



AEROSPACE



AERONAUTICS



DEFENSE



APPLICATIONS





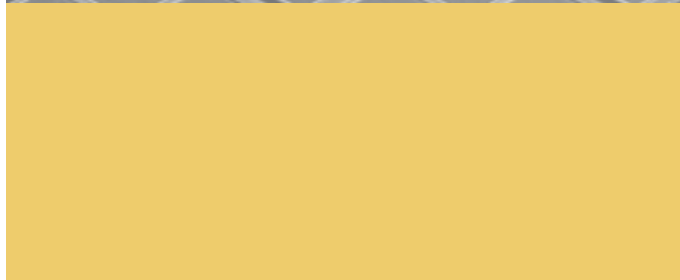
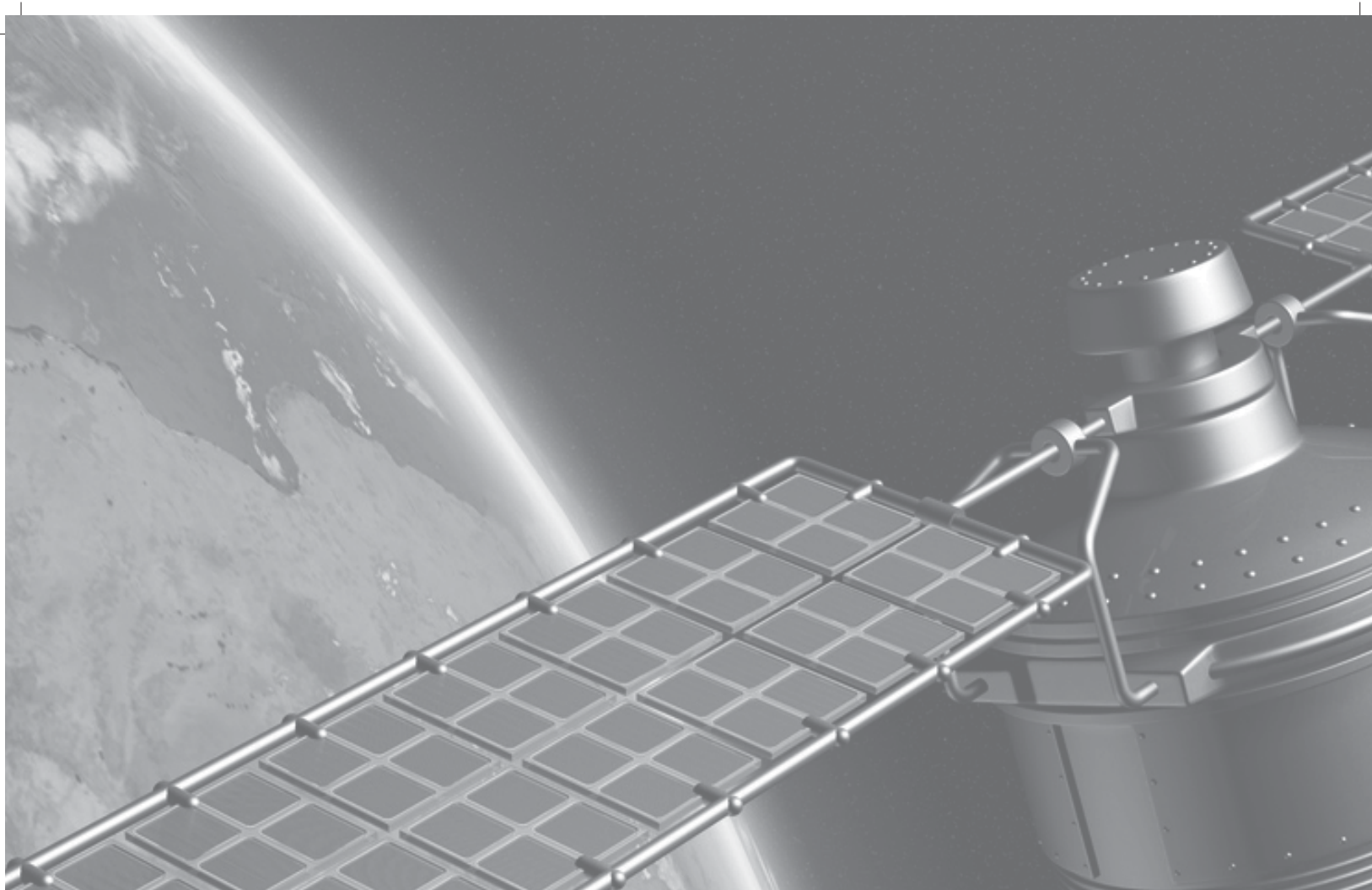
Angelantoni Test Technologies

Since 1952, Angelantoni has been producing and marketing worldwide, under the ACS brand, environmental test chambers for all types of tests on materials, components, and finished products. The ACS brand has always been associated with a vast experience and flexibility in customized solutions, and with undisputed expertise in technologies, gained in part through close cooperation with research institutions, universities, and industrial partners. The ACS brand has acquired a strong leadership position in the aerospace sector, the most challenging environment for simulation: after the first space simulator in 1988, Angelantoni became one of the few leading international manufacturers at international level, and a supplier for the most important space research centers testing satellites, subsystems, and components. With the acquisition of two companies, in France and in Germany, the Testing Division represented by Angelantoni Test Technologies currently consists of 3 business units:

- Environmental test chambers (ACS brand)
- Electrodynamic shakers (TIRA brand)
- Test benches and crash test systems for the automotive and aerospace sector (BIA brand)

Today **Angelantoni Test Technologies** boasts 6 production plants located in Italy, Germany, France, India, and China, with a total of over 400 employees.





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ACS “ World leader in Environmental Space Simulation”

International cooperation among the world's major space agencies has grown with the birth of new economic powers. New partners means an increased availability of funds and the possibility for more ambitious missions, bringing new life to the aerospace business sector.

In addition to the growing demand for global communication, public awareness has also increased in regard to the need to defend our planet from environmental degradation. Population growth has also led the major space agencies to push forward more ambitious programs, which even include a manned mission to Mars by 2030.

Angelantoni has been an active supplier in the aerospace Industry for over 20 years, as a producer and supplier of complete systems for environmental simulation testing. For example, Angelantoni space simulators are used to test components, subsystems, and complete satellites. The most common applications of the space simulator are related to the testing of satellites in a thermal vacuum chamber which involves the simultaneous control of two environmental parameters: pressure and temperature.



Space Simulator - HVT 240MC

Features and benefits

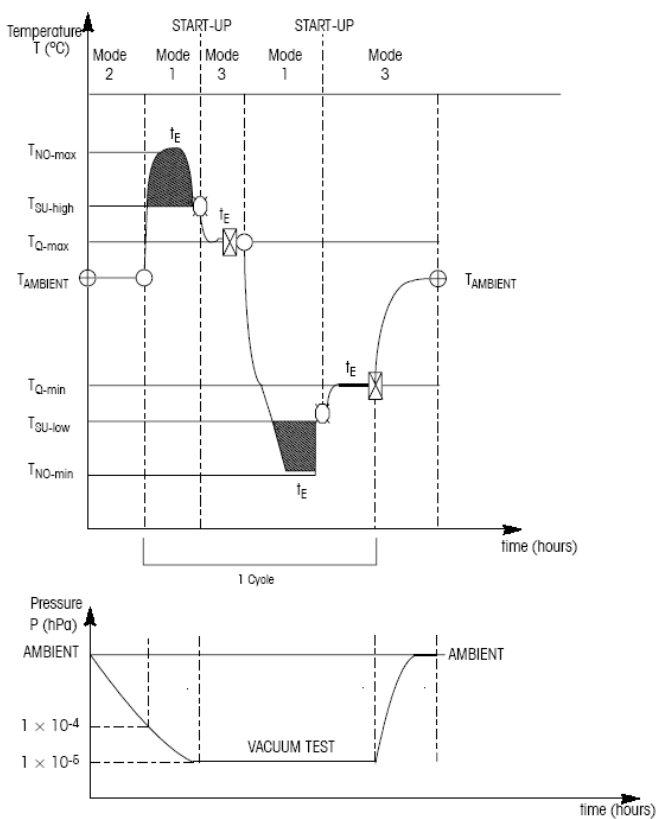
- Wide range of chamber sizes, with diameters ranging from under 1m up to 10m
- High quality and vast experience in vacuum pumping systems
- High quality of black shroud paint with a solution for low outgassing at maximum temperatures ($>+150^{\circ}\text{C}$) according to ESA standard ECSS-Q-ST-70-02C
- Special shroud design to withstand the highest heat dissipations ($>5 \text{ kW/m}^2$)
- Special attention to minimizing consumption through hardware solutions and software management of the plant
- Integrated control and monitoring system totally developed by ACS
- Special attention to and experience in redundancy aspects
- Full capability for supplying turnkey systems



Satellite Testing

Thermal cycling: used to subject the DUT (Device Under Test) to the alternation of high and low temperatures within a temperature range that is typically -100°C to $+100^{\circ}\text{C}$, while the pressure is maintained at values below 10^{-6} mbar (high vacuum). While the satellite is subjected to thermal cycling, it is possible for RF (radiofrequency) signals to be exchanged across the chamber through dedicated wave guides. These tests may take up to a month.

Thermal balance: made for the validation of the thermal-mathematical model of the satellite. Tests are performed by creating an environment with a temperature range similar to that which the satellite will encounter while in orbit (below -180°C). Some parts of the satellite are also subjected to heating from hot sources (lamps or IR emitters) to simulate the effect of sun rays which can cause temperatures to locally reach $+150^{\circ}\text{C}$. The satellite is kept at a constant pressure of 10^{-6} mbar during these tests.



Example of cycle from ECSS-E-10-03A

A wide range of thermal systems is available based on different test needs, economy, and flexibility, for example:

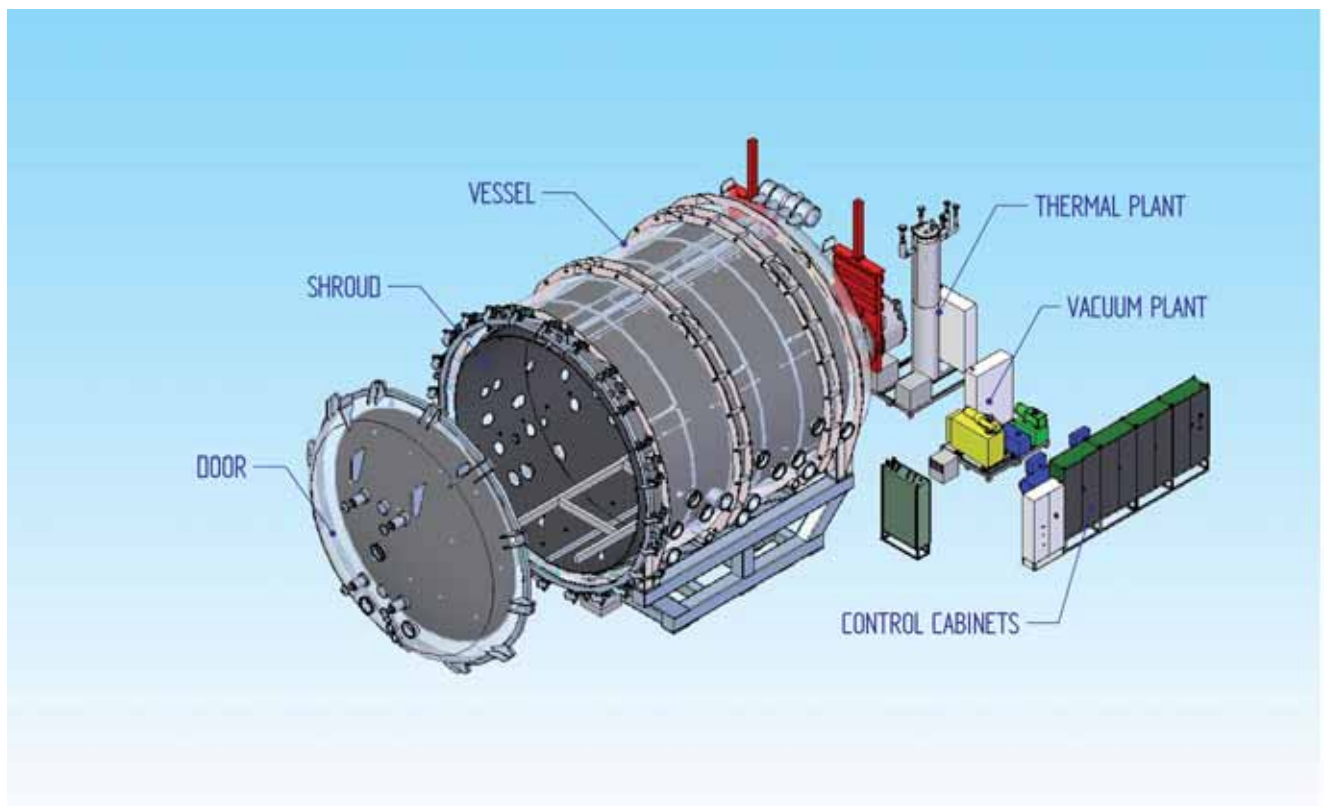
- Liquid nitrogen flooding (boiling mode)
- Liquid nitrogen flooding (boiling mode) with heating elements (lamps or IR emitters)
- Liquid nitrogen partial flooding (boiling mode) with heating elements (lamps or IR emitters)
- Liquid nitrogen pressurized circuit with heating elements (lamps or IR emitters)
- Pressurized gaseous nitrogen circuit
- Combined liquid and gaseous nitrogen modes
- Mechanical cooling with intermediate fluids

Construction

A space simulation chamber can be broken down into 4 main parts.

The vessel, produced from high-quality stainless steel, is the external structure of the testing area and is capable of withstanding the pressure differences between the internal and external environments. Inside the chamber there is an enclosed area in which the tests are carried out. It consists of a cylindrical body which, at one end, has a large door-shaped concave disc for accessing the objects to be tested. A cylindrical heat shield, the "shroud", is placed within the

vessel. This permits adjusting the temperature inside the test area. The DUT is placed in the center of the test area to ensure proper radiation at the specified temperatures. Two disc-shaped heat shields close the two ends of the cylindrical body completely, so as to achieve a uniform temperature field around the specimen. The shroud consists of two laminated sheets with a space of a few millimeters between them. This space is used for the passage of the fluid heat carrier from the thermal power generation system.



General lay-out of a space simulator with its main subsystems and parts



Heating system by ceramic element

The **thermal system** is located near the room and consists of all components (pumps, valves, heat exchangers, sensors) necessary for changing the temperature of the fluid heat carrier. This system is connected to the shroud through superinsulated pipes that pass through the walls of the vessel. The fluid heat carriers are typically liquid and gaseous nitrogen, but in some applications special oils can be used.



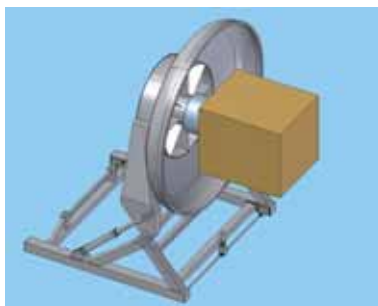
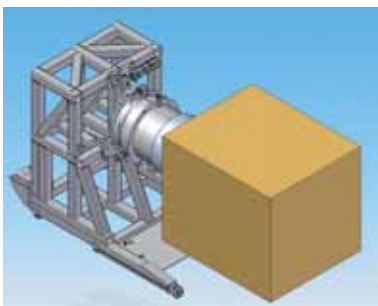
Vacuum plant

The **vacuum generation plant** consists of a set of vacuum pumps, whose main function is to extract air from the chamber to obtain and maintain the vacuum. There are two stages of pumping: the first stage, called primary or rough pumping, allows the transition from ambient pressure to values of around 10^{-2} mbar, necessary to trigger the operation of the second stage, consisting of more sophisticated pumps (cryogenic pumps) that allow the achievement of a high vacuum. Typical levels of final pressure inside the chamber are around 1×10^{-6} mbar, but can drop to values in the range of 10^{-8} mbar.

The **control and management system** of the space simulation chamber consists of a set of electrical cabinets for the power distribution and for the PLC-based control of the chamber subsystems.

The data acquisition system and the SW PC board provide the main user interface and the direct means for controlling and monitoring the whole chamber.

Examples of loading systems



Loading system on a trolley or on the door with horizontal control device (tilt and rotation)



Extensible beam with motorized crane for loading the DUT suspended in the middle of the test area

Examples of ACS products for Space Applications

Chamber model: HVT 35MC -5080



- Tests: high vacuum, temperature
- External dimensions (chamber only): 4000x10300x4000 mm (WxDxH)
- Internal useful dimensions: 3000x5000 mm (ØxL)
- Internal useful volume: 35 m³
- Temperature range: -50°C / +80°C
- Temperature variation rate:
 - 2°C/min from -50°C up to +80°C with 2000 kg internal load
 - 2°C/min from +60°C down to -50°C with 2000 kg internal load
- Vacuum limit: 1x10⁻⁶ mbar
- Special features: combined thermo-vacuum tests and optical measurements on satellite components

Chamber model: HVT 240MC -190130 GN2/LN2



- Tests: high vacuum, temperature
- External dimensions (chamber only): 7200x16000x9000 mm (WxDxH)
- Internal useful dimensions: 5500x10000 mm (ØxL)
- Internal useful volume: 240 m³
- Temperature range: -190°C / +130°C
- Temperature variation rate:
 - 1°C/min from -100°C up to +100°C
 - 1°C/min from +100°C down to -100°C
- Vacuum limit: 1x10⁻⁶ mbar
- Special features:
 - Door with tilting system for spacecraft loading
 - Special trolley for Spacecraft loading on rails
 - Internal monorail crane
 - Spacecraft horizontality control system

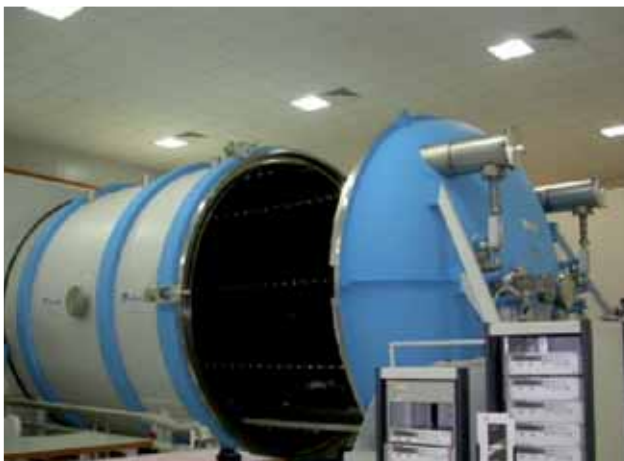


Chamber model: TC67 -185210 LN2



- Tests: temperature
- External dimensions: 4100x8000x4300 mm (WxDxH)
- Internal useful dimensions: 3500x5500x3500 mm (WxDxH)
- Internal useful volume: 67 m³
- Temperature range: -185°C / +210°C
- Temperature variation rate:
 - 20°C/min from -145°C up to +170°C
 - 20°C/min from +170°C down to -145°C

Chamber model: HVT 52MC -190150 LN2



- Tests: high vacuum, temperature
- External dimensions (chamber only): 4200x10000x4400 mm (WxDxH)
- Internal useful dimensions: 3900x4400 mm (ØxL)
- Internal useful volume: 52 m³
- Temperature range: -190°C / +150°C
- Temperature variation rate:
 - 1°C/min from -100°C up to +100°C
 - 1°C/min from +100°C down to -100°C
- Vacuum limit: 1x10⁻⁶ mbar
- Special feature: internal DUT frame with horizontality control system

Chamber model: HVT1100 -150150 GN2



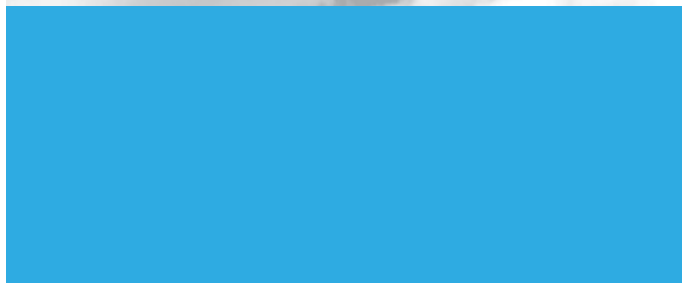
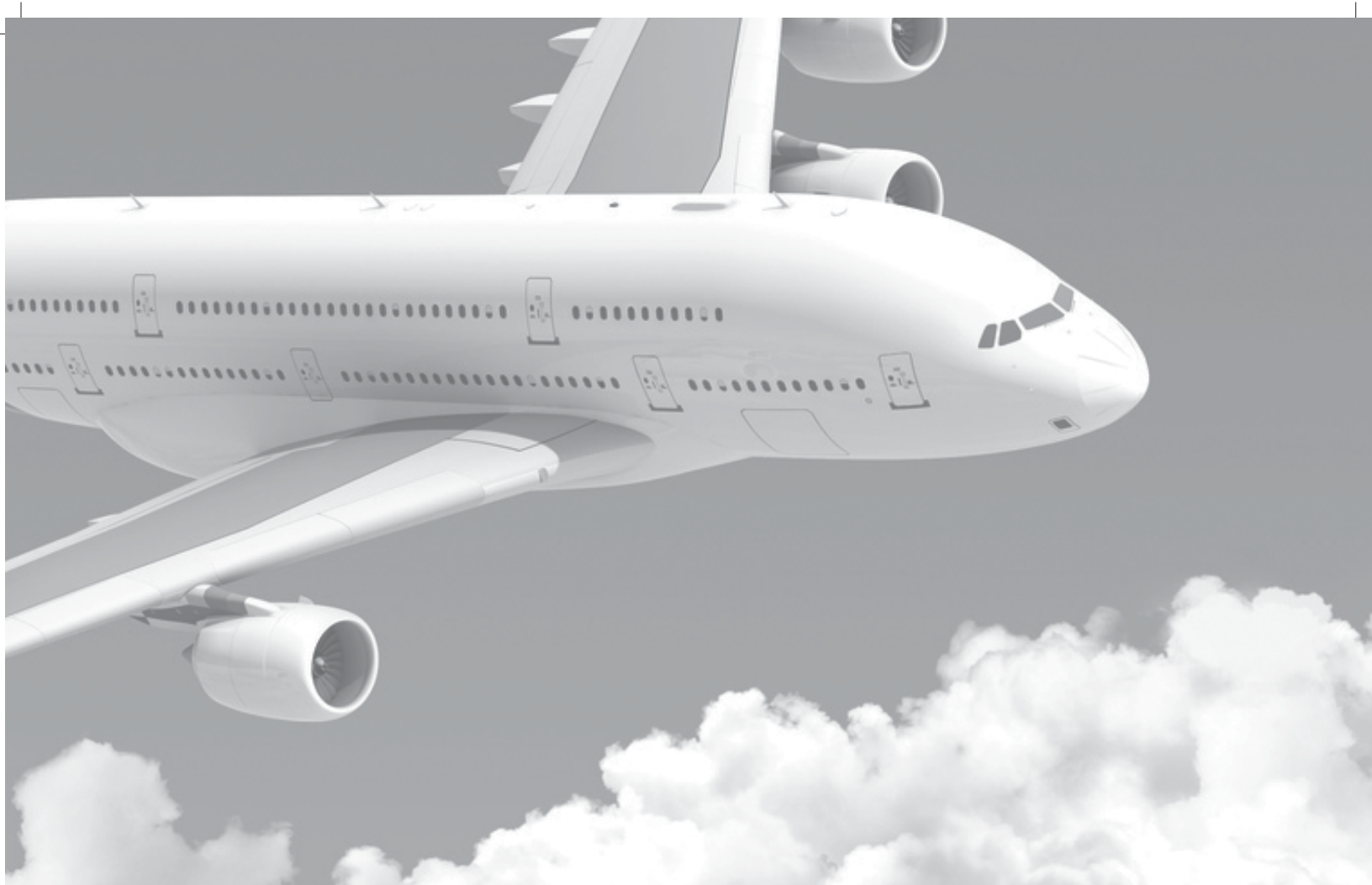
- Tests: high vacuum, temperature
- External dimensions (chamber only):
2000 x 3500 x 2500 mm (WxDxH)
- Internal useful dimensions: 1000x1400 mm (ØxL)
- Internal useful volume: 1100 l
- Temperature range: -150°C / +150°C
- Temperature variation rate with load under 8×10^{-4} Pa:
≥ 1.5°C/min in the range of -120°/+120°C with load.
≥ 1.0°C/min in the range of -150°/-120°C and
+150°/+120°C with load.
- Vacuum limit: 5×10^{-7} mbar

Acotec Clean Room



Acotec, a subsidiary of the Angelantoni Group, is specialized in the design, implementation, and validation of controlled contamination environments (clean rooms) for aerospace applications:

- Design and production in compliance with ISO 14644
- Control contamination classes from ISO Class 9 to ISO Class 5 with the possibility to comply with ISO Class 3 for micro-environments
- Supply of customized turnkey clean rooms of any size
- Control of temperature, humidity and ambient pressure parameters with high levels of tolerance levels
- Systems for continuous monitoring of particle contamination and critical parameters



AERONAUTICS

ACS "World leader in Environmental Testing of Aeronautics Components and Systems"

Environmental chambers in which it is possible to control pressure in order to simulate the altitude above sea level are a fundamental instrument in the aeronautics industry, both civil and military.

Over the years, the tests necessary for the development and qualification of new equipment have become

increasingly more complex and integrated. The need to have numerous parameters under control at the same time and to simulate extreme conditions has made the classic "altitude test chamber" a necessary instrument, but one that is not always sufficient for achieving the quality and reliability standards required.



Chamber model - UD1000C VT

Vacuum chamber to be combined with vibrating system. Vibration, temperature, humidity and altitude can be simulated at the same time



Angelantoni has gained valuable experience down through the years, enabling it not only to offer altitude test chambers for testing in compliance with the most common international standards of the sector, but above all to meet the most selective demands from the market.

In conventional chambers, altitude and temperature are simulated simultaneously, while the control of relative humidity is limited to the cases where the altitude is not included. Angelantoni is able to include all three parameters at the same time, making it possible to simulate on the tested aircraft the complex phenomena associated with rapid changes in all these parameters. Similarly, in conventional tests the vibration simulation takes place in absence of an altitude control; Angelantoni has developed chambers in which integration of the vibrating system is possible, thus permitting the simultaneous simulation of vibration and environmental parameters (temperature, humidity, altitude).

In addition to the simulation of the normal functioning conditions, it is sometimes necessary to simulate emergency or failure conditions; an example may be the instantaneous pressure change associated with a drop in aircraft pressurization. Angelantoni chambers are able to reproduce these phenomena, up to and including the so-called "explosive decompression" level, at which a pressure change of several hundred millibars occurs within fractions of a second. In some cases, in order to perform their functions correctly, the electronic equipment on aircraft must be air-conditioned (cooled) at a controlled temperature and flow rate. This complicates the simulation not only because of the addition of further parameters to be checked, but above all because the air used for the cooling of the equipment being tested hinders the possibility to maintain the pressure conditions associated with the altitude that must be simulated. In this case, also, Angelantoni chambers are able to provide optimal solutions for the testing needs.



CH14000 TC HY-ESS Hybrid chamber for stress screening tests

Features and benefits

- Combined control of humidity and altitude
- Integrated solutions including vibrations at high altitude
- Simulation of altitude at fast rates of change
- Simulation of "explosive decompression"
- Fast rates of temperature change
- Multi-shaker interfaces
- High load-bearing capability
- Flexible design to allow the testing of large physical dimensions
- DUT air conditioning at controlled temperature

Examples of ACS products for Aeronautics Applications

Chamber model: CH12000 C VT-30-ESS



- Tests: temperature, humidity, vibrations
- External dimensions (chamber only):
6400x3300x3200 mm (WxDxH)
- Internal useful dimensions: two separate rooms of
2500x1450x1600 mm (WxDxH) each
- Temperature range: -75°C / +200°C
- Temperature variation rate (with 600 kg internal load):
 - 30°C/min from -55°C up to +70°C
 - 15°C/min from +70°C down to -55°C
- Relative Humidity range: from 5% to 98%
(dew point range -5°C/+84°C)
- Special features:
 - floor interfacing with external shakers
 - removable intermediate wall to join the two rooms
in one of double volume

Chamber model: UD24000 C VT LN2



- Tests: temperature, humidity, vacuum
- External dimensions (chamber only):
2600x7800x3050 mm (WxDxH)
- Internal useful dimensions: 2000x6000x2000 mm (WxDxH)
- Temperature range: -75°C / +150°C
- Temperature variation rate (with 1600 kg internal load):
 - 5°C/min from -65°C up to +120°C
 - 5°C/min from +120°C down to -65°C
- Relative Humidity range: from 10% to 95%
(dew point range +2°C/+79°C)
- Pressure range: from ambient down to 10 mbar
- Special feature: fast depressurization from ambient down
to 45 mbar in 1 min.
- Special standard requested: DEF STAN 00-35 CL9 severities
B C Y E



DEFENSE

ACS “World leader in Environmental Testing of Defense Systems and Components”

One of the priorities for homeland security is the prevention of incidents (i.e. terrorist actions, destructive natural events) with a view to reducing the impacts they may have on national security. This means that countries must be able to collect data rapidly from various sources and process it into actionable intelligence. It also means they must develop plans to protect critical infrastructure and have the current and accurate global information necessary for understanding trends and protection needs. This information enables homeland security services to be able to visualize the situation and quickly identify the necessary actions to be taken.

The resulting information is derived from several different environments, mainly from the atmosphere and land. These environments are usually then divided into three main focus areas: surveillance of the territory through satellites, deterrence by airborne vehicles or navy, action by land

forces. The high reliability and the perfect functioning of the tools included in this chain are therefore indispensable prerequisites. Preventive inspection and testing of these materials is highly recommended to ensure the security of the system. Over many years various test specifications have been developed in support of these activities, with particular focus on the wide range of environments in which the equipment may be used, for example MIL-STD, ECSS, NASA, DEF STAN, STANAG, RTCA-DO, ITOP, etc.

Angelantoni, through the experience and knowledge it has acquired over five decades, is able to offer customers in this market area a wide range of testing solutions suitable for any method of the main standards, thus enabling our customers to be fully confident that the equipment they purchase to perform these crucial tests is supported by a supplier with an in-depth knowledge of industry specifications and test procedures.



Walk-in chamber for rain tests according to MIL-STD-810G

- Over 40 years' experience in designing and producing chambers for military applications
- Explosion-proof solutions
- Integrated mobile environmental test solutions
- Design and production of large testing facilities for full-scale military vehicles



Examples of ACS products for Defense Applications

Chamber model: CH22000 C VT LN2



- Tests: temperature, humidity, vibrations
- External dimensions (chamber only):
5800x3000x(3540÷3940) mm (WxDxH)
- Internal useful dimensions:
5500x1850x2000 mm (WxDxH)
- Temperature range: -60°C / +90°C
- Temperature variation rate:
 - 10°C/min from -60°C up to +90°C
 - 10°C/min from +90°C down to -60°C
- Relative Humidity range: from 10% to 95%
(dew point range +4°C/+59°C)
- Special features:
 - floor interfacing with external shakers
 - hydraulic lifting system
- Standard requested: BS 2011-IEC 68-2-32/50,
MIL-STD-810G

Chamber Model SOLAR SIMULATION PLANT



- Test: solar simulation
- External dimensions: 8600x16500x10000 mm (WxDxH)
- Internal useful dimensions:
8000x16000x7600 mm (WxDxH)
- Temperature range: +32°C / +49°C
- Temperature variation rate:
 - 0.05°C/min from +32°C up to +49°C
 - 0.05°C/min from +49°C down to +32°C
- Special features:
 - wide solar radiation area 6000x13000 mm (WxD)
 - hydraulic lifting system for lamps structure
- Standard requested: MIL-STD-810E method 505.3



DEFENSE

Chamber model: SD 1000 MIL



- Tests: sand and dust
- External dimensions (chamber only): 6500x3300x2300 mm (WxDxH)
- Internal useful dimensions: 1000x1000x1000 mm (WxDxH)
- Temperature range: ambient / +66°C
- Relative Humidity: below 22%
- Air speed: up to 29m/s
- Standard requested: MIL-STD-810F Method 510.4

Chamber Model: AnyVib



- External Dimensions (Typically): 2000x3476x2280 mm (WxDxH)
- Internal Dimesions (Typically): 1000x1130x1080 mm (WxDxH)
- Temperature range: -75°C up to +180°C
- Relative Humidity range: from 10% to 95%
- Standard requested: MIL-STD-810F Method 520.2

Chamber Model: CHADF-Explosives



- Tests: Combined Temperature-Humidity
- Temperature range: -55°C/+85°C
- Relative Humidity range: from 10% to 95%
- Standard requested: MIL-STD-810F, ITOP4-2-602



Chamber model: UC50-60130 CST



- Tests: the chamber consists of two testing rooms which can work independently or together to perform thermal shock tests and/or test profiles
- Useful dimensions:
CHAMBER (1): 3000x4000x2000 mm (WxDxH)
CHAMBER (2): 000x4000x2000 mm (WxDxH)
- Temperature range: -60°C/+130°C
- Temperature rate (average value, with 300 kg of compact Aluminium load, in the testing range -54°C/+120°C):
- ROOM (1): 3°C/min heating, 2°C/min cooling
- ROOM (2): 3°C/min heating, 2°C/min cooling
- LARGE ROOM (1 + 2): 3°C/min heating, 2°C/min cooling
- Thermal shock resetting time:
5 minutes in the range -40°C/+60°C, with 300 kg of compact aluminium load
- Humidity range: from 10% to 95% R.H. in the temperature range +20°C/+80°C
- Standard requested: MIL-STD-810G

Chamber Model: UC507-5575



- Tests on heavy vehicles
- Internal useful capacity: 507 m³ approx.
- Internal useful dimensions:
6500x13000x6000 mm (WxDxH).
- Door useful dimensions: 5600 x 5600 H mm .
- Floor capacity: 65 tons (in the full area)
- Temperature range: -55°C/+75°C (adjustable)
- Temperature accuracy (at steady conditions): ±1...±2°C
- Average temperature rate (without internal load):
- heating up from -55°C to +75°C --> 0.5°C/min
- cooling down from +75°C to -55°C --> 0.5°C/min
- Climatic range (without any heat load): +10°C/+75°C
- Humidity range: from 10% to 95% R.H. (adjustable)
- Air velocity (around the specimen): 0.25 m/sec < V < 1.5 m/sec
- Standard requested: MIL-STD-810F Meth. 501.4
Proc. I & II, Meth. 502.4 Proc. I, II & III, MIL-STD-810F
Meth. 507.4

Angelantoni Test Technologies (ATT), a company of the Angelantoni Group, is the only company capable of offering a broad range of test solutions for a great variety of applications, thanks to the expertise and technical know-how of its worldwide teams of experts. Three leading test technology brands belong to ATT: **ACS**, world-famous since 1952 for its design and manufacture of a comprehensive range of environmental test chambers, including high-tech test equipment such as high vacuum chambers for aerospace applications and calorimeters. With the acquisition of companies in France, Germany, China, and India, other brands of test chambers are now available on the worldwide market: BIA Climatic, TIRA Umweltsimulation, AMEC, and AKI.

BIA, providing test benches and crash test systems to major companies, mainly in the automotive and aerospace fields, since 1986. The company philosophy is to provide innovative solutions through close cooperation with the customer in order to guarantee continual improvement of product quality and performance and optimize testing costs.

TIRA, specialized in electrodynamic shakers, material testing equipment, and balancing systems. Internationally renowned automotive manufacturers and suppliers, manufacturers of high-speed rotating components, aviation and aerospace equipment manufacturers, research facilities and institutes, and test centres all benefit from TIRA products and services worldwide.

Our core competencies and services for total customer satisfaction:

- Training, both at our facility and at customer site
- Testing and quality checks
- Installation and start up
- Preventive maintenance
- Service
- Calibration using SIT certified instruments
- "Full risk" assistance contracts
- Extended warranties
- Existing chamber validation
- Retrofitting of older chambers, including instrumentation and new environmentally friendly refrigerants
- Exchange and sale of used chambers
- Research and development
- Production and assembly
- Market analysis and advice
- Special applications



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GROUP
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