U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

ORDER 3150.1C

April 4, 2006

SUBJ: AVIATION PHYSIOLOGY TRAINING FOR FAA FLIGHT PERSONNEL

1. **PURPOSE.** This order prescribes an aviation physiology training program for FAA flight personnel to include course content, location of agency, military training facilities, and procedures for applying for such training.

2. **DISTRIBUTION.** This order is distributed to branch level in Washington, Regions, Aeronautical Center, and Technical Center; and limited distribution to all Flight Standards, Air Traffic, and International Aviation Field Offices.

3. **CANCELLATION.** Order 3150.1B is canceled.

4. **OBJECTIVE.** The objective of this order is to provide information, list training sources, define the program content, and provide administrative procedures to enable FAA aircrew personnel to learn the physiological effects of flight and how to compensate for the numerous body handicaps posed by the flight environment.

5. **TRAINING REQUIREMENTS.** Aviation physiological training requirements are as prescribed in Order 4040.9D, FAA Aircraft Management Program. Initial qualification in physiological training is met by attendance at a course as outlined in Appendix B.

6. **TRAINING PREREQUISITES.** Prerequisites for receiving aviation physiological training are:

   a. A valid first-, second-, or third-class medical certificate. An inquiry shall be made concerning the current state of health of each trainee prior to the altitude chamber exposure. Doubtful cases shall be referred to a physician for appropriate decision.

   b. Assignment to flight duties within FAA as prescribed by Order 4040.9D.

   c. FAA personnel seeking flights on military aircraft should contact the appropriate military organization for clearance requirements.

7. **APPLICATION FOR TRAINING.**

   a. The trainee or their representative must contact the Civil Aerospace Medical Institute, Aerospace Medical Education Division (AAM-400), to arrange the initial physiological training course.

b. FAA personnel who must attend the initial or refresher training must have their course manager contact AAM-400, to be placed into a physiological training course.

8. **EVIDENCE OF TRAINING.** Upon the trainees' successful completion of the course, the physiological training facility, listed in Appendix A, shall issue FAA Form 3150-1, Physiological Training, to the individual. For FAA aircrew who maintain a required training folder under Order 4040.9D, an AC Form 3150-4, Individual Physiological and Survival Training Record, will be issued to the individual for their personnel records and an official roster will be sent to AVN-20, Resource Management Staff, and AVN-203, Resource and Data Management Branch, following course completion.

9. **COURSE CONTENT.** See Appendix B.

10. **FORMS.** AC Form 3150-4 and FAA Form 3150-1, are stocked electronically in AAM-400.

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Federal Air Surgeon

APPENDIX A - U.S. GOVERNMENT PHYSIOLOGICAL TRAINING FACILITIES

- Civil Aerospace Medical Institute, Oklahoma City, OK
- Andrews AFB, MD
- Beale AFB, CA
- Columbia AFB, MS
- Fairchild AFB, WA
- Ft. Rucker, Army, AL
- Langley AFB, VA
- Laughlin AFB, TX
- Moody AFB, GA
- Peterson AFB, CO
- Randolph AFB, TX
- Tyndall AFB, FL

APPENDIX B - TOPIC OUTLINE FOR ACADEMIC TRAINING

This lesson plan is a guide only. It is expected that the composition of the class will determine whether the instructor chooses to cover the subject material in a different sequence and/or depth. It might also be appropriate to change the curriculum subjects on occasion. The idea is to teach a basic course of pertinent facts to assure that the pilot has the necessary aeromedical knowledge to perform safely during flight. (See Appendix C for Flight Profiles.)

1. Physics of the Atmosphere
   - Chemical Composition
   - Divisions (Physical and Physiological)
   - Concept of Atmospheric Pressure and Partial Pressure
   - Gas Laws

2. Respiration and Circulation
   - Basic Anatomy and Physiology of the Respiratory and Circulatory Systems
   - Exchange of Oxygen and Carbon Dioxide: Environment-Lungs-Tissues
   - Changes in the Composition of Alveolar Gas with Altitude

3. Trapped Gases
   - Anatomical Areas Affected
   - Correlation of Gas Law Physics
   - Predisposing and/or Contributing Factors
   - Signs and Symptoms
   - Prevention and Treatment

4. Hypoxia
   - Definition, Types, and Causes
   - Correlation of Gas Law Physics
   - Symptoms and Signs
   - Time of Effective Performance/Useful Consciousness
   - Predisposing and/or Contributing Factors
   - Use of Oxygen to Prevent Hypoxia
   - Pressure Breathing at High Altitude

5. Oxygen Equipment Use and Equipment Familiarization
   - Description of Systems and Equipment used in Civil Aviation
   - Emphasis on High Pressure, Continuous Flow, and Portable Kits
   - Checking of Oxygen Equipment and Emergency Drills

6. Cabin Pressurization
   - Physiological Requirements for Cabin Pressurization
   - Isobaric and Differential Pressurization Methods
   - Causes and Types (slow, rapid, explosive) of Cabin Decompressions
   - Symptoms and Signs Following a Cabin Decompression
   - Emergency Procedures Following a Cabin Decompression

7. Hyperventilation
   - Definition and Causes
   - Symptoms, Signs, and Performance Effects
   - Prevention and Treatment

8. Altitude-Induced Decompression Sickness
   - Definition, Types, and Causes
   - Predisposing and Contributing Factors
   - Symptoms and Signs
   - Prevention and Treatment

9. Spatial Orientation and Disorientation
   - Role of the Visual, Vestibular, Auditory, and Propioceptive Systems in Spatial Orientation
   - Definition, Types, and Causes of Spatial Disorientation During Flight
   - Preventive Measures and Treatment
   - Practical Demonstration of Somatogyral and Coriolis Illusions (Barany Chair, Vertigon, Gyro-1, etc.)

10. Principles and Problems of Vision
    - Anatomy and Physiology of Day and Night Vision
    - Factors Affecting Vision
    - Dark Adaptation
    - Visual Scanning Methods
    - Hazards to Vision in Flight
    - Use of Sunglasses

11. Thermal Stress
    - Principles of Thermal Transfer and Body Temperature Regulation
    - Sources of Heat and Cold Stress in Aviation
    - Symptoms, Signs, and Performance Effects of Heat and Cold Stress
    - Predisposing and Contributing Factors to Thermal Stress
    - Prevention and Treatment of Heat Illnesses, Cold Injury, and Hypothermia

12. Hearing, Noise, and Vibration
    - Anatomy and Physiology of the Ear
    - Definitions, Types, and Causes of Noise and Vibration
    - Symptoms, Signs, and Performance Effects of Noise and Vibration
    - Prevention and Treatment of Noise and Vibration Exposures

13. Air Sickness/Motion Sickness
    - Definition and Causes
    - Predisposing and Contributing Factors
    - Symptoms and Signs
    - Prevention (including adaptation) and Treatment

14. Operational Fatigue
    - Physiology of Sleep, Sleep Loss, Circadian Rhythms
    - Definition and Causes of Fatigue
    - Predisposing and Contributing Factors (individual, environmental, operational)
    - Symptoms, Signs, and Performance Effects
    - Prevention and Countermeasures

15. Acceleration Exposure
    - Definition and Types (including terminology)
    - Sources of Accelerative Forces in Civil Aviation (crop dusting, aerobatics, aerial fire-fighting, push-pull effect)
    - Symptoms, Signs, and Performance Effects
    - Predisposing and Contributing Factors
    - Countermeasures and Preventive Measures

16. Self-Imposed Stress
    - Illnesses and Diseases (acute and chronic)
    - Poor Physical Fitness
    - Inadequate Diet/Nutrition
    - Inadequate Hydration
    - Excessive Body Weight
    - Drugs, Alcohol, and Tobacco Use/Abuse
    - Use of Medications (non-prescription and prescription)
    - Excessive Caffeine Consumption
    - Carbon Monoxide Poisoning
    - Psychological Stress

17. Human Performance Issues
    - Decision Making Process
    - Perception and Attention
    - Cognitive Processing
    - Memory (types)
    - Response/Reaction
    - Human Error

18. FAA Altitude Chamber Training Profiles

    USAF Physiological Training Units may select either one of the two chamber flight profiles shown in figures 1 and 2

APPENDIX - C ALTITUDE CHAMBER TRAINING

The following are the Altitude Chamber Training Profiles proposed by the FAA for the practical demonstration of the effects of individual exposure to decreased barometric pressure. These profiles can certainly be modified at the discretion of USAF aerospace physiologists/chamber operators to include a pre-exposure denitrogenation period, and/or to accommodate for technical and operational differences (hardware and software) among USAF altitude chambers.

Profile 1: FAA Altitude Chamber Training

Pre-flight briefing (in the chamber) for familiarization of trainees with oxygen equipment, communications system, other instrumentation, and safety procedures. Initiate ear and sinus check ascent to 5,000 ft (MSL) at a rate not to exceed 3,000 ft/min. Descend to ground level not exceeding 3,000 ft/min. Following the ear and sinus check, begin ascent to 8,000 ft (MSL). At 8,000 ft (MSL), begin the maximum ascent rate that the pump will allow up to 25,000 ft (MSL) to simulate a rapid decompression. Discuss rapid decompression signs and symptoms. Assure that all students have donned their oxygen masks by 18,000 ft (MSL). Continue ascent to 25,000 ft (MSL) at 3,000 ft/min. During ascent discuss gas expansion and elaborate further on the prevention of oxygen mask leakage, periodic checks of oxygen regulator operation and connections, etc. Divide trainees into two groups for the hypoxia exercises with each group; allow the trainees to experience the full onset of hypoxia but try to prevent any student from progressing to the point of loss of useful consciousness. Employ devices to challenge the mental and physical dexterity processes. On completion of the hypoxia exercises, begin chamber descent to 18,000 ft (MSL) for visual acuity demonstration. After this demonstration, begin descent to ground level at a rate not to exceed 3,000 ft/min. Discuss the individual tolerance factors, symptom variances, performance impairments, and time versus altitude to relation to severity. Encourage students to participate in enumeration of hypoxia symptoms. Students experiencing problems shall be evaluated by a Flight Surgeon if necessary.

Profile 2 – Part 1: Oxygen Equipment Familiarization and Hypoxia Symptoms

Orientation of oxygen equipment, intercom and instrumentation configurations. Pre-flight check. Oxygen pre-breathing is optional. Begin ear check ascent. Students should be breathing 100% oxygen. Do not exceed 1,500 FPM on ear check descent. Following the ear check, trainees will begin ascent to 25,000 feet. Average rate of ascent should not exceed 3,500 FPM. During ascent, discuss gas expansion and elaborate further on the elimination of oxygen mask leakage, periodic checks of oxygen regulator operation and connections, etc. Divide trainees into two groups for the hypoxia exercise. Level at 25,000 feet. Perform the hypoxia exercises on each group allowing the trainees to experience the full onset of hypoxia, but try to prevent any student from progressing to the point of unconsciousness. Employ devices to challenge the mental and physical dexterity processes. Upon completion of the hypoxia exercises, begin chamber descent. Average rate of descent should not exceed 3,000 FPM. Discuss the individual tolerance factors, symptom variances, performance

inabilities, time versus altitude in relation to severity, etc. Encourage students to participate in enumeration of hypoxia symptoms. Descent to ground level.

Profile 2 – Part 2: Rapid Decompression

Ascend chamber compartment to the predetermined altitude at which, when lock compartment is decompressed, the students will not level below 20,000 feet or higher than 25,000 feet. The rate of ascent should be controlled to prevent the students from ascending to level-off altitude faster than that performed on the Air Force Decompression Profile. Students should have their oxygen equipment in the standby position. Lock compartment should be ascended to 8,000 feet and the decompression performed without an obvious pre-signal to the students. The students will be expected to recognize the onset of the decompression and don their oxygen masks and check their oxygen equipment. Assistance will be given if necessary. During descent, discuss importance of pre-flight check, recognition of physical phenomena associated with decompression – rate of ascent versus cabin volume – possibility of excitement and hyperventilation, cure for hyperventilation.

Rate of descent should not exceed an average of 3,000 FPM. Personnel should experience pressure breathing by activating the emergency lever or pressure control knob as soon as possible after starting descent. After finishing the pressure breathing exercise, students should place the diluter control lever in the "normal oxygen" position.

Question all chamber participants regarding any physical discomforts. Make a negative remark on the sign-in cards or flight sheet. If affirmative, make a remark concerning their post-chamber treatment and condition when permitted to leave.

APPENDIX -D PHYSIOLOGICAL TRAINING COURSE RECURRENT TRAINING

TOPIC OUTLINE

This course given at the Aeronautical Center

Duration: 4 hours

1. Content – Classroom – 3 hours
   a. Hypoxia
   b. Self-imposed stress
   c. Decompression
   d. Oxygen Systems and Equipment
   e. Decompression Sickness

2. Altitude Simulator Flight – 1 hour
   a. Pre-flight Equipment
   b. Ear Clearance Pretest
      Descent from 10,000 feet to 2,000 feet at 1,500 FPM
   c. Rapid Decompression
      Ascent from 8,000 feet to 18,000 feet in 10 seconds
   d. Hypoxia
      Mask removed at 25,000 feet
   e. Pressure Breathing
      Trainees experience a mild pressure breathing effect at 25,000 feet
   f. Descent to ground level