ENPULSION

NANO AR³

THRUST VECTORING CAPABILITY

Building on the **flight heritage** of the *ENPULSION NANO* and the evolutionary design of the *ENPULSION NANO R³*, the *ENPULSION NANO AR³* expands controllability towards active **thrust vector control** – without any moving parts.

The *ENPULSION NANO AR³* therefore **combines** advanced vector controllability with the **very mature and flight-proven** FEEP technology and an increased reliability and environmental resilience.

ACTIVE THRUST VECTOR CONTROL

The *ENPULSION NANO AR³* allows to **control actively** its resulting thrust vector – **without any moving parts**. It can therefore steer, correct for CoG mismatch, or enable advanced missions requiring thrust pointing. It also features the same excellent controllability over the full thrust range and a low thrust noise of the heritage *ENPULSION NANO*.

CONTROLLABLE SPECIFIC IMPULSE UP TO 6,000 S

Due to the efficient ionization process, which allows the capacity to ionize up to 60% of the evaporated Indium atoms, the *ENPULSION NANO AR³* can provide a higher specific impulse than any other ion propulsion system currently on the market.

MATURE TECHNOLOGY

The core of the *ENPULSION NANO AR³* is a mature technology, developed under ESA contracts for 15 years, and is further building on the heritage of the *ENPULSION NANO* with **more than 37 units in space***, leveraging the proven design and component selection.

*as per September 2020

SAFE AND INERT SYSTEM

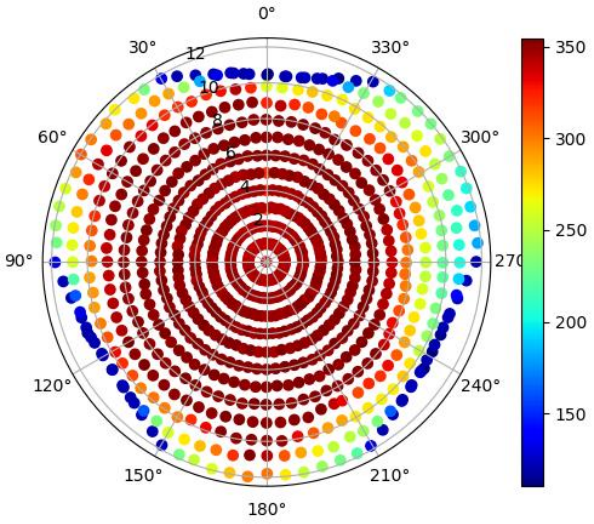
The *ENPULSION NANO AR³* contains no moving parts and the indium propellant is in its solid state at room temperature. Avoiding any liquid and reactive propellants as well as pressurized tanks significantly **simplifies handling, integration, and launch procedures**.

RAD-TOLERANT ELECTRONICS

All EEE components of the *ENPULSION NANO AR³* are procured in **lot-controlled batches**. Selected sets of these batches are subjected to radiation testing, so that each thruster can be traced back to a fully representative qualification model. EEE components were selected and integrated to be more tolerant to TID and SEE.

PROTECTIVE CASING

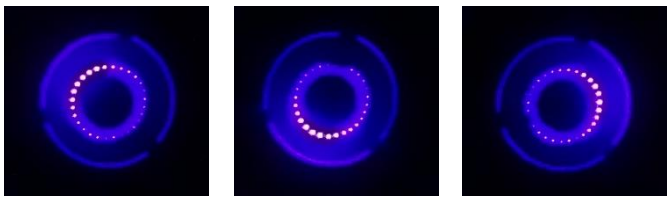
The thruster is assembled into a protective casing that **shields the electronics** from the hazardous space radiation environment, **facilitates handling** during integration, and allows **side mounting**.



Thrust vectoring capability of the *ENPULSION NANO AR³*

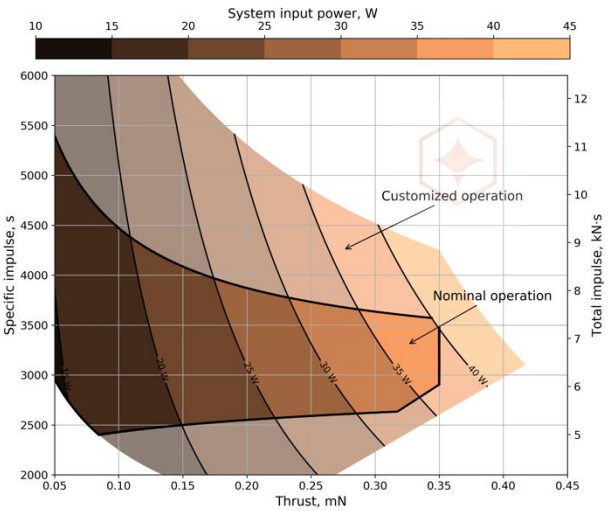
PROPERTIES AND PERFORMANCE

The *ENPULSION Nano AR³* uses differential emission throttling within the proprietary crown ion emitter to control actively the emitted ion beam and, therefore, thrust. The thrust vector capability is an additional feature compared to the *ENPULSION NANO R³* and does not reduce total impulse capability. The dependency of maximum thrust on thrust vector angle is shown on the left.



While the required power to operate the *ENPULSION NANO AR³* starts at around 8 W, at higher thrust levels one can choose between high thrust and high specific impulse operation. The *ENPULSION NANO AR³* can operate at an I_{sp} range of 2,000 to 6,000 s. At any given thrust point, higher I_{sp} operation will increase the total impulse, while it will also increase the power demand. The thruster can be operated along the full dynamic range throughout the mission. This means that high I_{sp} and low I_{sp} maneuvers can be included in a mission planning, as well as high thrust orbit maneuver and low thrust precision control maneuvers.

DYNAMIC THRUST RANGE	10 µN TO 0.35 mN
NOMINAL THRUST	350 µN
SPECIFIC IMPULSE	2,000 TO 6,000 s
PROPELLANT MASS	220 g
TOTAL IMPULSE	MORE THAN 5,000 Ns
POWER AT NOMINAL THRUST	40 W INCL. NEUTRALIZER
OUTSIDE DIMENSIONS	98.0 x 99.0 x 95.3 mm
MASS (DRY / WET)	<1230 /< 1450 g
TOTAL SYSTEM POWER	8 – 40 W
HOT STANDBY POWER	3.5 W
COMMAND INTERFACE	RS422/RS485
TEMPERATURE ENVELOPE (NON-OPERATIONAL)	-40 TO 95°C
TEMPERATURE ENVELOPE (OPERATIONAL)	-20 TO 40 °C
SUPPLY VOLTAGE	12 V, 28 V, OTHER VOLTAGES UPON REQUEST
THRUST VECTOR STEERING	UP TO 10 DEG OFF NOMINAL



Depending on available power, the user can choose from any operational point - data shown corresponds to 12 V configuration based on the heritage *ENPULSION NANO*