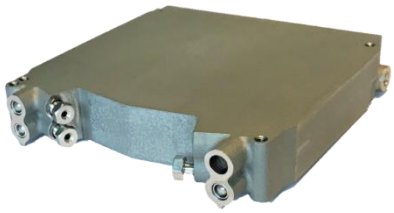
Additive Manufactured Propellant Tank

- 3D Printed 100ml CubeSAT Tank



Nammo Space has developed, in conjunction with **NANOspace AB**, Sweden, an additively manufactured fluid storage device for use on **CubeSat sized propulsion systems**.

This 3D Printed tank has been developed for a very specific porting need, and houses an integrated plenum tank, which allows for much tighter control of the fuel state at the plenum outlet. Ports are integrated within the compact 1U x 1U x 0.2U envelope, thus allowing for the tank to be placed at any location within the CubeSAT assembly stack. Larger volume variants of the tank can also be generated with relative ease.

The tank is a fully closed, "no weld" volume, showing final cleanliness levels which are an order of magnitude better than requirements.

Due to the flexibility of the Additive Manufacturing process, further integration of components is already in development, including integrated thrusters, transducers, valves and other MEMS components with a view to generation of a complete propulsion system. This improved functionality and reduction of part count leads to major savings on overall cost and assembly times.

Designing specifically for Additive Manufacturing means that much larger operating pressures can be sustained through the use of an internal structure within the tank which greatly reduces stresses, allowing for optimisation of wall and skin thicknesses and therefore production cost and mass.

The flexibility of the Additive Manufacturing process, has enabled Nammo to maximise the surface area of the filter inlets.

A range of tank materials are possible, including Titanium, Inconel, Aluminium and Stainless Steel.

Additive Tank aligned with a 3U CubeSAT frame

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Tank Materials	Titanium (Inconel, Aluminium, Stainless Steel also possible)
Fuel Volume	100cm^3 (Main + Plenum) (1)
Fluids	Butane, Nitrogen (2)
Dry Mass	180g (3)
Pressure [MEOP]	10 bar (3)
Proof Pressure	25 bar (3)
Burst Pressure	40 bar (3)
External Leakage	1x10^{-6} scc/s GHe (5)
Temperature Range	-5°C to +50° (5)
Shock (5)	100–500 Hz 12dB/Octave 500–5000 Hz 2000g
Life	5 Years (5)
Physical Envelope	1U x 1U x 0.2U (4)
Filtration	15 - 40 micron (5)
Cleanliness	ESA Spacecraft Propulsion Requirements ECSS-E-ST-35-06C (5)
Heater	Plenum temperature controllable via external heater
Ports	10-32 UNF Coned or as required
Configuration	No-Welds, fully 3D printed
Insert Blowout	40,000 psi rated

(1) Tank volumes will vary depending on defined envelope and interface needs. The baseline Tank envelope has been generated for very specific customer porting and interface needs.

(2) Xenon and various Cold Gas Media are also compatible with Titanium, Inconel, Stainless Steel, Aluminium. AlSi10Mg is an Aluminium alloy used in Additive Manufacturing and has been verified at Nammo for compatibility with HTP Green Propellant. Contact Nammo for further information.

(3) These are the baseline tank operating pressures and overall mass value. Much larger operating pressures are achievable if required. Overall pressure to mass ratio can be increased significantly using Additive Manufacturing via in-house optimisation methodologies.

(4) Different heights and/or basic envelopes are possible. Spacecraft sizes of 2U, 3U and 6U and beyond can be catered for (using Additive Manufacturing or other methods).

(5) This is a requirement for the baseline tank. Improved values are achievable if required. In particular, cleanliness is achieved to 10x system level requirements for a fully closed volume, no welds configuration.

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