MATERIALS AND STRUCTURES SYMPOSIUM (C2)
New Materials and Structural Concepts (4)

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DEVELOPMENT OF AN INNOVATIVE SANDWICH COMMON BULKHEAD FOR CRYOGENIC UPPER STAGE PROPELLANT TANK

Abstract

In the frame of the Future Launcher Preparatory Program (FLPP) investigating advancing technologies for the Next Generation of Launchers (NGL) a number of novel key technologies are presently under development for significantly improving the vehicle performance in terms of payload capacity and mission versatility. As a respective ESA guided technology development program, CUST (Cryogenic Upper Stage Technologies) has been launched within FLPP that hosts among others the development of a common bulkhead to separate the liquid hydrogen and liquid oxygen compartment. In this context, MT Aerospace proposed an advanced sandwich design concept which is currently in the development phase reaching for TRL4 under MT Aerospace responsibility. Key components of this sandwich common bulkhead are consisting of specific core material situated in between two thin aluminum face sheets and an innovative thermal decoupling element at the equatorial region. The combination of these elements provides excellent thermal insulation capabilities and mechanical performance at a minimum weight, since mechanical and thermal functions are merged in the same component. This improvement is expressed by substantial performance figures of the proposed concept that include a high resistance against reverse pressure, an optimized heat leak and minimized mass, involving the sandwich dome structure and the adjacent interface rings. The development of single sub-technologies, all contributing to maturate the sandwich common bulkhead towards the desired technical readiness level (TRL), are described in the context of given design constraints as well as technical, functional and programmatic requirements, issued from stage level. This includes the thermal and mechanical characterization of core materials, manufacturing issues as well as non-destructive testing and the thermal and structural analyses and dimensioning of the complete common bulkhead system. Dedicated TRL assessments in the A5-ME program track the progress of these technology developments and analyze their applicability in time for ME. In order to approximate A5-ME concerned preconditions, activities are initiated aiming at harmonization of the available specifications. Hence, a look-out towards a further technology step approaching TRL6 in a subsequent phase is given, briefly addressing topics of full scale manufacturing and appropriate thermo-mechanical testing of an entire sandwich common bulkhead.