SPACE EXPLORATION SYMPOSIUM (A3)
Mars Exploration – Part 1 (3A)

Author: Dr. Tim van Zoest
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, tim.zoest@dlr.de

Mrs. Susanne Wagenbach
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, susanne.wagenbach@dlr.de
Mr. Silvio Schröder
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, silvio.schroeder@dlr.de
Ms. Caroline Lange
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, Caroline.Lange@dlr.de
Mr. Eugen Ksenik
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, eugen.ksenik@dlr.de

PLANETARY ENVIRONMENTAL TESTING CHAMBER

Abstract

Testing, verification and validation is an important phase in the development process of spacecraft hardware. For studying the thermal behaviour of a system, there are thermal-vacuum chambers, where thermal cycles could be realized to simulate the harsh thermal environment in space.

In addition to the thermal cycles, the planetary simulation chamber at the Institute for Space Systems in Bremen can be filled with planetary soils and can also be flooded with an athmosphere (e.g. for Martian or Titan conditions). In this way, instruments for planetary surfaces can be tested in the chamber under very realistic conditions. The outer dimensions of the chamber are 3.3 meters height and 2.0 meters in diameter. However, the interior volume usable for tests is 1.8 m height and 1.4 m in diameter and is accessible from the top via a lid with a diameter of 1.4 m. The chamber can be easily cooled down to average Martian temperature (210K), but even to a minimum of 77K. Cooling is achieved by a copper thermal shroud inside the chamber that is being filled with liquid nitrogen in a pulsed mode, while heating is realized by 8 horizontally mounted 1000 Watt lights. A sun simulation system is planned to be installed.

There are two separate vacuum systems, one is the chamber vacuum for the specimen to be tested and the other one is for isolation. Both vacuum systems are evacuated by mechanical pumps separately. The minimum pressure in the test vacuum chamber that can be achieved is ¡ 10-5 mbar. Throughout an experiment the pressure is automatically held stable at a set value by the pressure control system.

Summarized, the planetary chamber is a unique tool for testing especially instruments for scientific exploration of planetary surfaces under realistic conditions rather than in usual thermal cycling chambers, which are more specific for instruments in free space.