subject to requirements of SOLAS and that some modifications are required to focus on the relevant safety characteristics, e.g. decomposition/softening and flammability.

12 IACS would suggest that consideration should be given to testing and assessing the decomposition of the resin in the FRP structure by measuring the surface temperature on the fire exposed side, for example by placing thermocouples under the insulation on the fire exposed side of the division. This procedure could verify that the skin temperature of the FRP composite remains below the decomposition/softening temperature of the polymer and core, so that the FRP component keeps its load-bearing capacity. This approach would support the performance approach for fire resistance, i.e. the load bearing capacity ("R"), integrity ("E") and insulation ("I") methodology.

13 This approach may also simplify the set-up of the test by not requiring a loaded test specimen during the test and make it possible to test several panel assembly details (panels joints, stiffeners) and not just panels. The result would also enable to approve a minimum insulation solution to specific FRP design which would apply on the ship irrespective of the load and, hence, bring a verification scheme close to the steel construction for fire resistance.

14 In addition to the above, IACS is of the view that FRP testing should also consider combustibility, flammability and smoke production.

Proposal

15 IACS supports, in principle, the proposals to address testing of FRP structures and suggests that the Sub-Committee take IACS' considerations in paragraphs 5 to 14 into account when revising the *Interim Guidelines for use of fibre reinforced plastic (FRP) elements within ship structures: fire safety* (MSC.1/Circ.1574) and considering the need for further action, as appropriate.

Action requested of the Sub-Committee

16 The Sub-Committee is invited to consider the above, the proposal in paragraph 15, and take action as appropriate.
