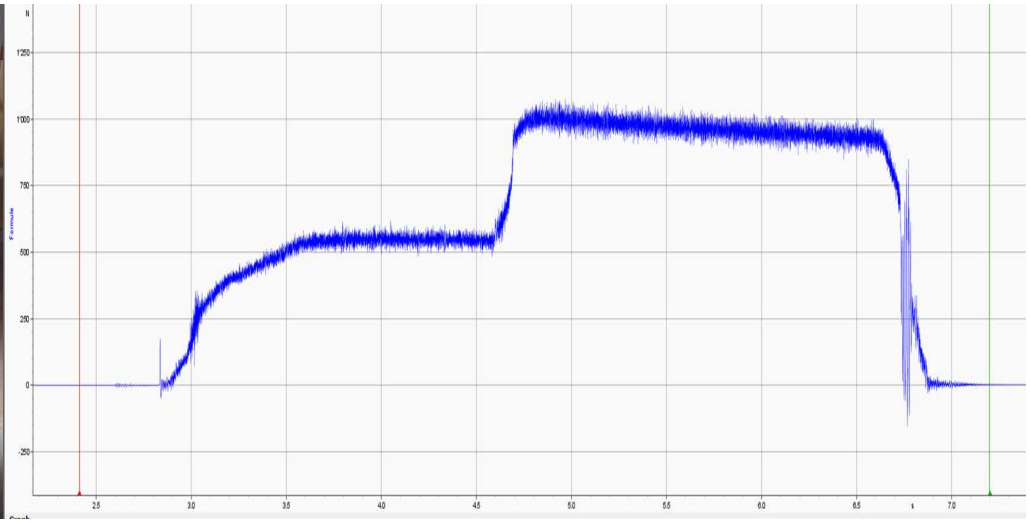
PR – HYPERION – DEMO-A2

PR – HYPERION – DEMO-A1

- Static fire test x2
- Nominal thrust at predicted tank pressure



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PR – DEMO-A2 Specifications

- Average thrust: ~1'500 N
- Peak thrust: ~1’700 N
- Propellants:
  - Fuel: Ethanol
  - Oxidizer: Nitrous Oxide
- Pressure fed:
  - Pressurant: Nitrogen
- Nominale tank pressure 33 bars
- Chamber pressure: 25 bars
- Burn time: 8.7 s
- Total impulse: 12000 Ns

PR – HYPERION – DEMO-A2

2.5 weeks test campaign – February 2023

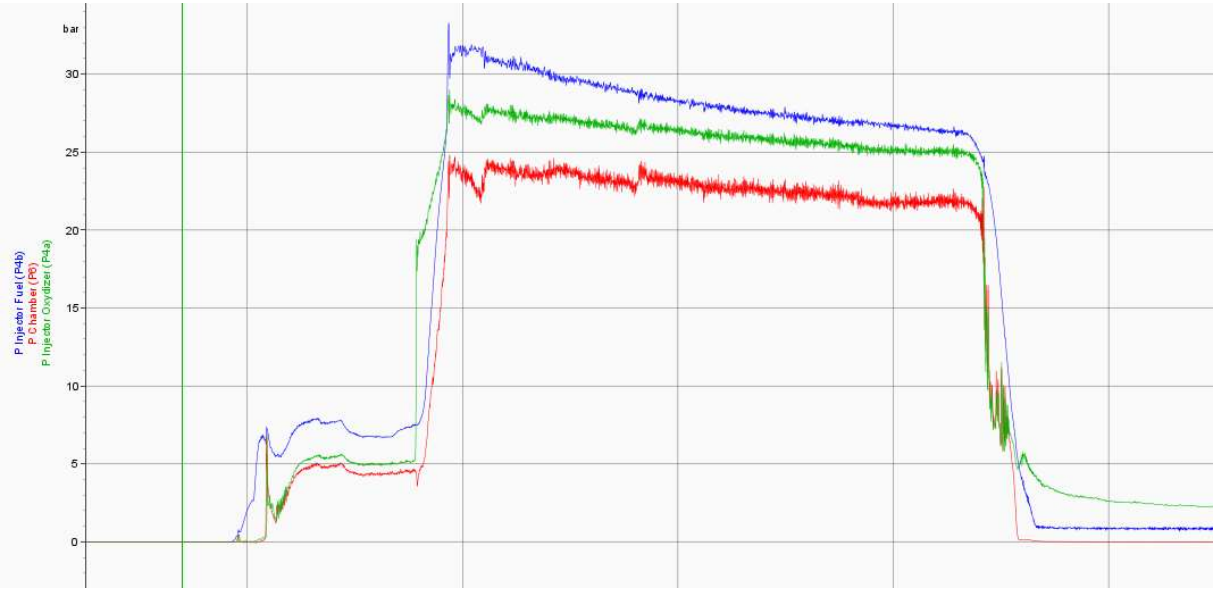
- 72+ cold flow tests of the injector (with water and propellant)
- 4 ignition tests
- 3 static fire attempts

Water cold flows	Injector characterization
Propellant cold flows	Close to nominal mass flow rate achieved
Ignition test at nominal pressure	Success
SFT (1)	Failure (no ignition, delay in valve opening due to a new actuator)
SFT (2)	Success, 28 bars, high amplitude oscillations in chamber pressure
SFT (3)	Success, 32.5 bars, unusable thrust data, hot spot on the chamber

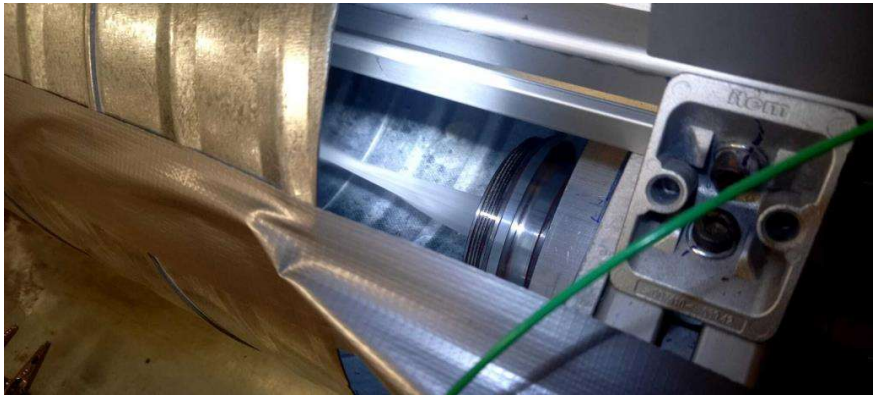
PR – HYPERION – DEMO-A2

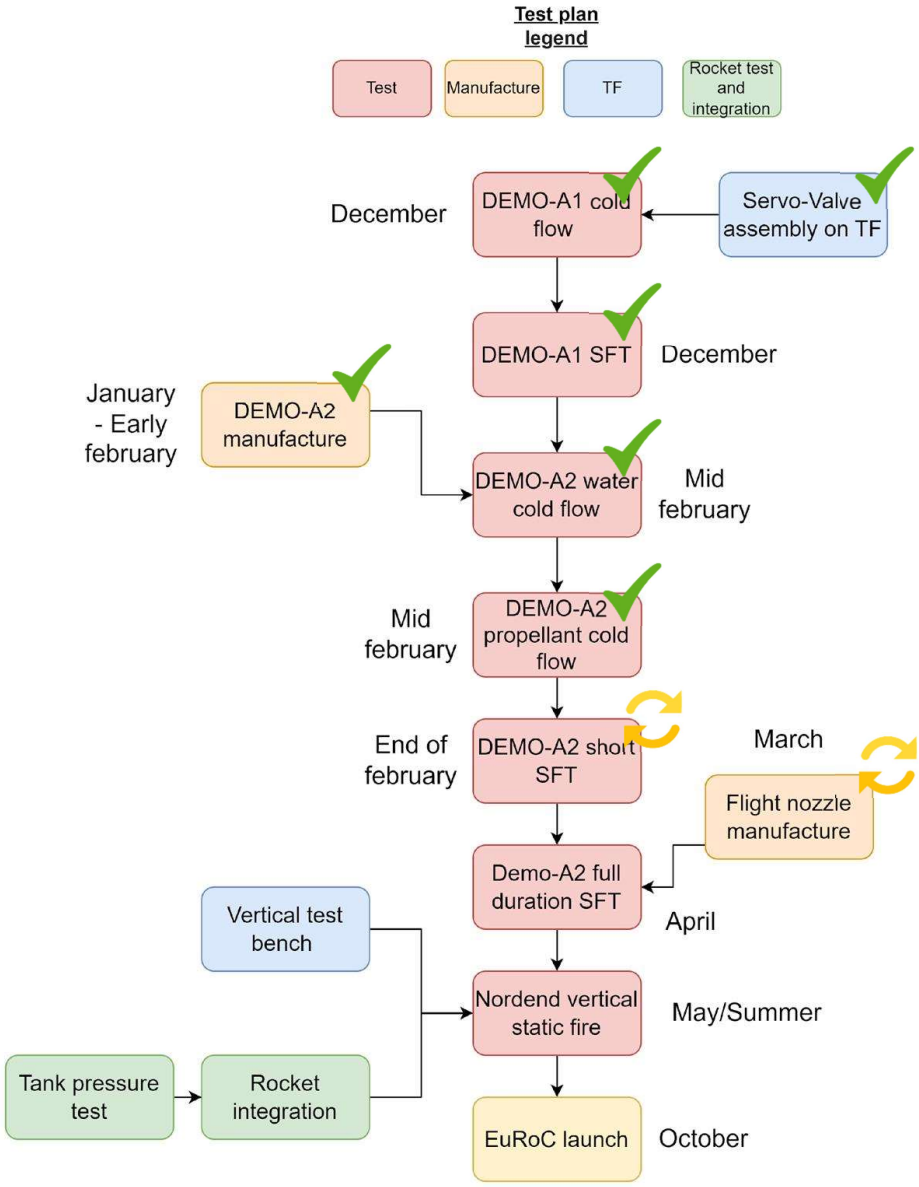
First 33 bars SFT

- Teflon stuck in Ox injector
- Pressure slightly too low
- Thrust estimated at about 1250N
- Leaking on combustion chamber



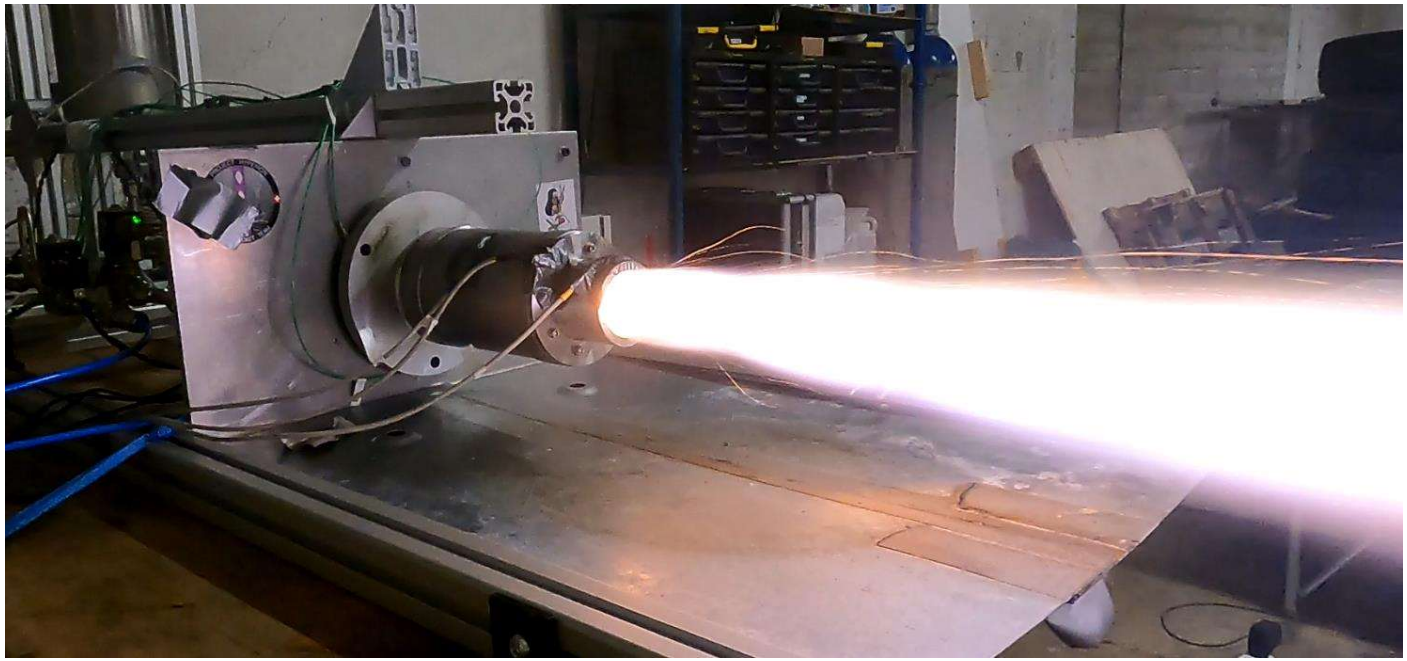
PR – Test Plan




Test plan legend
Test
Manufacture
TF
Rocket test and integration
December
DEMO-A1 cold flow
Servo-Valve assembly on TF
DEMO-A1 SFT
December
January - Early february
DEMO-A2 manufacture
DEMO-A2 water cold flow
Mid february
Mid february
DEMO-A2 propellant cold flow
End of february
DEMO-A2 short SFT
March
Flight nozzle manufacture
Demo-A2 full duration SFT
April
Vertical test bench
Nordend vertical static fire
May/Summer
Tank pressure test
Rocket integration
EuRoC launch
October

PR – Test Plan

- Cold flow : done
- Short static fire : next tests aim to attain nominale thrust, to gather good temperature data, and to test TEOS additive
- Long static fire : longer and longer test with copper nozzle to demonstrate the capability to obtain the desired impulse
- Flight rehearsal static fire with GSE, GS and Avionics

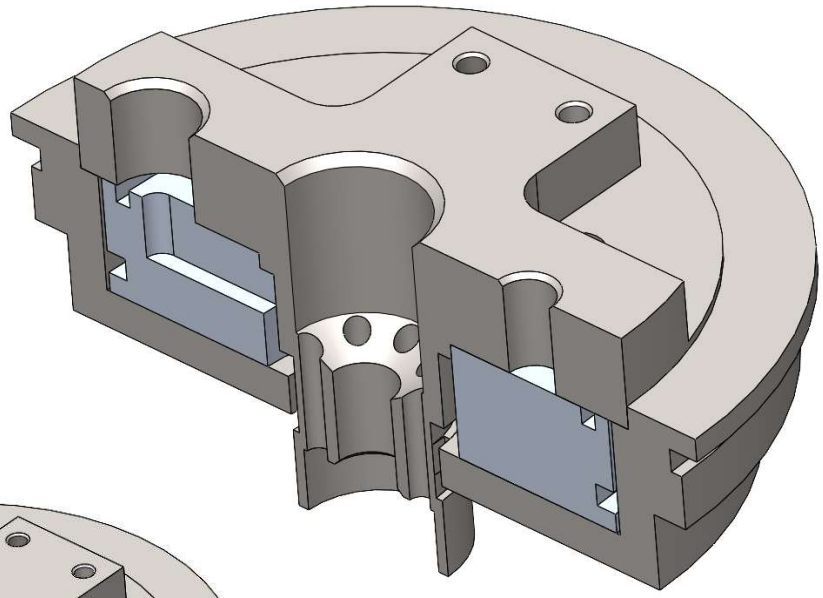


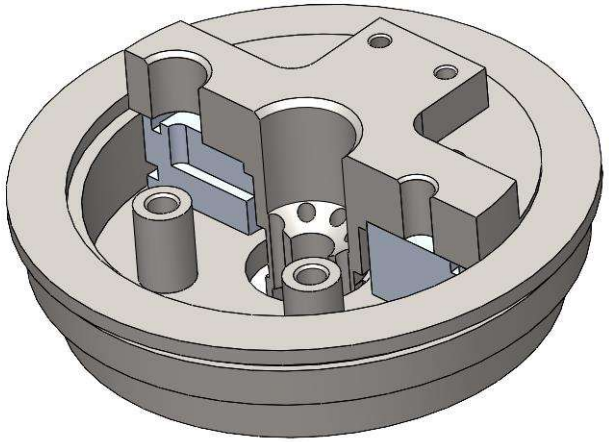
PR – DEMO-A2 Injector Design

- Redesign of the injector from Demo-A1
  - Classical pintle injector
- Vertical oxidizer and fuel inlet
- Chamber pressure sensor through injector
- Film cooling through injector possible
- O-ring seals in manifold

PR – DEMO-A2 Injector Design

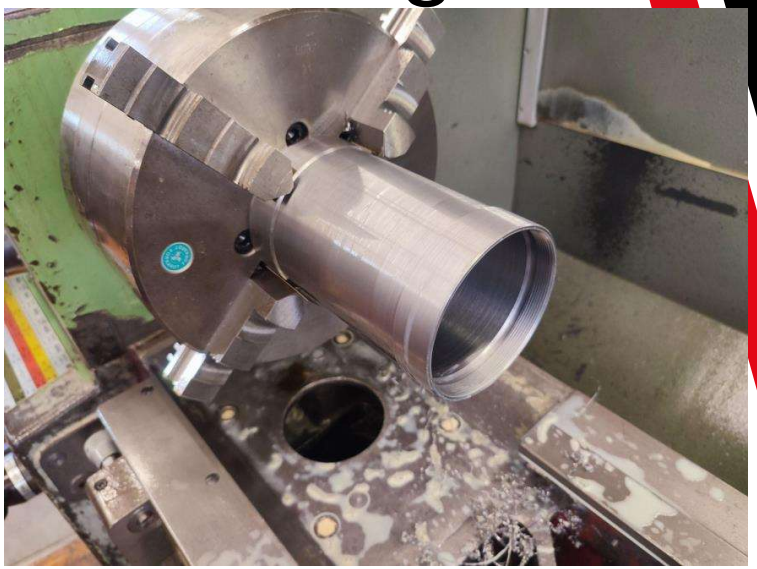
- V2 design underway based on first tests
  - Less mass/size
  - More o-ring protection
  - Simple centering feature
  - CNC manufacturing needed for one part





PR – DEMO-A2 Chamber & Nozzle Design

- Combustion Chamber
  - COTS thermal insulation combined with steel casing
  - Screwed on both ends
  - Aluminium seals

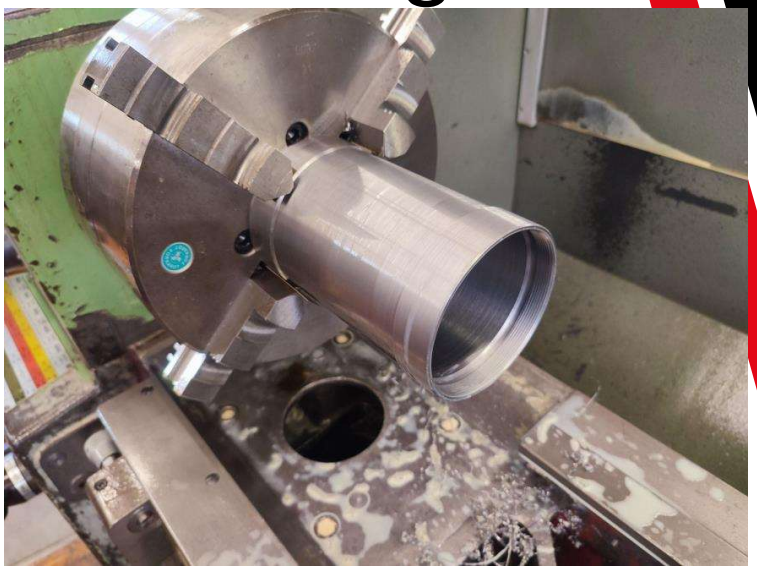


- Nozzle
  - Full graphite with metallic seal for high heat load resistance and mass reduction
  - Full graphite with o-rings as backup plan

PR – DEMO-A2 Chamber & Nozzle Design

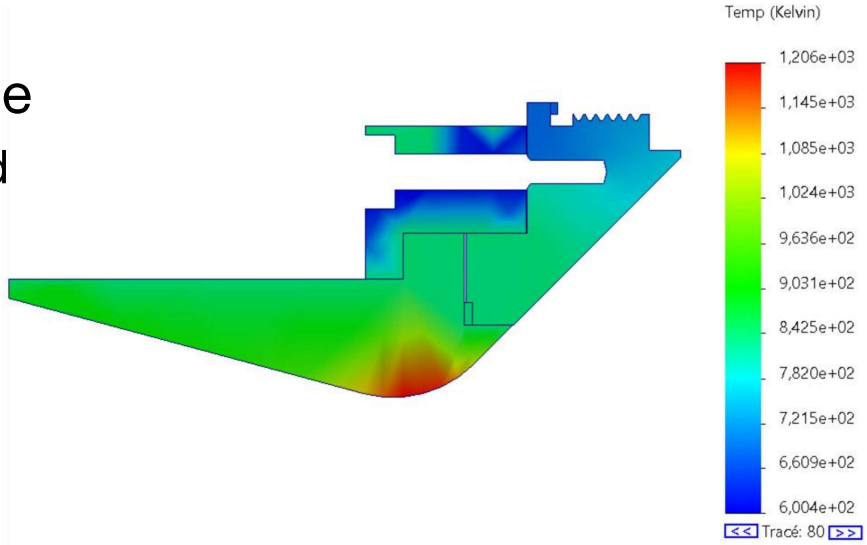
- Combustion Chamber
  - Easy assembly, much hardr disassembly
  - Sealing is tricky

- Nozzle
  - First test demonstrated that it is a good design
  - No nozzle/o-ring degradation near the nozzle
  - Copper nozzle for long duration burn testing
  - Graphite nozzle for flight

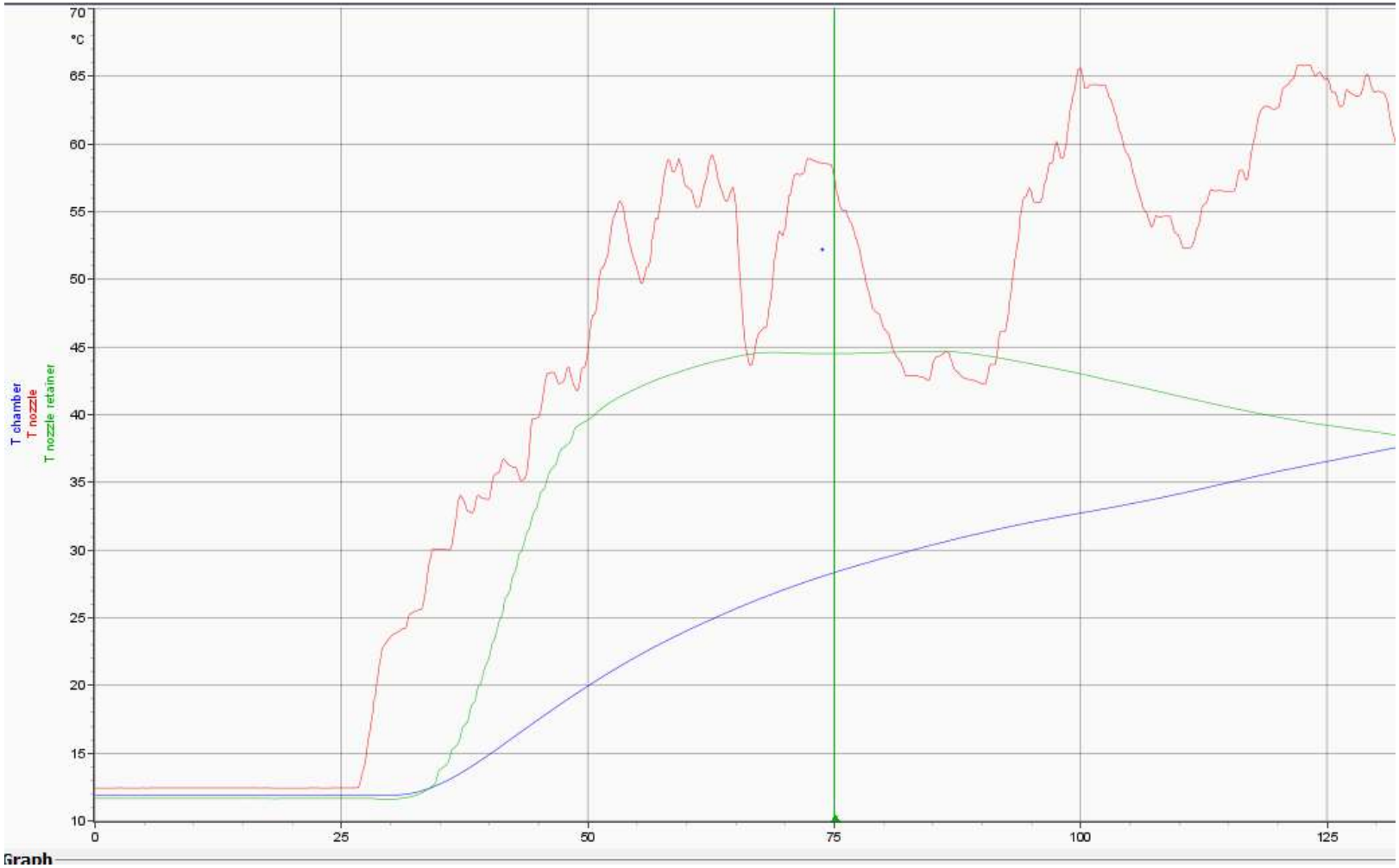


PR – DEMO-A2 Thermal Management

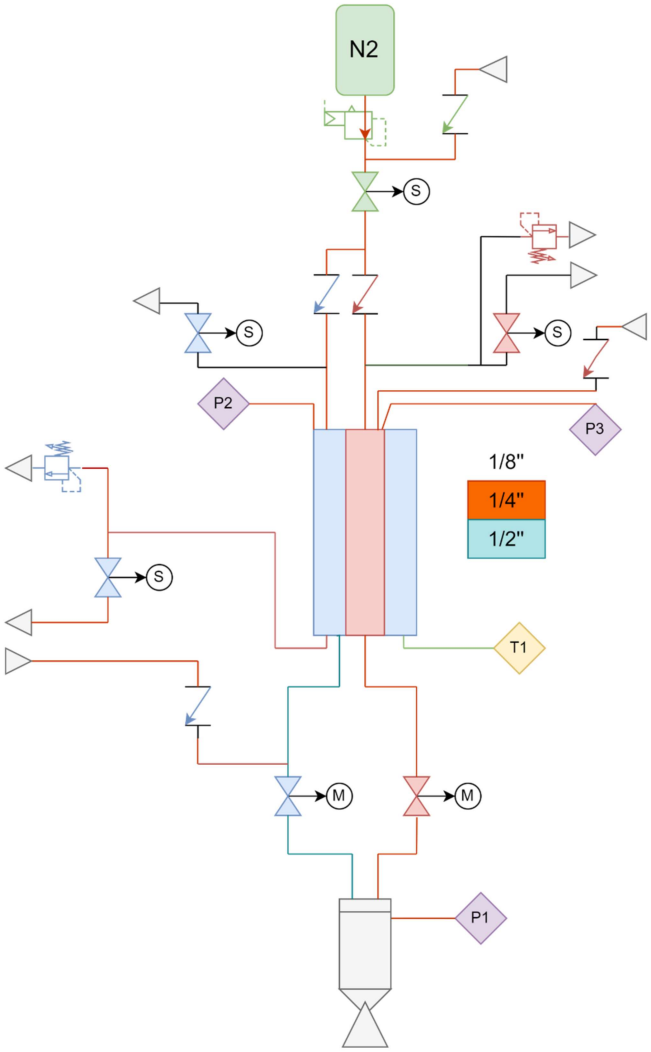
- Very reasonable degradation on chamber liner
- Hot spot on the chamber on injector side
  - Likely cause are chamber improperly sealed and insufficient protection near the injector
- Promising temperature data
- Main concern is probably the Nozzle holder
  - Possible addition of insulation between nozzle and nozzle holder



PR – DEMO-A2 Thermal Management



PR – Plumbing

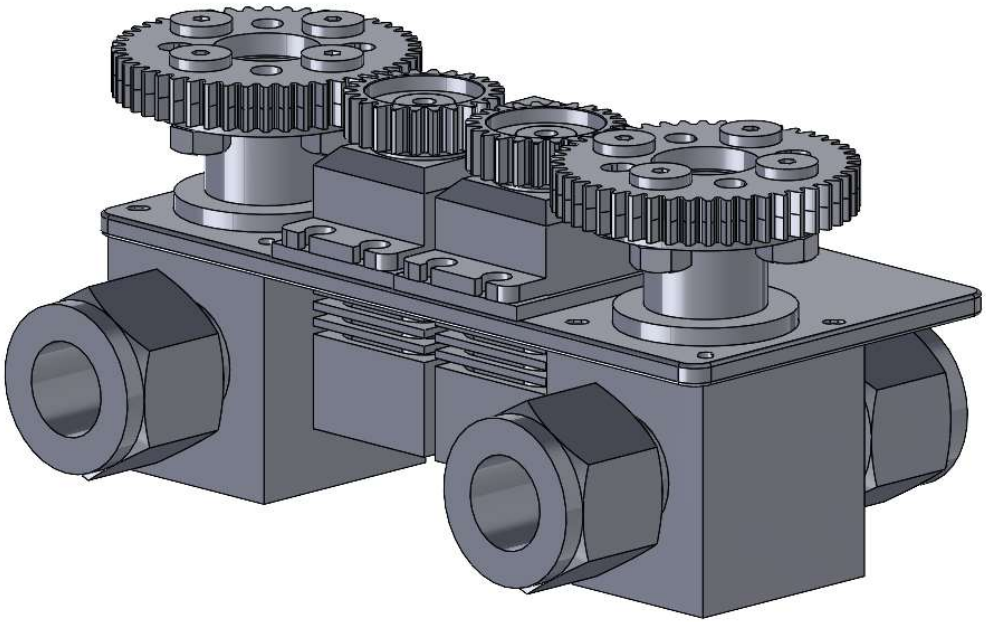


- Solenoids
  - 2 Solenoids NO for N2 venting
  - 1 solenoid NC for N2 pressurization
  - 1 N2O NC solenoid purge valve
- Main valves
  - 2 main servo-actuated cylindrical main valve
- 3 pressure sensors (Tanks and combustion chamber)
- 1 temperature sensor on N2O tanks
- Manual filling for Ethanol and N2, remote filling with GSE for N2O

Q: Need for a N2O purge valve?

PR – Plumbing

- Armotech 2L 1.1kg COPV
- Pressure tech MF101 pressure regulator (received)
- Main valve assembly with gears
- Plumbing ordered, mockup assembly in next few weeks



PR – ConOps

- Ethanol filled with a manual pump
- Manual N2 filling in the tent or at the pad
  - With a pressure booster if possible
  - With 300 bars bottle as backup
- N2O pre-chilled by water cooling, reach-20°C by venting
  - More density
  - Less autogenous pressure
  - Less risk of evaporation in tubing
- Igniter triggered by the rocket to ensure synchronisation
- Venting after 1st event, avoid perturbations on rocket's trajectory

T – 1 h	Ethanol and N2 filling
T – 45 min	Pad departure
T – 15 min	Filling procedure start
T – 3 min	Tank pressurization
T – 2 min	Disconnect
T – 3 s	Ignition
T – 0	Liftoff
T + 9 s	Burnout
T + 40 s	Tanks venting

PR – GSE

- Most of it is manufactured
  - Supertoast™ V1 is manufactured and being tested => some minor problems have been found
  - Structure is assembled
  - Plumbing received
- To do
  - Install thermal insulation and plumbing
  - Install and test water cooling device
  - Install disconnect mechanism

PR – GSE

Disconnect and filling

- Filling via side port, very similar to Bella lui 2
- Filling port attached to the rods instead of the panels
- Disconnect with a falling mass
- N2O mass measured with a load cell (serves also to stop the rocket on the rail)