



Airborne Photographer

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Agenda

- Introduction
- Instructor & students
- Prerequisites
- A very brief history
- Imaging basics
- Familiarization & preparatory training
- Advanced training
- Exercise participation
- Conclusion



A beginning...

- There is nothing hard about *beginning* to take pictures. If you keep your outfit *simple* and try to go *one* step at a time, you will have a bully time.

C. H. Claudy
The Camera
September 1916

Introduction

- This course prepares you to serve as an Airborne Photographer
- Obtaining AP qualification requires
 - Completion of prerequisites
 - Commander approval
 - Successful evaluation on all SQTR tasks
 - Successful completion of two missions
 - Actual or training

Instructor

- Lt Col William Martin
- Commander, Catskill Mountain Group
- Asst Director of IT, NYW
- ES Quals / Evaluator
 - MO, MS, AP
 - IC₃, OSC, PSC, AOBD, LO, MSA
 - UDF
- 40+ years still/mopic/video photography, incl. advertising, news, sports, event, PA, airborne

Students

- Show of hands to indicate you have
 - Actual mission aircrew experience
 - Actual airborne photography experience
 - More than basic photography skills
 - Experience with DSLR camera systems
 - More than basic computer skills
 - ES Quals: AP, MO, MP, AOBD, PSC, OSC, IC

 - *Used to assess experience level – not prerequisites*

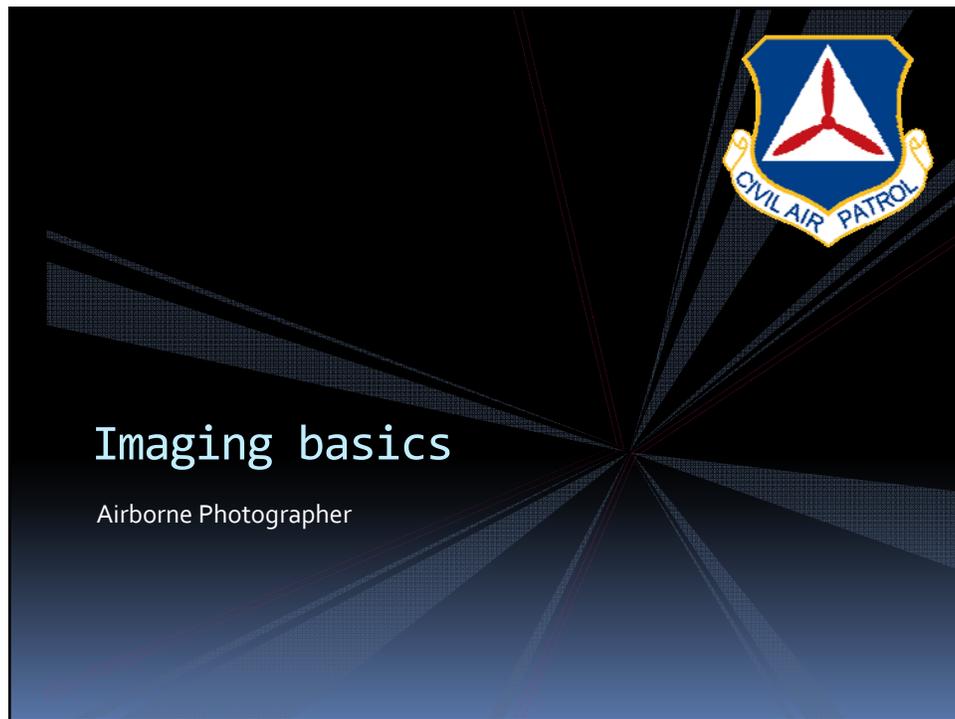
Prerequisites

- Mission Scanner
 - General Emergency Services
 - 18+ years old
- Commander Approval



Airborne Photographer

- Role defined in 2010 to support emergence of new mission – aerial imaging
- Qualification initially offered at NESAs
- Available nationally with rollout of AP SQTR
 - Provides training guidance for basic skills
 - Updated in 2011 by ADRS team
- No explicit standard for image delivery
 - Various tools & methods adopted across CAP
 - FEMA Uploader now used for many CAP missions



Imaging basics

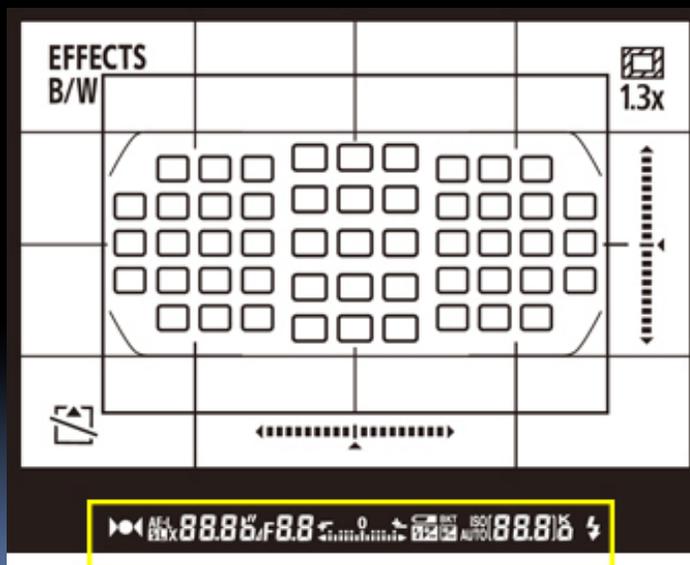
- Camera
- Lens
- Exposure
- ISO
- Shutter speed
- Aperture
- Depth of field
- Composition

Camera

- Viewfinder
- Displays
- Controls
- Shutter
- Battery
- Memory cards
- Lens mount



Viewfinder



Displays



- Displays on top and back of camera show shutter speed, aperture, shooting mode, capture format, space remaining, camera settings, and to view captured images

Controls



- Various controls exist to adjust shooting mode, shutter speed, lens aperture, release the shutter, power on/off, and more

Shutter

- Nikon DSLRs use a mechanical shutter like traditional film cameras
- Two sets of metal blades are used to open, then close the light path from the lens to the image sensor
- Time the shutter remains open is adjusted by the main command dial when you set the shutter speed

Battery

- Nikon DSLRs use a battery in an internal compartment, and can use supplemental batteries in a removable battery pack



Memory cards

- One or more memory cards placed in the camera provide storage for digital images
- The viewfinder and camera top display show number of images remaining
- Maximum number of images is determined by memory card capacity, number of cards available in camera, and capture format



Lens mount

- Provides physical and electronic interface between camera and Nikon F mount lenses



Lens

- Lens mount
- Optical glass
- Filter
- Lens hood & cap
- Controls
 - Focus
 - Auto / Manual
 - Aperture
 - Stabilization



Lens focal length

- Distance between lens and focal plane
- Measure of lens magnifying power
- Normal lens approximates view of human eye
- Normal is diagonal of image sensor
- FX $36 \times 24 = 43.27\text{mm}$ / rounded to 50mm
- DX $22.7 \times 15.1 = 27.3\text{mm}$ / rounded to 28mm
- FOV is inverse of focal length

ΤΑ ΟΠΤΙΚΑ

Field of view

- What is visible to an imaging system
- aka Angle of view
- Human FOV = H 180+ x V 135 degrees
- FOV varies with sensor size, focal length
 - $FOV = 2 \arctan (\text{sensor size} / 2F)$

Equipment reference

- Manufacturer user manuals provide detailed info on all facets of equipment operation
- *Read them!*
- Most available in PDF
- Visit AP web site
nyw.cap.gov/ap



Exposure

- Exposure is controlled by adjusting
 - ISO
 - Shutter speed
 - Aperture
- Learn how different settings affect the image
- Lighting outdoors is beyond your control, but is influenced by time of day, camera direction
- Planning is essential for good results

ISO

- International Org for Standardization
- Scale for film and image sensor sensitivity
 - Higher number: Greater sensitivity to light
 - Linear scale: ISO100 = 1/2 as sensitive as 200
 - D7100 offers ISO100-6400; up to 25600 HI mode
- Determines available shutter speed, aperture
- HI mode settings produce noisy images
- ISO1000 suitable for most missions



Shutter speed

- Expressed as fraction of second, e.g. 1/1000
- Shown on camera as integer, e.g. 1000
- Linear scale: 1/64 is twice as long as 1/125
- Lower shutter speed: Longer exposure
- Higher shutter speed: Shorter exposure
 - Sharper image, requires more light
 - 1/1000 optimal for most missions
- $1/(\text{focal length} \times 1.5)$ for minimum speed with given lens on DX format camera

Shutter release

- Button, typically on top of camera
- Half-press activates light meter, and focusing system if using AF mode
- Full press releases, or opens, the shutter
 - Shutter is in ready status prior to being released
- Modern shutters use vertical travel, metal bladed design
- Older cameras used horizontally travelling cloth shutters

Aperture

- Opening through which light passes
- f/stop is measure of aperture size
 - Ratio of lens focal length to aperture diameter
 - Larger number: Smaller opening

focal length mm	85												
f/stop	1.2	1.4	2	2.8	4	5.6	8	11	16	22	32	45	64
aperture mm	71	61	43	30	21	15	11	7.7	5.3	3.9	2.7	1.9	1.3
aperture in.	2.8	2.4	1.7	1.2	0.8	0.6	0.4	0.3	0.2	0.15	0.10	0.07	0.05

Aperture

- Each full stop change reduces light by half
 - 1.2, 1.4, 2, 2.8, 4, 5.6, 6.3, 8, 11, 16, 22, 32, 45, 64
- Examples show f/2.8 and f/16 apertures, with f/2.8 allowing 64 times more light to pass



Aperture

- Fast lenses, those with wide max aperture, are larger, heavier, and more expensive than slower counterparts
- Most CAP zoom telephoto lenses have max aperture between $f/3.5$ and $f/6.3$
- One of the fastest lenses ever produced was $3.259 \text{ in.}/83\text{mm } f/0.384$ for USAF aerial recon
 - *Lens diameter was 14.4 inches*

Depth of field



Depth of field

- Area, from near to far, that is in focus
- Affected by aperture, focal length, sensor size, and camera to object distance
 - Greater DOF produced by smaller aperture
 - Shallower DOF produced by longer focal length, larger image sensor, closer distance to subject
- Distribution from focal plane
 - Varies from approx. 33/66 near/far to 50-/50+
 - Approaches 1:1 as focal length, distance, f/stop number decrease

Composition



Composition

- Rule of thirds for traditional photography, but...for CAP imaging
 - Center object of interest within frame
 - Do not include extraneous objects, e.g. wing, strut, landing gear, door, glare shield
 - Do not deliver images to customer with these items visible in frame



Familiarization & preparatory

Airborne Photographer

F&P

- CAP/AFNORTH guidelines
- Image requirements
- Digital camera features
- Camera settings
- Keep equipment mission ready
- Image composition
- Sortie planning & safety
- Transfer/view images on computer
- Image processing software

CAP/AFNORTH guidelines

- Images are property of AF or other customer
- CAP MAJCOM insignia on CAP mission images
- Military format date : 25FEB17
- 24H format time on target: 1530Z
- City, State where target is photographed
- LAT/LON in minutes decimal: DDD MM.M
- North arrow
- Name/description of target
- *Task O-2214*

Image requirements

- Systems no longer used to process images
 - CAP Image Processing Program
 - WMIRS
 - ARGUS
- Variety of systems exist nationally in CAP
- NYW currently using
 - RoboGEO – delivery via Internet or physical media
 - FEMA Uploader – direct upload to gov site
- *Task O-2206*

Digital camera features

- Zoom lens – optical vs digital
- Viewfinder & diopter correction
- LCD screen
- Erasing images / Formatting memory card
- Memory card corruption
- Images formats
- Lossless vs. Lossy compression
- *Task P-2201*

Camera settings

- ISO
- Shutter speed, aperture
- Exposure lock
- Exposure modes
- Image capture buffer
- Resolution, quality
- Histogram
- *Task P-2202*

Keep equipment mission ready

- Remove batteries and charge after mission
- Store batteries separately once fully charged
- Replace cap on lens
- Wipe equipment with soft cloth
- Clean lens with blower brush
 - Use lens tissue & fluid only when lens is dirty
- Place equipment into proper storage cases
 - Ensure all camera kit items are properly placed inside storage case

Keep equipment mission ready

- Store equipment in secure, locked area
...*away* from
 - Temperature extremes
 - Strong magnetic fields
 - Moisture
- Keep silica gel / desiccant with equipment
- Perform periodic computer software updates
- Check equipment monthly to ensure function
- *Task P-2203*

Image composition

- Know what the customer wants
- Use a target control list
- Place the target in center of image
- Frame image so target fills viewfinder
- Use zoom if needed to concentrate on target
- Don't include aircraft parts in images
- *Task O-2204*

Sortie planning

- Know what the customer wants
- Prepare target control list
- Discuss sortie objectives, route with MP
- AP directs route, provides steering cues
 - *Review on ground using map before take off!*
- Third crewmember, if avail, keeps photo log
- *Task O-2215*

Sortie safety

- *Safety first!*
- Keep strap around neck
- Store loose items away from open windows or camera ports – *keep unneeded items in bag*
- Tell MP before adjusting seat or body position
- Take breaks as needed to avoid motion sickness or fatigue
- Relax by periodically looking away from camera, and at distant objects outside aircraft
- *Task O-2215*

Transfer images

- Create folders on image processing PC:
 - Missions – all missions stored in one place
 - Mission – sub-folder for mission, e.g. 17-T-1234
 - Sortie – sub-folder for each sortie, e.g. A0014
 - G – copies of selected sortie images to be processed, and uploaded / copied to CD/DVD/USB

- Images in last folder are processed, geotagged, labelled, and sent to customer

Transfer images

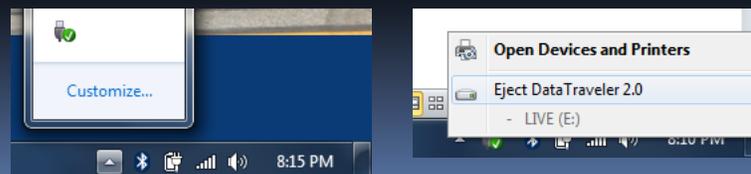
- Two methods to transfer images to PC
 - Insert memory card into card reader
 - Tether camera to PC using cable
- Card reader method is typically faster, and doesn't require camera to be present
 - Can drop off memory card, insert spare into camera, and immediately deploy on next sortie
 - Copy GPS track log before leaving for next sortie, unless data embedded in image EXIF header

Transfer GPS data

- GPS data must be copied to sortie folder
- Copy separate track log if using standalone GPS logger, e.g. AMOD, eTrex
- GPS data already embedded in image if using compatible camera and on-camera sensor, e.g. Nikon GP-1, Solmeta
 - *Nothing extra needs to be copied!*

Disconnect camera/card

- Your camera or memory card will display as a separate disk drive on most PCs
- Eject drive properly using green icon in system tray – right-click icon for eject menu
- Eject *after* copying files, *before* disconnecting camera or removing memory card



View images

- Images initially copied to sortie folder
- Select images from sortie to be geotagged
 - Copy these images to G sub-folder
- Working on subset of images speeds process
- Sortie typically produces more images than customer needs
 - *Exception:* FEMA route survey missions, where ALL images are usually uploaded
- *Task O-2205*

Image processing software

- If sortie flown for FEMA, send images using FEMA Uploader web app
- Otherwise, use RoboGEO program to geotag & label images
 - Images may be sent via Internet, e.g. to ftp site, or copied to removable media for delivery
 - No CAP national web or ftp site exists for external [non-FEMA] customer access
 - Select delivery method as part of mission planning



Exercise & evaluation
Airborne Photographer

The slide features a dark blue background with a radial pattern of lines emanating from the center. The Civil Air Patrol logo is positioned in the upper right corner. The main title 'Exercise & evaluation' is centered in a large, white, sans-serif font, with the subtitle 'Airborne Photographer' centered below it in a smaller, white, sans-serif font.



Advanced training
Airborne Photographer

The slide features a dark blue background with a radial pattern of lines emanating from the center. The Civil Air Patrol logo is positioned in the upper right corner. The main title 'Advanced training' is centered in a large, white, sans-serif font, with the subtitle 'Airborne Photographer' centered below it in a smaller, white, sans-serif font.

Advanced training

- Imaging patterns
- Crew communications
- Target control list
- Factors affecting success
- Sortie preparation
- Planning worksheet
- Aircrew briefing
- Sortie rehearsal

Advanced training

- Synchronize camera time
- Start GPS logging
- Conduct sortie
- Image post-processing
- Image delivery
- Sortie debrief
- Critique effectiveness

Imaging patterns

- Planning is essential to AP sortie success
- Know what customer wants
- Discuss targets, desired camera angles, with MP – work together to plan route
- Your exit from one target should sequence to lineup for next target
- Select flight patterns to cover targets in a logical order, as easily and quickly as possible
- Create target control list, use to direct flight

Imaging patterns

- Many missions, especially TRAEX, request image capture from four cardinal points
 - North, South, East, West
- Some missions may require flying a specific pattern, similar to SAR search patterns
 - FEMA may request this type of sortie, with image capture at specific intervals
 - All images from this sortie are typically uploaded
- *Task P-2208*

Crew communications

- AP or MO will direct route of flight, providing steering cues or direction to MP
- When on target, AP provides specific directions to fine tune course, e.g.
 - Aircraft to target offset distance
 - Speed over ground
 - Altitude – will typically be 1,000 AGL
 - Repeat route to retake missed/bad photos
- *Task P-2208*

Target control list

- List of targets to be photographed
- Should include
 - Target description
 - Location LAT/LON
 - Desired camera angles
 - Aircraft steering cues or route info
- TCL Excel spreadsheet and web apps available on AP web site
- *Task O-2216*

Factors affecting success

- Turbulence, wind, vibration
- Haze, clouds, smoke
- Daylight, time of day, shadows
- Camera settings
 - ISO, shutter speed, aperture, focal length, focus
- *Task P-2209*

Sortie preparation

- From AP Task Guide
 - *Normally the mission staff will have obtained all the information the aircrew needs and has prepared a thorough briefing.*
- Often you will receive only basic information
- *Request more details if needed*
- Plan target coverage and route with MP, then review with IC or AOBD if unsure

Sortie preparation

- TRAEX instructions will likely request images from four cardinal points of several targets
- Specific detail regarding targets and desired image characteristics will vary
- Typical TRAEX request is 5-10 images
- Actual missions should provide greater detail regarding targets and any special requests
- *Request additional info if details not provided*
- *Task O-2210*

Planning worksheet

- In addition to target control list, you may want to bring additional planning documents
 - Map, atlas, or tablet with mapping software
 - Printed Google Map / Earth images of target area
 - Briefing notes from mission staff or customer
 - CAPF₁₀₄ for mission objectives, comms, check-in, and other info

Practice sortie

- Execute the following on a practice sortie
 - Task O-2217 Aircrew briefing
 - Task O-2217 Sortie rehearsal
 - Task O-2218 Synchronize camera time
 - Task O-2218 Start GPS logging
 - Task O-2211 Conduct sortie
 - Task O-2212 Image post-processing
 - Task O-2213 Image delivery
 - Task O-2219 Sortie debrief
 - Task O-2211 Critique effectiveness



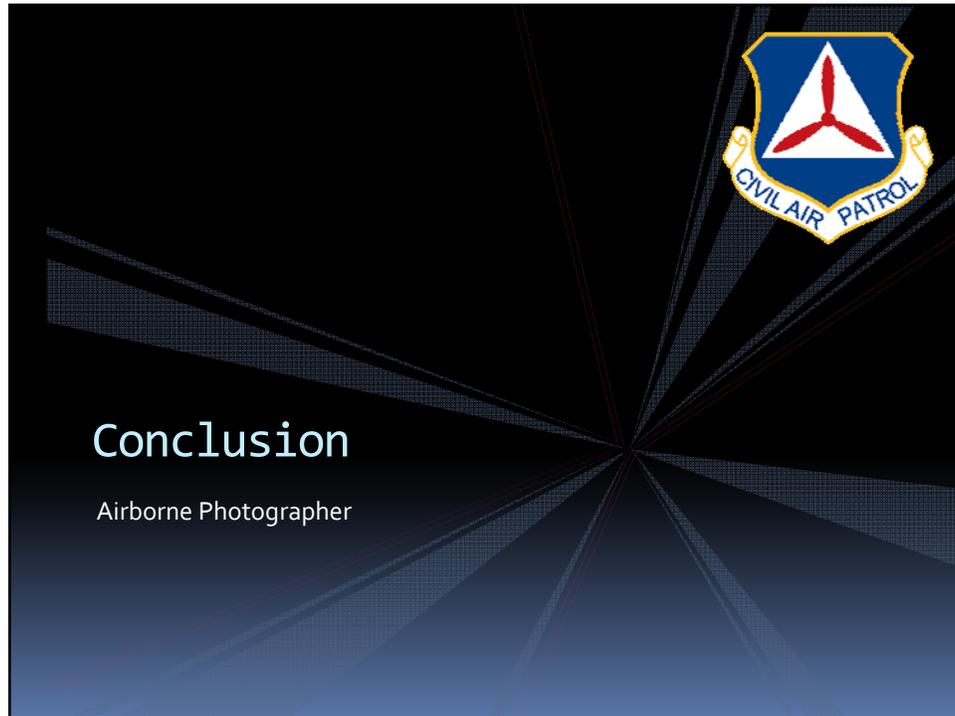
Exercise & evaluation

Airborne Photographer



Exercise participation

- Participation in two exercises required
- Must be in supervised trainee status
- Must have updated 101 card
- Qual must appear on 101 card: *AP
- Qualified evaluator must supervise & sign off
- Submit SQTR in Ops Quals with evaluator & mission info
- Keep paper SQTR as backup



Airborne Photographer

- A new qualification is a license to learn
- Practice often to keep current
 - Camera equipment
 - Photographic technique
 - Sortie planning
 - GPS logger
 - Computer equipment
 - Image transfer, management & post-processing

Recommended reading

- Airborne Photographer Task Guide
- Mission Aircrew Reference Text vol. III – AP
- Equipment checklists
- Camera user manuals
- General books on photography



Questions?

Airborne Photographer



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Depth of field

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- Understanding the Factors that Affect Depth of Field

Stefan Surmabojov, 25 Jun 2011

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Aperture

- Table of f/stops at various maximum apertures for 100mm lens

Own work, derived from formula for calculating f/stop: $f/stop = F / aperture$

- Diagram giving a large (f/2.8) and a small (f/16) aperture in the camera lens

Derived from image on Wikimedia Commons

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- Example of very fast aerial reconnaissance lens

Developed by American Optical Co., A.O. Fecker Division, 15 SEP 1967

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