

Key Technologies (7)  
Structures Modeling, Designing, and Testing (1)

Author: Mr. Kévin Danancier  
ISAE - Institut Supérieur de l'Aéronautique et de l'Espace, France

Mr. Baptiste Laulan-Souilhac  
ISAE - Institut Supérieur de l'Aéronautique et de l'Espace, France

A DESIGN OF A REUSABLE ANTI-SLOSHING AND GAS FREE TANK APPLIED TO AN ORBITAL  
REFUELING SYSTEM

**Abstract**

Following the multiplication of future projects to explore our solar system and the number of objects around the Earth's orbit, this last will soon be saturated with debris. Moreover, with the emergence of nano satellites and constellations, multiple solutions must be deployed to go further in space and to extend the duration of the missions to reduce the number of orbiting spacecrafts. Motivated by the facts, we propose a design of a reusable anti-sloshing and gas-free tank. Future space stations (like Artemis lunar gateway) and future spacecrafts could be the next recipients of this technology. Applied to those systems, it would allow them to refuel and be refueled with any kind of fuel and almost indefinitely. This could drastically improve the missions' duration and reduce the number of orbiting spacecrafts, hence, debris. This would allow regulation spacecrafts to emerge, i.e. spacecrafts that would catch debris or refuel passing-by spacecrafts, which wouldn't be possible with classic limited tanks, because of the multiple maneuvers needed for those kinds of missions. Thus, we propose a detailed design of this new system composed of valves and membranes driven by a screw-nut system compensated by reaction wheels dimensioned by the flow rate. By using a screw-nut membrane instead of a gas to compress the fuel inside the tank, the available payload mass is increased, and the sloshing effect is reduced. Finally, a simulation of the system implemented to demonstrate the feasibility of the design is described.