BEST PRACTICES IN HIGH-ALTITUDE OPERATIONS
CIVIL AIR PATROL
Spring 2009

1. Flight Training – use available on-line, classroom, textbook resources
   - Knowledge of effects of density altitude on aircraft and crew
     - Aircraft: Takeoff, climb, slow flight, approach and landing, weight/balance
     - Crew: Hypoxia, hyperventilation, trapped gas in ear/sinus
   - USAF high altitude chamber: CAP members can receive free training on hypoxia
   - Weather at high altitudes: mountain wave, icing, thunderstorms
   - Take a mountain flying course to integrate all aspects of high altitude flying
     - Classroom environment: Comprehensive, allows for questions and dialog.
     - On-line: Convenient, can be taken multiple times, makes excellent refresher course

2. Human Factors
   - Stages of hypoxia: Some crewmembers may experience mild hypoxia as low as 10,000 ft.
     - Indifferent, <10,000 ft.; decrease in night vision
     - Compensatory, 10-15,000 ft.; drowsiness, poor judgment, impaired coordination
     - Disturbance, 15-20,000 ft.; impaired flight control, memory, intellectual function
     - Critical, 20-25,000 ft., circulatory, central nervous system failure, convulsions
   - Prevention/treatment of hypoxia:
     - Use supplemental O_2 or descend below 10,000 ft.
     - Watch for symptoms when flying above 10,000 ft.
   - Hyperventilation symptoms: Caused by excessive loss of CO_2
     - Dizziness, muscle spasms, visual impairment (similar to hypoxia!)
   - Treatment of hyperventilation
     - Control breathing (12 to 16 breaths/min.), talk or sing, breath into sick sack
   - Trapped gas disorders
     - Respiratory infections; increasing pressure during descent blocks Eustachian tube
     - Infection, allergies swell mucous membrane of sinus, blocking pressure equalization
   - Treatment for trapped gas disorders
     - Avoid flying with a cold or suffering from congestion
     - Avoid rapid climbs to high altitude
     - Swallowing, yawning
     - Valsalva maneuver: Close mouth, pinch nose shut, and blow sharply
   - Stress and fatigue
     - Stress, emotion, and diet influence an individual's susceptibility to hypoxia
     - Fatigue symptoms: Inattention, poor judgment, slowed reaction time

3. Flight Planning
   - Weather: Winds aloft, turbulence, clouds, freezing level, mountain obscuration,
   - Aircraft performance: Weight, density altitude
   - Route:
     - Routes in mountainous terrain are defined by passes
     - Refer to maps to plan cross-country legs; GPS "direct" can cross inhospitable terrain

- Oxygen
  - Be sure bottle is filled and masks/cannulas are available.
  - Know how to use oxygen equipment
- In mountainous terrain, consult with local experts on routes, airfields, etc.
- Make and use a flight log as a aid for navigation by dead reckoning and pilotage.
  - Note: Pilotage landmarks should correspond with absolute altitude and ground speed
- Caution shall be used when using the "Direct" flight planning mode on the GPS, it can take directly to a mountain, use your charts for situational awareness

4. Weather
   - Winds have greater velocity at high altitudes. Ground speed can be half of true airspeed
   - Careful consideration of fuel and ETE
   - Have an alternate route if weather is a factor
   - Mountain waves can occur downwind from mountain ranges
   - Turbulence
     - In mountains, winds greater than 30 knots can cause moderate turbulence
     - Go or no-go based upon operational risk management
     - In turbulence use rough air airspeed ($1.7 \times V_{S1}$)
     - In moderate or severe turbulence, fly a level pitch attitude
     - Fly out of downdrafts; you cannot out climb them
   - Clouds
     - Clearance by 1000 ft above and below, 1 mi. lateral
     - Do not fly above extended undercast unless equipped for IFR and current
     - In mountains, visibility should exceed 10 miles

5. Aircraft Performance
   - Aircraft weight affects takeoff and climb performance
   - If feasible, keep aircraft weight no greater than 90% of maximum takeoff weight

6. Routes
   - Fly higher than the surrounding peaks when traversing mountain passes
   - Cross ridges at a 45° or greater angle
   - In mountains, use routes that follow lower-elevation, inhabited terrain
   - Fly on downwind side of valleys to allow turns towards lower terrain
   - In mountains, communications and VOR navigation is limited by terrain
   - On cross-country flights over lower terrain, use ATC flight following or file IFR
   - Night VFR flights should use FAA airways and the recommended MOCA or MEA on the charts for your minimum en-route altitude.
   - One way or blind canyons should be flown downhill, unless completely familiar with the terrain
   - Extreme caution shall be used when flying below any canyon rim, extreme wind turbulence up/downdrafts may be encountered and electric transmission power lines may cross canyons below the rim

- Extreme caution shall be used when flying on the leeward side of a ridge line, at or below the ridge line, when the forecasted or actual wind exceeds 30 knots at the ridge line

7. Descents
   - Plan ahead to know when to start descent
   - At 120 knots, multiply altitude loss (in thousands of feet) by 4 to obtain distance

8. Use of Supplemental Oxygen
   - Follow FAR 91.211, even if pilot doesn't "feel" hypoxic
   - If symptoms of hypoxia are detected, use supplemental O_2 regardless of altitude
   - If night vision is critical, use supplemental O_2 above 5,000 ft.

8. Mixture Control
   - Taking off at high altitude airports:
     - Lean to peak rpm for taxi to avoid fouling sparkplugs
     - Non-turbocharged engines must be leaned for smooth operation above 5,000 ft. DA
     - Above 8,500 ft., mixture can be set to 100-125° above rich during full power run-up
     - Operate turbocharged engines at full rich (or designated fuel flow) during takeoff
   - In flight, lean using EGT or TIT
     - When density altitude exceeds 8,500 feet, non-turbocharged engines produce < 75% power
       - 65-75% power: Set mixture to 100° rich of peak
       - <65% power: Set mixture to 25-50° rich of peak
   - Approach and landing at high-elevation airports
     - Set mixture for cruise at traffic pattern altitude (~100° rich of peak)
     - If case of go-around, first go to full power, then enrichen mixture as necessary

9. High-elevation Airports
   - Know takeoff and landing performance numbers before flying to high-elevation airports
   - Fly stabilized approach at proper <u>indicated</u> airspeed (expect a higher ground speed)
   - A go-around shows good judgment when an approach is not stabilized and on glide-path
   - On takeoff, rotate using airspeed indicator at proper indicated airspeed; do not rotate early
   - After takeoff, pitch attitude will be less than at low elevations
   - On departure, avoid flying towards rising terrain

APPENDIX

MOUNTAIN FLYING GROUND SCHOOLS AND CLINICS

Note: Rocky Mountain Region and Colorado Wing CAP generally offer mountain flying clinics each summer. Contact the RMR DO for additional information.

In-Person Instruction:
Colorado Pilots Association http://www.coloradopilots.org/
McCall Mountain Flying http://www.mountaincanyonflying.com/

On-line Instruction:
AOPA mountain flying course http://flash.aopa.org/asf/mountainFlying/html/flash.cfm

Books:
Mountain Flying Bible http://www.mountainflying.com/products/mfbr_info.html
Mountain Fury http://www.cap-ny413.org/Seniors/Aircrew/CAP%20Mountain%20Fury.pdf
Power Pt http://www.cawg.cap.gov/html/Pubs/other.htm
Contact Pete Kalisky pkalisky@capnhq.gov for more information
Mountain Flying http://www.flightguide.com/books.html

Safety Quizzes:
Hypoxia http://www.aopa.org/asf/asfquiz/quizzes.cfm?SA=Quizzes&QuizId=57