

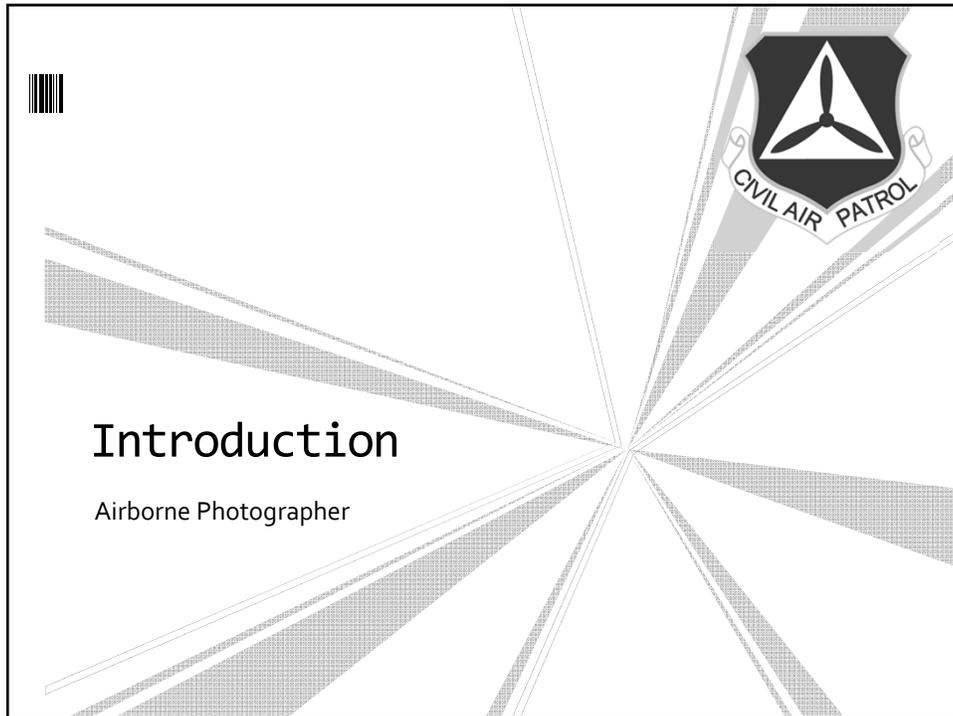


# Airborne Photographer

Lt Col William Martin  
Commander, Catskill Mountain Group, NYW  
AP Course Director, NERESA

## 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
  - IC<sub>3</sub>, 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*

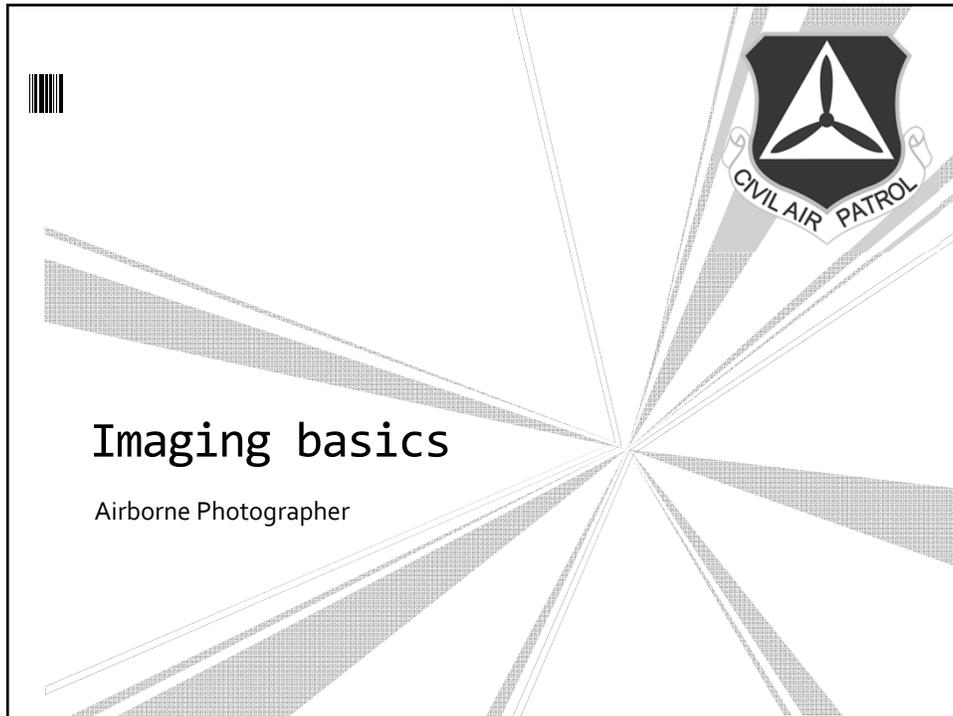
## Prerequisites

- 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

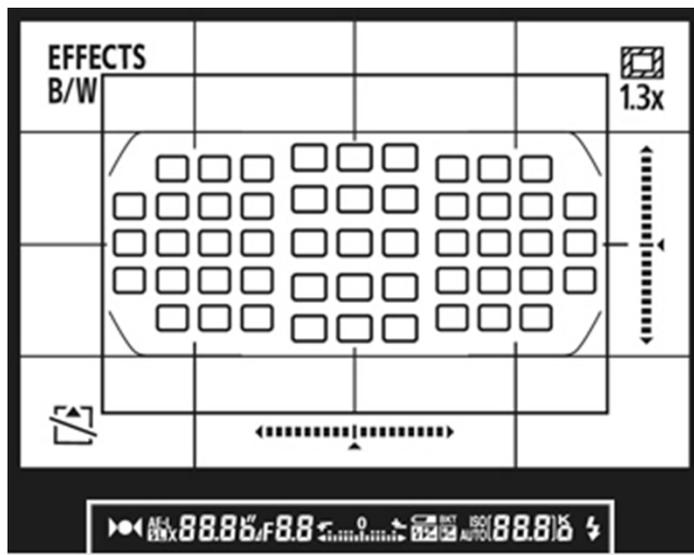
- Camera
- Lens
- Exposure
- ISO
- Shutter speed
- Aperture
- Depth of field
- Composition

## Camera

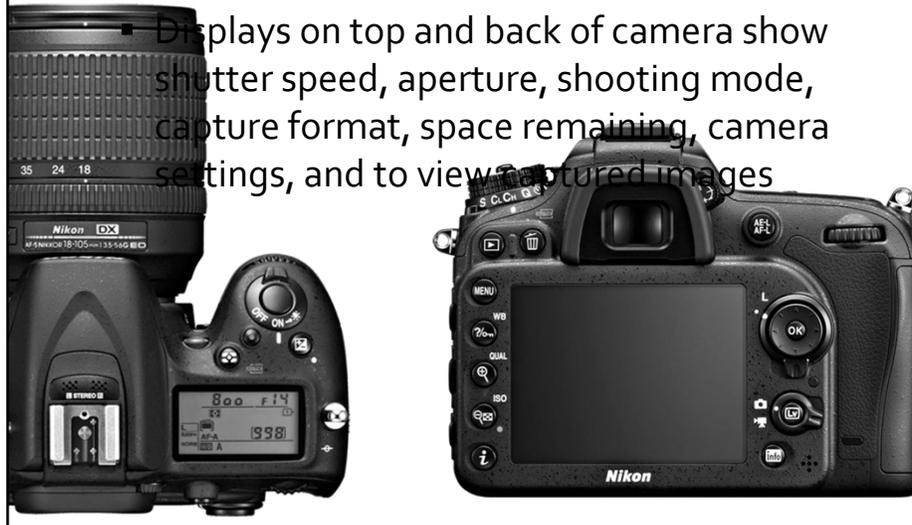
- Viewfinder
- Displays
- Controls
- Shutter
- Battery
- Memory cards
- Lens mount



## Viewfinder



## Displays



## Controls



## 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



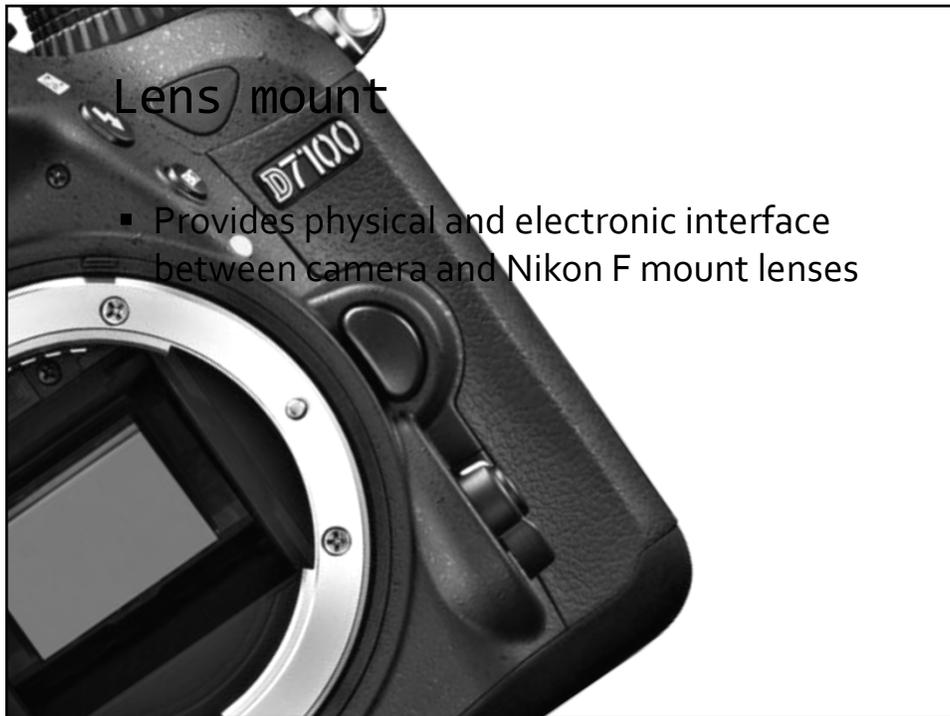
## Memory cards

- 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](http://nyw.cap.gov/ap)



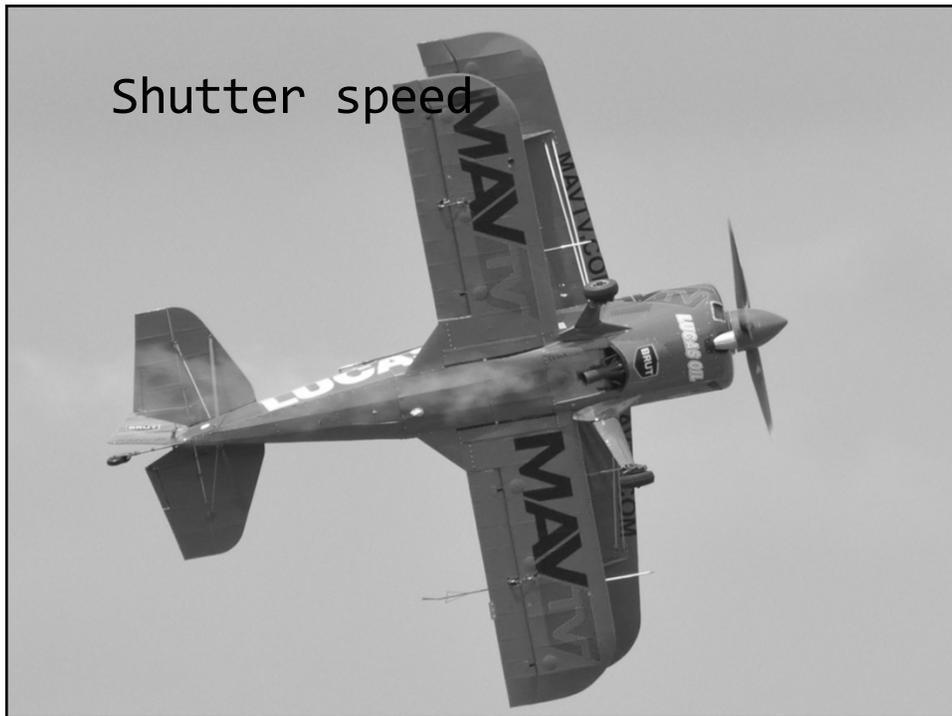
## Exposure

- 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



## 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													
<b>f/stop</b>	<b>1.2</b>	<b>1.4</b>	<b>2</b>	<b>2.8</b>	<b>4</b>	<b>5.6</b>	<b>8</b>	<b>11</b>	<b>16</b>	<b>22</b>	<b>32</b>	<b>45</b>	<b>64</b>	
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 in./83mm  $f/0.384$  for USAF aerial recon
  - *Lens diameter was 14.4 inches*

## Depth of field



## Depth of field

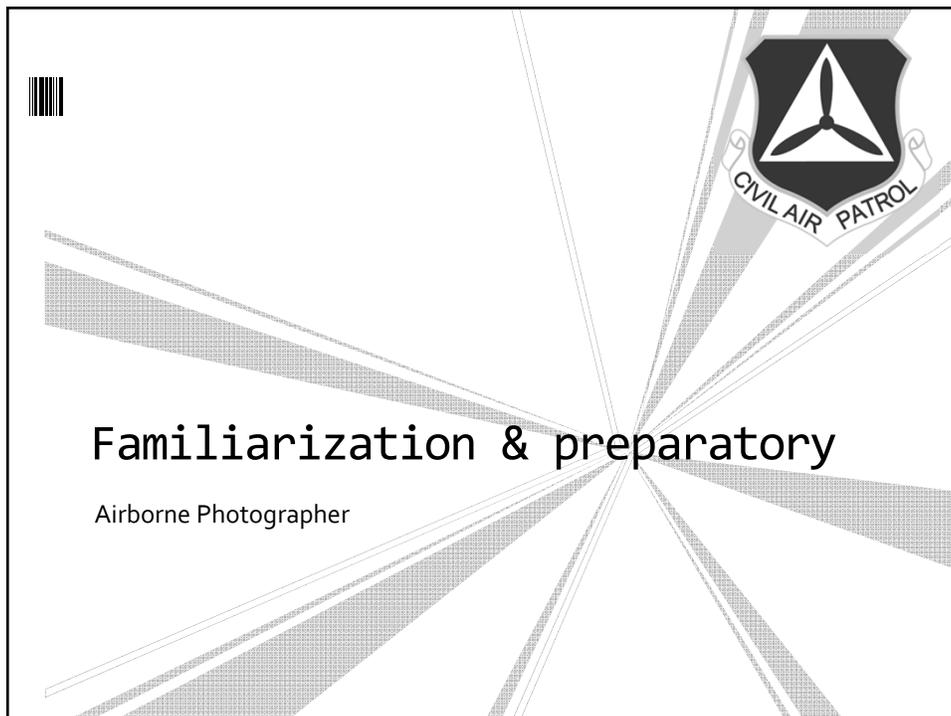
- Area, from near to far, that is in focus
- Affected by aperture, focal length, sensor size, and camera to object distance
  - Greater DOF produced by smaller aperture
  - Shallower DOF produced by longer focal length, larger image sensor, closer distance to subject
- Distribution from focal plane
  - 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



## 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

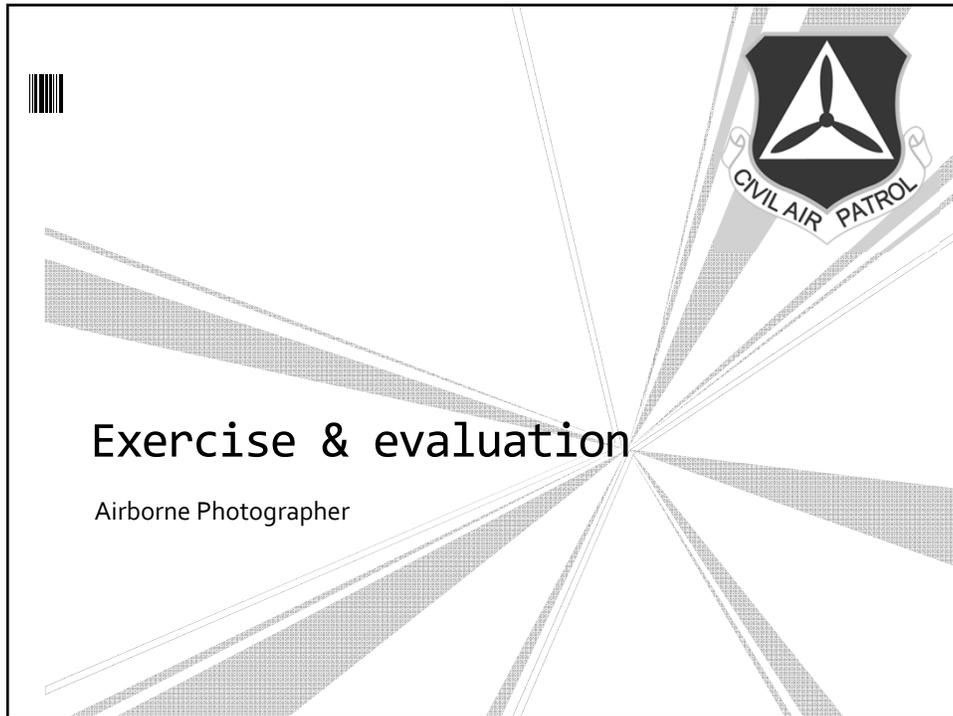


## View images

- 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



## 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

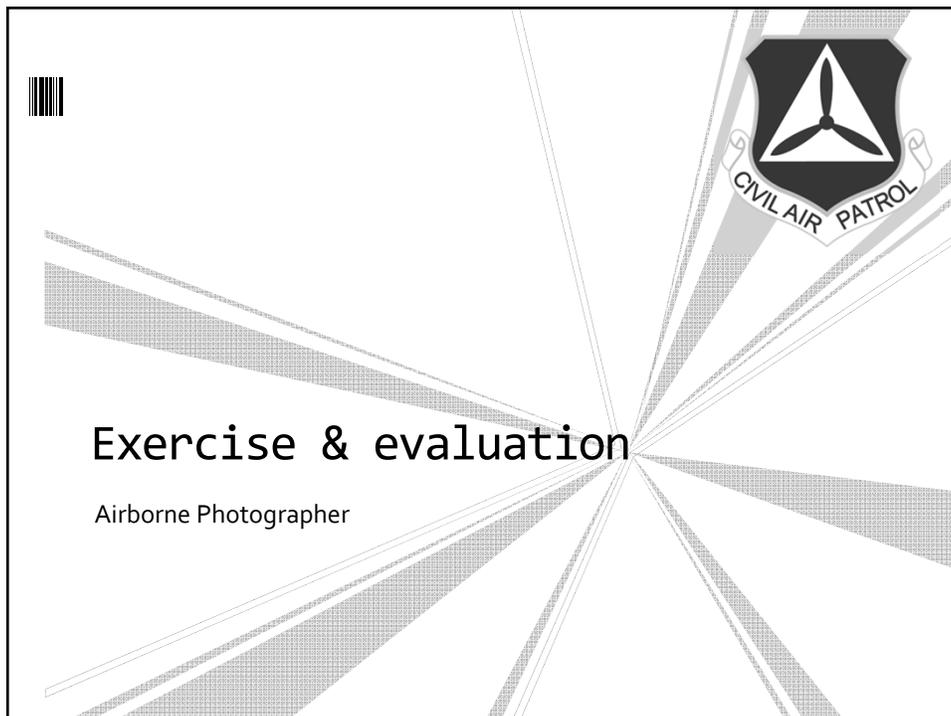
- TRAEX instructions will likely request images from four cardinal points of several targets
- Specific detail regarding targets and desired image characteristics will vary
- Typical TRAEX request is 5-10 images
- Actual missions should provide greater detail regarding targets and any special requests
- *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
  - CAPF<sub>104</sub> for mission objectives, comms, check-in, and other info

## Practice sortie

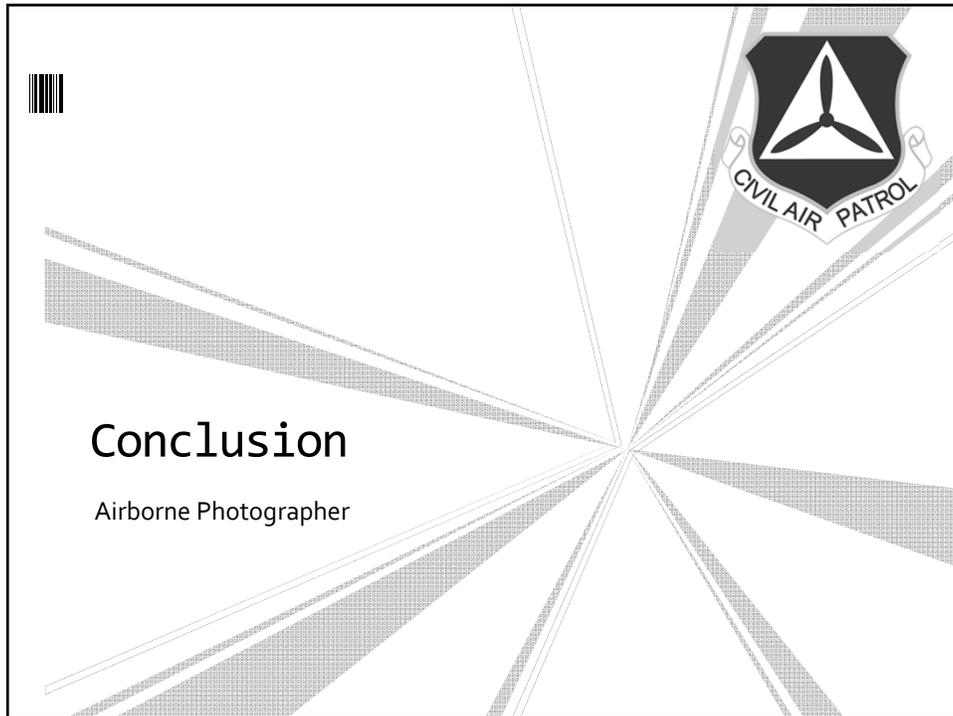
- Execute the following on a practice sortie
  - Task O-2217 Aircrew briefing
  - Task O-2217 Sortie rehearsal
  - Task O-2218 Synchronize camera time
  - Task O-2218 Start GPS logging
  - Task O-2211 Conduct sortie
  - Task O-2212 Image post-processing
  - Task O-2213 Image delivery
  - Task O-2219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





## Exercise 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





## Bibliography

### Images and reference material used in the Airborne Photographer presentation

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William Martin, Maj CAP, 2015

All Nikon product images except those noted below  
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Quote on slide 4: A beginning...  
C. H. Claudy, September 1916  
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- Examples of normal focal lengths for FX and DX format image sensors  
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[play.google.com/store/books/details?id=eCkAAAAAMAAJ](https://play.google.com/store/books/details?id=eCkAAAAAMAAJ)

- Illustration of how to calculate angle of view  
Neil Wayne Northey  
The Angle View of Your Lens, p. 477  
The Camera - Vol. 20, No. 9  
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#### Depth of field

- A Tedious Explanation of Depth of Field

Matthew Cole, 05 APR 2016

[www.uscoles.com/depthoffield.html](http://www.uscoles.com/depthoffield.html)

- Understanding the Factors that Affect Depth of Field

Stefan Surmabojov, 25 Jun 2011

[photography.tutsplus.com/articles/understanding-the-factors-that-affect-depth-of-field--photo-6844](http://photography.tutsplus.com/articles/understanding-the-factors-that-affect-depth-of-field--photo-6844)

#### 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

Mohylek, 17 AUG 2006

Zielona Góra, Poland

[upload.wikimedia.org/wikipedia/commons/d/d7/Apertures.jpg](http://upload.wikimedia.org/wikipedia/commons/d/d7/Apertures.jpg)

- Example of very fast aerial reconnaissance lens

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

[archive.org/stream/USAF\\_lens\\_datasheets/01-Section-1#page/n24/mode/1up](http://archive.org/stream/USAF_lens_datasheets/01-Section-1#page/n24/mode/1up)