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

Comments on the test method by using ultrasonic acoustic sensing for early detection of Deformation.

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SUMMARY

Executive summary: This document comments on the outcomes of the Correspondence Group on the Revision of the Interim guidelines for use of Fibre-Reinforced Plastic (FRP) (MSC.1/Circ.1574) This paper outlines suggestions for enhancing temperature measurement techniques during fire resistance testing, taking into account data from fire resistance tests of FRP composites conducted in China. It also discusses the factors influencing, and the typical failure behaviours of, FRP-core fire-resistant partitions when subjected to high temperatures, with emphasis on how thermal exposure affects their integrity and mechanical performance

Strategic direction, if applicable:

Output: 3-5

Action to be taken: 6-10

Related documents:

INTRODUCTION

1. FRP materials offer significant advantages—lightweight, corrosion resistance, and design flexibility—making them attractive for ship structures. However, their combustibility and unpredictable behaviour under fire conditions challenge existing IMO instruments that require non-combustible materials. As part of the revision of

MSC.1/Circ.1574, it is necessary to expand the scope from decorative and secondary structures to load-bearing and primary structural applications, accompanied by robust testing and risk-based justification methods under SOLAS regulation II-2/17. The present document supports this development by identifying key rule gaps, proposing non-destructive testing integration, and recommending amendments to ensure regulatory compliance and safety equivalence.

REGULATORY CONTEXT AND NEED FOR AMENDMENT

2. The current Interim Guidelines limit FRP to non-load-bearing applications. Advancements in material science justify a reclassification into: non-load-bearing FRP; load-bearing FRP (local strength); and load-bearing FRP (global strength). To accommodate these categories, updates to SOLAS Chapter II-2 and revisions to the FTP Code are required to include FRP-specific fire testing accounting for combined thermal and mechanical stresses, establish performance-based fire resistance standards equivalent to A-class divisions, and integrate FRP safety assessment frameworks under SOLAS II-2/17. These changes would maintain fire safety objectives while enabling regulatory flexibility, supporting innovation aligned with IMO's goal-based ship construction standards.

PROPOSAL

3. This paper proposes the formal recognition of Ultrasonic Testing (UT) as a standard NDE technique for assessing FRP hulls and structural components. UT can detect internal flaws such as delamination, voids, and resin degradation—defects not visible externally but critical for safety.

4. The method employs pulse-echo ultrasonic sensing to evaluate laminate quality and stiffness without dismantling components. Advanced automation and digital signal processing further enhance accuracy, enabling condition-based maintenance and predictive degradation monitoring.

5. UT should therefore be included within the revised MSC.1/Circ.1574 as an acceptable method of inspection and referenced in the FTP Code annexes for periodic in-service verification of FRP structures. Development of FRP-specific calibration and attenuation standards is recommended to ensure reliability across composite geometries.

CONSIDERATIONS FOR RULE DEVELOPMENT

6. Fire Performance: Current FTP test protocols must evolve to reflect.

7. FRP's combined mechanical-thermal response, requiring a new fire-load coupling test category to ensure safety equivalence.

8. Regulatory Compliance: Use of FRP should continue under SOLAS II-2/17, ensuring equivalency demonstration through analytical modelling, fire insulation, and verified performance tests.

9. Inspection & Maintenance: The Guidelines should introduce a structured composite inspection regime using UT and other NDE techniques to support long-term safety assurance.

10. Environmental Integration: FRP contributes to reduced ship weight and fuel consumption, promoting IMO's GHG reduction and decarbonization goals. End-of-life recycling and environmental impacts should be coordinated with MEPC and SSE sub-committees.

11. Research and Collaboration: Experience from research and operational vessels should inform final rule development, with classification societies assisting in establishing design validation criteria and fire safety equivalence documentation.

CONCLUSION

12. FRP represents a transformative material for modern shipbuilding, offering sustainability, corrosion resistance, and energy efficiency. However, its safe integration requires regulatory evolution.

13. This paper concludes that SOLAS Chapter II-2 and the FTP Code should be amended to define FRP categories and testing standards; ultrasonic testing should be officially recognized as a non-destructive evaluation method within MSC.1/Circ.1574; and cross-committee coordination with MEPC and SSE should address recyclability and environmental impacts.

14. Through these developments, IMO can ensure FRP adoption remains technically sound, safety-compliant, and environmentally responsible, promoting innovation and supporting the organization's long-term strategy for safer, cleaner, and more efficient ships.

We would like this paper to be used as the basis for our inclusion in the IMO Working group