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Title
Roadmap Towards a Qualified Aluminium Green Propellant Diaphragm Tank

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Abstract
Under the development scope of a hydrogen peroxide (HTP) based reaction and attitude control system (RACS) for the VEGA launcher family, Nammo is currently developing a propellant tank capable of fulfilling the mission needs [1]. Basing the design foundation primarily on the extensive set of system requirements and the decades-long hydrogen peroxide heritage present at Nammo [2], [3], the goal is to enable short lead time delivery of small-to-medium sized aluminium green propellant tanks for space application that are fully compatible with HTP and demisable during re-entry. With this in mind, the first priority is to fully qualify the tank design, with all associated processes and achieve flight heritage within the last phase of the project.

With a total volumetric capacity in the 70-liter class, the diaphragm tank is designed to maximize propellant compatibility and to ensure propellant expulsion in all mission phases. The main development drivers are the HTP specificities, requiring careful selection of the material in contact, the very high mission loads, the tank being attached to the launcher structure, and the link between design and manufacturing processes in order to enable both low-cost production and scalability of the final product. Successes in all those areas will enable Nammo to develop and qualify a robust design which could be readily reused and adapted for multiple space applications. The tank designed for VEGA RACS is for example planned to be used as well for the CALLISTO reusable demonstrator. Furthermore, basing the design on commercially available materials and parts, in addition to integrating modularity and scalability in the design, will aim at ensuring a secure value chain for many years of production.

Production processes are at the heart of all successful space products. In order for Nammo to successfully start production of the tank, a series of manufacturing processes are planned to be developed, industrialized and qualified to correctly manufacture the product. Minimizing in-process deviations and ensuring cleanliness levels congruent with the space standards is imperative to ensure a sustainable product line. One of these processes is a novel friction-stir weld, specifically developed to suit the tank size family.

The last, but not least, part of any space hardware production, are the acceptance tests. Streamlining the test battery performed on each unit is an important part in ensuring a short lead-time product. With the lessons learned from the initial proof of concept (PoC) test campaign further development of the recurring tests is under way to ensure schedule compression in the final production.

The present article will explore some of the main aspects of the development, focusing on the design drivers and novelties of the design. It will present as well the main results and lesson-learned from the latest full-scale PoC tank test campaign completed in 2022. The sum of the completed development activities have now enabled completion of the

PDR, and thus the planning towards qualification is also fully defined. An overview of the planned development activities will also be presented.

References

[1] Haemmerli B. and al. (2021); Overview of the Development of a H2O2 Based Chemical Attitude Control System for VEGA-C, Proceeding of 3AF Space Propulsion Conference 2020+1; SP2020-00363,
[2] Faenza, M. G. and al. (2017). Getting Ready for Space: Nammo's Development of a 30 kN Hybrid Rocket Based Technology Demonstrator, Proceeding of the 7th EUCASS Conference, Milan, Paper 410.
[3] Solli, L. and al. (2016). Development of a Propellant Tank for Hydrogen Peroxide for Launcher Applications. Space Propulsion 2016, SP2016_3124782