

THE FAA CIVIL AEROSPACE MEDICAL INSTITUTE



747 Aircraft Environment Research Facility (AERF) is a Boeing 747-100 with a cabin partitioned into multiple re-configurable sections (4 total) so that different areas can be used for multiple research and training activities simultaneously. It is equipped with audiovisual and testing gear, and with non-toxic smoke generators that can be used to conduct an array of cabin safety and health related research.



Flexible Aircraft Cabin Evacuation Simulator (FlexSim) is a state-of-the-art emergency evacuation simulator that is reconfigurable as multiple narrow-body transport category aircraft, (A320, B737, CRJ-700, ERJ170, MD80) with High-Fidelity Type C, I, and III exits, landing gear out pitch-and-roll attitudes, emergency scenario management computer system, out the window views throughout cabin, audio/video communications system, environmental control with theatrical smoke, staging and storage areas, and exterior stadium lighting for night time work

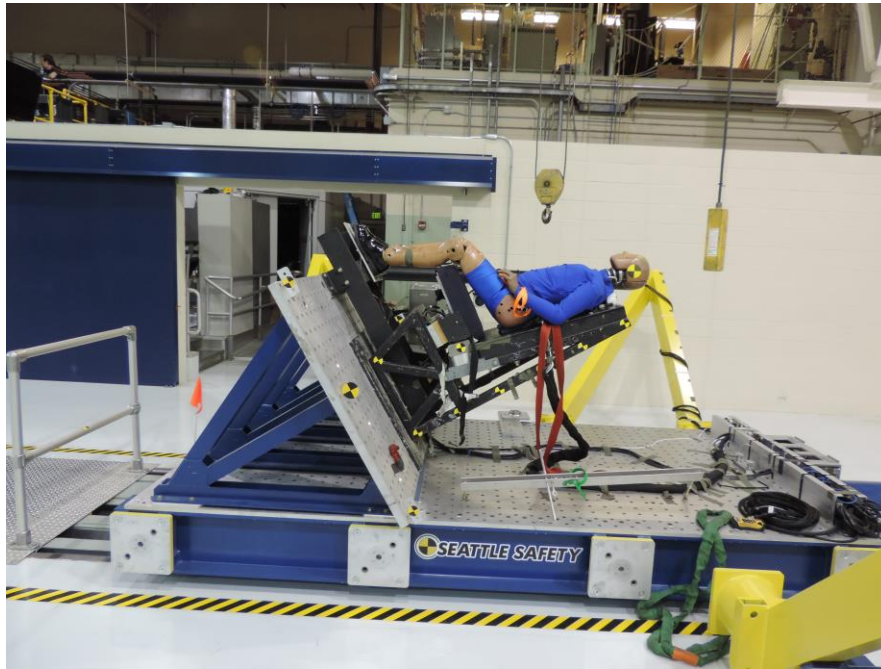


Water Egress Facility is used to study techniques and procedures for emergency egress from an aircraft, water survival, use of flotation devices, and personal rescue using a helicopter hoist. This 175,000-gallon indoor facility is 38 ft. wide, 43 ft. long and 15 ft. deep. The facility has underwater observation windows and the water temperature can be controlled from 45°F to 90°F.



Biodynamics Impact Track is 140 feet in length with two precision rails, a sled, winch, and a braking system. The "track" plays an important role in understanding crash environments using a sled propelled to 44 feet per second then suddenly decelerated to simulate an impact. The biodynamics track system can develop a maximum impact of 30 G with a time duration as short as 60 ms. Test-item positions on the impact sled can be adjusted to

duplicate multiple acceleration vectors. Test documentation is provided by 1000 frame per second high-resolution video cameras and an onboard data acquisition system. Head impact, energy absorbing seats, child restraint performance, and seat certification processes are just a few of the many test categories studied at CAMI.



Anthropomorphic Test Dummies (ATDs) is the "real name" for test subjects that help researchers understand what happens in aircraft crash scenarios, and how to better protect occupants from injury. There are more than 20 ATDs in the Dummy Shop, from infant size (6 month old) to large size 95th percentile adults. The most common dummy CAMI uses is the Hybrid II-50th Percentile ATD. The laboratory also utilizes state-of-the-art dummies such as the Hybrid III and EuroSID-2 ATDs. These dummies can be fully instrumented to measure accelerations and forces at many vital parts of the body. These measurements allow researchers to determine the exact type of injuries a person could sustain during a crash and the techniques to reduce such injuries.



Altitude Chamber is a computer-controlled low-pressure (hypobaric) chamber with a broad temperature and humidity range. It can accommodate six human subjects plus inside safety observers or researchers. This is

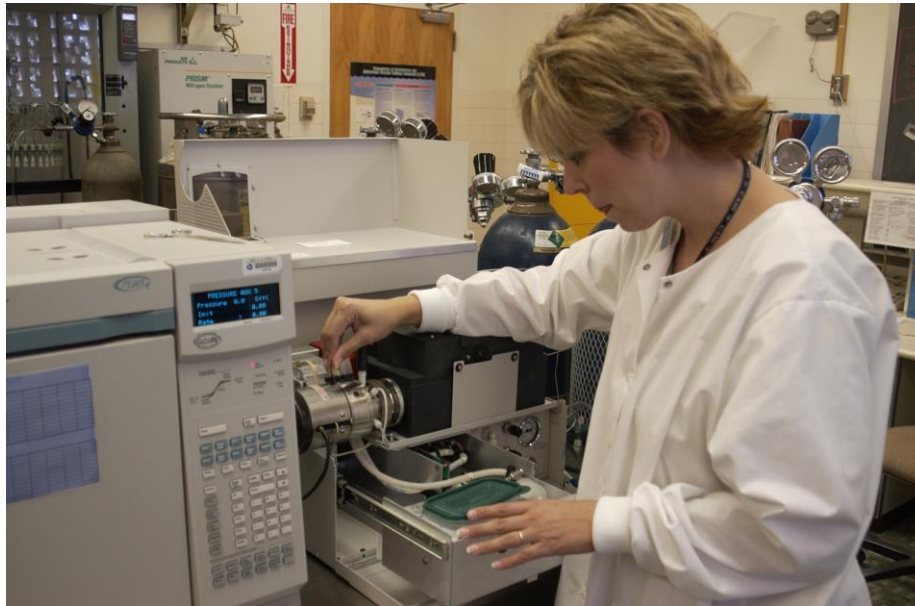
among the most technologically advanced altitude chambers in the world, and is the only one in the U.S. to meet the current safety standards in the pressure vessel industry to ensure the protection of occupants, operators, and maintenance staff. The chamber is capable of reaching a pressure altitude of 100,000 ft above MSL and can produce rapid and slow decompressions. Chamber-installed physiologic instrumentation includes mass spectrometer, electrocardiogram and trans-cutaneous carbon dioxide/oxygen analyzers.



Cold Exposure Environmental Facility is a thermal chamber used to study daytime and nighttime survival techniques and procedures in a cold (up to -20° Fahrenheit) and windy (15-20 miles per hour) environment. This facility can also be used to test the effects of cold exposure on different types of equipment.



Forensic Toxicology Analytical Research Laboratory is equipped with a multitude of cutting-edge analytical instruments including 5 Gas Chromatography/Mass Spectrometer (GC/MS) instruments. Other equipment includes a High-Performance Liquid Chromatography/Mass Spectrometer (HPLC/MS), 3 High Performance Liquid Chromatography/Ultra Violet (HPLC/UV) systems, a Gas Chromatography/Fourier Transform Infrared system (GC/FTIR), and a Gas Chromatography/Atomic Emission Detector (GC/AED). The diverse selection of analytical instruments allows the laboratory to stay on the forefront of drug/chemical testing and forensic toxicology research. This laboratory is certified by the College of American Pathologists (CAP) and by the American Board of Forensic Toxicology (ABFT).



Advanced General Aviation Research Simulator. This fixed-based flight simulator was specifically designed for research applications. It represents the Piper Malibu/Matrix class of aircraft (high-performance, retractable gear). Modifications allow it to present re-programmable electronic flight instrumentation in the place of or along with legacy round-dial instrumentation, including primary flight displays, multi-function displays, a head-up display (inset), and various system and/or navigation displays. It can be configured with conventional flight controls with appropriate force loading or a fly-by-wire side-arm performance-control system. It represents a high-performance, Technically Advanced Aircraft when in its glass-cockpit configuration. It can be used with its own 180-degree out-the-window visual system (shown) or used with the Wide-Angle Visual System. Research using this device has included investigations of flight displays (terrain-depicting synthetic-vision PFDs/HUD, supplemental terrain displays, NEXRAD displays, head-up and head-down flight guidance highway-in-the-sky displays, primary and back-up attitude indicators, add-on or portable navigation displays), flight controls (conventional and fly-by-wire performance controls), pilot performance during failures (autopilot, pitch trim, ADI fail to partial panel, recoveries from unusual attitudes), and pilot decision making (use of weather displays and/or information for severe weather avoidance). Data collection capabilities include digital capture of flight performance, video, and audio data.



Air Traffic Control Advanced Research Simulator (ATCARS) was designed to enable research about the effects of proposed technologies and procedures on controller workload, situation awareness, and performance. ATCARS capabilities include high fidelity En route, TRACON, and Tower position representations. Controllers from the field and the FAA's Academy provide data while they control simulated traffic. Data collection often includes the use of the Air Traffic Workload Input Technique (ATWIT), the Situation Present Awareness Method (SPAM), and electroencephalogram (EEG) and eye-movement recording equipment.

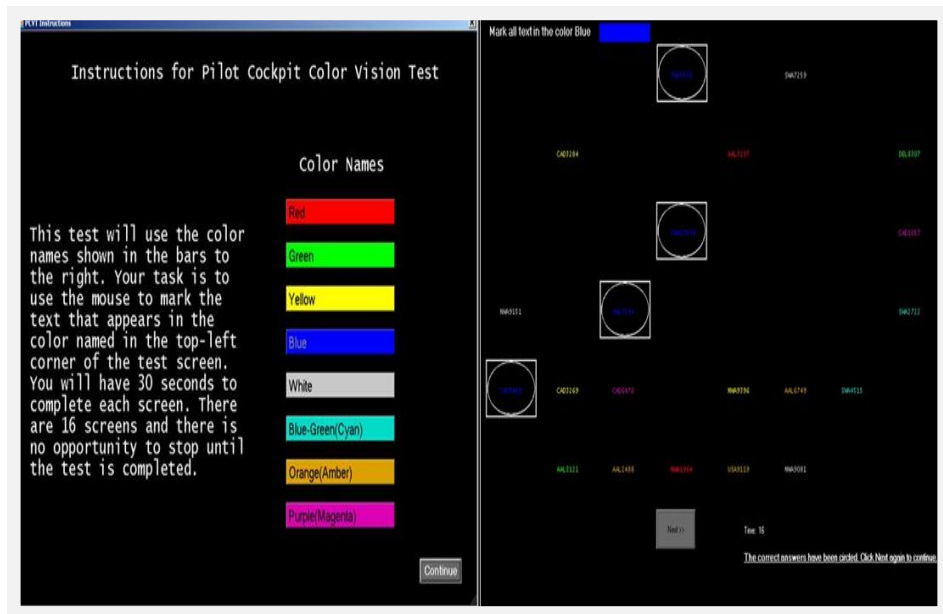


ATC Training and Performance Laboratory enables scientists to assess the performance of individuals on a wide array of cognitive, non-cognitive, and other complex performance measures. Performance data collected in the laboratory can be matched to subsequent training and job performance measures to identify factors that influence those outcomes. The Training and Performance Laboratory is a rapidly re-configurable computer-

based laboratory where specialized assessments can be administered in a standardized fashion to small and large groups of students or experimental subjects. The laboratory can also be used to investigate the effects of repeated assessments and coaching on test performance.



Color Vision Laboratory. The color vision lab conducts experiments to establish and maintain appropriate color vision for pilots and air traffic controllers. The lab is equipped with the current state of the art computerized color vision screening and diagnostic equipment: Colour Assessment and Diagnosis (CAD), Rabin Cone Contrast Test (RCCT), ColorDx (Konan Waggoner), a Nagel and an Oculus Anomaloscope. The lab contains essential equipment for measuring light, color chromaticity characteristics, and human color vision. Color and light measurement equipment includes a Photo Research PR-740, -520, -522, -524, and an LMT 1009. The lab makes use of a custom-designed, software-driven apparatus that is capable of presenting precisely-timed, colored LED and incandescent stimuli, which can be easily adapted to present RGB LEDs of almost limitless chromaticities for perception research. Another custom software program works with the PR-740 or an OEM X-Rite to automatically define display characteristic curves to find monitor-specific RGBs for Yxy chromaticity coordinates.



EEG Laboratory. The 64-channel electroencephalography (EEG) system provides high-density recordings to identify event-related potentials and independent components associated with pilot and controller cognitive performance within ATCARS and AGARS.



Envelope Protection Simulator. Based on a Cessna 182 using an actual C-182 fuselage and a comparable aero model, this was developed to allow researchers to examine how pilots interact with an active envelope-protection system having various features enabled or disabled. The simulator provides auditory, visual, and tactile (force and vibration) feedback to the pilot to indicate when the aircraft is nearing the edge of the allowable performance envelope, and these cues guide the pilot in keeping the aircraft within the envelope. It can be operated in both stability-augmentation mode or in warning mode and has integrated autopilot functions in the envelope-protection system. The simulator's high-resolution out-the-window visual scene is based upon X-plane and subtends approximately 160 degrees of horizontal visual angle. Previous studies include both the examination of pilot technical errors and recovery from extreme attitudes and pilot opinions and ratings of representative envelope- protection-system configurations.



Head-Mounted Display (HMD) Research System. This system supports display presentations on displays not permanently installed in the cockpit; specifically, head-mounted displays. The system, driven by high-end personal computers, currently supports both a monocular laser-based retinal-scan HMD and a stereoscopic LCD-based HMD, both see-through in nature. It can present both terrain information in various formats and synthetic imagery for guidance and obstacle avoidance. Recent research with this device has been completed in the Vertical General Aviation Research Simulator, examining both guidance imagery and obstacle imagery.



FaceLab™Eye Tracker. This system (cameras mounted in VGARS shown in above HMD system photo) consists of non-invasive cameras, IR emitters, and software from Seeing Machines, Inc. Dual eye-tracking cameras can be mounted in the cockpits of any of the flight simulators or near an external computer display. The software is installed on a workstation or laptop and allows the experimenter to monitor the participant's gaze direction, eye closure, facial gestures, and head position. Data are recorded on eye movement, head position and rotation, eyelid aperture, and pupil size.

Multimodal Input Control Laboratory (Completion Expected March 2016) will be a part of the Flight Deck Human Factors Research Division. The research conducted there will expand our understanding of how integration of multimodal interfaces into the flight deck will influence human performance in flight operations. The areas of interest include the research and development of multimodal interfaces where in addition to the conventional physical interfaces (e.g., knobs, buttons, cursor control devices), pilots use eye movements (e.g., gaze), voice/sound recognition, 2D (touch), and 3D (touch-less) gestures, in a synergistic fashion to control aircraft systems. The facility will include a simulator enclosure with a 220° field of view visual system that will be large enough to house a two-pilot crew fixed based platform and a modular flight deck console. The research conducted will support the examination of modality combination user interfaces based on rigorous analyses of pilot tasks across all phases of flight.



Multiple Task Performance Laboratory comprises a computer-based set of 5 workstations designed to measure the simultaneous performance of aviation-related tasks under various aerospace stressors, including fatigue. Multiple component tasks are studied to analyze varying levels of workload and assess different psychological functions important to aviation occupations. Tasks are presented to examine the relationship between aviation stressors and performance in a synthetic work environment. This research can also be used to evaluate environmental, pharmacological, and physiological stressors, and for studies concerning shift work and fatigue.



Unmanned Aircraft Simulation. The **Unmanned Aircraft System Control Station Simulator** is based on the Vigilant Spirit simulation, a realistic simulation of a generic unmanned aircraft system developed by the Air Force Research Laboratory at Wright Patterson Air Force Base in Dayton, Ohio. The data and communications protocols are compliant with NATO STANAG standards, meaning that the software can be used to interface with actual unmanned aircraft systems. The simulation is intended to provide a generic control station interface

that includes simulated air traffic and an integrated primary flight display that allows both vector and waypoint control schemes.



Vertical-flight General Aviation Research Simulator. This device uses a Microsoft Flight Simulator platform running on high-end personal computers to simulate both small (R-22) and medium (Bell 206) helicopters. The fixed-base simulator incorporates standard helicopter flight controls, along with conventional instrumentation beside a dual-EFIS (Cobham Systems) installation incorporating a PFD with synthetic vision and a multi-function (MFD) plan-view map display. The out-the-window visuals are presented on four large high-resolution liquid-crystal displays that, together, present a visual field of approximately 110 degrees horizontally. Weather conditions can be varied according to provisions in the software. Data-collection provisions allow approximately two dozen performance variables to be recorded for subsequent analysis, along with audio and video records of pilot actions and communications and display indications. This device has been used in conjunction with the Head-Mounted Display (HMD) Research System (described elsewhere) and eye-tracking equipment to perform research on head-mounted highway-in-the-sky guidance displays for helicopter EMS applications, and helicopter pilot avoidance of obstacles while combining natural and synthetic vision using the HMD.



Very-Light-Jet Simulator. This Frasca Flight Simulation Training Device (FSTD) for the Cessna Citation Mustang Very Light Jet (VLJ) was built to an equivalent level 5 FTD and is used as a research platform. The Frasca FSTD features an accurate flight-deck depiction with a Garmin G1000 avionics suite, accurate portrayal of control forces, and a high-fidelity digital surround-sound system that accurately replicates aircraft and environmental sounds. A graphical-user-interface station is provided that allows researchers to set and control all aircraft systems and environmental conditions. With automated scenario execution and enhanced data recording, this FSTD generates detail-rich reports for post-flight analyses. Seven-megapixel Internet protocol cameras capture various angles of the cockpit and pilot interactions with the controls and avionics. Flights are replayed on both the FSTD and a remote debrief station, including playback of audio communications, cockpit video, and digital flight data collected from the real-time flight model. The simulator is mated with a high-fidelity 225-degree hemispheric dome that gives the pilot a large field of view. The out-the-window display system consists of six projectors that are driven from six high-end Intel server-class computers that maintain 60 Hz update rates to the visual scene.



Spatial Disorientation Simulators provide civil aviation pilots, aviation medical examiners, and FAA flight crews with the opportunity to experience vestibular and visual illusions (spatial disorientation) that occur during Instruments Flight Rules (IFR) conditions in an inherently safe environment.

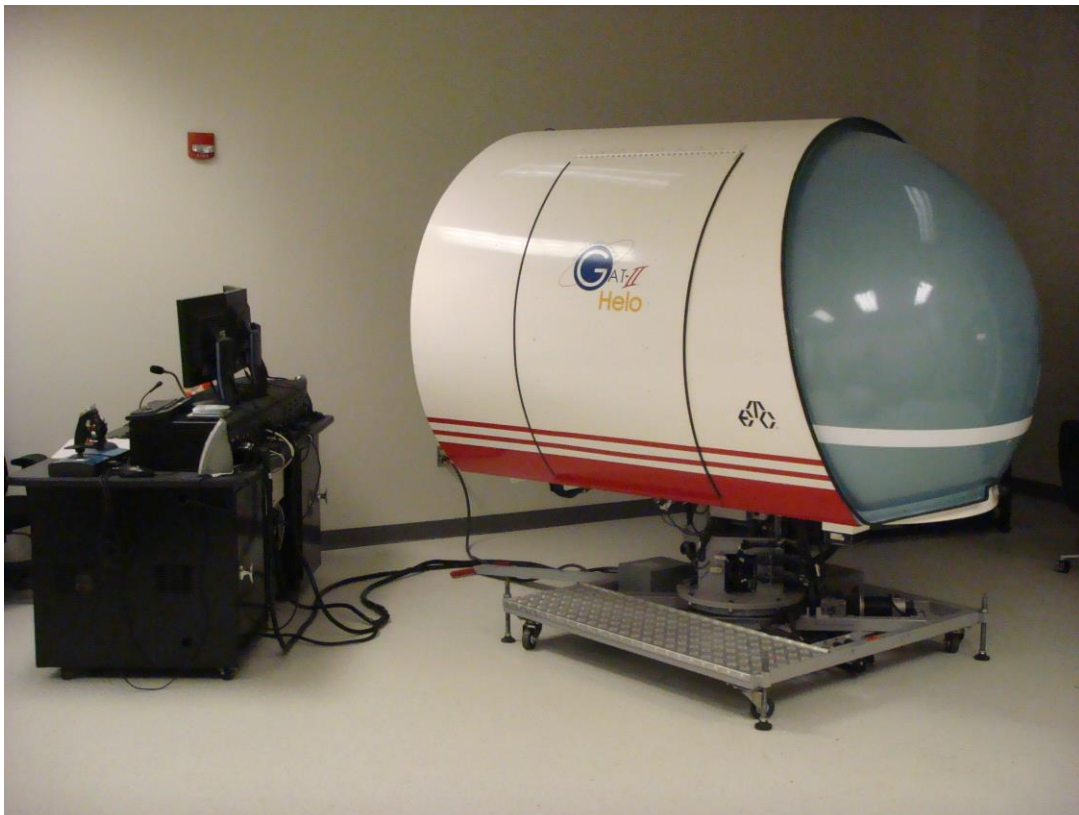
GYRO II is a spatial disorientation device that provides 360-degree continuous yaw motion as well as plus or minus 15 degree pitch and 30 degree roll, which, in conjunction with a computerized imaging system, results in a realistic simulation of flight. The programmed flight in the GYRO does not require an instructor—only an external safety observer. The pilot receives a 2-minute orientation and then takes the controls. The 6-minute flight progresses from VFR, with “out-the-window” scenes on a monitor, to IMC conditions.



GAT II (General Aviation Trainer) is a basic aircraft trainer that combines basic flight training, instrument training and spatial disorientation training in one low cost platform. The GAT-II features a single reciprocating engine, propeller driven flight model and realistic, computer generated instrumentation. It supports initial pilot training and it also provides a low cost way for pilots to satisfy some of their recurring instrument currency requirements. The GAT-II features an enclosed cockpit, realistic flight controls and a textured high quality out-the-window display to provide a highly realistic training environment. The 3 axes motion system is precisely coordinated with the visual display and the flight control inputs to provide a high fidelity learning environment. The pilot receives a 2-min orientation and then takes the controls. The 6-min. flight progresses from Visual Flight Rules (VFR) conditions, with "out-the-window" scenes on a CRT, to IFR conditions.



GAT II HELO is a basic Helo trainer that combines flight training, instrument training and spatial disorientation training in one low cost platform. The HELO GAT-II features an enclosed cockpit, realistic flight controls, and a wide-field-of-view. The 3 axes motion system is precisely coordinated with the visual display and the flight control inputs to provide a high fidelity learning environment. GAT-II HELO can be used at any time in any weather.



HOT SEAT FIXED WING AND ROTARY WING are complete Microsoft Flight simulator packages. Each includes a custom-built chassis, 6 speaker surround sound system and three flat screen TV's. We use the Hot Seat simulator in conjunction with the ROBD to enhance the pilots hypoxia experience. We have the pilots fly the simulator at 25,000 feet while attached to the ROBD. We simulate the pilots is flying at FL250 and has a cabin pressure of 8,000 feet. The ROBD introduces a slow decompression using mix gasses from 8,000 feet to 25,000 feet. Once the pilot experience hypoxia he treats him/her self with 100% oxygen.



Night Imaging Training Environment (NITE) Laboratory is specifically designed facility to demonstrate the use of Night Vision Goggles (NVGs). The objective of the lab is to show the capabilities and limitations of Aviation type NVGs. To accomplish this we use the ITT 4949 NVGs and the Liberty Graphics Terrain Board. The terrain board is a 600-1 scale model that shows the various terrains an aviator may encounter (Desert, OpenWater, Mountainous) while using NVGs. Additionally CAMI has incorporated a theatrical smoke generator to show the affects of particulates (fog, clouds, smoke, etc.) while using the terrain board. Also, we use an instrument panel that has compatible and non-compatible lights to show their affects on NVGs. Lastly, CAMI has a scale aircraft model (Super Cub) that shows the affects of compatible and non-compatible external aircraft lighting. The particulate demo as well as the demo for instrument and external lighting are CAMI innovations and are unique to CAMI's NITE-Lab.



PROTE (Portable Reduced Oxygen Training Enclosure) provides an environment where pilots learn to recognize their individual hypoxia symptoms and take corrective actions to re-oxygenate themselves. We use 10 Air-Separators to remove oxygen and replace it with nitrogen. This reduces the oxygen level from 21% oxygen down to 7.1% oxygen. This is equivalent altitude simulation of 25,000 feet. Most students feel their hypoxia symptoms within the first 3 minutes upon entry of the PROTE and will don their mask at the end of 5 minutes exposure.



ROBD (Reduced Oxygen Breathing Device) uses Thermal Mass Flow Controllers (MFC) to mix breathing air and nitrogen to produce the sea level equivalent atmospheric oxygen contents for altitudes up to 34,000 feet. The MFC's are calibrated on a primary flow standard traceable to the National Institute of Standards and Technology (NIST). The ROBD 2 introduces pressure changes and gas expansion as a function of altitude. Several safety features are built into the device: prevention of over pressurization of the subject's mask, prevention of reduced oxygen contents below those being requested for a particular altitude and an emergency dump switch that will supply 100% O₂ to subjects. The software is menu driven. The main operators menu consists of three selections, simplifying the use of the system for the field operator. Built-in self-tests verify all system component functionality before the operation of the system can begin. If any self-test fails the system will not operate. The system is designed to work with both bottled gases and gases produced by a Nitrogen/Air Generator (available separately). Features of the ROBD include: 1) 0-34,000 feet elevation, 2) 21% oxygen to 4.4% oxygen, 3) Integrated pulse oximeter, 4) Integrated oxygen analyzer, 5) Emergency Oxygen dump switch for delivery of 100% oxygen.



FATAL VISON GOGGLES (Fatal Vision® Impairment Goggles) are an internationally popular evidence-based prevention tool used to educate people of all ages about the consequences of alcohol misuse and abuse. Fatal Vision® Goggles use special lens technology that allows the wearer to experience a realistic simulation of impairment. Fatal Vision® Goggles simulate six distinct impairment levels and are available in a clear or shaded version to simulate either daytime or nighttime conditions. A popular activity to conduct with Fatal Vision® is to perform Standard Field Sobriety Tests such as walking a straight line heel-to-toe or the one-legged stand. Due to the loss of balance and equilibrium produced by the goggles, the wearer will exhibit behaviors that are similar to that of someone under the influence of alcohol and other drugs.

