Mechanical / thermal / optical GSE for satellite instrument testing

This custom GSE (Ground Support Equipment) was designed to replicate space conditions on ground (vacuum and temperature gradients) and test selected space hardware for satellites performing also electrical and optical measurements.

"How to test space hardware operations on ground"

Laboratory	DTM
Specialization Area	Mechatronics and Materials
Contacts	Marco Cavazzuti
Keyword	Vacuum chamber, mechanical testing, themal vacuum cycling, optical measurements

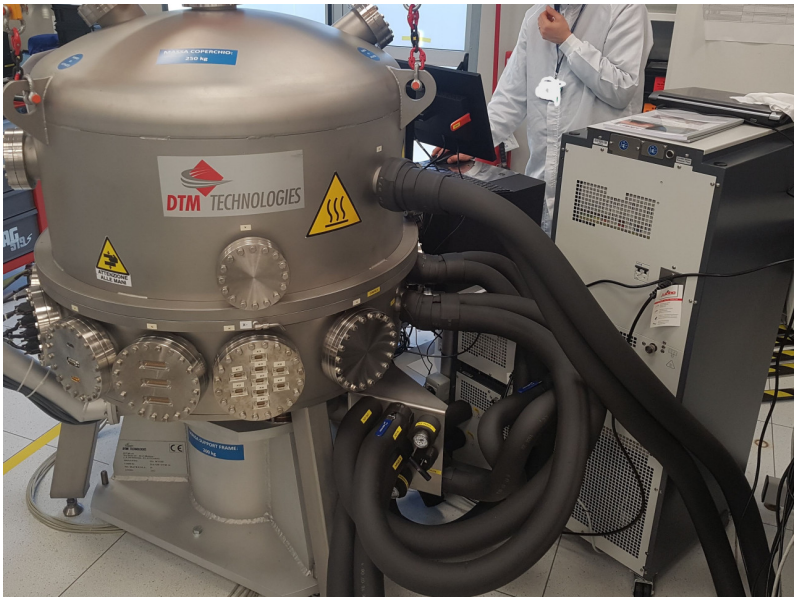


Fig. 1: Mechanical/thermal/optical GSE

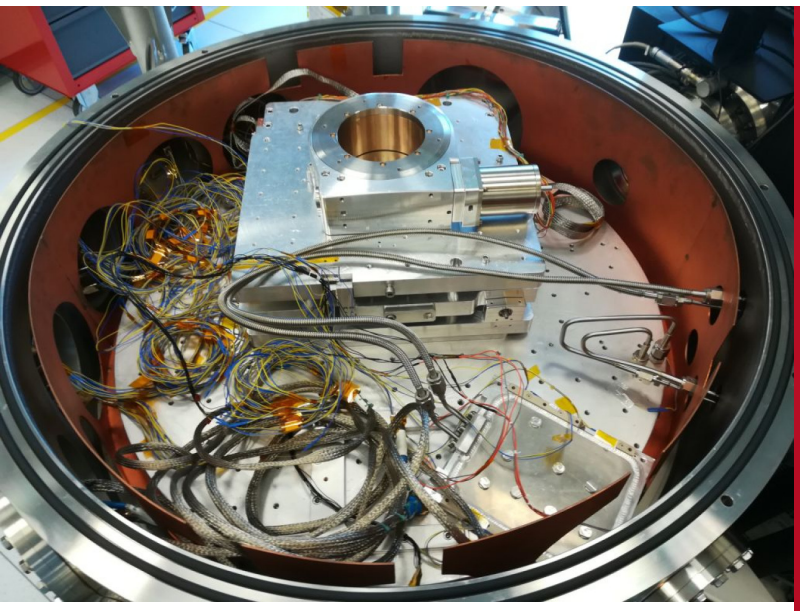


Fig. 2: GSE inside view with cold plates and 3-axes micro positioning system

Innovative aspects

This GSE is innovative because it combines several equipments together and it is possible to perform different tests (mechanical, thermal, optical) with a single GSE, remotely operating it with a single supervisor PC.

Potential applications

This kind of GSE can be adapted and customized in order to test several types of space hardware units (electronic, optical, etc.).

Description

This GSE was designed to replicate the space environment on ground for satellite hardware testing. It is based on a custom vacuum chamber capable to achieve high vacuum levels in a limited time, and two temperature control units capable to independently control the temperature on two different cold plates inside the chamber. A thermal shroud is also present inside the chamber lid in order to create a radiative environment all around the unit under test. The GSE also provides all the needed electrical feedthroughs for space hardware power supply and data transmission. The main cold plate, made of aluminium alloy, can be controlled between -40 and -60°C. A secondary smaller cold plate is equipped with four attachment areas for a space hardware unit, and each one of these areas can be controlled independently between -10 and +60°C by means of liquid circulation and electrical heaters. The GSE is also equipped with a high accuracy micro-positioning system, remotely operated and capable to rotate the unit under test around all three orthogonal axes. Some transparent quartz windows are placed on the chamber lid so that the unit under test is visible from outside during thermal vacuum testing, and the system is completed with two autocollimators that can measure the angular displacements of some points of interest on the unit in the microradiant order of magnitude. This can be useful to verify the displacements and deformations of the unit and compare them with the analytic results.

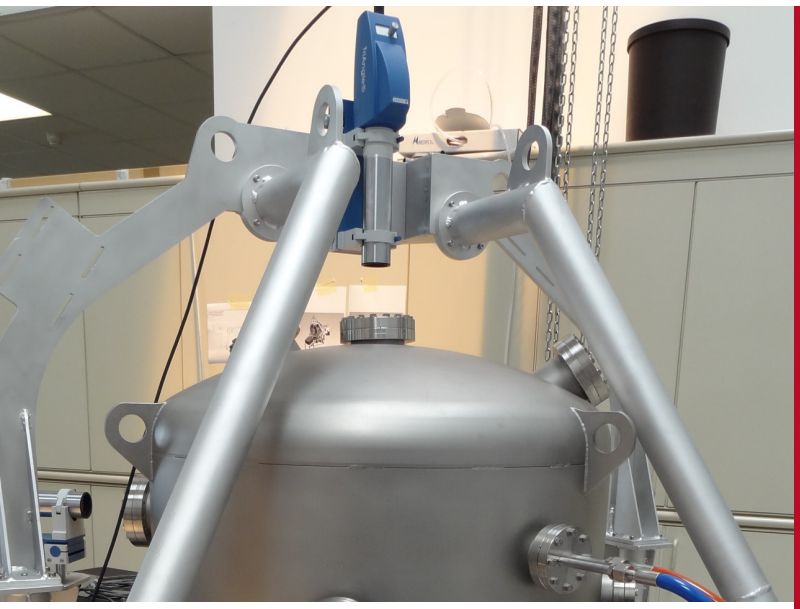


Fig. 3: Optical masurements with autocollimators mounted on GSE windows

Application example

Space hardware testing and qualification for satellite application

This custom GSE (Ground Support Equipment) was designed to replicate space conditions on ground (vacuum and temperature gradients) and test selected space hardware for satellites performing also electrical and optical measurements.

Involved partners	Leader European company in space industry.
Implementation Time	1 mese/persona
Technology Readiness Level	TRL9 - Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)
Exploitation	The mechanical/thermal/optical GSE has been operating inside a clean room environment for over 10 years for testing an instrument now flying on Bepi Colombo spacecraft. It has also been used for testing activities on parts of JUICE spacecraft, now flying towards Jupiter moons.

DTM

Design and technologies for high performance mechanics



DTM dal 1994 esegue attività ingegneristiche e di test potendo contare su sistemi di progettazione CAD 3D e software per il calcolo strutturale, termico e fluidodinamico.
Per la parte di laboratorio, integrazione e test, il laboratorio dispone di aree grigie e due clean room (ISO6 ed ISO 8) in cui vengono eseguite le attività di integrazione, test e qualifica. DTM dispone di un'autoclave per la realizzazione di prototipi in materiali compositi quali ad esempio strutture sandwich ed in fibra di carbonio, tre camere a termovuoto (TVC), strumenti per il test di sistemi fluidici ad altissima purezza. E' disponibile un carro ponte da 20 ton per integrazioni e prove su grandi strutture e sistemi oleo-pneumatici per effettuare prove di qualifica quasi statiche.
Il know-how acquisito in oltre 25 anni di attività in settori quali aerospazio, automotive, nautica e biomedicale, permette di fornire ai clienti lo sviluppo di progetti e sistemi di prova chiavi in mano con il pieno rispetto di requisiti, tempi e costi. DTM per garantire i migliori livelli di servizio implementa un sistema di gestione della qualità secondo le normative ISO 9001 e EN 9100 (aerospazio).

Website http://www.dtm.it/

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