COLORADO ALTITUDE TRAINING

Altitude Simulation Systems for Pilots

The CAT Hypoxic Aviation System™

686 S. Taylor Ave. Suite 101 ▲ Louisville, CO 80027 ▲ www.altitudetraining.com
Phone (760) 230 1601 or (877) 258-4883 ▲ Fax (303) 440-4105
E-mail swallace@altitudetraining.com

Hypoxic Training for Pilots

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The biggest danger to man at high altitudes is hypoxia. Its debilitating effect on our mental capability leads to errors, which causes accidents, which results in deaths. With a rapid depressurization the response needs to be quick and instinctive. With a slow depressurization the hypoxic effects will creep up on an ill-prepared aviator until he is unable to make accurate decisions and ultimately falls into unconsciousness. In both cases the key to survival is being prepared so the symptoms are recognized and the correct response is made immediately.

Current options: 1) Decompression Chambers

To train pilots in this field, the traditional equipment has been the hypobaric or decompression chamber.
The 2 main drawbacks with these are cost, and safety

Most private institutions cannot possibly afford to have their own hypobaric chamber, meaning they have to travel to use someone else's, such as at the FAA facility in Oklahoma City.
The inconvenience and cost of such trips means they are not conducted as often as instructors would like, and pilots only receive a fraction of the hypoxia training they need for the correct response to be instinctive.

Even with a hypobaric chamber there remain serious limitations. According to the paper *"Incidence of decompression sickness in hypoxia training with and without 30-min O_2 prebreathe."*[1]

"This training is performed in a hypobaric chamber and is considered high risk due to the potential for barotrauma and/or decompression sickness (DCS)."

Because of this, individuals are only allowed in once per day, including the Inside Observers (IO's). Consequently all subjects often have to be in the chamber at once. 2 groups requires there to be 2 sets of instructors.
IO's may need to breath pure oxygen for 30 minutes before entering [1] and even so it is still considered dangerous enough that, Navy, IO's receive hazardous duty incentive pay.

Current options: 2) Hypoxic Mask-Based Systems

A recent development has been the use of oxygen-depleted air supplied via a mask. While this successfully creates the hypoxia without any risk of DCS, the correct response cannot be learned as the aviator is already wearing a mask. In fact with this method the instinctive response that's taught becomes be to take the mask off, - the exact opposite of what should be taught.. Furthermore the wearing of the mask itself causes different breathing patterns and sensations, and the trainee is inevitably aware this device, so it does not fully train the aviator to notice hypoxic symptoms should they creep up in his usual mask-off working environment.

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The Future: The CAT Hypoxic Aviation System™

CAT's Hypoxic Aviation Systems™ use normobaric hypoxic, creating a low-oxygen environment within a enclosure, resulting in the most cost-effective and safe way to provide aviators with a full mask-off hypoxic experience up to 30,000'

Systems can be based on a double tent design, or use a custom modular clear-room. It is possible to convert suitable existing rooms or even a flight-simulator itself. In general no special preparations are needed and systems can be set up permanently, or even temporarily, virtually anywhere in your facility.

Unlike the hypobaric chambers, individuals can enter through the double doors or zippered entries without having to balance the pressure. Furthermore as there is no risk of DSC instructors can make multiple trips per day, breathing their own oxygen-enhanced air if they wish, so trainees can receive more personal instruction in the altitude environment.

At just a fraction of the price of a hypobaric chamber, CAT's altitude-simulation system is now affordable enough for many flight schools and other institutions to purchase or lease, and with minimal ongoing costs or required maintenance.

Advantages of using a CAT system compared with a hypobaric chamber:

- Lower cost
- Improved safety
- More convenient (ease of use, and possible location)
- More flexibility in design
- No risk of decompression sickness
- Multiple exposures per day are possible
- Modular design allows for future expansion of systems

CAT's normobaric aviation systems are already in use at the FAA facility in Oklahoma City, and at America's premier pilot training institution; Embry Riddle Aeronautical University in Daytona Beach, FL

Visit our website for additional information http://www.altitudetraining.com
Visit http://www.youtube.com/user/aviationhypoxia for video clips
Please contact CAT to discuss a custom solution to meet your needs.

Colorado Altitude Training LLC is located outside of Boulder CO, near the foothills of the Rocky Mountains

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CAT Hypoxic Aviation Systems™ - Equipment

The main components of CAT's altitude systems are:

- Enclosure options:
  - CAT double-layer Altitude Tent
  - Modular Clear-Room Enclosure with Ante-Room
  - Existing room if sufficiently well sealed.
- Control System
  - CAT Digital Controller, with remote PC Hook-up
- Altitude Air Generation
  - CAT-23RC Air Unit. Long lasting, fully automated, very low running costs

Enclosure option 1: Tents

CAT has manufactured altitude tents since 2001. They typically consist of rip-stop nylon (coated just sufficiently that they maintain the hypoxic environment), clear soft windows, and a framework of either aluminum or plastic. The door(s) are zippered, and the floor is sewn in place.

Tents have the advantage that:

- They can easily be packed up and stored, or shipped.
- They can be made in a variety of sizes.
- They are relatively inexpensive.

For high-altitude environments over 20,000' CAT uses a double tent system. This improves the overall sealing, and almost completely avoids any loss of altitude during entry or exit.

Enclosure Option 2: Modular Enclosure

Individual panels with aluminum frames and durable, soft clear windows, clip together to create a pleasant semi-permanent enclosure. Cut-outs in the frame for air hoses and electrical cords can be made in advance or created on-site.

Each enclosure is custom made and can be almost any size or layout.
For high-altitude systems over 20,000' it is necessary to have an ante-room. Combinations of sliding and swing-opening doors are possible. Swing-opening can ultimately seal better, but sliding doors lose less altitude during entry or exit.

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Control system: CAT Digital Controller

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In 2003, after several years of working with modified versions of generic logic controllers, CAT initiated a project to develop and build the world's first dedicated digital controller for hypoxic altitude environments. The result revolutionized the industry and opened the door for a whole range of stabilized, hypoxic systems. With this device the user enters the desired altitude and it communicates with the remote equipment to bring the environment quickly to the set-point, and stabilize it there. The controller also monitors other factors such as CO_2 and responds accordingly.

Displays:

- Set-Point Altitude
- Current Altitude*
- CO_2 (on demand)

Controls:

- On/Off (controls entire system)
- Feet/Meters
- Altitude Up/Down
- Altitude/CO_2 display
- Dimmer

Features:

- Dual Oxygen Sensors for self error-checking
- CO_2Sensor
- Pressure transducer to determine natural elevation
- Temperature Sensor
- Self-calibrating (automatically each 42 days, or on-demand)
- Alarms
- 3 Control channels for separate banks of equipment
- Data-Logging output

In 2007, at the request of the Federal Aviation Administration (FAA), an update was made to the firmware to allow for altitudes up to 30,000'

*The altitude is displayed in feet or meters. The Partial Pressure of Oxygen (PPO_2) is determined by measuring the oxygen content and the local pressure (dependant upon weather conditions and natural elevation). Using an algorithm developed by Professor John West [1], the altitude at which this PPO_2 would be experienced naturally is then determined.

1 **John B. West** Department of Medicine, University of California, San Diego
Prediction of barometric pressures at high altitudes with the use of model atmospheres Journal of Applied Physiology
Vol. 81, No. 4, pp. 1850-1854, October 1996

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Remote Display and PC Hook-Up

Unlike an athlete's altitude bedroom set at 9000', with a system capable of reaching 30,000' it is not always convenient to have to enter the enclosure to adjust the altitude. CAT has two solutions for this:

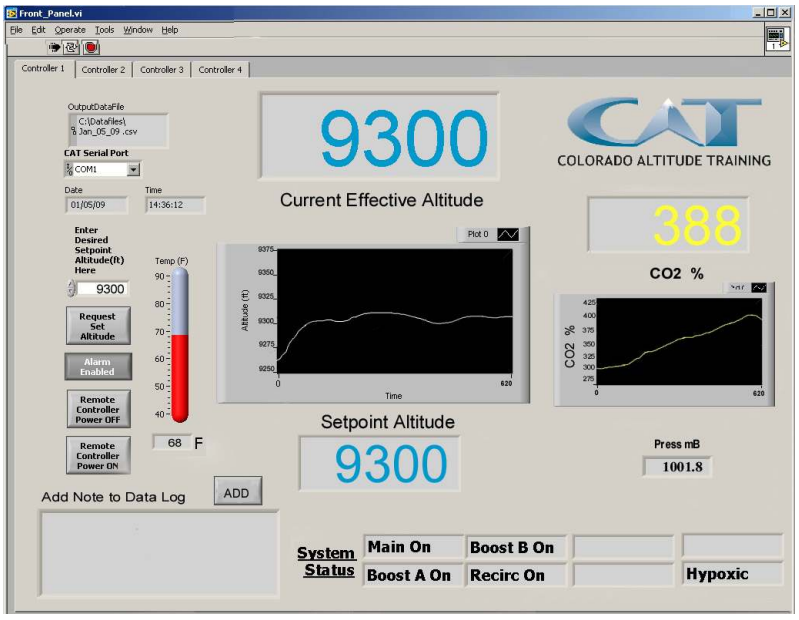
1) External display and control. Can be up to 10' from the sensors:

2) Remote PC control and display system.
It's now possible to observe and control the status of a CAT altitude system from a local computer.

Controller-to-Display information (updated in real-time)

- Effective altitude (digital current, and graphical history showing trend)
- Set-Point altitude
- CO_2 (digital current, and graphical history showing trend)
- Temperature
- Barometric Pressure
- Equipment Status
- The Controller's emergency alarms (Altitude & CO_2) can be echoed at the PC

This information is all data-logged to a Microsoft Excel compatible CSV file for subsequent review



Display-to-Controller commands

- Entire system can be turned on or off from the PC, or from the Controller
- Set-Point altitude can be adjusted on the PC, or on the Controller
- A time-stamped note can be added to the data-log report

The connection can be to an RS-232 ("serial") port, or to a USB port.
All current versions of Windows operating system supported.
Computer shut-down does not affect Controller.
Ask about wireless hookup.

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CAT Air Unit.

- Model: CAT-23
- Number per system depends upon occupancy requirements
- Weight 56lbs (25.5kg)
- Dimensions 20" x 15" x 26" (50cm x 37cm X 67cm)
- Power requirement: 120v / 60 Hz, 5 Amperes. (220v/50hz available)
- Typical number required = 1 per occupant

The CAT-23 is the newest version of CAT's air separation units, this general model line being introduced in 2002. The units can operate in two modes; one where it delivers a stream of low-oxygen air to the enclosure, and the other whereby it extracts and draws out oxygen from inside the enclosure. The most appropriate mode is determined and enacted by the Cat Controller.

- Maintenance: Minimal (occasional cleaning of intake screen)
- Consumables: None
- Expected life : est 20,000 hours operation.

Compared with CAT's original versions (CAT-9, CAT-12) the CAT-23 features a feedback-stabilized digital flow control, and the ability to create the higher altitudes required for this application.

The light weight and modular nature of the unit means that systems can be precisely sized based on the occupancy requirements. Existing systems can easily be increased in capacity by connecting additional air units.

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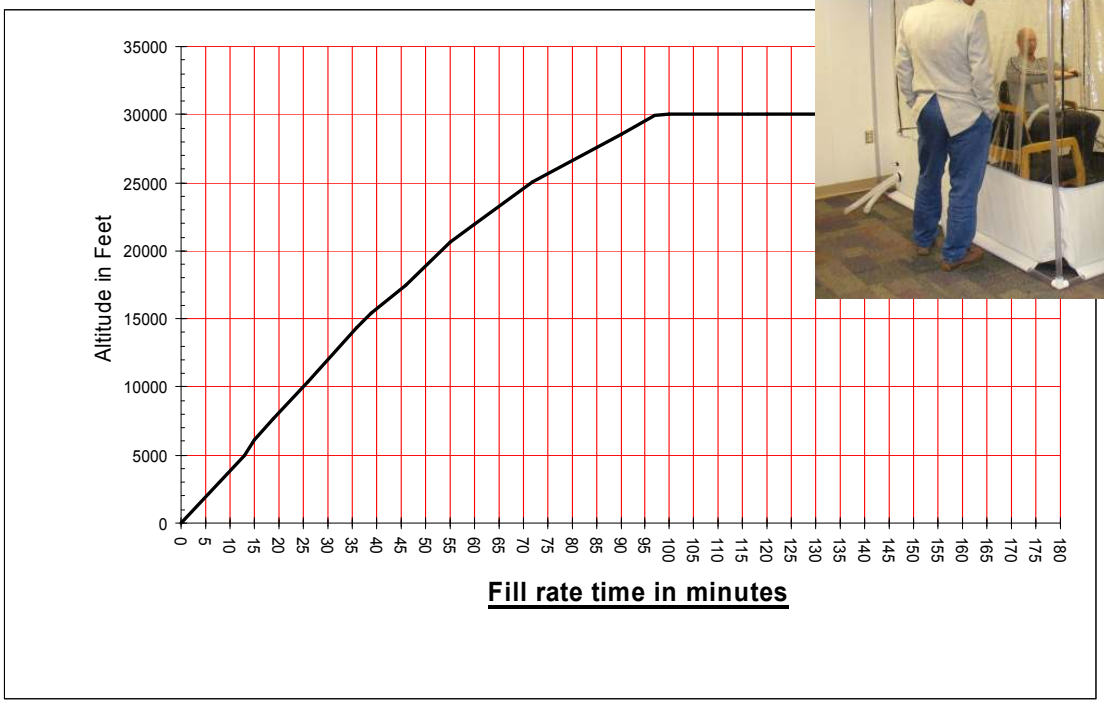
Examples of existing CAT Aviation Systems.

"FAA" Tent System.

The FAA requested a portable system which would enable them to perform testing at 25,000', with up to 5 individuals inside at one time.

- Inner tent: 7' X 7.5" x 6' high
- Outer tent: 7'8" X 9'6" x 6'6" high
- 5 CAT-23 Air Units.
- 1 CAT Intake Selector
- 1 CAT Controller with custom firmware

Time-to-Altitude of FAA tent system, - measured



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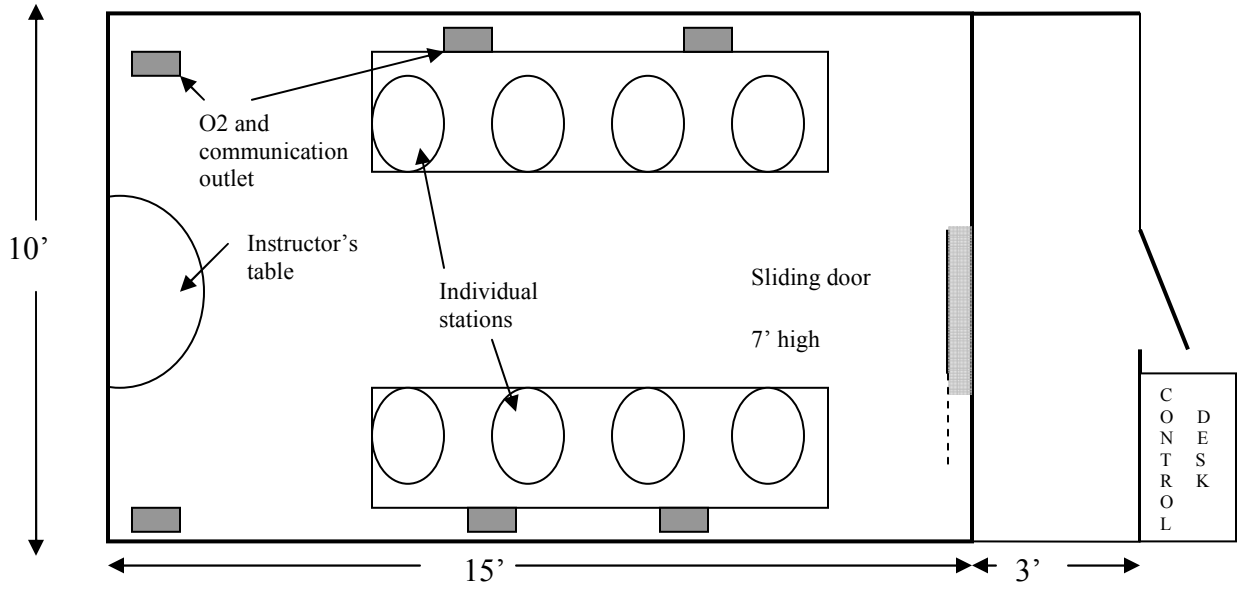
Embry Riddle Aeronautical University, enclosure-based system.

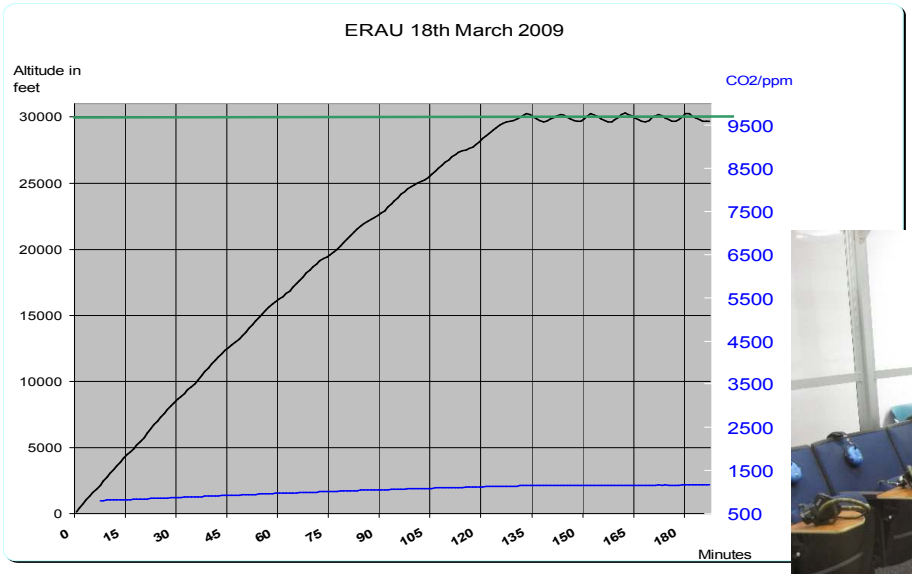
This was installed at Embry Riddle Aeronautical University in March 2009.
The system was designed to accommodate up to 10 individuals, and achieve 30,000'

Embry Riddle Aeronautical University system details

Size: 15 x 10', with 3' x 10' ante-room
Altitude range: 0 – 30,000'
10 CAT-23 Air Units

Enclosure Plan





Actual datalog of effective altitude, and of CO2

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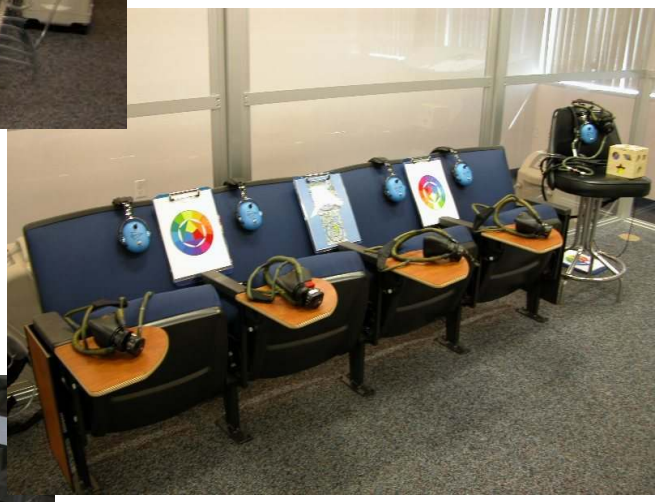
EMBRY-RIDDLE AERONAUTICAL UNIVERSITY
AERONAUTICAL SCIENCE

GRAND OPENING

HIGH ALTITUDE NORMOBARIC LAB



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