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Corresponding author: HEGRE Jan Sturla
e-mail of corresponding author: jan.sturla.hegre@nammo.com
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Title

6kN green fuel throttleable development engine – Design and Manufacturing

Authors

Jan Sturla HEGRE [1], Adrien Boiron [1], Jørn-Inge Ruud [1], Elliott Worsley[2], Matt Shaw[2]*

** Corresponding author*
[1] Nammo Raufoss AS, 2830 Raufoss, Norway, adrien.boiron@nammo.com
[2] Nammo U.K. Ltd, HP18 0XB Westcott, United Kingdom, elliott.worsley@nammo.com

Abstract

Within the framework of the General Support Technology Programme (GSTP) of the European Space Agency (ESA), Nammo (UK, Norway) is developing a green and throttleable bi-propellant rocket engine that could be used as an upper stage engine in launchers and/or as a landing engine for future exploration missions to the Moon.
The engine has been developed to provide 6 kN of vacuum thrust using high concentration H2O2 as an oxidizer and RP-1 or bio-ethanol as a fuel. The primary purpose of the current development activity is to be able to test a variety of combustion chambers together with different pintle setups. To accommodate better throttling, a moving pintle mechanism was also developed, actuated by an electric motor. The construction is modular so the chambers, the pintle unit, the catalyst unit and the moving mechanism can easily be changed. For initial testing, the combustion chamber is water cooled, but it is possible for the chamber to be oxidizer cooled. The catalyst unit used in the design is derived and further developed from the NAMMO FLPP hybrid programme [1]. The regeneratively cooled chamber will be additively manufactured in a nickel-based material.
The target is to deliver a specific impulse with RP-1 of 225 seconds at 6 kN sea level thrust, and be able to throttle down continuously to 1.2 kN with good stability and performance. It is designed for a chamber pressure of 50 bar at a nominal thrust point of 6 kN. The engine platform enables multiple fuels to be tested and by utilizing an adaptive engine such as this, many different data sets can be produced. This data will be valuable for Nammo's RELIANCE engine, which is also utilizing a pintle injection system and a regeneratively cooled, additively manufactured combustion chamber.
In November 2022, Nammo passed the Manufacturing Readiness Review (MRR) for the injector and are in the process of procuring parts ahead of the test campaign, planned for the summer and autumn of 2023. This article will present the design of the engine, its specifications, capabilities and the use of different fuels. It will describe the upcoming hot-fire test campaign and present the future capabilities of this engine platform.

References

[1] Development and testing of a scalable 100 kN hybrid motor for sounding rocket and micro launcher applications, Kolsgaard et al, SP2022_167, Space Propulsion 2022, Estoril, Portugal 2022