THE TENTH TRIENNIAL INTERNATIONAL
AIRCRAFT FIRE AND CABIN SAFETY
RESEARCH CONFERENCE
October 17-20, 2022, Atlantic City, NJ, USA

Lightweight CFRP Nitrogen Vessels enabling efficient Halon Replacement Solutions

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Halon replacement for cargo bay fire suppression systems has been an ongoing challenge for aerospace industry. Nitrogen as suppression agent, has proven to be a safe, sustainable and environmentally friendly alternative to , “chemical agents” such as halon. To facilitate the use of nitrogen in airborne fire suppression applications, nitrogen must be stored at high pressures (>300 bar). Therefore, efficient vessels for storage and discharge of nitrogen are required to develop novel competitive fire suppression systems, which minimize installation space and weight.

This work will present design aspects, prototyping and testing of a lightweight pressure vessel module, which is the result of Diehl Aviation’s recent research activities in the area of fire suppression. The nitrogen module comprises the pressure vessel and the valve. The vessel has an inner liner to inhibit nitrogen permeation and a CFRP reinforcement on the outside to take up the pressure loads. The valve is mounted to the vessel as an on tank valve and combines different functions for filling, monitoring the vessel and discharging the nitrogen in case of the activation of the system. The module was designed with respect to high volumetric and gravimetric storage efficiency of nitrogen, also considering normative regulations for pressurized vessels. For the pressure vessel shell the design focus was on low permeability materials and on a reinforcement structure that can withstand pressure loads, external loads and thermal loads, especially during discharge. The key aspects for the valve design were its reliability and its capability to provide the specified nitrogen mass flow. The module has been successfully tested in several discharge experiments.

In sum, the development of a nitrogen vessel contributes to the efforts for halon replacement by providing a key component for novel fire suppression systems, which use nitrogen instead of halon or other chemical agents. The efficient, lightweight design allows to minimize possible weight penalties as compared to the state of the art systems which use chemical agents.

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