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ENVIRONMENTAL SIMULATION CHAMBER FOR VARIABLE GRAVITY APPLICATION

Abstract

Within every space exploration strategy, the destination of robotic and/or human missions provides an environment that is very different in gravity, atmospheric composition, pressure environment, temperature environment, etc. to our own home planet and thus to the standard laboratory environment. Consequently, it is of paramount importance to create testing environments that are as close to the destination as possible. The development of the Environmental Simulation Chamber (ESC) at OHB was borne out of the necessity of such a chamber for internal research, especially in regards to Martian Atmosphere Simulation. When designing the chamber it showed that none of the existing environmental simulation chambers is known to be small enough to be put on a centrifuge or easily be adjusted in a parabolic flight rack to give the added bonus of tests in related gravity-environments of the planet's simulated environment. Thus, special focus was put on portability, flexibility for versatile application as well as requiring low maintenance. With the present design the chamber fits into ESA's Large Diameter Centrifuge (LDC), can be implemented in parabolic flights racks or fits on random positioning machines.

The ESC's external dimensions are 38x50x50cm and internally a Volume of 28L is available for experiments. It is equipped with state-of-the-art contactless sensors and actuators, which can be controlled and monitored remotely allowing the system to be used without requiring the user to be physically in front of the experiential setup. The chamber is also equipped with a load lock system, allowing samples to be placed in the main chamber without breaking its environmental conditions; thus, avoiding the samples experiencing vacuum during the chamber filling phase. Even though the ESC has been designed specifically for biological systems, its core properties allow alternative sample analysis therefore providing an extremely flexible, accurate, controllable and low-cost alternative for scientific research and also spaceflight hardware evaluation.

The combination of an environmental simulation chamber with a changing-gravity facility opens up a new aspect for researchers in regards to simulating extra-terrestrial planets' environments, which did not exist to date; it can help further the exploration research on ground tremendously. In addition, while the ESC was designed with the background of spaceflight and the gravity-aspects, its portability allows the usage in field research if a comparable, sealed environment on site is supporting research in other areas of interest.

This project is part of the ESA Strategic Partnerships Program and selected for the pilot phase.