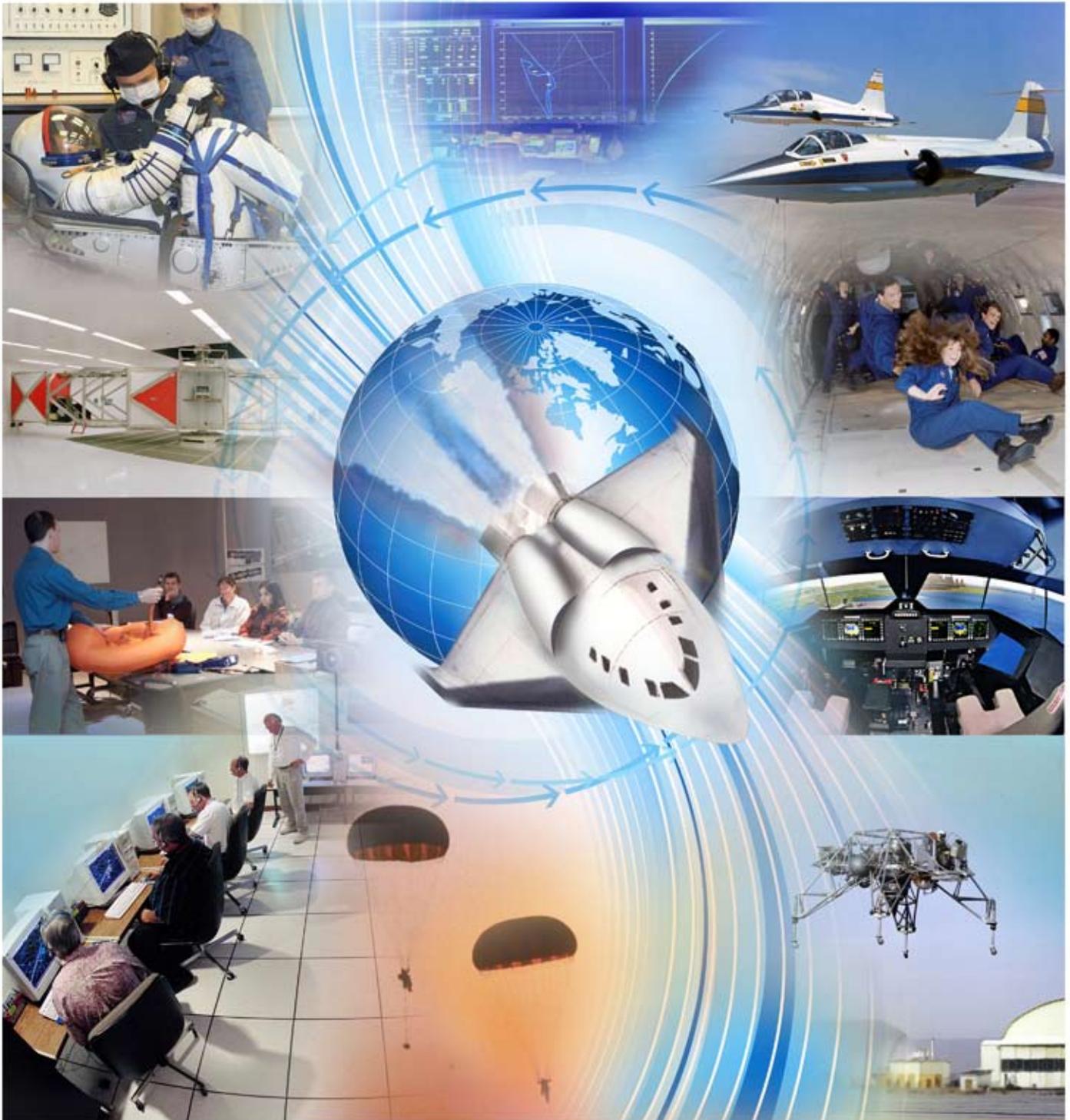




FAA Commercial Space Transportation



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Commercial Human Spaceflight Crew Training Survey February 2008

About the Office of Commercial Space Transportation

The Federal Aviation Administration, Office of Commercial Space Transportation, licenses and regulates U.S. commercial space launch and reentry activity as well as the operation of non-federal launch and reentry sites as authorized by Executive Order 12465 and Title 49 United States Code, Subtitle IX, Chapter 701 (formerly the Commercial Space Launch Act). The Office's mission is to ensure public health and safety and the safety of property while protecting the national security and foreign policy interests of the United States during commercial launch and reentry operations. In addition, the Office is directed to encourage, promote, and facilitate commercial space launches and reentries. Additional information concerning commercial space transportation can be found at <http://ast.faa.gov>.

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Available from

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HUMAN SPACEFLIGHT TRAINING OVERVIEW

A number of commercial, governmental, academic, and non-profit organizations exist that can provide commercial human spaceflight crew training and support. These training and support services range from teaching and simulating the physiological effects of working in the microgravity environment to high-fidelity simulation of spacecraft flight characteristics. A basic review of the traditional human spaceflight training programs provides a framework to understand the training roles that organizations profiled within this study can fill within commercial human spaceflight crew training programs.

In 1959, the Soviet Union and the United States began to recruit military personnel for human spaceflight training. The first human spaceflight crews conducted rigorous training in areas such as general space sciences, space physiology, spacecraft systems, and survival training. This training was designed to prepare the spacecraft crews for the known and unknown challenges of human spaceflight. As both countries gained human spaceflight experience, crew training programs were refined and systemized. Today, both the United States and Russia use standardized training curricula to prepare crew members, from a variety of cultural and professional backgrounds, for the challenges of human spaceflight. The following short overviews of the two most active human spaceflight vehicles, the Space Shuttle and the Soyuz, will introduce the basic elements of traditional human spaceflight training.

SPACE SHUTTLE TRAINING

The Johnson Space Center in Houston, Texas, is the primary NASA facility tasked with training Space Shuttle flight crews; however, a number of NASA facilities across the country participate in the training process. NASA’s Space Shuttle training program is divided into two major phases, astronaut candidate training and formal astronaut training. During astronaut candidate training, candidates receive basic classroom training in generic vehicle systems training and selected non-flight specific specialized training including flight training in various jet aircraft, how to egress from the Shuttle and survive in a water or wilderness environment. During formal astronaut training, crews are exposed to the effects of microgravity and are trained to perform work in that environment. Spacecraft simulators train the crews to operate space shuttle systems. Finally, crews conduct integrated operational training with flight controllers in the mission control center.

Elements of NASA’s Human Spaceflight Training Program	
Astronaut Candidate Training	Formal Astronaut Training
<p><u>Classroom training</u>: mathematics, geology, meteorology, guidance and navigation, oceanography, orbital dynamics, astronomy, physics, materials processing, etc.</p> <p><u>Flight training</u>: zero-gravity flights, T-38 jet aircraft, modified Gulfstream II that can simulate the space shuttle flight profiles</p> <p><u>Survival training</u>: emergency egress from vehicles, water and wilderness survival training, hyper/hypobaric training</p>	<p><u>Microgravity training</u>: neutral buoyancy laboratory, weightless environmental training facility</p> <p><u>Spacecraft simulation</u>: fixed based single system simulators, shuttle mission simulators</p> <p><u>Operations simulation</u>: integrated training of spacecraft flight crew and mission control center flight controllers</p>

SOYUZ TRAINING

Flight crew training for Russia’s human spaceflight vehicles occurs at the Gagarin Cosmonaut Training Centre in Star City near Moscow. The Russian training regime is divided into three general phases including general space training, specialized space training, and pre-flight training. The purpose of general spaceflight training is to acquire the knowledge, skills, habits, and qualities that cosmonauts require to conduct human spaceflight missions including classroom, flight, and survival training. The purpose of the specialized space training phase is to master the entire range of professional knowledge,

skills, habits, and qualities required to operate a spacecraft and perform specialized on-orbit tasks. Pre-flight space training prepares the crew for specific activities during the mission, including the interaction of the spacecraft crews and the flight control center during flight operations.

Elements of the Russian Human Spaceflight Training Program		
General Space Training	Specialized Space Training	Pre-flight Space Training
<p><u>Classroom training</u>: theoretical principles of astronautics, engineering training, principles of conducting applied scientific research, and experiments in the space</p> <p><u>Flight training</u>: flight and special parachute training, biomedical training, centrifuge, microgravity flights</p> <p><u>Survival training</u>: water and wilderness survival and psychological training</p>	<p><u>Spacecraft simulation</u>: engineering and operational training on simulators of mission specific spacecraft, training on life support systems</p> <p><u>Specialized simulation</u>: biomedical and psychological training, neutral buoyancy training</p>	<p><u>Operations training</u>: preparing for establishing and maintaining communication with the crew members and the Flight Control Center, review and practice procedures for experiments</p>

Based on this top level review of the two most experienced human spaceflight training programs, it is clear that the basic elements of the two training programs are similar. In addition, flight crews in both programs train anywhere from approximately a year to two years depending on mission complexity and flight tempo. Both programs use experienced astronauts to train new flight crews. This basic review of the traditional human spaceflight training programs provides a framework to understand the training roles that the organizations profiled within this study can fill within commercial human spaceflight training programs.

STUDY OVERVIEW

Futron Corporation conducted a Commercial Space Flight Launch and Reentry Vehicle Pilot Training Survey for the FAA’s Office of Commercial Space Transportation (FAA/AST). The recent development of commercial aerospace vehicles designed to carry humans has created a need for FAA/AST to determine how aerospace flight crews should be trained and qualified to meet the requirements of part 460, title 14 Code of Federal Regulation (14 CFR). The Survey will help the FAA understand the opportunities available in critical aviation and space flight training fields, by supplying profiles of training providers and a final report summarizing the survey.

A comprehensive survey of commercial and non-commercial aviation and space flight training providers was completed, resulting in profiles of these training providers in the following disciplines:

- Physiological Training
- High Performance Jet
- High Performance Gliders
- Altitude Chamber (hypobaric and hyperbaric)
- Parachute Training
- Unusual Attitude Training
- High Altitude Flight
- High-G (gravity)
- Pressure Suit Training
- Flight Simulation
- Spaceflight Operations
- Microgravity Low-G Training

PROFILES OVERVIEW

The following profiles describe a number of training providers in the various human spaceflight training fields. Because organizations often provide multiple types of training, some profiles include flight training information beyond the area of training included in this report. For example, the NASTAR Center profile resides in the physiological training section, but this organization also provides altitude chamber (hypobaric), unusual attitude training, high-g (gravity), and flight simulation training. See Appendix A for a complete list of human spaceflight crew training organizations and their areas of training. Profile data was collected through online research, direct communication with the training providers, and thorough review of documentation provided by the training providers and other organizations.

The profiles are organized by training area. Each profile includes the following items:

- List of the training area(s) that the organization provides
- Contact information
- Description of the training course(s)
- Brief background and professional training experience of the organization
- Description of the equipment and facilities that the provider owns or uses to conduct the applicable training
- Data on the cost of the training offered

PHYSIOLOGICAL TRAINING

Physiological training providers fall into three categories: government, commercial, and academic. The FAA's Civil Aerospace Medical Institute (CAMI) in Oklahoma City sets the standard for physiological training. Like CAMI, most physiological training providers also offer hyperbaric chamber flights as part of the physiological training program. The FAA physiological course is offered at a variety of military installations around the country. Research revealed two commercial organizations (Executive Aerospace and NASTAR Center) that provide physiological training. These providers offer unique services and fill different niches within the market.

Flight schools around the country provide at least some basic physiological training to their students. Futron selected the Aircraft Owners and Pilot's Association (AOPA) database of flight schools within the United States and Canada. Schools that are FAA Part 141 certified or that offer commercial, certified flight instructor (CFI), airline transport pilot (ATP) or other high-level training because they are more likely to offer dedicated physiological training. Using these parameters and the database, three university-based flight schools were identified (Arizona State University (ASU), Oklahoma State University (OSU), and the University of North Dakota (UND)) that offer physiological training to commercial customers. See Appendix B for a list of professional aerospace physiological organizations.

ARIZONA STATE UNIVERSITY POLYTECHNIC

TRAINING PROVIDER

Arizona State University (ASU) Polytechnic
7442 E. Tillman Ave., Mesa, AZ 85212
Website: <http://eastair.east.asu.edu/facilities/>

AREA(S) OF TRAINING

- Physiological Training
- Altitude Chamber (Hypobaric)

COURSE DESCRIPTION

One- and two-day training courses are available. The courses focus on high-altitude physiology. Training sessions and chamber flight profiles can be tailored to fit the customer's needs. Standard training includes:

- | | |
|--|-----------------------------|
| ➤ Trapped gas disorders | ➤ Health and wellness |
| ➤ Evolved gas disorders (decompression sickness) | ➤ Self-imposed stress |
| ➤ Vision | ➤ Survival |
| ➤ Oxygen equipment | ➤ Egress training |
| ➤ Loss of consciousness | ➤ Crew resource management |
| ➤ Smoke and toxic fumes | ➤ Hypoxia/Hyperventilation |
| ➤ Fatigue | ➤ Physics of the Atmosphere |
| ➤ Spatial disorientation | ➤ Respiration/Circulation |
| ➤ Cabin depressurization | ➤ Human Factors |
| | ➤ Noise and Vibration |

Enhanced training includes:

- | | |
|--------------------------|-----------------------|
| ➤ Spatial disorientation | ➤ Acceleration |
| ➤ Cabin pressurization | ➤ Noise and vibration |

BACKGROUND AND EXPERIENCE

Arizona State University Polytechnic's aeronautics program began offering commercial physiological training and altitude chamber training in 2001. The altitude chambers themselves were used for Air Force training from 1962 through the mid 1990s. ASU courses are taught by instructors with over 60 years of combined experience in all areas of Aerospace Physiology. All courses offered by ASU are FAA Part 141 certified.

EQUIPMENT AND FACILITIES

The ASU Polytechnic facilities include:

- Classrooms
- 19-man hypobaric altitude chamber
- 4-man hypobaric altitude chamber
- Altitude chamber oxygen equipment

COST

Standard training costs \$385 per person. Enhanced training costs \$550 per person.

CAMI – FAA CIVIL AEROSPACE MEDICAL INSTITUTE

TRAINING PROVIDER

Federal Aviation Administration, Civil Aerospace Medical Institute (CAMI)

6500 South MacArthur, Oklahoma City, OK 73169

Website: http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/cami/

AREA(S) OF TRAINING

- Aviation Physiology (theory and practice)
- Aviation Survival (theory and practice)

COURSE DESCRIPTION

CAMI provides a one-day physiological training course at the FAA Mike Monroney Aeronautical Center in Oklahoma City, OK. The following topics are covered during the training:

- Physics of the atmosphere
- Physiology of respiration and circulation
- Decompression effects on the human body
- Hypoxia signs and symptoms
- Hyperventilation
- Pressure equalization difficulties and/or trapped gas problems
- Self-imposed stresses
- Inflight spatial orientation and disorientation
- Acceleration, noise, vibration and thermal (heat & cold) stress effects
- Aviation oxygen equipment familiarization
- Altitude chamber oxygen equipment familiarization
- Altitude chamber flight including hypoxia and rapid decompression demonstrations
- Spatial disorientation demonstration using a Barany Chair, GAT-II, GAT-II HELO, Gyro-I, Gyro-II, or VRSDD

FAA physiological training courses are also offered at the following USAF and ARMY military installations:

- Andrews AFB, MD
- Beale AFB, CA
- Brooks AFB, TX
- Columbus AFB, MS
- Fairchild AFB, WA
- Ft. Rucker ARMY Base, AL
- Holloman AFB, NM
- Kadena AFB, Japan
- Langley AFB, VA
- Peterson AFB, CO
- Randolph AFB, TX
- Shaw AFB, SC
- Sheppard AFB, TX
- Tyndall AFB, FL
- Vance AFB, OK

CAMI also provides an aviation physiology DVD course. The following topics are covered in the course:

- Physics of the atmosphere
- Physiology of respiration and circulation
- Hypoxia
- Hyperventilation
- Trapped gas
- Altitude-induced decompression sickness
- General aviation oxygen equipment
- Self-imposed stress
- Fit for flight
- Motion sickness
- Vestibular disorientation
- Visual illusions
- Ups and downs of cabin pressure
- Acceleration
- Heat exposure

- Noise & vibration
- Fatigue
- Vision

CAMI provides a one-day aviation survival training course at the FAA Mike Monroney Aeronautical Center in Oklahoma City, OK. The following topics are covered during the training:

- Surviving a crash
- Psychology of survival
- Survival medicine
- Signaling equipment and techniques
- Fire starting equipment and techniques
- Obtaining food and water
- Emergency shelter
- Hot-land survival procedures
- Cold-land survival procedures
- Water survival procedures
- Post-crash emergency evacuation procedures
- Assembling a customized personal survival kit
- Cold exposure environmental facility demonstration
- Cabin evacuation facility demonstration
- Water egress facility demonstration

CAMI also provides an aviation survival DVD course. The following topics are covered in the course:

- Will to survive
- Survival signaling
- Survival kits and rafts
- Survival medicine
- Cold-land survival
- Hot-land survival
- Tropical survival
- Open water survival

BACKGROUND AND EXPERIENCE

Established in 1946 by the Civil Aeronautics Administration as a centralized training and logistics facility with approximately 350 employees, the Mike Monroney Aeronautical Center has grown to become a major organizational complex of the FAA, employing approximately 4,400 government and contract personnel. In fact, the Aeronautical Center is the largest concentration of Department of Transportation employees outside the Washington, D.C. area.

Since its inception, the Aeronautical Center has greatly expanded training and logistics services and added a number of other aviation safety-related and business support products and services. These products and services include, engineering services; medical, human factors, and organizational research; aircraft and airmen information; standards development for pilot and aircraft performance as well as flight procedures; and automated systems development and support. The customer base includes the entire FAA, all the transportation modes in the Department of Transportation, other Federal agencies, and foreign governments, as well as pilots, media, aircraft owners, and commercial air carriers.

EQUIPMENT AND FACILITIES

The CAMI facilities at the FAA Mike Monroney Aeronautical Center include:

- Hypobaric chambers (training and research)
- Aviation oxygen equipment
- Altitude chamber oxygen equipment
- Barany chair
- Gyro-I spatial disorientation demonstrator
- Gyro-II spatial disorientation demonstrator
- Virtual reality spatial disorientation demonstrator (VRSDD)
- GAT-II spatial disorientation demonstrator
- GAT-II-HELO spatial disorientation demonstrator
- Cold exposure environmental facility
- Cabin evacuation facility
- Water egress facility

- Fire starting classroom

- Water collection and purification classroom

COST

There is no charge for the FAA CAMI aviation physiology and survival training courses conducted at the Mike Monroney Aeronautical Center in Oklahoma City or for the DVD courses. There is a fee of \$50.00 per student for the FAA physiological training courses conducted at U.S. Military Physiological Training Facilities.

EXECUTIVE AEROSPACE PHYSIOLOGY TRAINING

TRAINING PROVIDER

Executive Aerospace Physiology Training
Institute for Exercise and Environmental Medicine, Presbyterian Hospital of Dallas
7232 Greenville Avenue, Dallas, TX 75232
Website: <http://www.wound.com/aero.html#index>

AREA(S) OF TRAINING

- Physiological Training
- Altitude Chamber (Hypobaric)

COURSE DESCRIPTION

Executive Aerospace offers a one day course that includes physiological training and utilization of the hyperbaric chamber. Topics covered during this training include:

- Physics of the atmosphere
- Respiration
- Circulation
- Hypoxia
- Hyperventilation
- Effects of pressure change
- Cabin pressurization
- Oxygen equipment
- Chamber flight profile

BACKGROUND AND EXPERIENCE

Executive Aerospace offers commercial access to the facilities of the Aerospace Medicine Department of the Presbyterian Hospital of Dallas. Executive Aerospace began offering physiological and high altitude training in 1994. Executive Aerospace consists of two physicians and six staff. Physicians of the Aerospace Medicine Department, in cooperation with Johnson Space Center, are actively involved with studying the cardiological effects of spaceflight on NASA's astronauts. Executive Aerospace also conducts one-day training for SimuFlites's Alternate Recurrent High Altitude Flight Training.

Executive Aerospace facilities include a classroom and one of the largest and most advanced hypo/hyperbaric chamber facilities in the world. The chamber can simulate altitudes of 3,048 meters (100,000 feet) above sea level and simulate depths to 50 meters (165 feet) below sea level at controlled rates of descent and ascent.

EQUIPMENT AND FACILITIES

The Presbyterian Hospital of Dallas, Institute for Exercise and Environmental Medicine, facilities include:

- Classrooms
- Hyper/hypobaric chamber

COST

Basic costs include a \$400 facility fee and a \$300 physician fee. Prices are negotiable based on the type of physiological and high altitude training requested.

NATIONAL AEROSPACE TRAINING AND RESEARCH (NASTAR) CENTER

TRAINING PROVIDER

National Aerospace Training and Research (NASTAR) Center
125 James Way, Southampton, PA 18966
Website: <http://www.nastarcenter.com>

AREA(S) OF TRAINING

- Physiological Training (including Spatial Disorientation Training)
- Altitude Chamber (Hypobaric)
- Unusual Attitude / Upset Recovery Training
- High-g (gravity)
- Night Vision and Night Vision Goggle Training
- Ejection and Egress Training

COURSE DESCRIPTION

NASTAR Center currently offers a range of training options ranging from complete aerospace physiology training programs to individual courses including:

- Situational awareness
- Spatial disorientation
- High-G, and G Tolerance for Space and Tactical Flight
- Egress and post-egress
- Survival
- Customize training
- Ground training on the physiological effects of high altitude flight

BACKGROUND AND EXPERIENCE

The NASTAR Center is open and recently completed training for Virgin Galactic “Founders” for sub-orbital space flight training. The NASTAR Center uses simulators developed by the Environmental Tectonics Corporation (ETC) and training and curriculum developed by ETC’s AeroMedical Training Institute (AMTI). NASTAR provides training for both aviation (military and civil) and spaceflight. NASTAR’s training programs are tailored to meet customer training requirements, personnel and crew demographics, types of missions supported, and types of aircraft/spacecraft flown. Each course is offered as an initial training course or a refresher training course.

EQUIPMENT AND FACILITIES

- ATFS-400 authentic tactical fighting system and flight simulator
- GYROLAB GL-2000 advanced spatial disorientation trainer
- Hypobaric altitude chamber
- Ejection seat simulator
- Night Vision and Night Vision Goggle Trainer

COST

The costs for training are undisclosed at this time, due to the customized nature of each training program. Prices for a custom program are available via direct inquiry.

OKLAHOMA STATE UNIVERSITY CENTER FOR HEALTH SCIENCES– TULSA

TRAINING PROVIDER

Oklahoma State University Center for Health Sciences (OSU-CHS), Tulsa
Center for Aerospace and Hyperbaric Medicine
801 E. 91st Street, A155-Riverside, Tulsa, OK 74132
Website: <http://www.healthsciences.okstate.edu/research/cahm/index.html>

AREA(S) OF TRAINING

- Physiological Training
- Altitude Chamber (hypobaric & hyperbaric)

COURSE DESCRIPTION

The Oklahoma State University training, consisting of educational lectures, combined with hands-on demonstrations, prepare the flight crew to recognize potential problems associated with humans in flight and teach the crews how to respond correctly.

Core Training:

- Atmospheric physics
- Hypoxia
- Hyperventilation
- Trapped gas disorders
- Decompression sickness
- Aviation related stress / human factors
- Cabin pressurization / oxygen systems
- Spatial disorientation
- High altitude endorsement (“Sign-off”)

Additional Training:

- Emergency egress
- First aid
- CPR and AED (Automated External Deliberator) training
- Land survival training
- Sea survival training

BACKGROUND AND EXPERIENCE

The Center for Aerospace and Hyperbaric Medicine started offering physiological training in the mid-1990s. The facilities are located in the Tulsa Technology Center Alliance Building at the R.L. Jones Airport in Tulsa, OK. The OSU staff is dedicated to quality instruction and research with more than 75 years military experience. The facilities include both hyperbaric and hypobaric chambers allowing for quick treatment of evolved gas disorders if they should occur during training. OSU currently trains a variety of clientele including the Missile Defense Agency, Walmart Aviation, Southwest Airlines, Hallmark, L3/Aeromet, and OSU students.

EQUIPMENT AND FACILITIES

The Center for Aerospace and Hyperbaric Medicine facilities include:

- Classrooms
- 16-person hypobaric (“altitude”) chamber
- 16-person research hypobaric chamber

- 12-person hyperbaric treatment chamber
- General Aviation Trainer (GAT II) flight trainer/simulator device

COST

Core training costs \$200 per person. Prices are negotiable for additional training.

UND AEROSPACE

TRAINING PROVIDER

University of North Dakota (UND), John D. Odegard School of Aerospace Sciences
4201 University Avenue, Grand Forks, ND 58203

Website: http://www.undaerospace.com/other_High%20Altitude.asp

AREA(S) OF TRAINING

- Physiological Training
- Altitude Chamber (hypobaric)

COURSE DESCRIPTION

The UND Aerospace two-day aviation physiology course includes training on topics such as:

- | | |
|----------------------------|--|
| ➤ Hypoxia/hyperventilation | ➤ Vision |
| ➤ Trapped gas disorders | ➤ Spatial disorientation |
| ➤ Evolved gas problems | ➤ Cabin pressurization |
| ➤ Oxygen equipment | ➤ Hypoxia demonstration (chamber flight) |
| ➤ Fatigue | ➤ Rapid decompression (chamber flight) |
| ➤ Stress | |
| ➤ | |

BACKGROUND AND EXPERIENCE

The John D. Odegard School of Aerospace Sciences began collegiate flight training in 1968. Today, UND Aerospace has more than 2,200 students and more than 500 faculty and staff members. UND offers FAA-certified Part 141 physiological and high-altitude training. The hypobaric altitude chamber was the first non-governmental altitude training facility in the nation. Representatives of more than one hundred thirty corporations from around the world have attended UND's aerospace physiology training since 1989.

Clients range from small flight departments to national flagship airlines, as well as U.S. Air Force and Air National Guard units. The aerospace physiology training staff has a total of 95 years experience.

EQUIPMENT AND FACILITIES

The UND Aerospace facilities include:

- | | |
|------------------------------|-------------------------------------|
| ➤ Classrooms | ➤ General aviation oxygen equipment |
| ➤ Hypobaric altitude chamber | ➤ Altitude chamber oxygen equipment |

COST

Initial corporate training costs \$875. Corporate recurrent training costs \$750

HIGH PERFORMANCE JET

Using high performance jet aircraft to prepare spaceflight crews has been a common practice since the beginning of human spaceflight. During the operation of a spacecraft, spaceflight crews are often exposed to various vectors and magnitudes of g-force (gravity) loading. High performance jet aircraft can simulate many of the physiological sensations associated with human spaceflight. In addition, certain high performance jet aircraft can be configured to simulate the flight profiles and control characteristics of spacecraft, especially those that used lifting surfaces. Therefore, high performance jets are often one of the most effective tools for preparing human spaceflight crews. Used primarily retired military aircraft, a variety of commercial high performance jet operators have been identified during this survey.

INTERNATIONAL JETS, L-39 PARTS & MAINTENANCE, INC.

TRAINING PROVIDER

International Jets, L-39 Parts & Maintenance, Inc.
96 Hangar Road, Gadsden, AL 35904
Phone number (o) 256-442-8099
Point of contact: Richard E. Hess
Email: hess37@aol.com

AREA(S) OF TRAINING

- Aerobatics, Unusual Attitude & Upset Training,
- L-39 Rating & High Performance Jet Aircraft Performance,
- High Altitude Physiology,
- Low-level Formation,
- Basic Defensive and Air Combat Maneuvering.

COURSE DESCRIPTION

International Jets teaches the full range of military style maneuvers for pilot training to include aerobatics, stalls, spins, unusual attitude recovery, normal & no-flap pattern & landings, with special emphasis on Simulated Flameout pattern & landing (SFO). [This is a steep, very aggressive, yet exceptionally precise maneuver that enhances any pilot's skills, especially for flying a Space Shuttle-type vehicle.] All systems, normal, and emergency procedures are covered. This course of study would qualify the candidate for an Authorized Experimental Aircraft rating.

BACKGROUND AND EXPERIENCE

The president and chief pilot, Richard Hess, is a Yak-52, CJ-6, L-29 and L-39 Instructor, a FAST (formation) instructor and evaluator, and an IP in the above and other aircraft. He and his cadre have flown many of the Soviet and American fighters and trainers to include L-39, MIG-21, A-10, F-15, F-16, B-1 and even helicopters.

Mr. Hess has 20,000 flight hours in A-10, F-15, T-37, T-38 (IP in both trainers), & C-141 (IP & EP); DC-9, MD-88, B-727, 737, 757, 767, 777; Yak-52, CJ-6, L-29, L-39, Casa Jet, MIG-15, T-33, T-34, T-28. He is an experienced instructor in numerous general aviation and Warbird aircraft and was also an FAA Designee at Delta Air Lines on the B-757 & B-767.

EQUIPMENT AND FACILITIES

International Jets in Gadsden, AL has an 8000 sq ft hangar and 1500 sq ft of office space. They are currently adding to that with a new 20,000 sq ft hangar and 2000 sq ft additional office space. The airport has non-precision approaches and two runways, 6800 and 5000 ft long. International jets have all the maintenance requirements to maintain about 65 L-39 Albatros jet aircraft as well as access through eastern block contacts to acquire and maintain just about any Russian jet aircraft, including MIGs.

COST

An L-39 flight costs \$1000/hour plus fuel. The instructor costs are \$750/day. Other aircraft types can be arranged with costs to be determined.

JETWARBIRD TRAINING CENTER

TRAINING PROVIDER

Jetwarbird Training Center
3662 Cerrillos Road, Suite A-3, Santa Fe, NM 87507
Phone: 505-471-4151
Website: www.jetwarbird.com

AREA(S) OF TRAINING

- High Performance Jet
- Unusual Attitude Training
- High-g (gravity)

COURSE DESCRIPTION

The Jetwarbird Training Center provides multiple high performance jet and unusual attitude training courses at the Sante Fe Municipal Airport, New Mexico. The training center uses high performance flight, rather than simulators. There are standardized training courses that use different aircraft for jet training, “upset recovery” (unusual attitude) training, and aerobatics. Specific training details can be modified to accommodate customer needs. Courses include ground school, necessary pre-flight and post-flight briefings, and flight time, usually in one hour increments.

The company’s standard jet flight training includes the ability to conduct and receive high altitude, high performance, and complex endorsements for jet flight.

The unusual attitude in-flight training course includes the following (with corresponding ground school and pre-flight preparation):

- Clearing turns (35 and 45 degree banks)
- 60 and 74 degree banks; g-loading of the pilot awareness
- Aileron rolls
- Two-point rolls; recovery from the inverted
- Limited aileron recovery
- Limited aileron recovery from the inverted
- Nose down attitude recovery from the inverted
- Nose down attitude recovery from the inverted with limited aileron
- Stall series: clean, dirty, accelerated
- Extreme attitude stall recovery techniques
- Descending spiral high-g and other recoveries

The aerobatic training course includes the following maneuvers: full stall series, aileron rolls, two point rolls, loops, immelmans, cuban 8's, cloverleaf, and barrel rolls.

BACKGROUND AND EXPERIENCE

The company was founded by Larry Salganek, the certified flight instructor and examiner. He has 6,000 hours as a flight instructor and 3,000 hours as an aerobatics instructor over the past 25 years. The company's customers include pilots at all levels of performance. For this reason, Jetwarbird training is tailored to the needs of the individual customer.

EQUIPMENT AND FACILITIES

Jetwarbird training uses five high performance aircraft with different flight characteristics and performance levels for training courses at the Sante Fe Municipal Airport:

- L-29 Delfin
- Fouga Magister
- L-39 Albatros
- T-33 T-bird
- MiG-15

The company keeps these aircraft sheltered in leased hangar space.

COST

- Hourly flight training rates range from \$1,240 to \$2,300 depending on the number of flights and the aircraft used
- A two-flight upset training course (unusual attitude training) in an L-39: \$2,950
- A two-hour introduction to aerobatics training course in a Fouga jet: \$2,500
- A two-hour introduction to aerobatics training course in a L-39: \$3,850
- A two-hour introduction to aerobatics training course in a T-33: \$4,200

AURORA AEROSPACE

TRAINING PROVIDER

Aurora Aerospace
510 Shore Dr. E.
Oldsmar FL 34677
Phone 813-476-2321
Contact: Howard Chipman
howardchipman@sprintmail.com

AREA(S) OF TRAINING

- High Performance Jet
- Unusual Attitude Training
- High-g (gravity)
- High Performance Glider Training

COURSE DESCRIPTION

Aurora Aerospace offers a 2-3 day course on spaceflight training and medical consulting for spaceflight. The course includes jet and glider flights, centrifuge training, and a medical evaluation. L-39 jet flight training offers acclimatization to g-forces, zero gravity, unusual attitudes, and recovery. Gliding flights in 2-place gliders simulate gliding re-entry from space, zero gravity maneuvers and acclimatization to g-forces. Additionally, Aurora offers high g- training in ground based centrifuges. Medical clearance and treatment is provided to enable space flight participants to fly into space safely and comfortably.

BACKGROUND AND EXPERIENCE

Howard Chipman, M.D. is a board certified Emergency Physician and Certified Flight Instructor rated in L-39 jets and gliders. He has attended cosmonaut training in Russia and is familiar with the training required to enable people to fly into space.

EQUIPMENT AND FACILITIES

Aurora Aerospace has an L-39 Albatross, various gliders, Piper PA-34 Seneca, and a centrifuge for high-g training.

COST

Various packages are available. A typical package including L-39 jet and glider flights, centrifuge training and medical examination costs approximately \$5000. Please contact Aurora Aerospace for specific costs for a particular training regime.

HIGH PERFORMANCE GLIDERS

For the purpose of this study, a high performance glider is defined as one that can be configured with a sink rate of 1,200-1,800 meters (4,000-6,000 feet) per minute without exceeding the glider maximum velocity. Such performance is the best analogous parameter for RLVs. Only a few gliders can be configured to reach this sink rate: the Blanik L-13, Blanik L-23, Schweizer 2-32, and Caproni a-21. However, the Caproni A-21 is not used very often in the United States. There are more than 80 glider training providers in the U.S. that have at least one of these gliders in their fleets. See Appendix C for a list of available high performance gliders. In identifying these providers, Futron used the Soaring Society of America database that includes all the commercial glider training providers in the United States.

Experts from Soaring Safety Foundation indicated that, even though the main glider flight instruction is the same, the training is adjusted from one region to another, depending on the geography where the instruction is offered. For example, training in a mountainous area may differ slightly from the training in a flatlands area. The wind patterns and the thermals are also different depending on location and students are required to take additional flight lessons if previous glider flight training was done in a different geographic location. Futron selected six providers for profiling. In doing the selection, we considered factors such as the number of aircraft for instruction, diversity of aircraft, relevant training information available, and geographical location in order to provide a representative mix of the providers. The providers profiled below are Colorado Soaring Association (CSA), Orange County Soaring Association (CA), Tampa Bay Soaring Society, Inc. (FL), The Chicago Glider Club (IL), The Washington State Soaring Association (WA), and Turf Soaring School (AZ).

COLORADO SOARING ASSOCIATION (CSA)

TRAINING PROVIDER

Colorado Soaring Association (CSA)
15000 N. County Road 7, Wellington, CO 80549
Phone: 970-568-7627
Website: <http://www.soarcsa.org/>

AREA(S) OF TRAINING

- High Performance Glider

COURSE DESCRIPTION

CSA flight instruction using CSA gliders is only open to CSA members. Depending on the customer's priorities, the general progression of training starts with flight training through solo, continues with preparation for the FAA written test, checkout in other gliders, flight instruction for badges, and ends with preparation to fly in competitions. CSA does not offer "class type" ground training, but has flight documentation available. CSA offers both primary and more advanced instruction.

CSA uses the training syllabus as a guide for flying glider instruction. The training syllabus, requires students to read the flight manual and the current copy of Federal Aviation Regulations. Among the topics covered by the CSA Sailplane Flight Training Syllabus are:

- Familiarization with pre-flight preparation, signals, controls in flight, straight and level flight, and turns
- Aerotow, turns, pattern and landing
- Minimum control speed in level flight and turns, stalls recognition and recovery
- Miscellaneous maneuvers such as accuracy landings
- Steep turns, crabs, and slips; use of slips for crosswind correction
- Slack line recovery, spiral dives, spins; use of slips for glide path control
- Emergency maneuvers

BACKGROUND AND EXPERIENCE

Incorporated in 1965, CSA was formed as a non-profit organization to promote safe soaring, advance the knowledge of the sport, and to provide its members with advanced sailplanes at minimum cost. Initially CSA operated at a different location, but since 1985 it operates at Owl Canyon Gliderport, initially known as Waverly West Soaring Ranch. All CSA flight instructors are certified.

FACILITIES AND EQUIPMENT

CSA owns and operates Owl Canyon Gliderport, located about 24 kilometers (15 miles) north of Fort Collins, Colorado. The gliderport is run as a club operation, and operating hours are generally weekends and holidays only, with an occasional weekday operation. The CSA fleet includes a Grob G-103, Blanik L-23, Schweizer 2-33, Solitaire 30, and Schweizer 1-34, as well as a Piper Pawnee 235-D as tow plane. Besides the fleet, CSA owns a tractor, trailers for some of the gliders, hangars for the planes, and a clubhouse with full utilities.

CSA owns 104 hectares (256 acres) of land extending 1.6 kilometers (1 mile) from the north fence to the south fence, and from the east fence to a varying property line on the west side. At the gliderport, runway 19 is the primary runway during the summer. Runway 19R is used for staging gliders and takeoffs and 19L is used for landing when 19R is occupied. Runways 27/09 and 15/33 are grass. Runways 19R/01L and 19L/01R are crossed diagonally at the north end by an old roadbed. This is just barely landable on the runway extensions, but everywhere else the old roadbed is unlandable. It is also unlandable at its intersection with the 09/27 runway extension.

COST

Only CSA members can receive flight instruction in one of the CSA planes and using the CSA instructors. The cost for CSA membership is \$50 per month plus a \$250 initiation fee. CSA is a chapter member of Soaring Society of America (SSA) and CSA members are required to belong to SSA. The SSA membership fee is \$64 per year and this fee is collected through the club.

An hour of ground or flight instruction costs \$20. To solo in 35 flights costs about \$1,345, not counting dues and initiation, but including the ground, flight instruction, the glider rental, and the aerotow rates of

\$10 for each 1,000 feet/305 meters. For the post-solo flights, glider rental is free, so the cost comes from instruction time and from aerotow rates.

For pilots transitioning from powered aircraft, the FAA requires at least 10 solo flights before taking the flight test. No written test is required for people who reached the level of private pilot in airplanes. Approximately 15 flights of dual are necessary before solo, so the total training cost for the transition will be around \$800.

ORANGE COUNTY SOARING ASSOCIATION (OCSA)

TRAINING PROVIDER

Orange County Soaring Association (OCSA)
P.O. Box 5475, Buena Park, CA 90622
Website: <http://www.ocsoaring.org/>

AREA(S) OF TRAINING

- High Performance Glider

COURSE DESCRIPTION

OCSA provides practical flight instruction as well as ground school, with a focus on training to the level of the private pilot glider designation. The practical flight instruction is done with a certified training instructor flying with the student in a two-seat glider. Ground school is usually conducted in November and December and takes place in the OCSA club house at the Hemet-Ryan airport. During the ground training program, the instructors teach the most updated Federal Aviation Regulations/Aeronautical Information Manual (FAR/AIM). The classes prepare participants for taking the FAA written test required for the private or commercial glider pilot license.

The following topics are covered during flight training for the pre-solo flights:

- Explanation of instruments, control functions, and their effects
- Turning and its side effects, effects of controls, straight and level flying
- Flying at minimum controllable airspeeds, coordination when executing turns
- Thermaling, centering techniques, low-G sensitivity, landing speed calculation
- Landings, divebreaks for altitude control, attitude for airspeed control
- Steep turns, spirals and wind effects, glider weight and balance
- Airspace, local field and wind conditions, cross-controlled and accelerated stalls, spot landing
- Forward slips and slips to landing
- Spin entry and recovery, off-field landings with no altimeter
- Normal and crosswind landings

The following topics are covered during flight training for the post-solo flights:

- Boxing wake, turns, thermaling, coordination, steep turns
- Spirals, flight at minimum control speeds
- Launches and landing (including spot landing), slack line
- Radio communication, traffic patterns, navigation
- Airport, runway, taxiway signs, marking and lighting
- Soaring techniques: thermal soaring, ridge and slope soaring, wave soaring

- Performance maneuvers: straight glides, turns to headings, steep turns
- Slow flights and stalls
- Emergency operations: simulated off-airport landing, emergency equipment and survival gear
- Post flight procedures: after-landing and securing

BACKGROUND AND EXPERIENCE

Established in 1959, Orange County Soaring Association started as a non-profit entity with the purpose of creating an educational organization for people who wanted to learn how to fly. Its focus is on primary gliding (train the students to the level of private pilot glider designation). OCSA has four pilots and four gliders available for training.

FACILITIES AND EQUIPMENT

OSCA has a club house in the vicinity of the Hemet-Ryan airport in Hemet, CA and conducts operations there. The OCSA fleet includes one PW-5, one Grob G-103 Twin Astir, and two Blanik L-13.

COST

The cost for training is determined mostly by the towing costs, as the training is free for flight club members. The cost for OCSA Flight Club membership is \$55 per month. This entitles members to unlimited access with no additional charges to all club aircraft, instruction, and facilities. Start up requires a one-time \$300 initiation fee, plus annual General membership (\$25 for OCSA and \$64 for SSA). Flight instruction/flight reviews are provided free of charge regardless of the number of instructional flights. All members assist in the maintenance of sailplanes and all club equipment, as well as in flight operations when assigned.

The towing price ranges between \$40 and \$60 per flight. In order to be able to fly solo, at least 40 flights are required and normally to obtain a private license, 80 flights are expected

THE CHICAGO GLIDER CLUB (CGC)

TRAINING PROVIDER

The Chicago Glider Club (CGC)
 26045 W. Airport Road, Minooka, IL 60447
 Phone: 815-467-9861
 Website: <http://www.chicagogliderclub.org/content/home.php>

AREA(S) OF TRAINING

- High Performance Glider

COURSE DESCRIPTION

Although the CGC is not set up as a primary glider flight school, the club offers training to club members. Club instructors offer their services free of charge to club members. The CGC offers instructor and commercial pilot instructional classes that begin in May and continue through summer on either the first or second Saturday of each month, with class work in the morning and flight instruction in afternoon. The CGC also has flight documentation available.

The training syllabus is specific to the CGC operations and is used as a training guide. In providing flight instruction, the CGC requires other mandatory readings, such as Soaring Flight Manual, Glider Flying

Handbook, Pilots Handbook of Aeronautical Knowledge, glider manuals and the current copy of Federal Aviation Regulations.

The following topics are covered during flight training for the pre-solo flights:

- Explanation of control functions and instruments
- Turns, relative wind and angle of attack, straight and level flying, attitude control for airspeed
- Tow-elevator only, flying at minimum controllable airspeeds, coordination while turning
- Tow-all controls, stalls, low-G sensitivity, thermalling, crabs for crosswind correction, landing
- Cross-wind takeoff, turning stalls, thermalling-centering techniques, divebreaks for altitude control, attitude for airspeed control
- Steep turns, glider weight and balance, effects of lift and effects of sink
- Local field, airspace, wind conditions rules, spot landing, forward slips and side-slips, accelerated stalls
- Slack line recovery, flying at minimum controllable air speed, downwind landings, effects of high winds on pattern
- Spin entry and recovery, off-field landings, steep turns

The following topics are covered during flight training for the post-solo flights:

- Turns, coordination, flight at minimum control speed, thermalling
- Boxing wake, steep turns
- Ground handling, cockpit management, visual signals
- Airport and gliderport operations: radio communications, traffic patterns, runway, taxiway signs, markings and lighting
- Spirals, flight at minimum control speeds, turns, coordination, thermalling
- Slack line, steep turns, stalls, spot landings
- Performance airspeeds: minimum sink airspeed and speed to fly
- Soaring techniques: thermal, wave, slope, and ridge soaring
- Performance maneuvers: straight glides, turns to headings, steep turns
- Navigation: flight preparation and planning, national airspace system
- Slow flight and stalls: maneuvering at minimum control airspeed, stall recognition and recovery
- Emergency operation and post flight procedures such as after landing and securing

BACKGROUND AND EXPERIENCE

The CGC was formed in 1957, with the purpose of providing fellowship, information, instruction, stimulation, and education for those interested in flying, gliding, and soaring, both locally and cross-country. The CGC has an active membership of about 80 pilots involved in all aspects of the sport, from instruction to participation in soaring contests. Many members are high time soaring pilots and some also have contest experience.

FACILITIES AND EQUIPMENT

The CGC owns its own grass runway, two large hangers, a clubhouse, and a large grass area for trailer tie-down and sailplane assembly. The runway is a grass strip about 91 meters (300 feet) wide and about 550 meters (1,800 feet) long with an east-west orientation. The club members fly on weekends and on weekdays whenever one of the tow pilot members is available to tow.

The CGC fleet includes three two-place gliders, (Blanik L-23, Schleicher ASK-21, and Schempp-Hirth Duo Discus) one single-seat glider, an ASW-24 and two tow planes: 235 hp Pawnee and 180 hp

Christen Husky. All club aircraft are maintained by CGC members and are always kept in the two hangars owned by the club.

COST

Only CGC members can receive flight instruction in one of the CGC planes and using the CGC instructors. The cost for CGC membership is \$25 per month plus a \$1,000 initiation fee. CGC is a member of Soaring Society of America (SSA) and CGC members are required to belong to SSA. The SSA membership fee is \$64 per year. Members of the CGC are also required to pay \$10 per year for the Chicago Glider Council, the entity which created the CGC. Instruction is free of charge for the CGC members.

For renting the Blanik L-23, the rate is \$15 per hour and the rent for the tow planes is \$60 per hour. The aerotow rates include a hook-up fee of \$8 and \$0.60 for each 30 meters (1 hundred feet) of tow.

TURF SOARING SCHOOL (TSS)

TRAINING PROVIDER

Turf Soaring School (TSS)
8700 West Carefree Highway, Peoria, AZ 85383
Phone: 602-439-3621
Website: <http://www.turfsoaring.com/default.htm>

AREA(S) OF TRAINING

- High Performance Glider

COURSE DESCRIPTION

TSS is a privately owned flight school offering glider flight instruction seven days a week. The training offered varies from beginner level to instructor and aerobatic training, and can be tailored to the needs of the customer. TSS also provides training for private power plane pilots interested in learning to fly a glider. Besides practical training, TSS offers ground school. TSS also has a series of glider flight books available for its students, including Glider Flying Handbook, Aviation Instructor's Handbook, Handbook of Glider Aerobatics, and Pilot Test Prep for private and instructor levels. TSS is using the most current Federal Aviation Regulations and Aeronautical Information Manual as their guidelines for training.

For customers licensed as private power pilots, a private glider rating may be added by taking the number of lessons necessary to solo, (depending on experience, but usually between six and ten lessons, for people who fly frequently), make ten solo glider flights, obtain a recommendation ride with a Certified Flight Instructor- Glider, and make a check ride. There is no written examination required for the transition from flying powered planes to flying gliders.

BACKGROUND AND EXPERIENCE

In business since 1967, TSS is a private business offering sightseeing rides, aerobatic sailplane lessons, and soaring lessons. All TSS flight instructors are FAA certified and have previous aviation experience, with glider flying experience between 5 and 30 years. The numbers of flight hours for the instructors varies between 3,000 and 6,000 and they have had at least 5,000 glider flights.

FACILITIES AND EQUIPMENT

TSS currently operates eight sailplanes (including a Grob 103 Acro, Schweizer 2-32, Schweizer 2-33, Schweizer 1-26, ASK-21, SWIFT) and three Pawnee towing planes. The TSS staff inspects the fleet daily and Federal Aviation Administration licensed mechanics inspect it after every 100 hours of flight.

TSS operates at Pleasant Valley Airport in Peoria, AZ. The airport has two main runways, with a dirt surface: one of 1,280 x 30 meters (4,200 x 100 feet) and one of 732 x 30 meters (2,400 x 100 feet). Runway separations do not meet minimum standards so simultaneous operation of the runways is not authorized.

COST

The gliders can be rented for an amount varying between \$36 and \$49 per hour, depending on the type of plane. The flight instruction costs \$39 per hour for regular instruction and \$49 for aerobatic instruction. Ground instruction costs \$39 per hour. The aerotows cost \$35 for the first 305 meters (1,000 feet), \$1 for every additional 30 meters (100 feet) to 1,200 meters (4,000 feet) and \$1.25 for every additional 30 meters (100 feet) to 1,800 meters (6,000 feet).

PARACHUTE TRAINING PROVIDERS

Given the parachute training needs of future RLV pilots, Futron focused on the training provided for using of emergency parachutes, rather than for the rectangular/square parachutes commonly used in recreational skydiving. In the U.S., most commercial parachute training providers use the square parachutes, and they provide instruction that involves skydiving lessons, with the actual jumps, either in tandem or solo. In creating the list of such training providers, we have used information from the United States Parachute Association (USPA). See Appendix D for a list of USPA member organizations.

To identify the emergency parachute training providers, Futron conducted secondary research and interviews with the Parachute Industry Association, USPA, different emergency parachute manufacturers, Systems Technology Inc., the U.S. Air Force Academy, and different U.S. Air Force Bases.

The research indicated that that only one company, Silver Parachute Sales & Service (SPSS), provides emergency parachute training commercially. The parachute manufacturers provide instruction for using their products through the user's manuals, and some of them tailor the instruction to the aircraft that the parachute will be used for. The military offers emergency parachute training but only for military personnel. Futron requested copies of the military training syllabus from Beale, Columbus, and Vance Air Force Bases, but the military did not feel comfortable releasing it to a commercial entity. Systems Technology Inc. has developed a parachute training simulator that could be relevant for training the RLV pilots. The entities profiled below are: SPSS, as the only company that does emergency parachute training; Butler Parachute Systems Group, Inc., Para-Phernalia, Inc., Strong Enterprises Inc., and National Parachute Industries, Inc., as the emergency parachute manufacturers, for their parachute usage information; and Systems Technology Inc., as the manufacturer of ParaSim, a parachute flight training simulator.

SILVER PARACHUTE SALES & SERVICE (SPSS)

TRAINING PROVIDER

Silver Parachute Sales & Service (SPSS)
P. O. Box 6092, Hayward, CA 94540
Phone: 510-785-7070
Website: <http://www.silverparachutes.com>
Email: allen@silverparachutes.com

AREA(S) OF TRAINING

- Parachute Training

COURSE DESCRIPTION

SPSS's parachute instruction is dedicated to teaching egress training to people who have no intention of bailing out, unless there is an emergency. The training takes the form of a bailout seminar that Allen Silver, the owner of SPSS, gives to different groups of pilots. Many of such seminars are designed taking into account specific aircraft types. Among the topics covered by such seminar are:

- Mental attitude, including when to make the bailout decision
- Becoming familiar with the aircraft
- Parachute storage and parachute service
- Pre-flight parachute inspection
- When & how to practice egress procedures
- How to choose the appropriate emergency parachute
- Differences between various types of parachutes, including weight & speed limitations
- Proper fit and adjustment of your parachute
- Reasons to leave the aircraft
- When to make the decision to bail out
- How to quickly egress and deploy the parachute
- Understanding the time it takes for your chute to open & loss of altitude during deployment
- Other elements of a successful bailout, proper clothing and survival equipment
- How to steer your parachute to a safe landing
- How to recognize and avoid life threatening obstacles during descent
- Preparation for landing and how this is achieved
- Post-landing actions that must be done to insure your safety and a quick rescue

BACKGROUND AND EXPERIENCE

Incorporated in 1972, SPSS provides personal parachute service to aerobatic and glider pilots, specializing in emergency parachutes. Besides parachute training, it offers complete rigging services including repack, recertification, major repair, and alteration. SPSS manufactures the AcroBelt five-point ratchet restraint system and S.M.A.K. PAK parachute survival kits. SPSS is also the largest dealer of the SOFTIE line of pilot emergency parachutes manufactured by Para-Phernalia, Inc. SPSS has done work for NASA and aerospace companies that required services for sophisticated and specialized parachutes.

Allen Silver owns and operates SPSS. He has been an FAA Master Parachute Rigger since 1974 and in 1991 was designated as a Parachute Rigger Examiner for the FAA. Allen has served as chairman of the Parachute Industry Association (PIA) Rigging Committee. Silver spent 25 years in the Air Force, out of

which 18 years were spent teaching egress training to pilots and servicing their equipment for the California Air National Guard. He has over 3,200 jumps but SPSS does not deal with skydivers. Silver also flies and has over 1450 hours of flight experience, of which most have taken place since 2002. He has written articles on emergency bailout for publications such as Sport Aerobatics and for soaring magazines and currently has a bi-monthly column in Sport Aerobatics called “Ask Allen” which answers questions about parachutes and other survival equipment.

FACILITIES AND EQUIPMENT

SPSS is located in Hayward, California, and currently has a facility of approximately 2,000 square feet. The training is done off site, at a location indicated by the customers. If needed, SPSS expressed interest in establishing a training area and even acquiring a parachute simulator.

COST

SPSS does not have a certain fixed price for the training it provides, since training is primarily in the form of a seminar at the customers location. Should there be a need for a formal training, SPSS expressed anticipates it will not take more than two days. The price of the training is not known since it depends on many variables, including: the type and number of parachutes, the equipment that needs to go on the parachutes, (automatic openers, oxygen, etc.), the type of craft the jumps will be made from, the necessity for a jump, and the need for virtual simulation.

EMERGENCY PARACHUTE MANUFACTURERS

Emergency parachute manufacturers offer information about how to use emergency parachutes, although without providing formal training. The manufacturers teach their customers how to use the parachutes they make by providing user’s manuals for a particular parachute. Below we have included a list of emergency parachute manufacturers and the type of information they offer. The manufacturers are listed in order of how much emergency parachute training information they have available.

BUTLER PARACHUTE SYSTEMS GROUP, INC. (BPS)

Butler Parachute Systems, Inc. (BPS)
P.O. Box 6098, Roanoke, VA 24017
Phone: 540-342-2501
<http://www.butlerparachutes.com/>

BPS specializes in engineering and manufacturing personnel parachutes, recovery systems, and related items. The company also provides recovery systems design, consulting, manufacturing, and testing services to government agencies, aerospace firms, and other parachute companies. BPS designs and manufactures a variety of parachutes and recovery system components and equipment ranging from small sub-munitions decelerators (8-inch) to solid cloth canopies up to 154 feet in diameter. BPS does not manufacture or service any equipment for sport parachuting.

Information relevant to emergency parachute training is provided in the parachute user manual as well as in the articles published on the company’s website. BPS indicates that they offer only basic information, which cannot be substituted for formal survival training and parachute jumping instruction. Such information includes:

- How to select appropriate emergency parachute
- How to distinguish an approved parachute type
- Parachute performance standards
- Parachute storage and maintenance

- Preflight inspection
- Fitting and wearing an emergency parachute
- Basic egress instruction, independent of the type of aircraft
- Basic information on how to maneuver the chute (turns)
- Landings, including dragging, water landing, tree landing, and power line landings

STRONG ENTERPRISES INC.

Strong Enterprises Inc.
 11236 Satellite Blvd., Orlando, FL 32837
 Phone: 407-859-9317
<http://www.strongparachutes.com/>

Founded in 1960, Strong Enterprises is one of the oldest full line parachute manufacturers in the U.S. The company builds sports, military, and emergency parachutes. Having a long history, Strong Enterprises has been involved in writing articles and providing information about parachutes, including emergency parachutes. The company does not offer formal training but, when asked, it does provide general basic information about how to use emergency parachutes, either by sending some of its people to talk to an audience or inviting people to their site. Strong Enterprises has safety information included in the owner's manual for its Para-Cushion parachutes, the emergency line of parachutes it manufactures, including:

- | | |
|----------------------------------|-----------------------------|
| ➤ Maintenance of the parachute | ➤ How to open the parachute |
| ➤ Using the parachute | ➤ How to steer |
| ➤ Preflight inspection | ➤ How to land |
| ➤ Fitting the parachute | ➤ Recovery |
| ➤ How to get out of the aircraft | |

NATIONAL PARACHUTE INDUSTRIES, INC. (NATIONAL)

National Parachute Industries, Inc. (National)
 47 East Main Street, Flemington, NJ 08822
 Phone: 908-782-1646
<http://www.nationalparachute.com/>

National is a manufacturer of emergency parachutes and does not provide any type of parachute training. The company was founded in 1976 selling sport parachute gear and four years later it began developing emergency parachutes. The National parachutes are fully steerable with a choice of three canopy sizes based on pilot weight. National focuses on manufacturing only.

COST

Since none of the manufacturers are emergency parachute training providers, there is no information available on cost of training. All the information they have available on emergency parachute training is free and available on their web sites or as part of the owner's manual.

PARACHUTE FLIGHT TRAINING SIMULATOR

SYSTEMS TECHNOLOGY INC. (STI)

Systems Technology, Inc.
13766 S. Hawthorne Blvd., Hawthorne, CA, 90250
Phone: 310-679-2281
<http://www.systemstech.com/>

Systems Technology Inc. is the manufacturer of ParaSim, a parachute flight training simulator used by smokejumpers, firefighters, operational airborne military, together with SERE (Survival, Evasion, Resistance and Escape), aviation psychology, and life support providers. This simulator may be a useful tool for emergency parachute training for RLV pilots.

Even though STI is not a training provider, we are including here a description of ParaSim as an alternative to the training information provided by the parachute manufacturers or by SPSS. The system was originally developed for USDA Forest Service smokejumpers to establish smooth basic parachute flight (canopy control) skills in extremely difficult conditions, and STI enhanced its characteristics over time so that now its usability extends beyond smokejumpers.

The installation suspends the trainee in a parachute harness attached to a suspension frame. The trainee can look around in a highly detailed and photo-realistic virtual reality world, which can replicate real world locations and forecast weather, using an HMD (Head Mounted Display) and head orientation tracker to look up to assess the parachute condition, from side-to-side for collision hazards, down at the ground to perceive wind speed and direction, and plan and execute a control and navigation strategy to make a safe upwind landing while avoiding obstacles.

When using the simulator, the trainee can be fully equipped with helmet, visor, oxygen mask, communication equipment, flight gloves, life preservers, ripcords (if applicable), seat kit, and other equipment, as needed. The instructor is equipped with two monitors: one monitor provides training control and status; the other provides the identical scene shown to the student through the HMD. Thus the instructor has a unique capability to see exactly where the student is concentrating his attention, and can move the mouse indicator over into this display to point out important concepts, all while observing and conducting a dialog and critique about the student's body positions and control actions. After setting up the simulated mishap situation, the instructor's training task then is to see that the student proceeds rapidly, but correctly, through an extensive memorized specific sequence of actions. The simulator senses and responds appropriately to head orientation, ripcords, risers, and steering inputs. Runs are automatically scored for safety throughout, and can be stored and replayed on completion.

Highlights of the training that ParaSim can offer include:

- What to do once outside the aircraft and what the body position should be
- Identification of possible malfunctions and identification of corrective actions
- Where to look once in the air, and what to look for
- Equipment procedures involving the equipment carried by the trainee
- Maneuvering the parachute
- Identify the safe landing areas
- What to do when there are visibility issues
- Ripcord procedures
- Equipment procedures

This simulator costs \$60,000. Currently there are approximately 280 such simulators used worldwide, of which about 2/3 are used for aircrew emergency training. One of these is at NASA Dryden Flight Research Center, mainly used for training test pilots.

UNUSUAL ATTITUDE TRAINING

Unusual attitude training is an important part of a training regime for commercial spaceflight which will be using a variety of vehicles and flight profiles. Spaceflight pilots could find themselves with vehicle orientations and inclinations outside of normal aviation experience requiring this type of training and flight experience to keep the pilot, participants, and uninvolved public safe.

Numerous flight training organizations throughout the United States provide unusual attitude training within their flight course offerings, sometimes in conjunction with other types of training applicable to spaceflight. The International Aerobatics Club lists nearly 100 flight schools in the United States and other countries, most of which can provide unusual attitude training. Included in the list are the aircraft that each provider uses and a short description of their instructors and flight offerings. The list can be found at this location: <http://www.iac.org/begin/schools.html>.

The high performance jet providers profiled previously can provide unusual attitude training as a part of their course syllabi. The organizations profiled below complement the high performance jet profiles, including training in propeller-driven aircraft. The profiles are not meant to be a comprehensive listing of all available unusual attitude training offered throughout the United States. Rather, these organizations are examples of providers using aircraft that could allow for appropriate performance conditions relative to spaceflight.

APS EMERGENCY MANEUVER TRAINING

TRAINING PROVIDER

APS Emergency Maneuver Training (Division of Aviation Performance Solutions LLC)
Phoenix Mesa Gateway Airport
5865 South Sossaman Rd.
Mesa, Arizona 85212
Phone: 866-359-4273 or 480-279-1881 Fax: 480-279-1882
Email: info@apstraining.com
Website: <http://www.apstraining.com>

AREA(S) OF TRAINING

- Unusual Attitude Training
- High-g (gravity)

COURSE DESCRIPTION

APS offers a range of emergency maneuver and life-saving safety flight training courses that give extensive academic instruction and in-flight scenario-based hands-on exercises in an Extra 300L aircraft. The company works with customers to tailor their training to the specific aircraft they will be flying. The courses range from a one-day introductory course to a four-day enhanced course on maneuvers and flight characteristics. The company's two-day, three-mission upset recovery course teaches about stall, unusual attitude, and spin prevention. The training course provides experience with unusual attitudes situations such as over bank, spiral dive, nose low, nose high, random entries, eyes closed recoveries, and extreme

attitude recovery conditions; basic aerobatics; stalls and rolls; and other aircraft maneuvering. Each of the three missions within this course includes the following items:

- Ground Pre-flight Theory/Briefing: 1.0 hours
- Flight Time: 0.9 hours

- Air Time (trainer controlled): 0.7 hours (typically a minimum)
- Ground Post-flight Debriefing/Tape Review: 0.5 hours

BACKGROUND AND EXPERIENCE

The company has 11 years experience teaching advanced flight training and moved to its current facilities in Arizona in November 2000. APS uses eight flight instructors to teach their various aerobatic, upset recovery, and spin training missions. The instructors have a range of military, commercial, and private pilot experience, along with advanced instructor certifications. The instructors have over 10,000 combined instructional flight hours dedicated exclusively to advanced aerobatic instruction, upset recovery, and emergency maneuver training.

EQUIPMENT AND FACILITIES

APS uses a propeller-driven Extra 300L aircraft for its training courses. All training courses are headquartered in the company's 25,000-square-foot corporate hangar/office facility located at the Phoenix Mesa Gateway Airport in Mesa, Arizona. The airport features three 10,000-foot runways.

COST

The APS upset recovery training course costs \$2,195. A single introductory upset recovery mission costs \$799. The most expensive four-day, six-mission course on emergency maneuvers costs \$4,115.

RICH STOWELL'S AVIATION LEARNING CENTER

TRAINING PROVIDER

Rich Stowell
P.O. Box 4597
Ventura, CA 93007
Phone: 1-800-869-6627 or 805-525-2037 Email: rich@richstowell.com
Website: <http://www.richstowell.com>

AREA(S) OF TRAINING

- Unusual Attitude Training

COURSE DESCRIPTION

Rich Stowell provides a three-module emergency maneuver program that includes stall/spin awareness, in-flight emergencies, and basic aerobatics. Rich Stowell himself, plus other instructors at the airfield, conduct the flight instruction. The course modules each contain four lessons teaching various skills that improve recovery from and operation in unusual attitudes. The modules increase in difficulty and must be taken in order. Each lesson consists of about 45 minutes on the ground and 45 minutes in the air. Two days is the recommended timeframe for completing each module. A detailed syllabus of the modules is provided on the organization's website.

There is also an additional two-lesson advanced spin training course in a more advanced Pitts S-2B aircraft that teaches unusual attitude spin recovery. A pilot must previously take Module I, Lessons 2 and 3 (or an equivalent) to take this advanced course.

BACKGROUND AND EXPERIENCE

Rich Stowell has been providing flight training since 1987, and was the 2006 FAA Western-Pacific Region Certified Flight Instructor of the Year. The organization specializes in spin, emergency maneuver, aerobatic, and tailwheel training. Mr. Stowell reports to have completed 28,000 spin maneuvers while clocking 7,800 total flight hours. CP Aviation (<http://www.cpaviation.com/index.html>, phone: 805-525-2138) also teaches this emergency training program, and has three additional certified flight instructors.

EQUIPMENT AND FACILITIES

Rich Stowell uses various propeller-driven aircraft with differing ranges of performance to conduct the training. The following are the aircraft offered:

- Citabria 7ECA (115 hp)
- Standard Decathlon (150 hp)
- Super Decathlon (180 hp)
- Pitts S-2B (260 hp)

The Pitts S-2B aircraft is used for the most advanced training modules. The training is conducted at Santa Paula Airport in Southern California. Rich Stowell uses the facilities of CP Aviation at the airport.

COST

Hourly rates for flight training in the various aircraft are as follows (as of January 1, 2008):

- Citabria 7ECA: \$84/hr
- Standard Decathlon: \$141/hr
- Super Decathlon: \$153/hr
- Pitts S-2B: \$250/hr

Instruction provided by Rich Stowell costs \$120 per emergency maneuver training session. Instruction by a CP Aviation instructor costs \$55 per hour.

Pricing per training module is also offered. Prices are based on approximately six hours of instruction with Rich Stowell plus approximately three hours of airplane rental at the above rates. The price will depend on the type of aircraft being used and will depend on airplane availability at the time of scheduling. The following are estimated prices for the different training modules:

- Module I: \$775
- Module II: \$815
- Module III: \$940
- All Three Modules (I-III): \$2,530
- Advanced Spin Training Module: \$615
- Module I Lessons 2 & 3, plus Advanced Spin Training Module: \$1,025

HIGH ALTITUDE FLIGHT TRAINING

The nature of reusable launch vehicle spaceflight will require pilots, crew, and participants to experience the characteristics of flight at extremely high altitudes, beyond that of the typical civilian aircraft operation. Pilots and crew must be capable of safely operating at these high altitudes. Therefore, it is necessary to ensure that they have received the proper ground training and have conducted flights at high altitudes to confirm their ability to perform. An additional method to train for high altitude is the use of a

hyperbaric chamber to simulate the physiological effects of operating at high altitudes. The providers of this method of training are profiled in a separate section of this report.

Two companies are profiled below that have the capability to give training to commercial reusable launch vehicle pilots and crew in the field of high altitude flight, among other fields. In addition to the organizations profiled below, high altitude flight training is offered by ATLAS Aerospace and CAMI (profiled in other areas of this report). The organizations in this report that offer other high-performance jet training are also likely candidates for providing high altitude flights.

F-104 STARFIGHTERS DEMONSTRATION TEAM

TRAINING PROVIDER

Starfighters F-104 Demonstration Team
1608 N. Jasmine Avenue
Tarpon Springs, FL 34689 USA
Website: <http://www.starfighters.net>
Email: info@starfighters.net

AREA(S) OF TRAINING

- Physiological Training
- Altitude Chamber (hypobaric)
- Unusual Attitude Training
- High-G (gravity)
- High Altitude Flight
- Life Support & Egress Systems Training
- High Performance Jet

COURSE DESCRIPTION

The company is considering becoming a training provider for commercial suborbital spaceflight. They are in the process of developing a comprehensive training program using their F-104 jet aircraft and facilities at NASA's Kennedy Space Center (KSC). A six-hour pre-flight is planned on the day previous to flight, as well as a full flight medical performed by a dedicated flight surgeon with more stringent requirements than what is required for a typical FAA pilot's license. The pre-flight training will cover topics including life support (man worn flight equipment), egress systems (ejection seats & parachutes) use, and the extreme physiological strain of suborbital flight (possibly using an altitude chamber and centrifuge to allow the trainee to experience the effects of hypoxia and high-gravitational forces before flight). Flight training will likely include two flights, with flexible flight profiles depending on the specific RLV targeted, featuring high speed, high altitude, and progressive-g-onset (3 to 5.5-6 Gs) over the Atlantic Ocean. The specifics of this program are currently a work-in-progress internally at the company.

BACKGROUND AND EXPERIENCE

The Starfighters F-104 Demonstration Team has operated their high performance aircraft for thirteen years performing at air shows and contract flights for the United States Navy and Air Force under the direction of president Rick Svetkoff. The company is strongly dedicated to safety in their flight operations, with a highly skilled support staff of maintainers and life support & egress systems technicians. The flight crew are current or former military with a total of over 100,000 hours of jet flight time and 30,000 hours of high-performance flight time. The company has made a recent move into the commercial spaceflight arena by entering discussions with the FAA and partnering with NASA, procuring a Space Act Agreement between both organizations for flights from Kennedy Space Center's Shuttle Landing Facility. They made preliminary flights from KSC's main runway on April 17, 2007 and to date

have a total of six successful flight tests completed with the scope to conduct further flights with the purpose of collecting data on possible commercial space flight trajectories.

EQUIPMENT AND FACILITIES

The envisioned flight training will be conducted using two-seat F-104 jet aircraft taking off from KSC's 15,000 foot-long runway and conducting operations over the Atlantic Ocean. This will allow for maximum performance and safety for experiencing conditions experienced during spaceflight. The company has invested and is investing in new flight hardware to optimize flight performance and safety. Starfighters has also leased space in the KSC hangar. In addition, the company either has or is considering the use of an altitude chamber, centrifuge, ejection seat trainer, parachute trainer, and pressure suits. Training is likely to be coordinated with other organizations within Florida, including Zero-G and the Florida Institute of Technology.

COST

The exact cost for training is to be determined, particularly dependent on the location of the training and facility and fuel costs. The current estimated cost is around \$20,000 per flight, but is likely to fluctuate according to flight requirements and the specifics of the customer relationship.

ADVANCED TRAINING SYSTEMS INTERNATIONAL (ATSI)

TRAINING PROVIDER

ATSI
6355-A South Sossaman
Mesa, AZ 85212 USA
Phone: 480-792-6200
Fax: 480-792-6201
Website: <http://www.ATSIFighterTraining.com>
Email: marketing@ATSIFighterTraining.com

AREA(S) OF TRAINING

- Unusual Attitude Training
- High-g (gravity)
- High Altitude Flight
- High Performance Jet

COURSE DESCRIPTION

ATSI offers comprehensive and customer-specific training programs that include ground, flight, simulation, and even English-language training for non-U.S. customers. The company has customized training syllabi that provide the exact type of training required by a customer. These syllabi are not specifically for commercial spaceflight and the company has not confirmed a capability or willingness to participate in spaceflight training as of yet.

ATSI has developed partnerships with outside organizations to help provide some of their training:

- International Simulation Training Systems, Inc. (ISTS): Ground school training and simulator training
- Chandler-Gilbert Community College (CGCC): English Language Training Program
- Air Force Research Laboratory - Warfighter Training Research Division (located in the same Phoenix/Mesa Gateway Airport complex): advanced training support and simulations

BACKGROUND AND EXPERIENCE

Since 2001, ATSI has provided superior tactical flight test and training services for government and defense industry customers, with a focus on pilot training, airborne tanker certification tests, and tactical air services for U.S. and allied militaries. The flight staff at ATSI is made up of senior military pilots with specific training experience in high-performance flight profiles and training.

EQUIPMENT AND FACILITIES

ATSI is based at Phoenix/Mesa Gateway Airport in Mesa, Arizona (formerly Williams Air Force Base). The airport has three active 10,000 foot-long runways. The company uses A-4N Skyhawks, two-seat TA-4J Skyhawks, or customer-supplied aircraft, as well as the facilities of its partners listed above.

COST

Cost is based on customized training needs and flight configuration specifics.

HIGH-G TRAINING

Space vehicles, whether orbital or suborbital, are subjected to high gravitational forces at various points during their flight profiles. Spaceflight participants must be able to withstand these forces, but more importantly, pilots and crew must be able to safely conduct operations under increased physical stresses. Applicable high-G training can be achieved through two methods: the use of a centrifuge to simulate the gravitational forces, or experiencing the forces through flight of a high-performance aircraft.

In addition to the organizations profiled below, high-G training is offered by a number of organizations profiled in other areas of this report. The following is a breakdown of the providers profiled elsewhere based on the type of training offered.

Centrifuge:

- ATLAS Aerospace
- NASTAR Center
- Wyle Laboratories

Flight:

- | | |
|--|------------------------------|
| ➤ Advanced Training Systems International (ATSI) | ➤ F-104 Starfighters |
| ➤ Albatross L-39 (AFTC) | ➤ Incredible Adventures |
| ➤ APS Emergency Maneuver | ➤ Jetwarbird Training Center |
| ➤ ATLAS Aerospace | ➤ Pride Aircraft |
| | ➤ Stallion 51 |

CIVILIAN AERO AND SPACE TRAINING ACADEMY (CASTA)

TRAINING PROVIDER

CASTA

Phone: 1-888-597-7223 or 808-651-6509

Website: <http://www.rocketranchacademy.com/>

Email: GRAVITYDFY@aol.com

AREA(S) OF TRAINING

- Physiological Training
- Psychological training
- Unusual Attitude Training
- High-g (gravity)
- High Altitude Flight
- High Performance Jet
- Flight Simulation
- Space Flight Operations
- Neutral buoyancy training
- Survival Training: Water and Mountain/Wilderness
- Pressure Suit Training
- Parachute Training

COURSE DESCRIPTION

CASTA's training is designed to give those involved with commercial orbital and suborbital spaceflight the confidence needed to operate in and enjoy the experience of spaceflight. Training includes a comprehensive academic ground program that includes topics such as flight physiology, high altitude flight effects, and high-G onsets.

BACKGROUND AND EXPERIENCE

CASTA began its plans for commercial spaceflight training in October 2006. The Director of CASTA is Joseph Sandlin.

EQUIPMENT AND FACILITIES

The company operates out of Washington State and has plans to operate at the proposed Washington Spaceport. The company has plans to use a centrifuge, simulation, Zero-G flights, supersonic jets, helicopters, and other light aircraft for future spaceflight training.

COST

The cost of training is to be determined.

ORBITAL COMMERCE PROJECT (OCP)

TRAINING PROVIDER

Orbital Commerce Project
23 Alafaya Woods Blvd #222
Oviedo, FL 32765 USA
Phone: 321-244-2550 Fax: 321-244-0491
Website: <http://www.orbitalcommerceproject.com/index.html>
Email: orbital@orbitalcp.com

AREA(S) OF TRAINING

- Physiological Training
- Altitude Chamber (hypobaric)
- Unusual Attitude Training
- High-g (gravity)
- High Altitude Flight
- Pressure Suit Training
- High Performance Glider
- High Performance Jet

COURSE DESCRIPTION

OCP is in the conceptual phase of developing a training course for suborbital spaceflight pilots, crew, and participants. Currently, there is no detailed training syllabus available, but the company is in the early stages of writing one. They are planning a set of three progressive phases of training, plus a fourth training section specifically for payload specialists.

- Piston Trainer: Fly in a piston aircraft, learning nominal and non-nominal flight. It will have a focus on un-powered landings in aerodynamic conditions similar to a suborbital vehicle.
- Rocket Trainer: Fly in a rocket-powered aircraft through all phases of flight, including emergency scenarios. Training will include high altitudes and pressurized cabin situations.
- Suborbital Pilot: A full suborbital flight profile will be flown, including high-G scenarios. There will be a minimum of four flights in this training section.
- Payload Specialist: Trainees will learn about operations on a suborbital rocket-powered vehicle, while experiencing high altitude, pressurized cabin, and high-G tolerance training.

BACKGROUND AND EXPERIENCE

OCP was created in 2004 specifically as a training provider for commercial suborbital spaceflight. The company is led by George Tyson and currently is based in Florida. OCP has three pilots on staff, one who is in the process of receiving a trainer's certificate, one who is a commercial pilot, and the other is a private pilot. Training is predicted to start in the late 2008 to 2009 timeframe.

EQUIPMENT AND FACILITIES

OCP has not determined its final location for operations. It had preliminary discussions with Mojave Air and Space Port and is considering the use of a Federal range. They plan to use a piston aircraft, a rocket-powered aircraft, a suborbital reusable launch vehicle, simulators, a \$5-million centrifuge, and a hypobaric chamber for their comprehensive training program. Currently, the company has developed preliminary prototype simulators and has an airframe use agreement, but no other hardware and minimal funding.

COST

The estimated cost of the training program is as follows, subject to market forces and changes to the training regimen:

- Pilot: \$200,000
- Crew: \$100,000
- Participants: \$20,000

PRESSURE SUIT TRAINING

Currently there are no standalone pressure suit training providers in the U.S.; those companies who do offer such training include it as part of a training service package along with other types of pilot training. Besides looking at these providers (treated elsewhere in this report), Futron investigated pressure suit manufacturers, as they can also instruct a user about the proper functioning and use of the pressure suit they produce. The results presented here are based on secondary research as well as direct interviews with the profiled manufacturers.

At present there is only one company in the U.S. that manufactures pressure suits, and it serves primarily U.S. Government customers: David Clark Company Inc. Another company, Orbital Outfitters, entered the market in 2006 and is scheduled to deliver its first pressure suit in 2007. When interviewing these companies, Futron also asked about future intentions in the event suborbital commercial spaceflight

becomes the main driver of demand for RLV pilot training. These intentions are presented below, together with a description of the companies' current capabilities and offerings.

DAVID CLARK COMPANY INCORPORATED (DAVID CLARK)

TRAINING PROVIDER

David Clark Company Incorporated
360 Franklin Street Box 15054
Worcester, Massachusetts 01615-0054
Phone: 508-751-5800
Website: <http://www.davidclark.com/index.html>

AREA(S) OF TRAINING

- Pressure Suit Training

COURSE DESCRIPTION

David Clark is a pressure suit manufacturer that also offers training for the usingthe suits they produce. The majority of the training currently offered is dedicated towards technicians and support staff at the company's U.S. Government customer's sites, and relates to the care and maintenance of the pressure suits, more than to the use of the suit. David Clark has the capabilities to offer pressure suit training directly to end users (such as RLV pilots) either in house or at the customer's location, but at the present, such services are offered through a service provider in the field (e.g., United Space Alliance offers such training for the Space Shuttle pilots, using the pressure suits manufactured by David Clark).

The training offered by David Clark to the technicians and support staff is done quarterly, and deals primarily with basic stitching, cementing operations, cleaning, and fine-tuning/sizing. Each pressure suit is manufactured based on a specific order and has an accompanying technical manual, also tailored to each suit system. These manuals are subject to ITAR restrictions so their content is (not yet) publicly available. The technical manual has two parts: one is an illustrative part break down, where the manufacturer offers information about the parts of the suit and provides details about the repairs or cementing, and the other part offers information about the proper use and operation of the suit by both crew members and technicians.

BACKGROUND AND EXPERIENCE

Founded in 1935, David Clark Company started in the knitting business, moved into the development of specialty knitted materials for specialty undergarments, and later specialized, among others, on pressure suits and space suits. The history of high altitude protective suits developed by David Clark goes back to 1940s, when the company created the first anti-g suit.

The pressure suits currently manufactured by David Clark Company are intended to be in service for 13 years, a period based on the current flight frequency and the established service life of the pressure suit's constituent materials. The company offers periodic inspection of the suits it sells and also provides a mid-life overhaul where it replaces many of the parts that no longer meet the required criteria for safety, reliability, and operation.

Even though the company continued to grow and expand its business in different areas, the pressure suit part of the business has not been ignored. Besides pressure suits, the company also manufactures space

suits (for outside the spacecraft), as well as other products, such as aviation headsets and intercoms, aviation accessories and vehicle intercom systems (fire/rescue). David Clark Company also has a wholly owned subsidiary, Air Lock Inc., that specializes in manufacturing of parts and components that are integrated in the space suits, such as visors, helmets, connectors, and bearings.

FACILITIES AND EQUIPMENT

David Clark has a classroom facility at its headquarters, and can also offer training at the customer's site. There is a test room, with breathing gas flowing in, for the suits to be tested for proper functioning. The test room allows for manned evaluations of the pressure suit in either the pressurized or unpressurized operating modes. David Clark Company, however, does not have facilities needed for a thermal testing of the suit nor an altitude chamber so that the users could train, wearing a suit, in a true vacuum.

COST

The pressure suits are made to order, and the price per suit varies by production order. The company does not currently have an individual price for pressure suit training, because the training it offers now is part of the contract with the Government customers for the suits sold. The current cost of the pressure suit is more than \$100,000, but the company anticipates that, once the demand from commercial sector increases, there will be a need for a new business model. In such model, the simplicity of configurations and the number of suits produced will drive the pressure suit cost down, "well under \$100,000."

ORBITAL OUTFITTERS (OO)

TRAINING PROVIDER

West Coast Office:
7115 Laurel Canyon Boulevard
North Hollywood, CA 91605

East Coast Office:
225 10th St SE
Washington, DC 20003

Phone: 202-546-8074

Website: <http://www.orbitaloutfitters.com/Home.html>

AREA(S) OF TRAINING

- Pressure Suit Training

COURSE DESCRIPTION

OO currently only develops and manufactures pressure suits, but intends to provide basic pressure suit training for operations and emergency use to both pilots and spaceflight participants as vehicles achieve flight status. The intended training for pilots will be more extensive as a crew suit needs to afford additional mobility to the wearer.

The first suit under development by OO is a basic pressure suit. Its primary function is to provide protection in the event of a loss of atmospheric pressure within a vehicle. OO Space Suits are being developed to meet several basic performance criteria:

- Provide life support function for 30 minutes or more at 500,000 feet
- Have a mass of < 20kg

- Are full pressure single gas (O2) suits
- Are comfortable to wear
- Are integrated into a parachute harness
- Grant the user visibility which is superior to existing suit designs
- Integrate advances in cooling developed in the auto racing and film industries
- Include a 15 minute completely independent system backup
- Have a rapid activation function in the event of rapid decompression
- Have an audio system integrated with the vehicle to provide internal and external audio capabilities as well as noise cancellation within the cockpit
- Have an integrated sensor suite to record real-time biometric information about the wearer of the suit as well as an option to record data from or about the vehicle
- Include a visual display of data so status is visible to both wearer and other crew members

The basic training on the OO SubOrbital Suit (SOS1) will include:

- Suit Familiarization. This will be basic, classroom style instruction to teach users:
 - How to put on and take off the suit
 - How to read the suit displays and understand the information presented
 - Suit functionality and limitations.
- Suit Mobility
 - Walking, climbing, ingress, and egress of the vehicle
 - Use of controls and general flexibility (for pilots only)
 - Emergency procedures
- Suit Activation. OO is exploring activating the suit in a pressure chamber for training purposes. Once having put the suit on, and in this chamber, a pilot will get a chance to become more familiar with using the suit and operating the vehicle in an unpressurized environment.

BACKGROUND AND EXPERIENCE

Founded in 2006 by Rick Tumlinson, Krysta Paradis, and Jeff Feige the company's team includes employees who have individual experience in suit development, life-support systems, astrobiology, human factors, aviation and spacesuit suit design. The company's first announced customer is XCOR Aerospace, who is scheduled to receive the first SOS1 in 2007.

OO's parent firm, Xtreme Space Inc. intends to provide passenger/participant training and support, but does not intend to focus on pilot training.

FACILITIES AND EQUIPMENT

As OO does not offer training; at the present the company does not have training facilities, but, in the event there is demand for more suits and more training, OO may consider developing them. A classroom environment can be arranged easily enough, but a pressure chamber and a mockup vehicle to simulate egress will require further investment. Orbital Outfitters also manufactures mockup suits and other simulation hardware should there be a need for suits for or other equipment.

As the technology development phase is still ongoing for Orbital Outfitters' first pressure suit, there is no user manual available yet.

COST

For the time being OO's baseline business plan does not include the outright sale of pressure suits. During the early years of industry operations OO's intent is to lease them to both the crew and space flight participants. The company envisions an end-to-end customer care service that will be priced as a

package. OO has not yet released training prices, but indicated that “these costs would be in the low single digit thousands of dollars.”

FLIGHT SIMULATION

Flight simulation is a valuable method for preparing flight crews to operate reusable spaceflight vehicles. The first flight simulators were developed during World War I to quickly familiarize flight crews with the design of an aircraft’s cockpit and the basic sensations felt during maneuvering. Those first flight simulators bear very little resemblance to the wide variety of high-tech flight simulation devices that exist today. Today’s flight simulators are capable of simulating in high fidelity the sights, sounds, and physical sensations associated with flight. The first private organization to develop, test, and fly into space heavily relied on flight simulation to successfully train their flight crews for the challenges of operating a vehicle both within Earth’s atmosphere and in the relative vacuum of space.

Three flight simulation organizations have been identified and profiled. These three organizations provide the majority of flight simulation equipment and training services. Special emphasis was placed on identifying simulation systems that could most accurately recreate vertical as well as horizontal flight.

FLIGHTSAFETY INTERNATIONAL

TRAINING PROVIDER

FlightSafety International
9601 Trinity Boulevard
Hurst, TX 76053
Website: <http://www.flightsafety.com/index.php>

AREA(S) OF TRAINING

- Flight Simulation

COURSE DESCRIPTION

FlightSafety International in Hurst, Texas, provides initial and recurrent simulator training for the various models of Bell helicopters. FlightSafety in West Palm Beach, Florida, provides initial and recurrent simulator training for the various models of Sikorsky helicopters. Training courses are modular and can be tailored to the needs of the customer. Various training modules include:

General Operational Subjects (Ground School)

- Weight and Balance
- Performance
- Flight Planning
- Approved Rotorcraft Flight Manual
- Windshear Training
- Crew Resource Management (CRM)

Aircraft Systems (Ground School)

- Aircraft General
- Powerplant
- Fire Protection
- Fuel System
- Electrical
- Lighting
- Caution / Warning System and IIDS (As Applicable)
- Powertrain
- Main Rotor
- Tail Rotor
- Flight Controls / AFCS
- Hydraulic Power

- Environmental Systems
- Ice and Rain Protection
- Avionics
- Kits and Accessories
- Preflight
- Systems Review, Examination, and Critique

Simulator Training (Initial 9 hours and recurrent 4 hours)

- Bell 430
- Bell 212
- Bell 214St
- Bell 412
- Sikorsky S-76
- Sikorsky S-70
- Sikorsky S-92

BACKGROUND AND EXPERIENCE

FlightSafety is one of the largest flight training providers with 43 learning centers in the U.S., Canada, France, and the United Kingdom. FlightSafety operates approximately 230 FAA-certified flight simulators, training over 75,000 aviation professionals annually in general, commercial, and military aviation. FlightSafety has 1,500 instructors offering training in 135 aircraft models. FlightSafety offers more than 3,000 courses for pilots, maintenance technicians, flight attendants, and dispatchers.

EQUIPMENT AND FACILITIES

- Flight simulators (Type C & D)
- Classrooms

COST

- Full Service Bell 430 - Initial: \$33,400 Recurrent: \$22,700
- Full Service Bell 212 - Initial: \$29,900 Recurrent: \$20,300
- Full Service Bell 214ST - Initial \$13,100 Recurrent: \$7,750
- Full Service Bell 412 - Initial: \$29,900 Recurrent: \$20,300

CAE, INC.

TRAINING PROVIDER

8585 Côte de Liesse
 Saint-Laurent, Quebec
 Canada H4T 1G6
 Telephone: (514) 341-6780
 Website: www.cae.com

AREA(S) OF TRAINING

- Flight Simulation

COURSE DESCRIPTION

Commercial and Business Aviation Training:
 CAE offers customized training services for pilots and maintenance technicians in commercial and business aviation ranging from integrated programs to deployable ground school capabilities and e-learning solutions. CAE teams with airlines and original equipment manufacturers to improve services, and offer training solutions for every segment on the market. To address the current pilot shortage, CAE offers a pilot provisioning service to a range of airlines, and founded the CAE Global Academy, an alliance of flight training organizations.

Military Training:

CAE provides its military customers with turnkey training solutions as well as comprehensive training support services such as simulator instruction and maintenance at over 60 locations worldwide. CAE also provides a range of simulation-based professional services to support design, analysis, and experimentation applications.

BACKGROUND AND EXPERIENCE

CAE provides simulation and modeling technologies and integrated training solutions for the civil aviation industry and defense forces around the globe. With annual revenues exceeding C\$1 billion, CAE employs approximately 6,000 people at more than 75 sites and training locations in 20 countries. CAE has the largest installed base of civil and military full-flight simulators and training devices. Through a network of 27 civil aviation and military training centers, CAE trains more than 75,000 crewmembers yearly.

EQUIPMENT AND FACILITIES

COMMERCIAL AVIATION TRAINING CENTERS:

Amsterdam, the Netherlands - B737 NG (4); F50 (2); F70/100 (2); F100

Bangalore, India (upcoming) - A320; B737 NG

Brussels, Belgium - A300; ATR42/72; B737-300; B757/767; C-130/L100; Do328TP; F27

Burgess Hill, U.K. - A320 (3); A340-600; B747-400

Charlotte, North Carolina, U.S. – CRJ200; CRJ200/700

Dallas, Texas, U.S. - B737 NG

Denver, Colorado, U.S. - A320; CRJ200; CRJ200/700

Doha, Qatar - A330/340

Dubai, United Arab Emirates - A320 (2); A330/340; B737 NG (2); B777

Kuala Lumpur, Malaysia - A320 (2); B737-400

Madrid, Spain - A320 (4); A330/340; A340; B747-200; CRJ200/700/900; Dash 8; MD-82; MD-87/88

Miami, Florida, U.S. - A320 (2); A320 (2) ; A330/340

Montreal, Quebec, Canada - A310; A330/340

Moscow, Russia - A320

Phoenix, Arizona, U.S. - CRJ200/700/900; ERJ-145

Rome, Italy - A320; B767-300 ER; B777-200

Santiago, Chile - A320; B737-200; B767-300 ER

Sao Paulo, Brazil - A320 (2); A330/340; B737-700; B737 NG

Seattle, Washington, U.S. - CRJ700

Singapore, Singapore - A320

Toronto, Ontario, Canada - A320 (3); B767-200; B767-300 ER; B777-300; CRJ200; CRJ200/900; Dash 8-100/300; Do328 Prop; EMB170; EMB190

Vancouver, BC - A320; A330/340; B737-200; B767-300 ER; Dash 8-100/300

Zhuhai Flight Training Centre (ZFTC) - A320 (4); A330; B737-300 (2); B737 NG (3); B757-200; B777-200; ERJ-145

BUSINESS AVIATION TRAINING CENTERS:

Burgess Hill, U.K. - Falcon 7X; Falcon 900EX EASy; 2000EX EASy. (Global Express; Phenom – upcoming.)

Dallas, Texas, U.S. - BBJ; Beechjet 400A (2); Cessna 400 FTD; Challenger 601; Cheyenne II FTD; Citation I/II; Citation III,VI,VII; Citation V; Citation X; Citation Excel; Citation Jet; Citation Ultra/Bravo; Falcon 10; Falcon 20; Falcon 50; Falcon 900/900EX; Falcon 2000; Gulfstream II; Gulfstream III; Gulfstream IV; Gulfstream V; Hawker 700; Hawker 800/1000; Hawker 800XP; King Air 200; King Air 350; King Air C90 FTD; King Air C-90B FTD; Learjet 24/25/C21; Learjet 35/36; Learjet 55; Turbo Cdr FTD; Westwind I/II. (Phenom – upcoming).

Dubai, United Arab Emirates - ACJ (2); BBJ (2); Bell 412; Gulfstream IV; Gulfstream V/550; Hawker 800/800XP. (Hawker 800XPi; Global Express – upcoming.)

Morristown, New Jersey, U.S. - Falcon 7X; Falcon 900EX EASy; 2000EX EASy; Gulfstream IV; Sikorsky S76. (Challenger 300; Gulfstream 450/550; Hawker 800XPi; Falcon 50EX – upcoming).

MILITARY TRAINING CENTERS:

CAE USA, Tampa, Florida, U.S. - C-130H Hercules aircraft

RAF Benson, U.K. (Medium Support Helicopter Aircrew Training Facility (MSHAFT)) - CH-47 Chinook, EH101 Merlin, & Puma helicopters

Rotorsim Training Centre, Sesto Calende, Italy (consortium) – Agusta Westland helicopters, including A109 and AW139

CAE GLOBAL ACADEMY:

- Brussels, Belgium
- Evora, Portugal
- Moncton, Canada
- San Diego, California, U.S.
- Tucson, Arizona, U.S.
- Langkawi, Malaysia

COST

Pricing varies based on the training needs. Contact CAE for more information.

SPACEFLIGHT OPERATIONS

Operating spacecraft in the unforgiving space environment is a challenge that only a handful of organizations can claim to be experts at. Spacecraft flight crews will be only one component of a team that will need to work together to design, test, pre-flight, launch, land, and maintain an operational spaceflight system. A rich base of knowledge on spaceflight operations has been developed by the United States and Russia after almost 50 years of experience operating human spaceflight systems.

Four spaceflight operations training providers were identified and profiled. Three of these organizations currently work with the United States human spaceflight program while the fourth works with the Russian human spaceflight program.

BARRIOS TECHNOLOGY

TRAINING PROVIDER

Barrios Technology
16441 Space Center Blvd.,
Suite B-100
Houston, TX 77058
Website: <http://www.barrios.com>

AREA(S) OF TRAINING

- Spaceflight - crewmember, mission/flight controller, ground systems personnel
- Space vehicle flight simulation

COURSE DESCRIPTION

Barrios Technologies provides a variety of aerospace services including engineering, information technology, space operations, and training. As of the writing of this profile (June 2007), Barrios was interested in supplying training services to the commercial human spaceflight market but had not yet finalized what specific services they would offer. What follows is a summary of the services that they currently offer their customers:

Training

- Instructional Systems Design
- Requirements Analysis
- Custom Curricula Development
- Total Media Selection
- Train-the-Trainer Programs
- Evaluations-Student/Trainer
- Personnel Certification

Space Operations

- Command & Control
- Console Operations
- Operations Concepts
- Requirements Definition
- Resource Planning
- Real-time Mission Support
- Procedures Development

Engineering

- Avionics
- Electrical Power
- Astrodynamics
- Vehicle Integration
- Trajectory Design
- Guidance, Navigation, & Control
- Systems Modeling & Simulation

Information Technology

- Software Development
- Integrated Systems Design
- Specialized Prototypes
- Database Management
- Infrastructure Services
- Network Design
- Security Management

BACKGROUND AND EXPERIENCE

Founded in 1980, Barrios Technology is an aerospace engineering and technology services firm. Headquartered in Houston, Texas, near NASA's Johnson Space Center, Barrios works with NASA's human spaceflight programs. In addition, Barrios has an office in Colorado Springs, Colorado, that focuses on space systems support to the Department of Defense. Barrios is a woman-owned small business with approximately 500 employees.

EQUIPMENT AND FACILITIES

- Physical and Internet classrooms
- Currently Barrios primarily utilizes NASA facility for training purposes. However, Barrios is interested in offering more than just classroom training and may develop their own facilities or work out agreements with other organizations to acquire access to spaceflight training equipment and facilities.

COST

Cost is dependent upon the customer's requirements. Contact Barrios for custom quotations.

UNITED SPACE ALLIANCE

TRAINING PROVIDER

United Space Alliance LLC
1150 Gemini
Houston, Texas 77058
281-212-6200
Website: <http://www.unitedspacealliance.com/>

AREA(S) OF TRAINING

- Spaceflight Operations
- Flight Simulation
- Microgravity Low-G Training
- Pressure Suit Training
- Parachute Training

COURSE DESCRIPTION

The United Space Alliance (USA) is NASA's primary industry partner in human space operations, including the Space Shuttle and the International Space Station. USA is the prime NASA contractor for all astronaut flight simulation, spaceflight operations, and EVA-related microgravity low-G discipline training, except that directly related to medical training. This training includes related pressure suit

training and parachute training and is divided into two categories: astronaut candidate/generic training and flight assigned training. The astronaut candidate/generic training focuses on generic operations and vehicle systems training and selected specialized non-flight specific training (land and water survival, SCUBA, EVA, etc.). The flight assigned training focuses on activities associated with the astronaut's flight assignment. The flight assigned training begins 24 - 12 months before the flight (depending on the complexity of the flight and the astronaut's specific assignments) and is staged to evolve from part task training to fully integrated spacecraft/Mission Control Center simulations. All of this training typically ends three to four weeks prior to the flight.

The United Space Alliance's capabilities include:

- Mission, manifest and trajectory planning and analyses
- On-orbit assembly, payload deployment, and servicing
- Extravehicular activity planning and execution
- Rendezvous/proximity operations and docking
- Space logistics/supply chain management
- Space operations software engineering
- Ground system design engineering
- Advanced space flight technology
- Launch and recovery operations
- Launch vehicle and flight hardware processing
- Mission control operations
- Space systems training
- Sustaining engineering
- Flight crew equipment preparation and maintenance
- Large scale integration

BACKGROUND AND EXPERIENCE

Headquartered in Houston, Texas, United Space Alliance was established in 1996 as a limited liability company. USA is equally owned by The Boeing Company and Lockheed Martin Corporation and employs 10,000 people at facilities in Texas, Florida, Alabama, and the Washington, D.C. area. United Space Alliance is the prime contractor for the Space Program Operations Contract (SPOC), implemented October 1, 2006, following the conclusion of the 10-year Space Flight Operations Contract (SFOC). USA is NASA's primary industry partner in human space operations, including the Space Shuttle and the International Space Station. Additional work includes:

- International Space Station (ISS) contracts (Boeing)
- Mission Support Operations Contract (Lockheed Martin)
- Extra Vehicular Activity (EVA) Systems (Hamilton Sundstrand)
- ISS Cargo Mission Contract (Lockheed Martin)
- Ares I Crew Launch Vehicle Stage I studies (ATK)
- Crew, Robotics And Vehicle Equipment (CRAVE) contract support
- Support NASA Data Mining & Trending Work Group (NASA Langley)
- Orion Crew Vehicle team, led by Lockheed Martin.

EQUIPMENT AND FACILITIES

USA has an extensive classroom facility used to train USA personnel and selected NASA personnel including astronauts. The other facilities and equipment used to train the astronauts are owned by the government. However, these facilities and equipment could be used to train commercial spaceflight crews, on a non-interference basis with required NASA training.

COST

- Training costs will be negotiated based on clients' needs.

WYLE

TRAINING PROVIDER

Wyle
1290 Hercules Drive
Houston, TX 77058
Website: <http://www.wylelabs.com/services/csfs.htm>

AREA(S) OF TRAINING

- Physiological Training
- Altitude Chamber (hypobaric)
- High-g (gravity)
- Spaceflight Operations
- Microgravity Operations

COURSE DESCRIPTION

Wyle offers a variety of aerospace services including consulting, medical screening and remediation, training, data and risk management, and mission and ground operation support. Specific commercial spaceflight training courses offered at their facilities at Brooks City-Base in San Antonio include:

Human Centrifuge Training and Medical Screening

- Flight readiness testing and training, training in established protective techniques, and customer-specific training programs
- Medical screening
- Evaluation of cardiovascular, neurophysiological, and musculoskeletal responses (ECG, EOG, EMG, EEG, blood pressure, field of view, and video images)
- Assessment of acceleration effects on perception, cognition, and motor skills
- Human-rating of new air/spacecraft life support equipment and assessment of new aeromedical instrumentation.

Altitude Chamber Training and Medical Screening:

- Flight readiness training including hypoxia training, emergency egress training, ejection seat training, and customer-specific training programs
- Medical screening/human performance assessment including physiological measurements (EKG, oxygen saturation, inspiratory demand) and assessment of psychological responses
- Equipment performance assessment

Oxygen Systems Safety Services:

- Unmanned and manned oxygen system performance testing (breathing pressures, mask oxygen concentration, inspiratory demand)

Decompression Sickness Assessments:

- Human performance assessment (ECG, oxygen saturation, inspiratory demand) and equipment

BACKGROUND AND EXPERIENCE

Wyle began business in 1949 in Southern California. Wyle has grown and diversified into a variety of aerospace engineering, scientific, and technical services for customers including the Department of Defense, NASA, and a variety of commercial customers. Wyle has 3,000 employees at 30 facilities nationwide. Wyle generates annual revenues of approximately \$500 million.

Wyle's life sciences group in Houston, Texas, has 35 years experience in life science research, space medical operations, and engineering for the enhancement of human performance and safety in air and space. Wyle is the prime contractor for NASA's Bioastronautics contract. In this capacity Wyle provides medical operations, ground and flight research, space flight hardware development and fabrication, science and mission integration for flight, and habitability and environmental factors in support of the Space Shuttle, International Space Station, Constellation, and Human Research programs. Wyle is also part of NASA's Occupational Medicine and Occupational Health contract under which Wyle offers clinical and occupational health care for NASA personnel and the astronaut corps. In San Antonio, Wyle supports the Air Force Research Laboratory to conduct research and develop technologies to enhance the performance and safety of U.S. Air Force combat pilots.

Wyle is the current provider of all US Medical Operations and Crew Health Care Systems training for NASA's astronauts and flight controllers under the Bioastronautics contract. Under this contract, Wyle also provides physical training and rehabilitation to prepare the astronauts for the rigors of spaceflight. Acceleration training for all first time shuttle crewmembers is performed on the centrifuge operated by Wyle in San Antonio. Wyle also provides training in microgravity operations for medical and life science activities using NASA's C9 microgravity simulation flights. Wyle is currently under contract to Virgin Galactic, providing Chief Medical Officer and medical operations and training services. Wyle has also supported several of the Space Adventure clients who have flown to the International Space Station.

EQUIPMENT AND FACILITIES

- Altitude, thermal, and humidity chamber
- 20-man hypobaric altitude chamber
- Man rated centrifuge
- Oxygen systems safety of flight evaluation equipment
- Instruction and mission simulation facilities
- Integrated medical simulation facility
- Flight proven training curricula

COST

The cost for access to facilities and training services are negotiated based on the customers need.

MICROGRAVITY LOW-G TRAINING

Most flight crew in a weightless environment experience arbitrary and unexpected changes in their sense of verticality. Cockpits that are thoroughly familiar when viewed in one orientation may become unfamiliar when viewed from a different up-down reference.

Since low gravity and zero gravity can only be duplicated here on Earth for very short periods of time, aircraft have been developed that will tolerate sustained periods of microgravity through parabolic flight maneuvers. These maneuvers produce periods of microgravity ranging from 30-45 seconds depending on the vehicle capability and profile being flown. Microgravity low-g training is designed to give the flight crew a short experience similar to what they will experience either during a suborbital or orbital flight.

These short microgravity insights help the flight crew understand the necessary adaptation to vertigo and spatial disorientation that will occur during their missions.

NASA currently operates their own McDonald Douglas C-9 jet aircraft used for astronaut training and research. Russian companies such as ATLAS Aerospace can charter parabolic flights on Russian aircraft. In the United States, ZERO-G offers commercial parabolic microgravity flights.

ZERO-G

TRAINING PROVIDER

Zero-G
5275 Arville Street, Suite 116
Las Vegas, NV 89118
Website: <http://www.gozerog.com/>

AREA(S) OF TRAINING

- Microgravity Low-G Training

COURSE DESCRIPTION

ZERO-G offers parabolic microgravity flight services to the general public (age 8 and over), the entertainment and film industry, corporate and incentive markets, the non-profit research and education sector, and the government. ZERO-G does not currently train commercial human spaceflight crews but has trained human space flight candidates and recently was awarded a contract by NASA to continue that service. ZERO-G has astronauts and former NASA KC-135 employees on staff. ZERO-G is capable of chartering training flights from almost any airport capable of supporting a Boeing 727 aircraft.

During a typical entertainment flight, participants undergo a brief training session before embarking on the aircraft. The total flight duration is approximately 90 minutes, during which participants experience Martian gravity (1/3-gravity), Lunar gravity (1/6-gravity), and zero gravity. ZERO-G's aircraft interior is divided into two zones. The rear area is called the Seating Zone, which provides seating and FAA-required provisions (i.e., emergency oxygen, escape path lighting, floatation device, etc.) for up to 35 cabin passengers and crew. The Floating Zone is the forward section (approximately 90 feet in length) where participants float and fly during the periods of weightlessness. For entertainment flights, the floor and walls of the Floating Zone are covered with a special FAA-approved 1.5-inch energy absorbing Ensolite padding.

BACKGROUND AND EXPERIENCE

Founded in 1993, Zero Gravity Corporation (ZERO-G) is a privately-held space entertainment and tourism company. ZERO-G has since flown more than 4,000 passengers aboard 150 flights. In April 2006, ZERO-G gained permission from the Kennedy Space Center to use the shuttle runway and landing facilities to operate its weightless flights. As of April 21, 2007, ZERO-G also offers regular flights for the general public from Signature Air Terminal at McCarran International Airport in Las Vegas. ZERO-G follows the safety and risk mitigation standards as set by the FAA. Aircraft operations take place under Part 121 of the Federal Aviation Regulations, which are the same rules set for commercial passenger airlines. Furthermore, ZERO-G crew are also FAA-certified. The company is fully insured and carries all required third-party and passenger liability insurance. ZERO-G owns the specially-modified Boeing 727-200 used to conduct its weightless flights which is operated by Amerijet International, Inc.

EQUIPMENT AND FACILITIES

- Modified Boeing 727
- Space Act Agreement with NASA to operate from any NASA center, uses NASA Kennedy Space Center Shuttle Landing Facility and Visitors Center complex.

COST

The ZERO-G Experience, which includes training led by a professional astronaut, a flight of 15 parabolas, flight suit, complimentary merchandise, awards, a post-event party, photos, and a DVD of the flight, is offered at a price of \$3,500 per seat. Chartering an entire flight costs approximately \$100,000; depending on flight duration, profile, etc.

APPENDIX A: COMMERCIAL HUMAN SPACEFLIGHT CREW TRAINING OFFERED BY ORGANIZATION

TRAINING OFFERED	Organization	Type	Website
Altitude Chamber (hyperbaric)	Oklahoma State University - Tulsa	Academic	http://www.healthsciences.okstate.edu/research/cahm/index.html
Altitude Chamber (hypobaric)	Arizona State University Polytechnic	Academic	http://eastair.east.asu.edu/facilities/
Altitude Chamber (hypobaric)	Executive Aerospace	Commercial	http://www.wound.com/aero.html#index
Altitude Chamber (hypobaric)	F-104 Starfighters Demonstration Team	Commercial	http://www.starfighters.net
Altitude Chamber (hypobaric)	FAA Civil Aerospace Medical Institute	Federal Government	http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/cami/
Altitude Chamber (hypobaric)	National Aerospace Training and Research Center	Commercial	http://www.nastarcenter.com
Altitude Chamber (hypobaric)	Oklahoma State University - Tulsa	Academic	http://www.healthsciences.okstate.edu/research/cahm/index.html
Altitude Chamber (hypobaric)	Orbital Commerce Project	Commercial	http://www.orbitalcommerceproject.com/index.html
Altitude Chamber (hypobaric)	UND Aerospace	Academic	http://www.undaerospace.com/other_High%20Altitude.asp
Altitude Chamber (hypobaric)	Wyle Laboratories	Commercial	http://www.wylelabs.com/services/csfs.htm
Flight Simulation	CAE SimuFlite	Commercial	http://www.cae.com
Flight Simulation	Civilian Aero and Space Training Academy (CASTA)	Commercial	http://www.rocketranchacademy.com
Flight Simulation	FlightSafety International	Commercial	http://www.flightsafety.com
High Altitude Flight	Advanced Training Systems International (ATSI)	Commercial	http://www.atsifightertraining.com
High Altitude Flight	Civilian Aero and Space Training Academy (CASTA)	Commercial	http://www.rocketranchacademy.com
High Altitude Flight	F-104 Starfighters Demonstration Team	Commercial	http://www.starfighters.net
High Altitude Flight	FAA Civil Aerospace Medical Institute	Federal Government	http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/cami/
High Altitude Flight	Orbital Commerce Project	Commercial	http://www.orbitalcommerceproject.com/index.html

High Performance Glider	Colorado Soaring Association	Non Profit Organization	http://www.soarcsa.org/
High Performance Glider	Orange County Soaring Association	Non Profit Organization	http://www.ocsoaring.org/
High Performance Glider	Orbital Commerce Project	Commercial	http://www.orbitalcommerceproject.com/index.html
High Performance Glider	The Chicago Glider Club	Non Profit Organizations	Website: http://www.tbss.us/
High Performance Glider	Turf Soaring School	Commercial	http://www.turfsoaring.com
High Performance Jet	Advanced Training Systems International (ATSI)	Commercial	http://www.atsifightertraining.com
High Performance Jet	International Jets, L-39 Parts and Maintenance, INC	Commercial	http://www.internationaljets.com
High Performance Jet	Civilian Aero and Space Training Academy (CASTA)	Commercial	http://www.rocketranchacademy.com
High Performance Jet	F-104 Starfighters Demonstration Team	Commercial	http://www.starfighters.net
High Performance Jet	Jetwarbird Training Center	Commercial	www.jetwarbird.com
High Performance Jet	Orbital Commerce Project	Commercial	http://www.orbitalcommerceproject.com/index.html
High Performance Jet	Aurora Aerospace	Commercial	
High-g (gravity)	Advanced Training Systems International (ATSI)	Commercial	http://www.atsifightertraining.com
High-g (gravity)	International Jets, L-39 Parts and Maintenance, INC	Commercial	http://www.internationaljets.com
High-g (gravity)	APS Emergency Maneuver Training	Commercial	http://www.apstraining.com
High-g (gravity)	Civilian Aero and Space Training Academy (CASTA)	Commercial	http://www.rocketranchacademy.com
High-g (gravity)	F-104 Starfighters Demonstration Team	Commercial	http://www.starfighters.net
High-g (gravity)	Jetwarbird Training Center	Commercial	www.jetwarbird.com
High-g (gravity)	National Aerospace Training and Research Center	Commercial	http://www.nastarcenter.com
High-g (gravity)	Orbital Commerce Project	Commercial	http://www.orbitalcommerceproject.com/index.html
High-g (gravity)	Wyle Laboratories	Commercial	http://www.wylelabs.com/services/csfs.htm
Low-g (gravity)	Zero-G	Commercial	http://www.zerog.com/
Parachute Training	Butler Parachute Systems Group	Commercial	http://www.butlerparachutes.com/
Parachute Training	F-104 Starfighters Demonstration	Commercial	http://www.starfighters.net

	Team		
Parachute Training	National Parachute Industries	Commercial	http://www.nationalparachute.com/
Parachute Training	Silver Parachute Sales & Service (SPSS)	Commercial	http://www.silverparachutes.com
Parachute Training	Systems Technology Inc.	Commercial	http://www.systemstech.com/
Physiological Training	Arizona State University Polytechnic	Academic	http://eastair.east.asu.edu/facilities/
Physiological Training	Civilian Aero and Space Training Academy (CASTA)	Commercial	http://www.rocketranchacademy.com
Physiological Training	Executive Aerospace	Commercial	http://www.wound.com/aero.html#index
Physiological Training	F-104 Starfighters Demonstration Team	Commercial	http://www.starfighters.net
Physiological Training	FAA Civil Aerospace Medical Institute	Federal Government	http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/cami/
Physiological Training	National Aerospace Training and Research Center	Commercial	http://www.nastarcenter.com
Physiological Training	Naval Operational Medicine Institute	Federal Government	http://www.nomi.med.navy.mil/NAMI/index.htm
Physiological Training	Oklahoma State University - Tulsa	Academic	http://www.healthsciences.okstate.edu/research/cahm/index.html
Physiological Training	Orbital Commerce Project	Commercial	http://www.orbitalcommerceproject.com/index.html
Physiological Training	UND Aerospace	Academic	http://www.undaerospace.com/other_High%20Altitude.asp
Physiological Training	Wyle Laboratories	Commercial	http://www.wylelabs.com/services/csfs.htm
Pressure Suit Training	David Clark Company Incorporated	Commercial	http://www.davidclark.com/index.html
Pressure Suit Training	F-104 Starfighters Demonstration Team	Commercial	http://www.starfighters.net
Pressure Suit Training	Orbital Commerce Project	Commercial	http://www.orbitalcommerceproject.com/index.html
Pressure Suit Training	Orbital Outfitters	Commercial	http://www.orbitaloutfitters.com
Spaceflight Operations	Barrios Technology	Commercial	http://www.barrios.com
Spaceflight Operations	United Space Alliance	Commercial	http://www.unitedspacealliance.com/
Spaceflight Operations	Wyle Laboratories	Commercial	http://www.wylelabs.com/services/csfs.htm
Unusual Attitude Training	Advanced Training Systems International (ATSI)	Commercial	http://www.atsifightertraining.com
Unusual Attitude Training	International Jets, L-39 Parts and Maintenance, INC	Commercial	http://www.internationaljets.com
Unusual Attitude	APS Emergency Maneuver	Commercial	http://www.apstraining.com

Training	Training		
Unusual Attitude Training	Civilian Aero and Space Training Academy (CASTA)	Commercial	http://www.rocketranchacademy.com
Unusual Attitude Training	F-104 Starfighters Demonstration Team	Commercial	http://www.starfighters.net
Unusual Attitude Training	FAA Civil Aerospace Medical Institute	Federal Government	http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/cami/
Unusual Attitude Training	Jetwarbird Training Center	Commercial	www.jetwarbird.com
Unusual Attitude Training	National Aerospace Training and Research Center	Commercial	http://www.nastarcenter.com
Unusual Attitude Training	Orbital Commerce Project	Commercial	http://www.orbitalcommerceproject.com/index.html
Unusual Attitude Training	Rich Stowell's Aviation Learning Center	Commercial	http://www.richstowell.com

APPENDIX B: PROFESSIONAL AEROSPACE PHYSIOLOGICAL ORGANIZATIONS

Organization	Websites
Aerospace Medical Association	http://www.asma.org/
Aerospace Human Factors Association	http://www.asma.org/Organization/ashfa/
Aerospace Nursing Society	http://www.asma.org/organizations/constituent/constituent.view.php?cid=3
Aerospace Physiology Society	http://www.aspsociety.org/
Airlines Medical Directors Association	http://www.asma.org/organizations/constituent/constituent.view.php?cid=6
American Society of Aerospace Medicine Specialists	http://www.asams.org/
International Association of Military Flight Surgeon Pilots	http://iamfsp.net/
Society of U.S. Air Force Flight Surgeons	http://www.sousaffs.org/
Society of U.S. Naval Flight Surgeons	http://www.aerospacemed.org/
Space Medicine Association	http://www.asma.org/Organization/smb/smb.htm
Alliance of Air National Guard Flight Surgeons	http://www.aangfs.com/
Aviation Medical Society	http://www.amsanz.org.nz/
U.K Association of Aviation Medical Examiners	http://www.aame.co.uk/
Civil Aviation Medical Association	http://www.civilavmed.com/
French Aerospace Medical Association	http://www.soframas.asso.fr/
German Society of Aerospace Medicine	http://www.dglrm.de/
Latin American Society of Aerospace Medicine	http://www.dglrm.de/
Japan Society of Aerospace & Environmental Medicine	http://wwwsoc.nii.ac.jp/jsasem/
SAFE Association	http://safeassociation.com/
Slovenian Aerospace Medical Association	http://www.sasma.szd.si/
Society of NASA Flight Surgeons	http://snfs.org/
Australasian Society of Aerospace Medicine	http://www.asam.org.au/
Indian Society of Aerospace Medicine	http://www.isam-india.org/
Netherlands Aerospace Medical Centre	http://www.aeromed.nl/
Austrian Society for Aerospace Medicine	http://members.aon.at/asm-austrian_soc_f_aerospace_medicine/
Turkish Civil Aviation Medicine Association	http://hvtd.org/
Spanish Society of Aerospace Medicine	http://www.semae.org/
American Society for Gravitational and Space Biology	http://asgsb.indstate.edu/
European Society of Aerospace Medicine	http://www.esam.aero/
International Academy of Aviation and Space Medicine	http://www.iaasm.org/

APPENDIX C: LIST OF AVAILABLE HIGH PERFORMANCE GLIDERS

STATE	NAME	WEBSITE	Blanik L-23	Blanik L-13	Schweizer 2-32	OTHER AVAILABLE GLIDERS
Alabama	Huntsville Soaring Club	www.huntsvillesoaring.com	1	1		
Alabama	Southern Eagles Soaring	www.SouthernEaglesSoaring.com	1			(1) Scheibe SFS-34B, (1) Schleicher Ka-8, 8B
Alabama	Sylacauga Soaring Society	http://www.sylacaugasoaring.com/		1		(1) Schleicher ASW-15, 15B
Arizona	Turf Soaring School	http://www.turfsoaring.com/			1	(2) Grob G-103A Twin II, (1) Schleicher ASK-21, (1) Schweizer SGS 1-26D, 26E, (6) Schweizer SGS 2-33, 33A, (1) Swift S-1
Arkansas	Memphis Soaring Society	http://www.memphis-soaring.org/	2			(1) PZL Bielsko SZD-51-1 Junior, (1) Schweizer SGS 1-26A, 26B, 26C
California	Antelope Valley Soaring Club, Inc.	http://www.soarav.com/		1	1	(2) Schweizer SGS 1-26A, 26B, 26C
California	Central California Soaring Club	http://www.soaravenal.com/		1		(1) Schweizer SGS 1-26A, 26B, 26C, (2) Schweizer SGS 2-33, 33A
California	Northern California Soaring Assoc.	http://www.norcalsoaring.org/		2		(1) Grob G-102 Standard, (2) Grob G-103 Twin Astir, (1) Schweizer SGS 1-26A, 26B, 26C
California	Orange County Soaring Association	http://www.ocsoaring.org/		2		(1) Grob G-103 Twin Astir, (1) PZL Swidnik PW-5 Smyk
California	Phoenix Club Soaring Group	http://soaring.thephoenixclub.com/	1			(1) Glasflugel 205 Club Libelle, (1) Grob G-103 Twin Astir
California	Sierra Soaring Club	http://www.sierrasoaring.com/	1			(1) Schweizer SGS 1-35
California	Sky Sailing, Inc.	http://www.skysailing.com/			2	(1) Grob G-102 Standard, (2) Grob G-103 Twin Astir, (2) Schweizer SGS 1-26A, 26B, 26C, (1) Schweizer SGS 1-36, (7) Schweizer SGS 2-33, 33A, (1) Stemme S-10, 10V, 10VT
California	So. Cal Douglas Soaring Club, Inc.	http://www.netmeister.net/~scdsa/		1		(1) Grob G 102 Club IIIB, (1) Grob G 103 Twin Acro, (1) Schempp-Hirth Discus A,B,CS
Colorado	Black Forest Soaring Society	http://soarbfss.org/	1			Schleicher ASK-21, Schweizer SGS-2-33, Schweizer SGS-1-26,
Colorado	Colorado Soaring Association	http://www.soarcsa.org/	1			SGS 2-33, Grob G-103
Colorado	High Flights Soaring	http://www.highflights.com/		1		(1) Schweizer 2-33, (1) Schweizer 1-26s,

	Club, Inc.					(1) Schweizer 1-34
Colorado	Soaring Society of Boulder	http://www.soarboulder.org/			1	(1) DG 505, (1) Schweizer 1-34, (1) Grob 102, (1) Grob 103
Florida	Coastal Soaring Association	http://members.cox.net/coastal-soaring/			1	Schweizer 1-34
Florida	North Florida Soaring Society	http://www.soar-nfss.org/			1	(1) Schweizer SGS 1-36, (1) GROB G-103 Twin II
Florida	Seminole-Lake Gliderport	http://www.soarfl.com/main.htm	1			(1) Grob 103, (1) SGS1-34, (1) DG300
Florida	Tampa Bay Soaring Society	http://www.tbss.us/			1	(1) Grob 103, (1) Schweizer 1-26, (1) Lark IS-29D2.
Florida	Unusual Attitudes, Inc	http://www.unusualattitudes.biz/	2			(1) Schempp-Hirth Std Cirrus
Georgia	Southern Eagles Soaring	http://www.southerneaglessoaring.com/	1			(1) Ka-8b , (1) Scheibe SF-34
Hawaii	Honolulu Soaring	http://www.honolulusoaring.com/			1	(1) Schweizer 2-33, (1) L-19 Bird Dogs, (1) ASK-21
Hawaii	Sailplane Ride Adventures.Com	http://www.soarhawaii.com/			1	(1) Grob 103 Acro, (1) Schweizer 2-33
Idaho	Grand Teton Soaring Club	http://www.tetonsoaring.org/	1			(1) Genesis 2 on lease, (1) Slingsby Dart 17m
Illionis	Chicago Glider Club	http://www.chicagogliderclub.org/content/home.php	1			(1) Centrair Pegasus 101A, (1) Schempp-Hirth Duo Discus, (1) Schleicher ASK-21
Illionis	Silvercreek Glider Club	http://www.silvercreekgliderclub.com/			1	(1) SGS2-33A, (1) ASW-27, (3) Discus, (2) H-201 Standard Libelle, (1) SGS1-23H-15, (1) Standard Cirrus Ka-8b
Illionis	Sky Soaring, Inc.	http://www.skysoaring.com/	1		1	(1) Schweizer SGS 1-26A, 26B, 26C, (1) Schweizer SGS 1-34, (1) Schweizer SGS 2-33, 33A
Illionis	St. Louis Soaring Association	http://www.stlsoar.org/			1	(1) Grob G-102 Standard, (1) Grob G-103 Twin Astir, (1) Schleicher ASK-13, (1) Schweizer SGS 1-26A, 26B, 26C, (1) Schweizer SGS 1-26D, 26E, (1) Schweizer SGS 1-34, (1) Schweizer SGS 2-33, 33A
Iowa	Silent Knights, Inc.	http://www.knightglider.com/			1	(1) Schweizer SGS 1-26A, 26B, 26C, (1) Schweizer SGS 1-34, (1) Schweizer SGS 2-22, 22A, 22C, 22E
Maryland	Atlantic Soaring Club	none			1	(1) Schweizer SGS 1-23, 23B, 23C, (1) Schweizer SGS 2-33, 33A

Maryland	Cumberland Soaring Group Inc.	http://cumberlandsoaring.org/		1		(1) Schempp-Hirth Cirrus, (1) Schweizer SGS 1-26A, 26B, 26C, (1) Schweizer SGS 1-34, (1) Schweizer SGS 2-33, 33A
Massachusetts	Cape Cod Soaring Adventures	http://www.capecodsoaring.com/	1			(1) Schweizer SGS 2-33, 33A
Massachusetts	Greater Boston Soaring Club	http://www.soargbsc.com/	2	1		(1) LET L-33 Solo, (2) Pilatus B-4, (2) Schweizer SGS 1-26D, 26E, (1) Schweizer SGS 1-34, (2) Schweizer SGS 2-33, 33A
Massachusetts	Mohawk Soaring Club	http://www.mohawksoaring.org/		2		(1) IAR Brasov IS-28B2, (1) Schweizer SGS 1-26D, 26E
Michigan	Adrian Soaring Club, Inc.	http://www.localhangar.com/cgi-bin/clubs/club_home.pl?CLUBNO=4	1			(1) Schleicher ASK-13, (1) Schleicher ASK-21
Michigan	Marshall Soaring Club	http://www.soaringclub.org/		1		Centrair Pegasus 101A, (1) Grob G 103B Twin II, (1) Schweizer SGS 1-26A, 26B, 26C, (1) Schweizer SGS 2-33, 33A
Michigan	Northwest Soaring Club	http://www.northwestsoaringclub.org/	1			(2) Schleicher ASK-13, (1) Schweizer SGS 1-26D, 26E, (1) Schweizer SGS 2-33, 33A
Michigan	The Vultures Soaring Club, Inc.	http://www.geocities.com/capcanaverall/6260/		2		(1) Schleicher Ka-8, 8B
Minnesota	Stanton Sport Aviation Inc.	http://www.soarmn.com/stanton/ ; http://www.stantonairfield.com/ ; http://www.soarmn.com/msc/index.htm		1		(1) LET L-33 Solo
Mississippi	Central Mississippi Soaring Society	none	1			(1) PZL Swidnik PW-5 Smyk
Montana	Glacier Eagles Soaring Club Inc	none		1		
Montana	Sunbird Aviation	none		1		(1) DG Flugzeugbau DG-505 Elan Orion
Nebraska	Omaha Soaring Club	http://www.omahasozaring.net/		1		
Nevada	Soaring Las Vegas, LLC	http://www.soaringlasvegas.com/			1	(1) Schweizer 2-33
New Jersey	Aero Club Albatross	http://www.geocities.com/aeroclualbatross/		1		(1) Pilatus B-4, (2) Schweizer SGS 1-26A, 26B, 26C, (1) Schweizer SGS 1-34, (1) Schweizer SGS 2-33, 33A
New Jersey	South Jersey Soaring	http://sjsozaring.home.comcast		1		

	Society	.net/wsb/html/view.cgi-home.html-.html				
New Jersey	Yards Creek Soaring	http://www.yardscreeksoaring.com/			1	(2) Schweizer SGS 2-33, 33A
New Mexico	White Sands Soaring Assoc.	http://www.netmdc.com/~geo/WSSA.htm		1		(1) Grob G 103A Twin II Acro, (1) Grob G-102 Astir
New York	Adirondack Soaring Group	http://www.adirondacksoaring.com/data/		3		(1) Schempp-Hirth Duo Discus
New York	Finger Lakes Soaring	http://www.flsc.org/		1		(1) AviaStroitel Russia AC-4C, (1) Grob G 102 Astir CS Jeans, (1) Schleicher ASK-21, (1) Schweizer SGS 1-26A, 26B, 26C
New York	Long Island Soaring Association	http://www.longislandsoaring.com/	1		1	(1) LET L-33 Solo, (1) Schweizer SGS 1-26D, 26E, (1) Schweizer SGS 1-34, (2) Schweizer SGS 2-33, 33A
New York	Sky Sailors, Inc.	http://www.skysailors.com/	1		1	(1) Schweizer SGS 2-33, 33A
North Carolina	Harrier Soaring	http://www.harriersoaring.org/		1		
North Carolina	North Carolina Soaring Association	http://www.ncsoaring.org/		1		(1) LET L-33 Solo, (1) HpH Ltd Glasflugel 304C
Ohio	Caesar Creek Soaring Club	http://www.soarccsc.com/index.shtml	1			(1) Grob G-103 Twin Astir, (2) Schleicher ASK-21, (2) Schweizer SGS 1-26A, 26B, 26C, (1) Schweizer SGS 1-34, (3) Schweizer SGS 2-33, 33A
Ohio	Fun Country Soaring Club, Inc.	http://www.funcountrysoaring.com/		1		(1) Grob G-102 Club, (1) Grob G-103A Twin II, (1) Schweizer SGS 1-26A, 26B, 26C
Ohio	Soaring Thunderbirds	http://web.raex.com/~monotube/		1		(1) LET L-33 Solo
Oklahoma	Tulsa Skyhawks Soaring Club, Inc.	http://www.tulsasoaring.com/		1		(1) Schweizer SGS 2-33, 33A
Oregon	High Desert Soaring Club	http://www.hdsoaring.org/		1		(1) Schempp-Hirth Nimbus 2, 2C, (1) Schleicher ASK-21, (1) Schweizer SGS 1-26A, 26B, 26C
Pennsylvania	Cloudniners	none		1		(1) Schweizer SGS 1-26D, 26E
Pennsylvania	Kutztown Aviation	http://www.kutztownair.com/			1	(2) PZL Krosno KR-03A Puchatek, (1) Schweizer SGS 1-26D, 26E
South Carolina	Lowcountry Soaring Association	http://www.lowcountrysoaring.org/		1		(1) PZL Swidnik PW-5 Smyk
South Dakota	Black Hills Soaring Club, Inc.	none		1		
Tennessee	Chilhowee Soaring	http://www.chilhowee.com/		2		(1) Alisport Silent, (1) Schleicher Ka-6CR,

	Association, Inc.					(1) Schleicher Ka-7
Tennessee	Smoky Mountain Soaring Assoc.	http://www.soarsmokymtn.org/	1			(1) LET L-33 Solo
Texas	Greater Houston Soaring Assoc., Inc.	http://www.houstonsoaring.org/	3			(1) Glasflugel H-301 Libelle, (1) Grob G 102 Standard III, (1) IAR Brasov IS-28B2, (1) Schweizer SGS 1-26D, 26E
Texas	Hill Country Motorgliding, LLC	http://www.learn2soar.net/		1		(1) Eiri Avion PIK-20D, (2) Grob G-109, (1) Issoire Edelweiss C-30S, (1) Schweizer SGS 2-33, 33A
Texas	Marfa Gliders	http://www.flygliders.com/	2			(1) Schweizer SGS 1-36
Texas	Permian Soaring Association	http://www.permiansoaring.us/		1		(1) Schweizer SGS 1-26A, 26B, 26C
Texas	Soaring Club of Houston	http://www.scoh.org/	2			(1) Grob G-103 Twin Astir, (1) IAR Brasov IS-28B2, (1) LET L-33 Solo, (1) PZL Swidnik PW-5 Smyk, (1) Schweizer SGS 2-33, 33A
Utah	Cache Valley Soaring Association	http://www.cachesoaring.org/		1		
Vermont	Post Mills Soaring Club	http://www.flypmc.org/		1		(1) Schweizer SGS 1-23H, (1) Schweizer SGS 2-33, 33A, (1) HpH Ltd Glasflugel 304C
Vermont	Sugarbush Soaring Association	http://www.sugarbush.org/	2		1	(1) Grob G-102 Standard, (2) Schleicher ASK-21, (1) Schweizer SGS 1-26A, 26B, 26C
Virginia	Blue Ridge Soaring Society, Inc.	http://www.brss.net/	2			(2) LET L-33 Solo,
Virginia	Shenandoah Valley Soaring	http://www.svsoar.org/	1			(1) Schweizer SGS 2-33, 33A
Virginia	Tidewater Soaring Society	http://www.tidewatersoaring.org/	1			(1) LET L-33 Solo, (1) Schweizer SGS 1-26D, 26E, (1) Schweizer SGS 2-33, 33A
Washington	Cascade Soaring Society	http://www.nwi.net/~blanikam/css/default.htm		1		(1) AviaStroitel Russia AC-4C, (1) IAR Brasov IS-28B2
Washington	Evergreen Soaring Inc.	http://www.evergreensoaring.org/		2		(1) Apis WR-13, (1) Schweizer SGS 1-36
Washington	Puget Sound Soaring Assoc., Inc.	http://www.pugetsoundsoaring.org/PSSA.php		1		(1) Schweizer SGS 2-33, 33A
Washington	Washington State Soaring Association	http://www.wastatesoaring.com/	2			(1) Grob G 102 Astir CS Jeans, (1) LET L-33 Solo, (1) Schweizer SGS 1-26D, 26E, (1) Schweizer SGS 1-34

APPENDIX D: UNITED STATES PARACHUTE ASSOCIATION MEMBERS

STATE	CHUTE TRAINING PROVIDER	WEBSITE
Alabama	Emerald Coast Skydiving Center	www.emeraldskydive.com
Alabama	Opelika Skydiving Association	www.skydiveopelika.net
Alabama	Skydive Alabama	www.skydiveal.com
Alaska	Alaska Skydiving, Inc.	
Arizona	Complete Parachute Solutions	www.cpsworld.com
Arizona	Desert Skydiving Center	www.desertskydivingcenter.com
Arizona	Marana Skydiving Center	www.skydivemarana.com
Arizona	Phoenix Area Skydiving	www.phoenixareaskydiving.com
Arizona	Skydive Arizona	www.skydiveaz.com
Arizona	Skydive Sedona at Cottonwood	
Arizona	United States Instructional Rating School	www.usirs.net
Arkansas	Skydive Skyranch	www.skyranch.com
Arkansas	South Arkansas Skydivers SPC	southarkskydivers.tripod.com
California	Adventure Center Skydiving, Inc.	www.1800funjump.com
California	Bay Area Skydiving	www.bayareaskydiving.com
California	Cal City Skydive	www.calcityskydive.com
California	California Parachute Club/The Jim Wallace Skydiving School	www.jimwallaceskydiving.com
California	Lake Tahoe Skydiving Center	
California	Madera Parachute Center	www.skydivemadera.com
California	Pacific Coast Skydiving	www.pacificcoastskydiving.com
California	Perris Valley Skydiving	www.skydiveperris.com
California	SkyDance SkyDiving	www.skydanceskydiving.net
California	Skydive California City	www.skydivecaliforniacity.com
California	Skydive Elsinore	www.skydiveelsinore.com
California	Skydive Imperial	
California	Skydive Monterey Bay	www.skydivemontereybay.com
California	Skydive San Diego	www.skydivesf.com
California	Skydive San Francisco	www.skydivesf.com
California	Skydive Santa Barbara	www.skydivesantabarbara.com
California	Skydive Taft	www.skydivetaft.com
Colorado	Colorado Skysports	www.coloradoskysports.com
Colorado	Elaborate Skydiving at Calhan	www.elaborateskydiving.com
Colorado	Mile-Hi Skydiving Center, Inc.	www.mile-hi-skydiving.com
Colorado	Skydive The Rockies!	www.skydivetherockies.com
Connecticut	Boston-Hartford Fun Skydiving	www.funskydiving.com
Connecticut	Connecticut Parachutists, Inc.	www.skydivect.com
Delaware	Skydive Delmarva, Inc.	www.skydivedelmarva.com
Florida	Air Adventures of Clewiston	www.skydivefl.com
Florida	Florida Skydiving Center	www.floridaskydiving.com
Florida	Freefall Adventures	www.ffadventures.com
Florida	The Jumping Place	www.jumpjax.com
Florida	School of Human Flight	www.skydivetallahassee.com
Florida	Skydive City	www.skydivecity.com
Florida	Skydive DeLand, Inc.	www.skydivedeland.com

Florida	Skydive Jacksonville	www.skydivejacksonville.com
Florida	Skydive Key West	www.skydivekeywest.com
Florida	Skydive Miami	www.skydivemiami.com
Florida	Skydive Palatka	www.skydivepalatka.com
Florida	Skydive Sebastian	www.skydivesebastian.com
Florida	Skydive Space Center	www.skydivespacecenter.com
Florida	Skydive Southwest Florida	www.skydiveswflorida.com
Florida	Skydive Umatilla	www.skydiveumatilla.com
Georgia	Chuting Star Rigging Loft	www.chutingstar.com
Georgia	Skydive Atlanta	
Georgia	Skydive Monroe	www.skydivemonroe.com
Georgia	Skydive The Farm	www.skydivethefarm.com
Hawaii	Pacific Skydiving Center	www.pacific-skydiving.com
Hawaii	Skydive Kauai	www.skydivekauai.com
Idaho	Skydive Idaho	www.skydiveidaho.com
Idaho	Skydown Sport Skydiving	www.skydownskydiving.com
Illinois	Archway Skydiving Center	www.archwayskydiving.com
Illinois	Chicagoland Skydiving Center	www.skydivecsc.com
Illinois	Greater St. Louis Parachute Club	www.gslpc.com
Illinois	Illinois Skydiving Center	www.illinois-skydiving-center.com
Illinois	Illinois Valley Parachute Club	www.ivpc.org
Illinois	Mid-America Sport Parachute Club	www.skydivetaylorville.com
Illinois	Parachutes Over Carmi	www.skydivecarmi.com
Illinois	Quad City Skydiving Center, Inc.	www.qc-skydiving.com
Illinois	Rock River Valley Skydivers	
Illinois	SEMO Skydive	
Illinois	Skydive Chicago, Inc.	www.skydivechicago.com
Illinois	Skydive Midwest	www.skydivemidwest.com
Indiana	Air Indiana Skydiving Center, LLC	
Indiana	Indiana Skydiving Academy, LLC	www.indianaskydivingacademy.com
Indiana	Jerry's Skydiving Circus	www.skycircus.com
Indiana	Skydive Fort Wayne, Inc.	www.skydiveftwayne.com
Indiana	Skydive Greensburg	www.skydivegreensburg.com
Iowa	Accelerated Freefall Iowa, Inc.	
Iowa	Des Moines Skydivers, LLC.	www.couchfreaks.com
Iowa	Skydive Iowa	www.skydiveia.com
Kansas	Air Capital Drop Zone	www.aircapitaldropzone.com
Kansas	Kansas State University Parachute Club	www.skydivekstate.com
Kansas	Skydive Kansas	www.skydivekansas.com
Kansas	Skydive Suppesville	
Kentucky	Greene County Sport Parachute Center	www.skydiveky.com
Kentucky	Kentucky Skydiving Center	www.kentuckyskydivingcenter.com
Louisiana	Skydive Louisiana	www.northlouisianaskydiving.com
Louisiana	Skydive N'awlins	www.skydivenawlins.com
Maine	Central Maine Skydiving	www.centralmaineskydiving.com
Maine	Skydive New England	www.skydivenewengland.com
Maryland	Ocean City Skydiving Center	www.skydriven.com
Maryland	The Freefall Academy	www.skydriven.com
Massachusetts	Airborne Adventures Skydiving School	
Massachusetts	Jumptown/MSPC, Inc.	www.jumptown.com

Massachusetts	Pepperell Skydiving Center	www.skyjump.com
Massachusetts	Skydive Plum Island	
Michigan	Capital City Skydiving	www.capitalcityskydiving.com
Michigan	Midwest Freefall Sport Parachute Club, Inc.	www.midwestfreefall.com
Michigan	Napoleon Skydiving Center	www.napoleonskydivingcenter.com
Michigan	Premier Skydiving	www.premier-skydiving.com
Michigan	Skydive Harbor Spring	
Michigan	Skydive Michigan!, Inc.	
Michigan	Skydive Plainwell	www.skydiveinc.com
Michigan	Skydive Tecumseh	www.tecumsehskydiving.com
Michigan	Wild Wind Skydivers	www.wildwindskydivers.com
Minnesota	Minnesota Skydivers Club, Inc.	www.mnskydive.com
Minnesota	Skydive Twin Cities	www.skydivetwincities.com
Mississippi	Gold Coast Skydivers	www.goldcoastskydivers.com
Missouri	Adrenaline Air Play	
Missouri	Freefall Express Skydiving, Inc.	
Missouri	Missouri River Valley Skydivers	www.skydivemrvs.com
Missouri	Quantum Leap Skydiving Center	www.stljump.com
Missouri	Skydive Kansas City, Inc.	www.skydivekansascity.com
Missouri	Skydive Missouri	www.skydivemissouri.org
Missouri	The Kansas City Skydiving Center	www.kcskydiving.com
Montana	Skydive Lost Prairie, Inc.	www.skydivelostprairie.com
Nebraska	Crete Skydiving Center, Inc.	www.skydivecrete.com
Nebraska	Lincoln Sport Parachute Club	www.skydivelspc.com
Nebraska	Skydive Atlas	www.skydiveatlas.com
Nevada	Skydive Mesquite	www.skydivemesquite.com
Nevada	Vegas Extreme Skydiving, Inc.	www.vegasextremeskydiving.com
Nevada	SkydiveLasVegas.com	www.skydivelasvegas.com
Nevada	Sin City Skydiving, LLC	www.sincityskydiving.com
New Jersey	Freefall Adventures/Skydive Crosskeys	www.freefalladventures.com
New Jersey	New York Skydiving School/Skydive Sussex	www.newyorkskydivingschool.com
New Jersey	Skydive Jersey Shore	www.skydivejerseyshore.com
New Jersey	Skydive Wildwood	www.freefalladventures.com
New Mexico	Skydive New Mexico	www.skydivenm.net
New York	Blue Sky Adventures	
New York	Blue Sky Ranch	www.theblueskyranch.com
New York	Duanesburg Skydiving Club	www.duanesburgskydiving.com
New York	Finger Lakes Skydivers	www.skydivefingerlakes.com
New York	Frontier Skydivers	www.frontierskydivers.com
New York	Long Island Skydiving Center	www.longislandskydiving.com
New York	Malone Parachute Club	www.maloneparachuteclub.com
New York	Mohawk Valley Skydiving	www.mohawkvalleyskydiving.com
New York	Rochester Skydiving Center	www.rochesterskydivers.com
New York	Saratoga Skydiving	www.saratogaskydiving.com
New York	Skydive Long Island	www.skydivelongisland.com
New York	Skydive The Ranch	www.skydivetheranch.com
New York	United States Military Academy Parachute Team	www.usma.edu/uscc/dca/clubs/jump/index.htm
North Carolina	Adrenaline Air Sports/Carolina Skydiving Inc.	www.CarolinaSkydiving.com

North Carolina	Carolina Sky Sports	www.carolinaskysports.com
North Carolina	Laurinburg-Maxton	
North Carolina	Raeford Parachute Center	www.jumpraeford.com
North Carolina	Skydive Coastal Carolinas	www.skydivecoastalcarolinas.com
North Carolina	Southern Comfort Air Ranch Skydiving	www.southerncomfortskydiving.com
North Carolina	Tradewind Skysports	www.tradewindskysports.com
North Carolina	U.S. Army Parachute Team/Golden Knights	www.armygoldenknights.com
North Dakota	Skydive Fargo!, Inc.	www.skydivefargo.com
Ohio	Aerohio Skydiving Center, Inc.	www.jumptoday.com
Ohio	Alliance Sport Parachute Club	www.skydivericks.com
Ohio	Canton Air Sports	www.cantonairsports.com
Ohio	Clevelandparachute.com	www.clevelandparachute.com
Ohio	Ohio State University Skydiving Club	www.osuskydive.com
Ohio	Skydive Columbus Ohio	www.skydivecolumbusohio.com
Ohio	Skydive Wayne County	www.skydiverichmond.com
Ohio	Start Skydiving	www.startskydiving.com
Ohio	Tri-State Skydivers, Inc.	www.tristateskydivers.com
Oklahoma	Oklahoma Skydiving Center	www.skydiveok.com
Oklahoma	Pegasus Skydiving	www.skydiveok.com
Oklahoma	Skydive Airtight	www.skydiveairtight.com
Oregon	Central Oregon Skysports	www.skydivecentraloregon.com
Oregon	Eugene Skydivers	www.eugeneskydivers.com
Oregon	Skydive Oregon, Inc.	www.skydiveoregon.com
Pennsylvania	Above the Poconos Skydivers/NEPA Ripcords, Inc.	www.paskydiver.com
Pennsylvania	Chambersburg Skydiving Center, Inc.	www.skydivingcenter.net
Pennsylvania	Endless Mountain Skydivers	www.skydiveems.com
Pennsylvania	Erie Skydivers	www.erieskydivers.com
Pennsylvania	Freefall Oz Skydiving Center	www.freefallozskydiving.com
Pennsylvania	Kutztown Skydiving Center LLC	www.skydivekutztown.com
Pennsylvania	Maytown Sport Parachute Club	www.skydivemspc.com
Pennsylvania	Pennsylvania Skydiving U. Corp.	www.skydivehappyvalley.com
Pennsylvania	Skydive Pennsylvania	www.skydivepa.com
Pennsylvania	The Skydivin' Place, Inc.	www.skydivepa-md.com
Pennsylvania	Sky's the Limit	www.skysthelimit.net
Rhode Island	Skydive Newport	www.skydivenewport.com
South Carolina	Flying Tiger SPC	www.flyingtigerspc.com
South Carolina	Skydive Carolina!	www.skydivecarolina.com
South Carolina	Skydive Walterboro, Inc.	www.skydivewalterboro.com
South Dakota	Skydive Adventures	www.skydiveadventures.net
Tennessee	Skydive Paris, Inc.	www.skydiveparis.com
Tennessee	Skydive Smoky Mountains	www.skydivesmokymountains.com
Texas	Austin Skydiving Center	www.austinskydiving.com
Texas	Capitol Skydiving, Inc.	www.capitolskydiving.com
Texas	Eagle Flight Skydiving	www.eagleflightkydiving.com
Texas	East Texas Skydiving Club, LLC	www.skydiveeasttexas.com
Texas	Ground Rush Skydiving Club	www.groundrushskydiving.com
Texas	Skydive Aggieland, Inc.	www.skydiveaggieland.com
Texas	Skydive Dallas	www.skydivedallas.com
Texas	Skydive Houston	www.skydivehouston.com

Texas	Skydive San Marcos	www.skydivesanmarcos.com
Texas	Skydive Spaceland	www.skydivespaceland.com
Texas	Skydive Temple	www.skydivetemple.com
Texas	Sky's The Limit Parachute Center, Inc.	www.skysthelimit2.com
Texas	Texas Freefall	
Utah	Air Venture Skydiving, LLC	www.airventure1.com
Utah	Ogden Skydiving Center	www.skydiveogden.com
Utah	Skydive Moab	www.skydivemoab.com
Utah	Skydive Utah	www.skydiveutah.com
Vermont	Vermont Skydiving Adventures, Inc.	www.vtskydiving.com
Virginia	Skydive Orange, Inc.	www.skydiveorange.com
Virginia	Skydive Suffolk	www.skydivesuffolk.com
Virginia	Skydive The Point	www.skydivethepoint.com
Virginia	Skydive Virginia!	
Virginia	West Point Skydiving Adventures	www.skydivewestpoint.com
Washington	Blue Skies Skydiving Adventures, Inc.	www.blueskies-skydiving.com
Washington	Kapowsin Air Sports	www.skydivekapowsin.com
Washington	Skydive Snohomish, Inc.	www.skydivesnohomish.com
Washington	Skydive Toledo	www.skydivetoledo.com
Washington	West Plains Skydiving	www.westplainskydiving.com
Wisconsin	AtmosphAIR Skydiving Center, Inc.	www.diveout.com
Wisconsin	Green Bay Skydivers	www.greenbayskydivers.com
Wisconsin	Seven Hills Skydivers	www.sevenhillsskydivers.org
Wisconsin	Sky Knights Sport Parachute Club	www.skydivemilwaukee.com
Wisconsin	Skydive Adventure	www.skydiveadventure.com
Wisconsin	Skydive Superior	www.skydivesuperior.com
Wisconsin	Skydive Wissota/Indianhead SPC	www.skydivewissota.org
Wisconsin	Tri-State Skydivers, Inc.	www.tri-stateskydivers.com
Wisconsin	Wolf River Skydivers	www.wolfriverskydivers.com