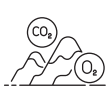
terraXcube
eurac research

Large Cube

Education-Training on the effects of exposure to high altitudes on human physiology

The test in a nutshell



Atmosphere


Group testing


Sport

terraXcube

terraXcube is Eurac Research's extreme climate simulation centre at the NOI Techpark in Bolzano, South Tyrol, Italy. Within its chambers, even the most extreme of all our Planet's environmental conditions can be created. By combining hypobaric and altitude technology with state-of-the-art environmental simulation, we aim to investigate the effects of extreme climate conditions on humans, ecological processes and industrial products.
The climate chambers differ in size and equipment and can accommodate people, plants and other living organisms for up to extended periods and have the space to accommodate large machines and products.
Each day our team breaks new ground with scientists and industry partners and prepares the path to gain discoveries.

Test description

This test procedure is a simulation of high altitudes and their respective effect (real, measurable) on the human body.
This simulation can be offered to physiology students, who first learn about the effects of high altitude at university and can then actually experience those effects themselves during exposure to an absolute pressure of 600 mbar (corresponding to a simulated altitude of 4000m).
Prior to the test itself, the test chamber is fitted with one or more cycle ergometers complete with a gas and blood analyser, a stretcher and an ultrasound machine.
The test itself consists of two phases. A first phase in which the absolute pressure in the chamber is equal to the barometric pressure of Bolzano on that day.
Students are asked to take turns to sit on the cycle ergometer and complete an exercise test until they are exhausted i.e. a test with an automatically increasing ramp of resistance upon which the person on the ergometer is asked to maintain a pedaling frequency above a certain value. The test ends when the participants can no longer maintain the pedaling frequency of the pre-set threshold.
During the test, a gas analyser, also called a metabolic cart is used to determine oxygen uptake (VO2), carbon dioxide production/output (VCO2), respiratory exchange ratio (RER), pulmonary ventilation (VE). respiratory frequency (Rf), tidal volume (VT), end-tidal O2 pressure (PETO2), expiratory O2 fraction (FEO2), end-tidal CO2 pressure (PETCO2), expiratory CO2 fraction (FECO2), and energy expenditure (EE). The mechanical power exerted by the student on the ergometer is measured and also logged.
After the test to exhaustion is complete, the participants then move to and lay on the stretcher, where they are subjected to an ultrasound test by other students in order to measure their cardiac functions (cardiac output, ejection fraction, chamber volume/size during the contraction phase, blood flow etc.).
The second part of the test is the same as the first one, except for the fact that the exhaustion test and the ultrasound are carried out inside the chamber at an absolute pressure of 600 mbar, corresponding to an altitude of 4000m. All students and teachers that are exposed to high altitude carry a telemetric physiological monitoring system provided by terraXcube that continuously monitors, displays and records ECG, heart rate, respiratory rate and oxygen saturation.
During the test at altitude, the test chamber is always kept at 4000m and the students are brought up to altitude using the airlock and the ambulance room that act as a lift between the

Contact: T +39 0471 055 550 – terraxcube@eurac.edu – terraxcube.eurac.edu

altitude of Bolzano and 4000m. Depending on the number of students and teachers, the tests inside the test room can be organised in different shifts.
The tests to exhaustion at altitude will show a degraded performance for all students, proving what they have already learned during the course.

Main focus

Training-Education on the effects of the high altitude on the human physiology: monitoring physiological performance during a test to exhaustion and changes to functionality in the body using an ultrasound device.

Large Cube - General Characteristics and Environment Control

Internal dimensions	12 m x 6 m x 5 m (L x W x H)
Useful Square Footage	137 m² + 100 m² for test setup
Access to the chamber	Large sliding door: 3.6 m x 4 m (W x H)
Maximum simulated altitude	9,000 m ±10 m (~ 30,000 ft)
Maximum Rate of Climb (ROC)	6 m/s (~ 1,180 ft/min); 14 m/s (~ 2,756 ft/min) in the airlock
Minimum Rate of Climb (ROC)	0.1 m/s (~ 20 ft/min)
Temperature Range According to IEC 60068-3-5	-40...+60°C (± 1°C in time ± 2°C in space)
Temperature Rate of Change According to IEC 60068-3-5	± 0.5°C/min (cooling & heating)
Relative Humidity T > 4°C and according to IEC 60068-3-6	10...95% ± 3%
Humidity Rate of Change T > 4°C and according to IEC 60068-3-6	0.4%/ min cooling; 0.5%/ min heating
Wind	Up to 30 m/s
Precipitations	Rain: 0...60 ±1 mm/h Snow: up to 50 mm/h

Other Features

Power Supply	230Vac 1~ 50Hz, 400Vac 3~ 50Hz, 63A
Data-acquisition equipment Smoke/Fire detection system + Fire suppression system CC cameras	
Network connection	Gigabit-Ethernet (1000BaseT) PoE, Wi-Fi