

# National Aerospace Training & Research Center

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The logo for the NASTAR Center is displayed on a blue building facade. The word "NASTAR" is written in large, blue, outlined letters, with a yellow sunburst icon integrated into the letter "A". Below "NASTAR", the word "CENTER" is written in smaller, red, outlined letters. A white swoosh underline is positioned beneath the "NASTAR" text.



# Crew and Passenger Training for Space Flight

or, how do you get them *THERE* from *HERE*?

- Informed Consent
  - Mitigating Risk
- Medical Screening
- Spaceflight Training

# History



- Grand Opening 2007- Philadelphia, PA USA
- 30,000 sq.ft. AeroMedical Facility
- Created Because: National BRAC (Base Realignment & Closures) & growing pilot training needs and to showcase facility for ETC manufactured equipment
- Public company. Wholly owned subsidiary of ETC (1969). 40 years of motion system technology in 87 countries across the globe.
- BSI Certified to: ISO 9001 : 2000, ISO 9000-3, ISO 13485 & MDD, EU PED.

# Equipment



Hyperbaric Research Lab



Gyro-Flight Trainer



Land & Water Survival Systems

Altitude Chamber (Above and Right)



General Aviation Trainer (GAT)



GAT - Helo Trainer



Spatial Disorientation Trainer (GYROLAB)



Ejection Seat Trainer (EST)



High Performance Human Centrifuge



Night Vision Trainers

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# Federal Register

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Friday,  
December 15, 2006

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Part II

Department of  
Transportation

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Federal Aviation Administration

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14 CFR Parts 401, 415, 431, 435, 440 and  
460

Human Space Flight Requirements for  
Crew and Space Flight Participants; Final  
Rule



**The Federal Aviation  
Administration (FAA)  
has established  
“Guidelines” for  
“Human Space Flight  
Requirements for Crew  
and Space Flight  
Participants; Final  
Rule”**

## §Part 460.5 Crew Qualifications and Training

*(b) Each member of a flight crew must demonstrate an ability to withstand the stresses of space flight, which may include high acceleration or deceleration, microgravity, and vibration, in sufficient condition to safely carry out his or her duties so that the vehicle will not harm the public.*



## §Part 460.5 Crew Qualifications and Training

- (3) Receive vehicle and mission-specific training for each phase of flight by using one or more of the following –*
- (i) A method or device that simulates flight;*

## §Part 460.15 Human Factors

*(d) Vehicle operation, so that the vehicle will be operated in a manner that flight crew can withstand any physical stress factors, such as acceleration, vibration, and noise.*



## §Passengers?

...document focuses on informed consent and provides little guidance on medical clearance ...



# ***Space Flight Participant's Ability To Be Informed.***

- Section 460.45(f) requires each space flight participant to provide written informed consent.
  - Participant understands risks
  - Presence on board the vehicle is voluntary
  - FAA does not consider a person under the age of 18 someone who can provide informed consent.

# Informed Consent

- Informed consent only provides legal protection (defense) from the inherent risks of an activity and **not from negligence**
  - Study on Informed Consent for Spaceflight Participants Document Number: APT-CFA-230-0001-02F September 26, 2008
- In order for informed consent to be considered valid, **the client must be competent** and the consent should be given voluntarily.

# Spaceflight and informed consent

- Individual perception of risk and reward varies greatly
  - **An individual may consent to risk that the operator would not...!!!**
- Examples
  - Military Aviation – grounding a pilot for minor medical problems
  - Civilian Aviation – medical requirements for pilot in command
  - Spaceflight – many individuals would risk life and limb to achieve the dream of space flight
    - Does the commercial operator wish to participate at that risk level?
    - Medical clearance and training are not required, but do they help the operator mitigate their risk?
    - What about the other passengers and their willingness to share in the risk of a flight with another individual with medical problems?
    - Would you sell a “one way ticket”?

# Physical Examination

- “The FAA is **not** requiring that a space flight participant obtain a physical examination. The Federation agreed with this decision in its comments. As it discussed in the guidelines and the NPRM, the FAA recommends such an examination.”

# Mitigating risk to the commercial operator

- Is it negligent to accept a passenger with a medical condition that would deteriorate as a result of space flight? Even if they “consent”?
- Is it negligent to fly a passenger without providing some training to endure the physiologic stress?



# Medical screening and training

- Can mitigate risk to the operator
- Can enhance the experience of the space flight participant and participants around them

# Training for Spaceflight

- “Zero” G Exposure
- Sustained G Exposure (simultaneous Gx, Gz)
- Altitude Exposure (Hypoxia, DCS, RD)
- Spatial Disorientation Adaptation
- Motion Sickness Desensitization



# STS-400 Centrifuge

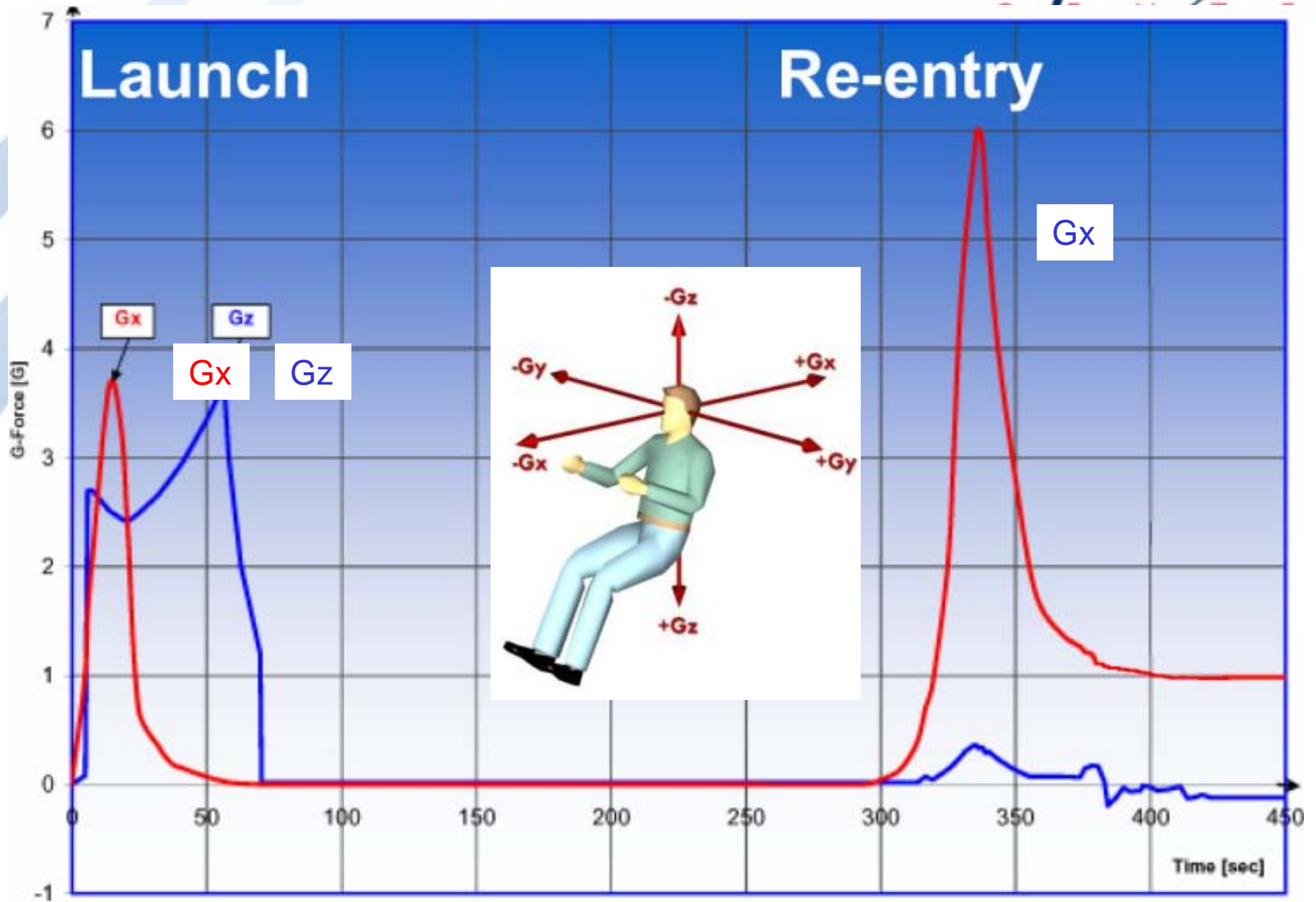
## Space Training System



- World's Highest Performance "Flyable" Human Centrifuge
- ARM: 25 foot; 11 ton
- MAXIMUM G: +15Gz  
ONSET /OFFSET: 10 G/SEC  
MAX PAYLOAD: 1200 lbs.  
(544kg)
- Dual Gimbaled Axis, "G-Pointing"
- Interchangeable Cockpits (1-2 seats)
- Integrate Customer Aero-Model
- Replicates Flight Profile

High Fidelity, Multi-Axes, Sustained G Force Motion Platform

# Air Launched Vehicle Profile



# STS-400 Cockpit



## Training Programs for Space Launch Operators, Pilots, Researchers & Participants

### Suborbital /Orbital

- Stand Alone/Integrated Cockpit
- Satellite Imagery; Seat Shaker
- Medical Screening Capability
- Floor level access for quick Medical Egress.
- Safe, controlled environment



Space  
Training  
Simulator  
(STS-  
400)  
Cockpit

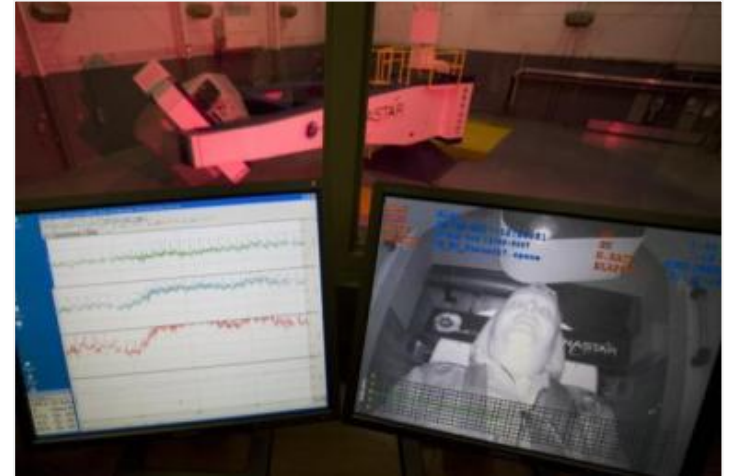


# NASTAR Center is the Official Space Training Provider to Virgin Galactic



**Nearly 200 spaceflight trainees including Richard Branson have trained for commercial spaceflight so far**

# Medical Monitoring and Training to Optimize Human Performance & Safety



Age Range: 18- 88 years old



Medical Monitoring of ~80 Virgin Galactic trainees in centrifuge – CCTV, BP, Oximeter, ECG

# Space Training Program



## Average 2 Day Programs Include:

- Acceleration Factors & Dynamics of Space Flight Accelerations
- Physical and Physiological Effects of G Forces (Cardiovascular, Breathing & Vision)
- Human Tolerance to Acceleration (G-Tolerance Flights)
- Anti-G Straining Maneuver (AGSM) & Breathing Techniques Demonstration and Practice
- Space Flight Profiles
- Prerequisites: Current FAA Class 3 Medical Certificate. Must be at least 18 years of age.

# Medical screening for sub orbital space flight training on centrifuge

- Participants sign a medical screening form indicating conditions that would disqualify them from participating
- Participants are instructed to go to an AME and obtain a Class III Medical Certificate
- If they successfully complete a Class III Medical but have a waived cardiac condition (treated hypertension etc) then a copy of a recent ECG is requested for the file.
- Certain conditions which might be disqualifying for Class III (e.g. vision, hearing, depression under treatment) are NOT disqualifying for the centrifuge experience.

# Results



- Roughly 200 participants to date including Virgin Galactic founders
- Medical monitoring with Flight Surgeon monitoring ECG in the beginning, transitioned to Paramedic monitoring (without ECG) on sight with ambulance present, transitioned to Paramedics on alert but not on sight.
- ALL participants who can obtain a Class III medical have demonstrated the ability to safely endure centrifuge based physiologic training without special medical monitoring. Feedback has been very positive.
- Of the most recent 100 participants, only three could not obtain a Class III (2 vision, one for antidepressants) and these were reviewed and waived to allow participation with no untoward effects or problems.





# Advantages of using FAA AMEs and the Class III requirement

- Few people are disqualified
- Individuals with disqualifying conditions have clear process for further evaluation to seek waivers
- Operator has no cost, individual incurs cost for medical clearance
- Network of examiners is reliable, interested, and informed about commercial space flight
- Translates well to international clients



# FAA Safety Approval

- The NASTAR Center is the first Space Flight Training commercial organization in line to receive Safety Approval from the FAA. (Est. May 2010)
- “Custom & Standard” Training Programs available to Launch Providers which meet the requirements of FAR §414.11, which can be easily inserted into their space flight program.

# Space: Graduating Class



**October 3, 2007 - Buzz Aldrin, Anousheh Ansari and Greg Olsen Training  
Greg Olsen trained at NASTAR for Soyuz Flight TMA 7, which launched Oct.1,  
2005**

[www.NASTARcenter.com](http://www.NASTARcenter.com)

# Space: Graduating Class



**March 2006 - Malaysian Cosmonauts ( Dr. Sheikh Muszaphar Shukor – Soyuz TMA 11, launched 10 Oct.2007)Train for Flight on the ATFS-400**

# Space: Graduating Class

**NASTAR**  
C E N T E R



**October 2008 – Virgin Galactic Trainees**



# The World Leader in Training Technology

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