

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Technologies (5)

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MT AEROSPACE'S CONTRIBUTION TO A5 ME UPPER STAGE TANK DEVELOPMENT

Abstract

ARIANE 5 today is a high performance launcher, leading in reliability and orbit insertion precision. Nevertheless, the market requires further improvements. Therefore, the intention is to modify the launcher and its upper stage to be implemented in the second phase of Ariane 5's exploitation phase up to 2025. The new "Ariane-5-ME" upper stage is systematically customer-oriented by the increase of payload capacity and mission flexibility. The objective is to achieve a maximum dry mass reduction while meeting highly complex technological requirements at competitive cost. After successful LSCR (Launcher System Concept Review), the release of the next phase of the upper stage development took place. MT Aerospace was assigned with the development of the metallic bare tank, consisting of separate tank compartments for liquid hydrogen and oxygen. The bare tank represents one of the most critical upper stage components, as the so-called Common Bulkhead (CB) – the structural and thermal element – , needs to be newly developed and qualified. The main challenge of this common bulkhead concept is to design a thermal barrier between the liquid oxygen and hydrogen. In a first stage MT Aerospace performed studies to analyse and assess different options how to design this CB. Concepts under investigation were e.g. a CB with wetted insulation, a foam/honeycomb stiffened sandwich CB and a vacuum version. These options were assessed versus different criteria as e.g. structural margin, mass budget, volume, manufacturing effort, and technology maturation level.

Several optimisation tasks were initiated. Within this optimisation different components of the tank were undergoing a mass optimisation wrt the margin policy and taking into account the related manufacturing effort. This approach should secure a design which is not only optimal from structural point of view but as well from series production (RC) point of view. In the analysis process the optimisation software was employed for the preliminary analysis methods as well as for the detailed finite element models.

Furthermore, activities with a high criticality for the A5 ME Program were initiated, as e.g. the design of the welding bench for the bare tank closure welds, as well as the procurement of important long lead items. On the engineering side, a further down-selection and optimisation of common bulkhead concepts was performed.