

CIVIL AIR PATROL
U.S. Air Force Auxiliary

Mission Aircrew
Reference Text



Volume III
Airborne Photographer

Revision December 2017

This text is designed to provide the minimum academic knowledge required by the Civil Air Patrol (CAP) Airborne Photographer. and supplemental training for qualified SAR/DR Mission Pilots that concentrates on the unique aspects of aerial photography or video missions. This text, instructor guides, PowerPoint presentations and examinations have (and continue to be) tested at the CAP National Emergency Services Academy Mission Aircrew School (NESA MAS).

The importance of safety is emphasized throughout the text. Lessons stressed in this text will enable aircrew members to operate in a safe and efficient manner, thus reducing accidents and incidents.

Airborne Photographer

The Airborne Photographer (AP) serves as a member of a Civil Air Patrol (CAP) flight crew and is tasked with taking airborne photographs and/or video of specified targets in such a way that completely meet or exceed our customer's objectives and needs.

SAR/DR Mission Pilot

In addition to the normal duties and responsibilities of a SAR/DR Mission Pilot (MP), the MP plans and flies aerial photo or video sorties. The MP works closely with the Airborne Photographer to ensure the success of each imaging sortie. NOTE: Mission Pilots who don't wish to qualify as an Airborne Photographer are encouraged to fly some sorties as an AP trainee to better appreciate the needs of the AP and improve communications between the crewmembers.

Third Crewmember

A third crewmember is preferred to act as a log keeper and assist the crew in other related tasks. Any qualified Mission Pilot, Observer or Scanner can be trained to perform these duties.



Operating the *Aerial Digital Imaging System* (ADIS; was SDIS) is covered in a separate course and associated Task Guides. However, the skills and knowledge needed to take the photos that are transmitted by ADIS are covered in this text.

Operating the *Geospatial Information Interoperability Exploitation-Portable* system (GIIEP) is covered in a separate course and associated Task Guides. However, the skills and knowledge needed to take the photos that are transmitted by GIIEP are covered in this text.

The *ARCHER* system is operated by a small number of specially trained personnel, and is controlled by National HQ. Therefore it is not covered in this text. If you are interested in this system, refer to CAP's ARCHER TRAC training courses and the *Hyperspectral Imaging Operations Manual*.

Ownership of Photos and Video

If you are taking photos or video on a training mission (i.e., not for delivery to a specific customer), the pictures are the property of CAP. If you want to post them or use them outside the training mission, please contact your IC and get approval for the specific use of the photos

If you are taking photos or video for a customer (including CAP) the photos are the property of the customer. They may not be used for *any* reason (including training) without the expressed written consent of the customer. Contact your IC to get permission for the specific use, and don't be surprised that the customer may not want you to disseminate or use the photos or video for other purposes.

NOTE: Do not allow crew members to take photos on their personal cameras or cell phones unless they understand that their photos are not for personal use and will become the property of the customer.

Organization and Guidance

As a reference text this document contains more material than is needed to qualify. Each chapter has a list of objectives to assist students, school directors, project leaders and instructors. In addition, AP Tasks are linked to the objectives that support them. For example, Objective 1 of Chapter 1 discusses optical and digital zoom, and which to use on CAP imaging missions. Following the Objective is {P-2201}, which means this is an Airborne Photographer task. The remainders of the objectives are designed to provide supporting and/or more detailed information to aid in your training.

Microsoft PowerPoint slide presentations act as complementary information to the text and associated Task Guides. Although developed and organized for instructors, the slides contain many examples of photos that are not found in the text and should be viewed by students studying the text or task guides.

This is a mission-specific text. Refer to *MART Volume I, Mission Scanner* and *Volume II, Mission Observer/SAR-DR Mission Pilot* reference texts for the academic knowledge and operational tasks required by the CAP Mission Scanner, Mission Observer, and SAR/DR Mission Pilot specialty ratings. Task Guides and other aircrew training and reference material are available electronically on the SWR ES Education and Training webpage (est.swrcap.com/).

This text and supporting material was developed by Lt Col Richard Simerson with input and assistance from several valuable sources: Maj Eric Templeton and staff of the NESAS MAS and several Texas Wing members, particularly Col Brooks Cima, Lt Col Don Fisher, and Lt Col Jack Jackson. If you have any comments or suggestions or wish to provide extra information or photos, please e-mail rsim@suddenlink.net.

NOTE: This text contains links to web sites, and web addresses often change. If selecting the link does not take you to the desired site, either try copying and pasting the url: into your browser's address bar or search for the particular site or document with your favorite search engine.

Task Guides

Airborne Photographer (AP) tasks: [Must be a qualified Mission Scanner to begin]

- P-2201 Discuss Digital Camera Features
- P-2202 Select Camera Settings
- P-2203 Keep Camera and Accessories and GPS System Mission Ready
- P-2208 Describe Imaging Patterns and Communications
- P-2209 Discuss Factors Affecting the Success of Imaging Sorties
- O-2204 Discuss Consideration Variables to Image Composition and Compose an Image
- O-2205 Transfer Images to and View Images on a Computer
- O-2206 Discuss CAP Image/Graphic Requirements and Image Processing Software *
- O-2207 Prepare an Image with CAP Graphics utilizing Image Processing Software *
- O-2210 Prepare for an Imaging Sortie – Complete Mission Planning Worksheet
- O-2211 Conduct an Imaging Sortie – Critique Your Effectiveness
- O-2212 Post-process Airborne Images with Image Processing Software with CAP Logo and Positional Information or Upload Images and GPS Track to Repository *
- O-2213 Send Images to the Customer
- O-2214 Discuss CAP/AFNORTH Guidelines and/or Restrictions on Photography Work *
- O-2215 Discuss Imaging Sortie Mission Planning and Identify Safety Issues related to Airborne Imaging
- O-2216 Describe Target Control List
- O-2217 Conduct Imaging Sortie Rehearsal and Aircrew Briefing
- O-2218 Synchronize Camera Clock and GPS Time – Verify Start of Tracking
- O-2219 Conduct an Imaging Sortie Debrief

* Note: O-2206, O-2207, O-2212 & O-2214 are deleted, but still signed off in the SQTR

The following MP tasks should be studied and practiced by *SAR/DR Mission Pilots*:

- P-2203 Keep Camera and Accessories and GPS System Mission Ready
- P-2208 Describe Imaging Patterns and Communications
- P-2209 Discuss Factors Affecting the Success of Imaging Sorties
- O-2210 Prepare for an Imaging Sortie
- O-2211 Conduct an Imaging Sortie

The following tasks should be studied and practiced by the *third crewmember*:

- P-2203 Keep Camera and Accessories and GPS System Mission Ready
- P-2208 Describe Imaging Patterns and Communications
- P-2209 Discuss Factors Affecting the Success of Imaging Sorties
- O-2210 Prepare for an Imaging Sortie
- O-2211 Conduct an Imaging Sortie

References

1. The following CAP Regulations (CAPR):
 - a. 70-1, *CAP Flight Management*
 - b. 60-3, *CAP Emergency Services Training and Operational Missions*
 - c. 62-1, *CAP Safety Responsibilities and Procedures*
 - d. 62-2, *Mishap Reporting and Investigation*
2. Adobe Photoshop & Photoshop Elements User Guides (adobe.com)
3. ArcSoft PhotoStudio (www.arcsoft.com/en-us/index.asp)
4. Ben Long, *Complete Digital Photography* (4th Edition, Charles River Media)
5. Canon Optura 20 Instruction Manual (www.usa.canon.com)
6. Canon PowerShot SD500 Instruction Manual (www.usa.canon.com)
7. COSports.com Lat/Lon Coordinate Converter (boulter.com/gps/)
8. iTouchMap.com Find the Lat/Lon of a Point/Address (itouchmap.com/latlong.html)
9. Dave Johnson, *How to Do Everything with Your Digital Camera* (McGraw-Hill/Osborne, 2003)
10. Digicamhelp (digicamhelp.com)
11. Digital Camera Resource Page (dcresource.com)
12. Digital Photography Review (<http://www.dpreview.com/>) including Vincent Bockeaert at <http://123di.com>
13. AIM Studios, Allen H. Moore (Virginia Wing, CAP)
14. dpMagic (dpmagic.com)
15. FileZilla (<https://filezilla-project.org/>)
16. GIMP (gimp.org)
17. Globalscape CuteFTP (globalscape.com/products/ftp_clients.aspx)
18. Google Docs/Google Drive (google.com)
19. Google Earth (google.com/earth)
20. Google Picasa (picasa.google.com)
21. GeoSetter (geosetter.de/en/)
22. Jeffrey's Exif Viewer (regex.info/exif.cgi)
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24. Infanview (irfanview.com)
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30. Nikon D90 Checklist and Operations V1.3 (NHQ)
31. Nikon D7100 User's Manual
32. Nikon ViewNX 2 (was *Picture Project*) (nikonusa.com)
33. Paint.net (getpaint.net)
34. Wikipedia (en.wikipedia.org)
35. SugarSync (sugarsync.com)
36. Dropbox (dropbox.com)
37. OneDrive (onedrive.live.com/about/en-us/)
37. LaWg *Instructions for Aerial Photography Sorties/Missions*
39. CAP *Web Mission Information Reporting System* (WMIRS)
40. SWR ES Education and Training webpage (est.swrcap.com/).

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Summary of Changes

Following are the significant changes and updates in the December 2017 revision. Some of the more significant changes are **highlighted**.

1. Updated to latest CAPR 70-1
2. Revised Chapter 10 to reflect the newest FEMA Image Uploader program and the removal of the photo upload function in WMIRS (*still in progress?*)

1. Digital Cameras

Airborne Photographers have to know the camera and how to use it, so they can concentrate on planning, framing and taking aerial photos that will meet mission objectives. When you are flying is not the time to be learning how to use the camera.

There are several types of Digital Single Lens Reflex (DSLR) cameras currently being used by CAP, such as the Nikon D90, D100 and D200. NHQ has begun shipping the Nikon 7100, which uses the same telephoto lens as the D200. [This text primarily uses the Nikon D200 as an example, but does include equipment included with the D7100 kit.](#)

Note: CAP NHQ will send camera package kits to Wings for use during emergencies.

OBJECTIVES:

1. Discuss the difference between optical and digital zoom, and which to use on CAP imaging missions. {P-2201}

Demonstrate operation of the optical zoom. {P-2201}

2. Discuss the limitations of optical viewfinders, and describe the purpose of the diopter correction. {P-2201}

Using the optical viewfinder, take a picture of a table or desk. Frame the picture so the bottom edge of the table or desk is just at the bottom of your view through the viewfinder. Then compare what you saw through the viewfinder versus what you see in the LCD screen or on a monitor, noting how much space below the bottom edge of the desk or share (that you didn't see in the viewfinder) was captured by the camera. {P-2201}

3. Discuss the limitations of using an electronic viewfinder or the LCD screen during aerial imaging.

Demonstrate how to turn the screen on and off, take a picture and display it on the camera's LCD screen, then view the photo in varying degrees of brightness (shadow to full sunlight). {P-2201}

4. Discuss telephoto lens controls, zoom creep, setup and operation.
5. Discuss the purpose of formatting a media card and when this should be done. Format a media card in the camera. {P-2201}
6. Describe actions to avoid so that you won't accidentally corrupt a memory card.

Demonstrate the proper way to remove and insert a media card into a camera and a media card reader. {P-2201}
7. Describe the advantages and disadvantages of the JPEG and RAW file formats. {P-2201}

** Throughout this text, each objective is followed by the AP Task to which the objective applies*

Use of Member-Owned (Personal) Cameras

1st AF requires that only CAP cameras be used on actual missions. CAP NHQ will ship D90 kits the affected wing overnight so they can accomplish an Air Force Assigned Mission (AFAM). If more cameras are needed, they will be sent from other locations in the affected wing or from other wings.

However, personal cameras can be used on non-AFAM sorties in order to practice basic skills such as proper framing and composition, learning effective communications with the pilot to set up and execute imaging patterns, and transferring photos to and browsing photos on a computer. With prior approval, you can practice with your own camera on AFAM training missions.

More Information

Each CAP camera's User Guide is available for download on the Nikon website (www.nikonusa.com/) Service and Support section. Also, for an in-depth discussion of the features and performance of your camera go to *Digital Photography Review* (<http://www.dpreview.com/>).

1.1 Digital Cameras

"Pixel" stands for picture element. A single pixel is the basic building block of a digital image. A photograph composed of more pixels will have more detail than one made from fewer pixels. Digital camera capture levels are rated by megapixel (one megapixel equals one million pixels). For example, the Nikon D200 is a 10.2-megapixel camera, when set to the highest pixel resolution (more on this later).

Pixels (or megapixels) alone do not define a camera's picture quality. Quality is also determined by type of lens, zoom, shutter speed, and shooting modes. These are covered later in the text.

1.1.1 Optical Zoom and Lens Properties

There are two types of lenses - prime and zoom. Prime lenses have a fixed focal length and zoom lenses have variable focal lengths. CAP cameras use zoom lenses because of their versatility.

CAP cameras, such as the Nikon D200, are Digital Single Lens Reflex (DSLR) cameras that can be fitted with many types of lenses. The term Single Lens Reflex designates a type of camera which incorporates a viewing system where the subject is seen through the lens. The subject's photo is reflected on a mirror which passes through a prism that can be seen in the viewfinder. In fixed lens cameras, subjects are seen through a viewfinder that is near the lens, which makes the photographer's view different from the lens' view.

Digital cameras (as well as digital camcorders) offer two types of zoom - optical and digital. We make good use of optical zoom and we try to forget we ever heard about digital zoom.

- Optical zoom means that the actual glass lens of the camera zooms through a range that goes from a wide angle view of the scene in front of the camera to a narrower (telephoto) view that makes a distant target look bigger.

A zoom lens provides tremendous flexibility during framing; this will be discussed later.

- Digital zoom means that the camera's electronics provide an even larger photo that can be captured optically; this is done by interpolating the photo captured by the optical lens. Digital zoom simply crops a center part of the captured photo; other slightly more sophisticated digital zoom implementations take this same center crop and then interpolate it back up to the camera's full (native) resolution. Because of this function, the camera's viewfinder cannot accurately depict a subject that is digitally zoomed; you must use the LCD to preview the target.

On most cameras, digital zoom is activated when you hold the zoom switch all the way to the maximum zoom, release the switch, and then move it in the zoom direction again and hold it. While there may be times when digital zoom is necessary to get a photo of a distant object, the truth is that it does not create as good an image as can be recorded optically.

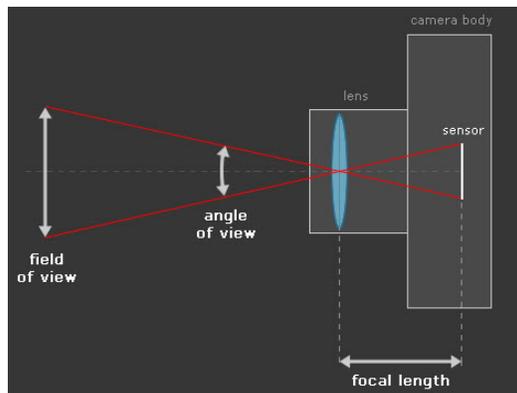
Don't use digital zoom! Turn it off (if your camera has a setting for this), or be careful not to activate it when you zoom.

1.1.2 Focal Length, Angle of View, and Field of View

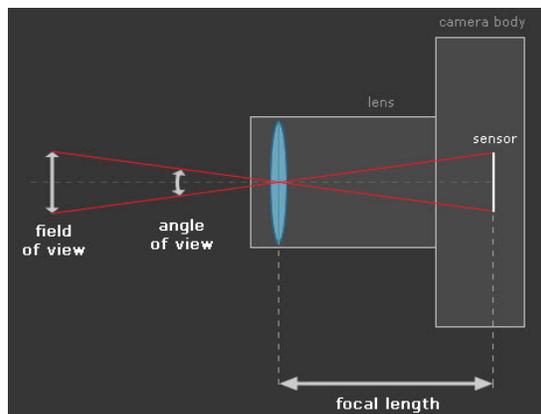
Focal length, usually represented in millimeters (mm), is the basic description of a photographic lens. It is not a measurement of the actual length of a lens, but a calculation of an optical distance from the point where light rays converge in the camera lens to form a sharp image of an object, to the digital sensor at the focal plane in the camera.

The focal length tells us the **angle of view** (how much of the subject area that is projected onto the camera sensor by the lens.) and the magnification (how large individual elements will be). **Field of view** is another way of representing the angle of view, but expressed as a measurement of the subject area, rather than an angle. Simply put, it's what you see when you look through the viewfinder (accounting for the fact that the camera captures more; see "Viewfinders" below).

A shorter focal length gives a wider angle (and field) of view:



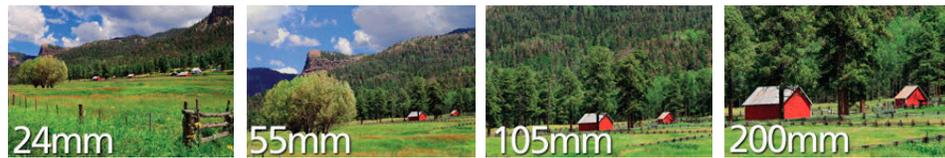
A longer focal length produces a narrower angle (and field) of view:



Focal length is one of the most important components of an aerial camera. Some of the tasks we receive from partner agencies (e.g., FEMA) require us to select a focal length that results in a specific field of view (e.g., 3,000 ft²). [Note: For reference, a section of land is one mile square (27,880,000 ft²), and a football field including the end zones is 420 ft. in length by 160 ft. wide (67,200 ft²)]

CAP normally uses a telephoto lens, which gives us greater (and easier) control of focal length. One type of lens used on the Nikon D200 and D90 is the Sigma DC 18-200mm; 18-200mm indicates focal lengths between 18mm (wide angle) and 200mm (telephoto). Telephoto (zoom) lenses also offer great flexibility in terms of framing and camera position.

The human eye has a field of view of 50°-55°; so a 55mm lens is considered “normal;” a 28mm lens is considered wide angle and 200mm is considered long telephoto. When you zoom in on a subject you are increasing the focal length of the lens, thus producing more magnification and a narrower field of view (as a comparison, a 200mm lens corresponds roughly to binoculars with 11x magnification). Below are photos taken by a 35mm camera using four different camera lenses, all shot from the same distance from the trees:



Anything shorter than about a 50mm lens on a digital DSLR will include the plane's wing struts or landing gear in the photo (which will also affect autofocus). Long lenses work very well, but lenses longer than 200 mm are tough to use since their slower speeds tend to require longer shutter speeds, and the longer focal length dictates even shorter shutter speeds.

For aerial photography, it is impossible to hold the camera steady enough to use very long focal lengths. Telephoto is mainly used to improve camera framing without changing altitude, and you know you have zoomed too much when you see the image shaking in the viewfinder.

1.1.3 Viewfinders

A. Optical Viewfinder

A camera's optical viewfinder is normally positioned above the actual lens, and there is also a horizontal offset. So what you see through the optical viewfinder is different from what the camera's lens projects onto its sensor. This "parallax error" is most obvious at relatively small subject distances. DSLR cameras have no parallax error, and exact focus can be confirmed by eye.

Most optical viewfinders only allow you to see a percentage (80 to 95%) of what the sensor will capture. Additionally, the viewfinder normally shows a lower percentage (e.g., 85%) of the final image area at telephoto range (this percentage increases to 89 - 95% at wide angle settings). So *don't be surprised if an aircraft's wheel, strut or wingtip shows up in your picture, even when you didn't see it in the viewfinder while you were framing the shot.* With practice you can anticipate this effect when framing your shot. [The Nikon D7100 viewfinder shows 100%, so what you see (or don't see, such as the strut or wingtip) is what the sensor captures.]

B. LCD Screen Instead of a Viewfinder

Cameras with optical viewfinders are essential for airborne photography. Many cameras let you use (and some only have) the LCD screen to frame a shot. However, most LCD screens are small, difficult to use in an airplane and hard to view in bright sunlight. Additionally, using the LCD screen all the time can quickly deplete your batteries. For these reasons, it is highly preferable to use a viewfinder during CAP missions.

C. Electronic Viewfinder (EVF)

An electronic viewfinder is a viewfinder where the image captured by the lens is projected electronically onto a miniature display. They essentially give you a second LCD that's shielded from bright light, uses less battery power, and offers a through-the-lens view of your whole image frame that shows both exposure and focus changes. EVFs in digital still cameras are very similar to those in video cameras.

Electronic viewfinders have some advantages over optical viewfinders, such as the ability to show 100% coverage of the final image; this removes the chance of an aircraft wheel, strut or wingtip showing up in your photo. They also allow you to display (overlay) information about the scene, such as a histogram, directly on the EVF display. Finally, shooting video with an EVF is as close to a camcorder experience as you'll get with a still-image camera.

However, *with EVFs there can be a noticeable lag between the changes in the scene and what you see on the EVF display.* And, when you depress the shutter, the image is "frozen" on the EVF just as it is on the LCD screen; this makes shooting several photos in quick succession more difficult, as you have to halfway depress the shutter button in order to "refresh" the photo in your EVF (this can be accomplished with a little practice).

D. Diopter Correction

If you're among those with less than perfect vision, being able to frame your shot using the color LCD instead of looking through the small optical viewfinder may seem best. But in aerial photography, you will use the viewfinder more often than not because of the difficulties unique to the cockpit of a small airplane. And when you use the viewfinder you may not be able to see the full frame if you have to put your glasses on to look through it.

Diopter correction is a feature that allows you to focus the image in the optical viewfinder, usually by means of a knob, slider, or dial located next to the viewfinder. This feature is normally only found on larger cameras, like the D200.

Part of mission preparation includes setting up the camera, and this includes setting the diopter correction. Look at something within shooting range, raise the camera's viewfinder to your eye, and adjust the diopter until the scene is sharp. For the D200, press the shutter-release button halfway and adjust the diopter until the focus brackets are in sharp focus.

1.2 Zoom (telephoto) Lenses

Most CAP DSLRs have a multipurpose zoom lens made by the Sigma Corporation, primarily 18-200mm. The Nikon D90 and D7100 come with a newer version that has an advanced optical stabilization feature. However, basic operation is similar for all zoom lenses.



The figure above shows the lens full extended (zoomed), and illustrates the focus ring and the distance scale. Note the infinity symbol on the focus ring, a setting often used in aerial photography.

The figures below illustrate the control switches associated with the lens.



The lens Lock is located below the zoom ring and to the left of the focal length scale; other switches include an Autofocus/Manual (AF/M) selector switch and an Optically Stabilizer (OS) On/Off switch.

The lens lock, also called the zoom lock, will prevent the lens from extending when not in use (i.e., it locks the lens in the 18mm position). The AF/M switch turns the autofocus on or off (i.e., off allows manual focus). The OS switch turns the lens image stabilizer on or off.

Zoom creep is the effect gravity has on a zoom lens; the lens tends to slowly zoom in or out under its own weight if pointed straight up, straight down, or at a sharp angle (most of the creep occurs between 30-130mm in the zoom range). This is normal and the zoom action can't be tightened to eliminate creep. The zoom lock will prevent damage to the lens when you are just carrying it around or adjusting the camera settings. However, zoom creep can be a problem when you are taking photos with the camera. As you point the camera downward the lens may try to creep outward, and this changes your focal length and can interfere with your focus. [A simple method of preventing this is to use a wide rubber band to help hold the lens in place after you set the desired focal length.](#)



Zoom creep usually increases on older, heavily used cameras.

Operation of the lens is integral to operation of the camera, and is discussed in Chapter 2 and throughout the text. However, a few basic operations are worth emphasizing.

Setup

- Check the position of the lens Lock. It is best to keep the lens locked when it is stowed in the camera bag or when you are handling the camera but not taking photos.
- If you are going to use autofocus, you must move the Focus Mode Selector switch out of the Manual (M) position. This switch must be in either the Single- (S) or Continuous-Servo (C) autofocus positions; newer CAP cameras (right) have a single Autofocus (AF) position.



- Check that the lens Optical Stabilizer (OS) switch is in the 'On' position (Vibration Reduction – VR – on older lenses).

Operation

- The focus ring is automatically adjusted by the camera as you zoom in and out. However, you may need to manually turn it to the "Infinite" position for certain types of photos, such as when you are manually operating the zoom and set a specific focal length for photos to be taken in quick succession (covered later).
- Limit operation to the 18-135mm range for the great majority of sorties; it is difficult to hold a steady image beyond this range, even when using OS. *You can tell you've zoomed too much when the image in your viewfinder starts to shake.*
- If you are taking photos and notice that the camera is no longer auto-focusing, check to see that you haven't inadvertently switched AF off or moved the Focus Mode Selector switch to Manual (M).

1.3 Batteries

Most digital cameras tend to consume a lot of power. This means that you need to use high-performance batteries and that you'll probably want to buy a set of rechargeable batteries that fit your camera and the portable GPS (usually 'AA' batteries) that attaches to the camera, if applicable.

Some cameras come with custom-designed rechargeable Lithium Ion battery packs in the box. If this is the case, there's no decision of which brand and type of batteries to buy; get an extra battery pack from the manufacturer and keep it charged as a spare (usually included in CAP camera kits).

Older-style batteries (particularly Nickel Cadmium - NiCad) had what is termed the memory effect: if you ran a rechargeable battery down only halfway before recharging, the battery would eventually give you only half as much battery life. This required users to drain them completely before recharging. This is no longer an issue with the new Lithium Ion and NiMH batteries, so after the second recharging you can top them off anytime (such as just before a mission).

Even the newer rechargeable batteries can only be expected to last about three years (five at most). Once they are spent, you should dispose of them properly (or recycle in the case of lithium ion batteries).

If battery charge becomes an issue during a sortie, remember that the two biggest drains on the batteries are the camera's LCD screen and the flash (not applicable to CAP missions). *Turning off the LCD screen will extend battery life during a sortie.*

Cold temperatures will shorten battery life. Lithium Ion batteries (not the rechargeable types) often function much better in cold weather than do NiMH or alkaline batteries.

Refer to the battery section in the "Between Missions" chapter for battery care.

1.4 Media Cards

Digital cameras use a variety of flash memory cards to store their photos, the most common being Secure Digital (SD) and Compact Flash (CF; Type I).

Media cards are great for storing photos or video. They don't need electrical power to hold data and they should hold data for about 100 years without deterioration.

The type of memory card you use is dictated by which digital camera you buy. These physically different cards are not interchangeable. Regardless of the media, the tables below give an approximate number of photos that a particular card will hold, depending on the resolution of the camera.

For storing JPEG photos (100% quality):

Megapixels	File size (MB)	1GB	2GB	4GB	8GB	16GB	32GB
4MP	1.2	715	1430	2861	5722	11444	22888
5MP	1.5	572	1144	2288	4577	9155	18310
6MP	1.8	476	953	1907	3814	7629	15258
7MP	2.1	408	817	1634	3269	6539	13078
8MP	2.4	357	715	1430	2861	5722	11444
10MP	3.0	286	572	1144	2288	4577	9155
12MP	3.6	238	476	953	1907	3814	7629
14MP	4.2	204	408	817	1634	3269	6539
16MP	4.8	178	357	715	1430	2861	5722
22MP	6.6	130	260	520	1040	2080	4161

For storing RAW photos:

Megapixels	File size (MB)	1GB	2GB	4GB	8GB	16GB	32GB
4MP	12.0	71	143	286	572	1144	2288
5MP	15.0	57	114	228	457	915	1831
6MP	18.0	47	95	190	381	762	1525
7MP	21.0	40	81	163	326	653	1307
8MP	24.0	35	71	143	286	572	1144
10MP	30.0	28	57	114	228	457	915
12MP	36.0	23	47	95	190	381	762
14MP	42.0	20	40	81	163	326	653
16MP	48.0	17	35	71	143	286	572
22MP	66.0	13	26	52	104	208	416

For CAP mission purposes, you should have two memory cards for your camera. Using two cards instead of one gives you more flexibility; you give the card you just used to the mission staff, load the fresh card into your camera, and launch on your next sortie while the staff processes your photos.

Fortunately, memory cards are not very expensive. For CAP cameras you should have two 2-4 GB cards (at least; the D7100 has two 16 GB cards). This way you shouldn't have to worry about running out of space during an imaging sortie.

1.4.1 Formatting a Media Card

Digital cameras provide two ways of deleting photos from a memory card: erasing and formatting. Erasing deletes photo and video files, but not other data on the card. It does not remove photos that have been protected.

Formatting (also known as initializing) overwrites everything on the card, including protected photos, directories and camera data. Formatting also sets up new folders and data on the card. To help ensure the integrity of the folders and data, *it's important to format the card using your camera, not a computer.*

When a card is formatted, files can still be recovered until they are overwritten. To ensure no one will be able to read deleted photos, some digital cameras have a "Low Level Format" option that completely erases data on a card (this type of formatting takes longer than regular formatting).

Format a card only after transferring your photos to a hard drive or other storage device and then checking them. *Additionally, you should regularly format your memory cards to help prevent them from becoming corrupted.*

1.4.2 Media Card Corruption

A corrupted media card has damaged data that prevents it from performing properly, and may even become unreadable. Since media card corruption often results from human error, understanding the main causes can help prevent it from occurring.

- Turning off a camera before a photo is completely written to the memory card. Wait a few seconds to let the camera finish writing the information from the buffer to the card; if your camera has a blinking activity light, make sure it has stopped blinking. Only then should you shut off the camera and remove the card.
- Removing the memory card from a camera while a photo is being written to the card
- Removing the card from a memory card reader while files are still being transferred to a computer
- Removing the card from a card reader while folders and files from the card are open on a computer
- Opening, deleting, renaming or moving files on the card while its contents are open on a computer
- Using a memory card which has not been formatted in the camera, or using a memory card from one camera in a different camera without first formatting it in the new camera
- Formatting a card in a computer instead of the camera
- Inserting a second memory card into a card reader before closing and removing the first, when viewing photos on the card from a computer
- Taking photos when camera batteries are nearly empty
- Taking photos so rapidly that the camera cannot complete writing one photo to the card before starting the next
- Continually shooting and deleting photos when the card is full
- Letting a media card get too full before downloading the photos to a computer or storage device. Cards that are too full may overwrite the card headers.
- Exposing media cards to powerful electrical sources (remember that static electricity from walking on a carpet in winter can produce a very high voltage charge that can damage a card) and strong magnetic fields (walk-through x-ray machines and scanners at airports are safe, but some of the new more powerful x-ray machines that they use on checked luggage may damage your cards). If you have any doubt or concerns, carry your media cards on the plane.

If your card becomes corrupted, try formatting the card in your camera and see if this corrects future problems.

1.5 Photo File Formats

Digital cameras save photos onto memory cards, but you (the camera operator) must choose how the photo is saved. Your choice will affect how the photo can or cannot be used by our customers. In this chapter we'll review the basic photo file formats, and then discuss resolution and quality in more detail in the following chapter.

For CAP missions, the photo format and size is usually determined by the customer's needs. Generally, customers want photos in either the JPEG or RAW photo file formats.

For CAP purposes, we need to realize whether or not our photos have been compressed. If they were compressed, we need to know by how much so we can determine if they still meet our customers' needs.

1.5.1 Photo Compression

Lossless compression is similar to what WinZip or PKZip does. For instance, if you compress a document into a ZIP file and later extract and open the document, the content will be identical to the original. No information is lost in the process. RAW is a photo format that can be compressed in a lossless way.

Lossy compression reduces the image size by discarding information and is similar to summarizing a document. For example, you can summarize a large document into a two-page document that represents the original, but you cannot re-create the original out of the summary because information was discarded during summarization. JPEG is a photo format that is based on lossy compression.

The table shows how, on average, a 5-megapixel photo (2,560 x 1,920 pixels) is compressed using the various photo formats.

Photo Format	File size	Comments
Uncompressed TIF	14.1MB	Reference
Uncompressed 12-bit RAW	7.7 MB	Reference
Compressed TIF	6.0 MB	Lossless compression
Compressed 12-bit RAW	4.3 MB	Lossless compression
100% Quality JPEG	2.3 MB	Hard to distinguish from uncompressed
80% Quality JPEG	1.3 MB	Sufficient quality for 4" x 6" prints
60% Quality JPEG	0.7 MB	Sufficient quality for viewing on a computer and on the Web

1.5.2 Photo Formats used in CAP Cameras

A. JPEG (also JPG)

JPEG (Joint Photographic Experts Group) is the preferred photo format for CAP purposes because the quality is almost the same as RAW but results in much smaller-size files; this significantly reduces the time it takes to save, convert, adjust, download or upload files. With JPEG you can shoot hundreds of photos at a time and the files are ready for release with no further processing.

JPEG is not a file format, but rather a method of data encoding used to reduce the size of a data file. Its compression can produce very small files for speedy downloads, and it is supported by all popular digital cameras and Web browsers.

A rule of thumb is that saving an uncompressed file as a high quality JPEG results in a file 95% the size of the original; medium 75-85%; and low 23%.

JPEG is designed for compressing either full color or gray scale images of natural, real-world scenes, so it works well on photographs and for Web display.

The JPEG format is adjustable for quality versus file size. Larger JPEGs record enough data, even at the milder compression settings, so that artifacts don't occur. JPEGs at the correct quality settings have no visible artifacts. Note: If you set your camera to save at a low quality, you cannot get any of the original quality back; this

is why we recommend setting your camera's quality at the highest setting for CAP purposes.

B. RAW

Unlike JPEG, RAW is not an abbreviation but literally means "raw" as in "unprocessed." Many DSLR cameras include a raw format setting, which switches off in-camera processing and instead writes the image data directly to the card, with minimal or no photo processing whatsoever. RAW images contain the maximum amount of detail that the camera is capable of capturing.

The RAW format, when processed on the computer into a finished photo, is invariably of better quality than an in-camera processed equivalent. And because a RAW photo contains the full range of color and tone captured by the camera, it's often possible to correct white balance and exposure mistakes after the fact in imaging software, making pictures look exactly as if they were properly exposed on the best white balance setting in the first place.

However, saving a photo in the RAW format (versus letting the camera convert it to JPEG) results in very large files, and significantly increase the time it takes to upload your photos. Additionally, some photo browsers and editors don't recognize these proprietary RAW files so you may not be able to view them in the browser or work on them in an editing program. So, if you shoot RAW you should also archive everything in a standard JPEG format so you'll be assured of having the best chance of being able to open and use the files in the future. [Note: *Photoshop Camera Raw* (built into *Photoshop* and *Photoshop Elements*) supports many camera types and can import RAW files from all the major camera makers; Nikon's *ViewNX* allows you to view JPEG files and edit or convert RAW files. Also, the *Microsoft RAW Image Thumbnailer and Viewer* download provides thumbnails, previews, printing, and metadata display for RAW photos from most Canon and Nikon digital cameras on Windows XP/7.]

For many CAP imaging missions saving your photos at the highest quality JPEG format is best. However, many customers want RAW photos. [As long as you're using a large-capacity media card, save your photos in the RAW + JPEG format](#); this allows you to use the JPEG photos for quick review on a computer or TV and deliver the RAW photos to the customer if they ask for it.

2. Exposure and Settings

Airborne Photographers have to know the camera settings and how to set or change them, so they can ensure the camera is properly set up for the mission and quickly adjust to customer requests and on-scene conditions. When you are flying is not the time to learn how to change a camera setting.

The most important decisions faced by an AP concern shutter speed and sensor sensitivity setting (ISO), which affect light sensitivity and thus image exposure. While CAP cameras can make these decisions for the AP (using Auto or Program modes), there are missions that require the AP to set shutter speed and/or ISO to meet a particular situation or customer requirement. Therefore, a sound knowledge of exposure and settings is crucial.

OBJECTIVES:

1. Discuss the relationship between ISO, shutter speed and aperture.
Demonstrate how to set ISO, shutter speed and aperture. {P-2202}
2. Discuss the purpose and use of exposure lock (pre-focus).
Demonstrate how to use the exposure lock. {P-2202}
3. Discuss the various exposure modes.
Demonstrate how to select each mode. {P-2202}
4. Discuss the effects of shutter delay (lag), and the use of continuous (burst) shooting modes.
Demonstrate how to set and use single-frame and continuous shooting modes. {P-2202}

5. Discuss image resolution and quality, and what settings are best for most CAP imaging missions. {P-2202}

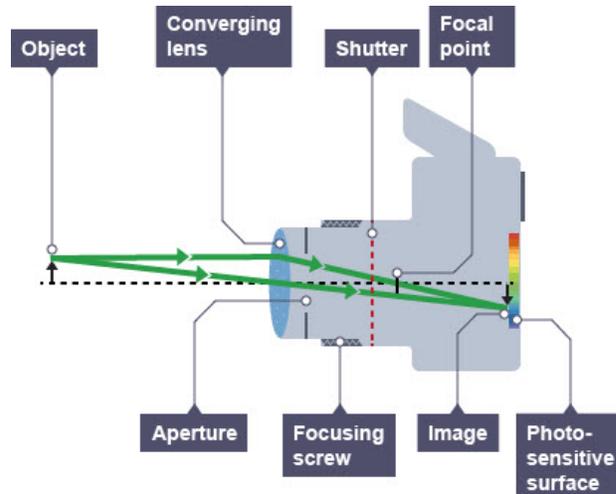
Demonstrate how to set resolution and quality. {P-2202}

6. Discuss the information contained in a photo's histogram, and demonstrate how to display and interpret a photo's histogram on the camera.

2.1 ISO, Shutter Speed, and Aperture

Airborne Photographers have to know the camera settings and how to set or change them, so they can ensure the camera is properly set up for the mission and quickly adjust to customer requests and on-scene conditions. When you are flying is not the time to learn how to change a camera setting.

When you press the camera shutter-release button to expose an object, light travels through the lens optics and passes through an aperture. Once through the aperture the light encounters a shutter that opens to let the light pass through to the photo-sensitive image sensor.



Photography is built upon an “exposure triangle” consisting of shutter speed, aperture and light sensitivity (ISO). The aperture works the same way as the iris in your eye, opening/closing in a circle to control how much light is allowed to pass through. The shutter mechanism is either fully open or closed; shutter speed is the time its open, thus controlling the length (time) of the exposure. ISO adjusts how sensitive the digital image sensor (such as a Complementary Metal Oxide Semiconductor) is to the incoming light. To get an image properly exposed (not too bright and not too dark), these three legs of the triangle must work together.

So, shutter speed and aperture together control how much light is projected onto the image sensor. How much light is needed for proper exposure is determined by the sensitivity of the digital image sensor, which is controlled by the ISO setting.

2.1.1 ISO

ISO defines how sensitive a camera’s sensor is to light. In digital cameras, instead of changing film you can simply adjust the camera’s light sensitivity (ISO setting). The higher the sensitivity, the less light is needed to make an exposure.

Lower ISO settings (where the sensor is less sensitive to light) are best used in bright lighting conditions; higher ISO settings (the sensor is more sensitive to light) can help in low-light situations such as early evening, winter, overcast, and very humid conditions. However, higher sensitivity also amplifies undesired image noise, which can cause fringing or artifacts to appear in the photo and reduce the quality of your image. *CAP cameras don’t show a noticeable increase in image noise at or below ISO 400 (ISO 800 for the D7100).*

ISO sensitivity can be adjusted by pressing the ISO button and rotating the main command dial until the desired setting is displayed in the control panel or viewfinder.

2.1.2 Shutter Speed

Shutter speed determines how long the camera's sensor is exposed to light. The dimmer the light, the longer the camera needs to collect enough light to make a good photo. Since CAP aircraft are traveling over the ground at around 150 feet-per-second (90 kts.) when taking photos, fast shutter speeds are better.

Shutter speeds are expressed in fractions of seconds, typically as (approximate) multiples of 1/2, so that each higher shutter speed halves the exposure by halving the exposure time: 1/2s, 1/4s, 1/8s, etc. If you want to change how motion is rendered you can use different speeds.

In aerial photography you should use the fastest shutter speed you can (*no less than 1/250s*) because short shutter speeds mean less jitter. You can also manipulate the ISO setting to reduce shutter speeds for a given lighting situation. If you increase the sensor's sensitivity to light by increasing the ISO to 400 (i.e., roughly four times as light sensitive as ISO 100), the shutter speed will be 1/250s (ISO 800 results in 1/125s).

2.1.3 Aperture

Aperture refers to the size of the opening in the lens (iris) and thus affects the amount of light falling onto the camera's sensor. Aperture affects exposure and depth of field. The size of this opening is controlled by an adjustable diaphragm of overlapping blades similar to the pupils of our eyes.

The size (diameter) of a lens's aperture at any given moment is called the f-stop (also f/stop or f/number), which is expressed in several different ways: f8, f/8, f-8, and 1:8. A lower f-stop number (f2.8) opens the aperture and admits more light onto the camera sensor, while higher f-stop numbers (f11) make the camera's aperture smaller so less light hits the sensor.

Just like shutter speeds, each whole f-stop represents a doubling or halving of the amount of light hitting the sensor, depending on whether you widen or narrow the aperture; for example, going from f8 to f11 will reduce the light hitting the sensor by one-half.

The example below (not to scale) shows some sample f-stops:



The maximum aperture of a lens is also called its lens speed. A lens with a large maximum aperture (f2.8) is called a "fast" lens because the large aperture allows you to use high (fast) shutter speeds and still receive sufficient exposure. The big advantage of these lenses fast lenses is that they are ideal for shooting moving subjects in low light conditions. Zoom lenses specify the maximum aperture at both the wide angle and telephoto ends (e.g. 28 - 200mm f3.5 - 6.3). A

specification like 28 - 100mm f3.5 implies that the maximum aperture is f3.5 throughout the zoom range.

Note: As you stop your lens down (i.e., set a higher f-stop number), diffraction effects can occur that result in a loss of sharpness. Take a few test shots with your camera to determine how much you can stop your lens down before you notice an unacceptable loss of sharpness.

2.1.4 Relationships

The primary camera settings we are interested in are shutter speed and ISO. A fast shutter speed is important in order to freeze motion as we (and the camera) are usually travelling 152 feet/second (90 knots). It also helps prevent camera shake from aircraft movement and vibration. ISO is important because we want to get the highest quality possible under all conditions. *Aperture*, which is mainly used to control depth of field, *isn't a big concern in aerial photography* as we are flying at or above 1000' AGL (essentially focusing to infinity).

But the faster the shutter speed, the shorter the time the image sensor is exposed to light. The shorter the time the image sensor is exposed to light, the darker the resulting photograph. To offset this effect, you can raise the sensitivity of the image sensor because at higher ISO sensitivity the sensor needs less light (the result of fast shutter speeds) to make a proper exposure.

Another reason you may want to select a higher ISO setting is when you encounter low-light situations such as early evening, winter, overcast, and very humid conditions.

APs are constantly doing a balancing act between needing a fast shutter speed to freeze motion and capture a sharp photo at high speed, and wanting to keep ISO low enough to ensure a high-quality photo. **For CAP purposes, limit ISO to 400 or less (800 or less with the D7100).**

2.2 Metering System

The metering system in a digital camera measures the amount of light in the scene and calculates the exposure value based on the selected (or default) metering mode. Automatic exposure is a standard feature in all digital cameras; all you have to do is select the metering mode, point the camera and press the shutter release. Most of the time, this will result in a correct exposure.

The metering method defines which information of the scene is used to calculate the exposure value and how it is determined. Metering modes depend on the camera and the brand, but are mostly variations of the following:

- *Center-weighted Average* Metering is probably the most common metering method and is the default for those digital cameras which don't offer metering mode selection. This method averages the exposure of the entire frame but gives extra weight to the central part of the scene. Since this method assumes that you are most interested in what is in front of the scene, the camera tries to expose this part properly. This method is designed for conditions where your subject is in the middle of the frame, and the background contains bright lights, dark shadows or other extreme lighting situations that may confuse the metering in the center of your image. *This is the preferred setting for aerial photography.*

- *Matrix* (also Multi-Segment or Evaluative) Metering offers the best exposure in most circumstances. Essentially, the scene is split up into a matrix of metering zones which are evaluated individually, instead of concentrating primarily on the center. This method delivers outstanding results under a broad range of conditions, and is the best choice for most situations where you're using the camera's automatic features.
- *Spot* (Partial) Metering measures only a small area of your image, usually the center, thus allowing you to meter the subject in the center one percent of the frame (or on some cameras at the selected AF point) while ignoring the rest of the frame completely. This type of metering is most commonly used for dealing with extremely backlit situations such as very light or very dark backgrounds.

2.3 Autofocus Lock (Pre-focus)

The autofocus lock feature is one of the handiest features you can use in a digital camera. It is usually activated by applying slight pressure to the shutter release button – not enough to activate the shutter and take a picture, but enough that you feel the button move and the camera respond. This is sometimes referred to pre-focusing.

Autofocus lock works only if the Focus Mode Selector, which is located on the front of the camera near the lens, is not in the Manual (M) position. The switch may have three primary positions, or just two (e.g., 'AF' and 'M' positions):

- S – Single-servo autofocus is designed for stationary subjects. The focus locks when shutter-release button is pressed halfway. *The shutter can only be released (photo taken) when the camera's in-focus indicator light is illuminated.* [Note: This setting may have two possible selection positions, one of which isn't marked. The first is designed for slower focus and the other gives a faster focus.]
- C – Continuous-servo autofocus is designed for moving subjects. The camera focuses continuously while the shutter-release button pressed halfway (pre-focus). However, *photos can be taken even if the in-focus indicator light is not illuminated.*
- M – Manual focus.

On most cameras, when you hold the shutter button halfway a steady 'Ready' or 'In-Focus' light or symbol next to or within the viewfinder illuminates. If you get a blinking (or different colored) 'Warning' light rather than a steady 'Ready' light it can indicate one of two things: 1) there is insufficient light (e.g., from cloud cover) for the picture, or 2) the camera thinks it's too close to the target because of a reflection from the window (this is why we shoot photos through an open window).

Since we fly at a constant altitude (1000' AGL or higher), the distance between the camera and the target remains constant, allowing you to lock focus on your target at the earliest possible moment. This enables you to concentrate on framing the target to best advantage before you press the shutter release the rest of the way to capture the photo. Another advantage to using autofocus lock is that it reduces the time between pushing the shutter release and the camera actually capturing the photo, which is a nice feature when you are taking a picture from a moving airplane. This time lag (called shutter lag) can be significant with low- to medium-priced digital cameras, but *isn't a concern in CAP DSLRs.*

Normally, taking photos in the Continuous-servo autofocus mode will work well, but quickly varying terrain or lighting conditions can cause the camera to

continuously search for the correct focus. This can lead to out-of-focus photos as this mode doesn't prevent you from taking a photo when the lens is not in focus.

Most DSLRs also have an AE-L/AF-L button. With the shutter release button pressed halfway to initiate focus, pressing and holding the AE-L/AF-L button will keep focus and exposure locked even if you release the shutter release button. This is a very useful feature in airborne photography, allowing multiple photos to be taken in succession with the same focus and exposure settings.



[Note: You can program the AF-L/AE-L button to 'AE lock (hold)' so that exposure locks when the button is pressed and remains locked until the button is pressed a second time (or the standby timer expires).]

Warning: If you are taking photos and notice that the camera is no longer auto-focusing, check to see that you haven't inadvertently moved the Focus Mode Selector to 'Manual' (M). This is easy to do when handling the camera.

Weaknesses

Most camera autofocus systems rely on contrast detection: it will focus the lens until the image has as much contrast as possible. In other words, contrast detection is largely a function of the available light in your scene. If the area you're trying to focus on is too dark, or uniformly colored, the camera won't be able to detect any contrast and may be unable to lock on.

For example, the Nikon D200 user manual lists several situations where its autofocus may not work well:

- There is little or no contrast between the subject and the background (i.e., the subject is the same color as the background)
- The focus area contains areas of sharply contrasting brightness, such as when the target is halfway in the shade
- The subject contains many fine details, such as a field containing patches of snow or light-colored soil or rock

Another condition that can cause this problem is when you're shooting under a heavy overcast and the air is saturated.

In these cases, you may need to use Manual focus or use autofocus lock to focus on another subject at the same distance and then recompose the image. If this doesn't work you may try increasing the ISO setting.

2.4 Exposure Modes

2.4.1 Auto

Most of the time we operate CAP cameras in the fully Automatic exposure mode: the camera analyses the target environment and tries to choose the settings (shutter speed, aperture and ISO) that will produce the best result.

The Automatic mode of the camera determines the optimal combination of aperture, shutter speed, and sensitivity based on the exposure value determined by the camera's light metering system. The camera's microcomputer usually assumes that you want to take a picture using the fastest available shutter speed because this minimizes camera shake and the blur that can result from a moving object. As it chooses the shortest possible shutter speed, it is only limited by how small the aperture can go given the current lighting conditions and ISO setting.

Note: The D7100 has an "Auto Flash" mode, which prevents the flash from automatically firing when the lighting is poor. Since the GPS is mounted on top of the flash, we don't want the flash to deploy; this mode prevents this from occurring.

2.4.2 Program

If Automatic mode isn't producing the results you want, the Program exposure mode allows more control over camera settings.

The Program (P) mode is similar to the automatic mode. Although the camera selects aperture and shutter speed, you can modify some of the camera's selections by turning a dial or pressing a button. You can thus increase or decrease shutter speed, and the camera will adjust the aperture to match; many cameras also let you adjust ISO, white balance and exposure compensation.

Your camera's light meter will try to capture a well-exposed photo by adjusting shutter speed and aperture (and maybe ISO). It will always prioritize shutter speed in order to prevent blurring caused by camera shake.

You may also use the **Auto ISO function**, which is simple and works well under most lighting conditions. In the Shooting Menu, set the "Minimum ISO/ISO Sensitivity" to 200, then set the "Maximum ISO/Maximum Sensitivity" to 400 (800 for the D7100). Set the "Minimum Shutter Speed" to 1/200th of a second (the rule of thumb is to set it to 1 over the focal length of your lens; in this case a 200mm lens). The camera will monitor your shutter speed and if it drops below the "Minimum Shutter Speed" it will automatically increase the ISO to a higher number to try to keep the shutter speed above this setting. Experiment with the "Minimum Shutter Speed" (no lower than 125) and see what works best. [Note: The Sigma lens Image Stabilizer might also help to decrease camera shake.]

NOTE: CAP cameras work very well under most conditions, but they only work within limitations. The camera will tell you if you've gone outside the boundaries of what it can adjust for you by flashing a warning in the viewfinder. You will have to re-adjust your settings (e.g., choose a lower ISO) in order to clear the warning.

During the flight you'll need to constantly monitor shutter speed through the viewfinder, as lighting conditions can change dramatically during a long sortie.

2.4.3 Manual

Most digital cameras feature a full 'Manual' (M) mode, allowing you to can set both the aperture and the shutter speed. *This can be useful to ensure that the same exposure is used for a sequence of photos* or when shooting in special circumstances such as direct sunlight. When in full manual exposure mode, the camera will often display a simulated exposure meter which will indicate how far over- or underexposed the image is compared to the exposure value calculated by the camera's metering system. If the camera has a "live" LCD preview it will often simulate the effects of the exposure on the LCD.

In most point-and-shoot digital cameras these settings are made on the LCD screen. Some professional style DSLRs use traditional controls, where you turn the aperture ring on the lens to change the f/stop and use a dial on the camera body to set shutter speed.

2.4.4 Shutter or Aperture Priority

In the Automatic or Program modes your camera makes the assumption that you want an evenly exposed image with a fast enough shutter speed to prevent blurring. Sometimes, these assumptions are incorrect.

Two other modes act between the auto and manual modes: shutter or aperture priority modes. In 'Shutter Priority' (S) mode, the camera will adjust the aperture to keep the exposure value (discussed below) constant; this can be used to lock in a speed fast enough to freeze action scenes. In the 'Aperture Priority' (A) mode you to select the aperture over the available range and have the camera calculate the best shutter speed for correct exposure.

For some aerial photography missions, using Shutter Priority with an ISO setting that ensures at least 1/250s is very effective.

2.4.5 Scenes

Many digital cameras come with a variety of "scene" modes such as landscape, night, portrait, sports, sand or snow. The sports mode will set a fast shutter speed while sand or snow modes compensate for very bright backgrounds which would otherwise underexpose your image. When used appropriately, these scene modes work well for what they are designed to do, but aren't recommended for CAP airborne photography missions.

2.4.6 Shutter Delay (Lag) and Shooting Modes

You may notice that, after pressing the shutter release on inexpensive cameras, there is a delay before you can take another picture (usually denoted by a flashing light next to the viewfinder). The reason for this delay is that, after each shot, the camera must:

- Set the focus, exposure time and white balance
- Charge the sensor
- Copy the photo out of the microprocessor into RAM
- Compress the photo after it's been taken
- Write the photo to the flash memory

The better (i.e., more expensive) the camera, the shorter is the delay between pictures. So you must know your camera's delay and make allowances for it, particularly since you are shooting from an airplane that travels over the scene at 75 - 90 kts. *CAP cameras don't have a noticeable delay.*

Shooting Modes

Normally, a camera is set for single frame mode, where the camera takes one picture each time you press the shutter release button.

Most digital cameras have another shooting mode for capturing pictures called the "continuous" or "burst" mode. If you set the camera for this type of shooting mode and hold down the shutter button and don't release it, the camera will take pictures until you release the shutter or you fill the camera's memory buffer (the

D200 can take up to 37 JPEG Fine Large photos in this mode). The time between pictures varies with the camera; the more expensive the camera the shorter the time between pictures.

Digital compact cameras typically allow 1-3 frames per second (fps) with bursts of up to about ten photos, while DSLRs have fps of up to seven or more and can shoot dozens of frames in JPEG and RAW. The D200 has two settings: Continuous Low, which records at 1-4 fps; and Continuous High which records up to 5 fps.

Using this feature with Medium and Standard resolution settings can make the pictures appear less sharp. Also, you can quickly fill up a memory card; how fast this occurs depends on the resolution and quality settings.

Note: Some cameras have an "auto-bracketing" feature that allows you to take three pictures in quick succession when you press the shutter release. You can then pick the best of the three to keep.

2.5 White Balance

This section is for reference only, and is primarily useful when you are using the camera on the ground.

White Balance (WB) is nothing more than an adjustment to get the colors you want. White balance only adjusts far enough to make lights that look white to us look white in photos. Most of the time you have the camera set for Automatic White Balance (AUTO or AWB). Fortunately, digital cameras even make manually setting WB easy; you just set the white balance to look good on the color LCD.

Different light sources have different color temperatures, so a photo will appear to have a slightly different color tone depending on how it is illuminated. The color of artificial light is quite different from natural outdoor light. For example when compared to outdoor light, ordinary light bulbs appear more yellow, candlelight appears redder, and fluorescent lights appear greener.

If your camera is balanced for one kind of light source (e.g., daylight) and you photograph a scene illuminated by tungsten light, the photo won't reflect the true colors in the scene. Fortunately your camera has a way to adjust for these different light sources. The white balance setting on your camera allows you to specify the color temperature of the scene.

In many cases, your camera will automatically adjust; however, it often guesses wrong and gets the improper white balance. So, if your whites are not white, you will have to make the setting yourself using the camera "Scene" modes:

In the *AUTO* mode the camera makes its best guess for each shot. Even though it may or may not work well for normal photos, *AUTO* almost always works great for under unusual mixed artificial lighting without flash. *AUTO* mode works well with flash, both indoors and outdoors. Usually the photos will still be fairly blue in shade and pleasantly warm indoors at night. When the flash is on most cameras automatically switch to flash white balance.

Tungsten (the camera displays the symbol of a light bulb, and is also called "indoor") is very, very blue most of the time except indoors at night, for which it looks normal. "Tungsten" is the name of the metal out of which the bulb's filament is made. Even indoors many people prefer the warmer *AUTO* setting.

Daylight (symbol of a sun) is bluish normal. Compare this setting to "cloudy" and go with the one you prefer.

Cloudy (symbol of a cloud) is a little warmer than the daylight setting. If you prefer photos on the warmer side, use this for most photos outdoors in direct sunlight.

Flash (symbol of a lightning bolt) is almost identical to “cloudy” but sometimes redder, depending on the camera. Settings are normally optimized for the little on-camera flashes (which tend to be blue), so this setting tends to be warm to compensate.

Shade (symbol of a house casting a shadow) is very orange. This is perfect for shooting in shade, since shade is so blue. It's also for shooting when you are under a cloud on a partly cloudy day, or for shooting in backlight, again since the subject is lit more by the blue sky instead of the direct sunlight.

Fluorescent (symbol of a long rectangle or fluorescent tube) is used if your photos are too green or under fluorescent, mercury, HMI or metal halide lights (street lights). It will make other things look a bit purplish. With Nikons the fine-tuning adjustment (+-3) is much stronger in this setting and adjusts from fairly warm to fairly cool; because of this you may not be able to get the exact color you want under Fluorescent lighting, in which case try the AUTO setting.

Fine Tuning (+3 to -3) allows you to get the exact amount of coolness or warmth: + is cooler and - is warmer. Nikons allow you to adjust this and remembers your preference for every setting.

Manual, Custom or Preset (sometimes a symbol with a dot and two triangles) allows you to point the camera at something you want to be neutral and it makes it that way. Read the manual to your camera for specifics.

Remember, look at your subject on the color LCD and scroll through the settings until you get the best photo!

When used appropriately, these scene modes work well for what they are designed to do, but *aren't used for CAP airborne photography missions*.

2.6 Photo Resolution and Quality

Resolution and quality are two different things: resolution is the number of pixels in the picture, and quality is how much you compress them. Based on these two factors, some pictures will be of a higher quality than others. Also, the resolution and quality settings you choose dictate how many pictures you can fit on your memory card.

2.6.1 Resolution

The sensors in a digital camera are made up of millions of pixels (megapixels), each one registering the brightness of the light striking it as the photo is taken. The number of pixels in the photo is about equal to the number of pixels on the sensor; this number is referred to as the photo's resolution. The easiest way to visualize pixels is to compare them to a puzzle; pixels make up a digital photo much like the pieces of a puzzle are assembled to create the puzzle image.

A digital camera records digital pixels onto a removable media card. A 5-megapixel (MP) camera can process and record photos that consist of approximately five million pixels apiece.

Simply put, the greater the number of pixels in an image, the higher the resolution. And the higher the resolution, the more detail you (and the customer) can see.

Most digital cameras allow you to change the resolution setting, so you can fit more or fewer photos on your memory card. The table depicts resolution settings for two cameras:

Nikon D200

Resolution Setting	Resulting size
Large	4.8 megapixels (3872 x 2592)
Medium	2.7 megapixels (2896 x 1944)
Small	1.2 megapixels (1936 x 1296)

2.6.2 Quality

The quality setting indicates how much the picture is compressed to save space on the memory card. The pictures are normally captured in a JPEG file format, except for the “Uncompressed” quality setting which captures the picture in an uncompressed file format. With the uncompressed RAW file format, the file size is very large and takes up a large amount of space on the memory card. [Note: Newer cameras allow you to save photos in both the RAW and JPEG formats at the same time (RAW + JPEG).]

In other words, quality is inversely proportional to the amount of JPEG compression the camera uses. Thus, a higher quality photo will have less compression, and vice versa. As you lower the quality and increase the compression, there will be more "artifacts" in your photo that are a result of the higher JPEG compression. You will notice that edges will seem blurry or that little squares (“jaggies”) will appear.

You can set your camera to take pictures with different quality settings. The Nikon D200 gives you these options:

- ‘RAW’ photos are saved in the Nikon Electronic Format (NEF)
- ‘JPEG Fine’ photos are compressed at a ratio of ~1:4. This setting is usually recommended for CAP missions.
- ‘JPEG Normal’ photos are compressed at a ratio of ~1:8
- ‘JPEG Basic’ photos are compressed at a ratio of ~1:16

NOTE: RAW photos can’t be viewed on many all-purpose photo browsers (e.g., Windows *Photo Viewer*), making a quick review of your photos impossible. However, CAP cameras allow you to record two copies of an image at the same time by using the RAW + JPEG setting. This way you will have a JPEG of each image for review purposes.

2.6.3 Resolution and Quality Settings

The following tables give you an idea of how the different combinations of resolution and quality settings effect file size (and thus how many pictures you can fit on a memory card). This table shows the D200 recording to a 1GB card:

Resolution setting	Quality setting	File size (MB)	# of Photos
Uncompressed	NEF (RAW)	15.8	60
Large (3,872 x 2,592)	JPEG Fine	4.8	167
Medium (2,896 x 1,944)	JPEG Fine	2.7	294
Small (1,936 x 1,296)	JPEG Fine	1.2	650
L	JPEG Normal	2.4	332
M	JPEG Normal	1.4	578
S	JPEG Normal	0.63	1200
L	JPEG Basic	1.2	650
M	JPEG Basic	0.7	1100
S	JPEG Basic	0.33	2200

If the quality and image correction flexibility of the pictures is most important, use Uncompressed/RAW (no compression), Large RAW + Fine, or Best/JPEG Fine (little compression) quality setting and Ultra or High/Large resolution. These are the best choices if the photo will be studied in detail (e.g., expanded or “blown up”) or when you don’t know the end use of the photos (most flexibility).

Using the examples above, *the best choice for many CAP imaging missions is JPEG Large Fine (D200) or equivalent.* This results in high-quality, low-compression JPEGs of manageable file size while still allowing you sufficient memory card space for most sorties. *If the customer wants RAW file format photos, use the RAW + JPEG Fine setting;* this setting allows you to use the JPEG photos for review on a computer photo browser or TV while capturing RAW photos to send to the customer.

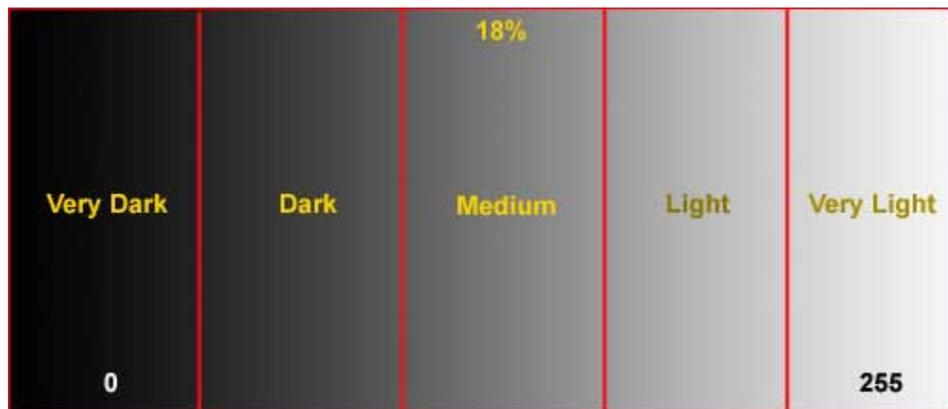
If space on your memory card is limited or the pictures are just going to be viewed on a monitor or posted on a Web page, use the Normal or Basic JPEG quality setting (all compress the photos) and Medium or Small resolution.

2.7 Histograms

Possibly the most useful tool available in digital photography is the histogram. Virtually every digital camera, from the simplest point-and-shoot to the most sophisticated DSLR has the ability to display a histogram directly or superimposed upon the photo just taken. On most cameras the histogram displays on the rear LCD screen, and most cameras can be programmed to do this both on the image that is displayed immediately after a shot is taken, or later when single frames are being reviewed.

Note: If your camera has a histogram feature, review the manual so that you will interpret it correctly. Some cameras show the histogram ‘upside down’ when compared to the histograms shown in this text; however, the weighting (e.g., left side = dark) is usually the same.

The histogram is a simple graph that displays where all of the brightness levels contained in the scene are found, from the darkest to the brightest. These values are arrayed across the bottom of the graph from left (darkest) to right (brightest). The vertical axis (the height of points on the graph) shows how much of the image is found at any particular brightness level.



The names of the five zones (or F-stops) containing the dynamic range recordable by a camera is arbitrary.

A histogram that shows more weight at the left of the graph represents a dark image (also called a low-key image); a histogram with more weight to the right of the graph represents a bright (or high-key) image.

An image with a low-key histogram may be overexposed, and an image with a high-key histogram may be underexposed, though this is not necessarily always the case. For example, histograms of photos taken from a high-wing aircraft such as a C172 usually shows more weight at the left of the graph because the wing shadows the camera as you shoot pictures of well-lighted targets on the ground. Your eye - not a histogram - should always be your final judge.

3. Composition

Airborne Photographers have to know basic composition in order to properly frame targets during aerial photo or video imaging missions. Composition concerns how you arrange a subject in a picture and how you translate what your eyes see into a digital image.

The key to composition is remembering that a digital camera doesn't "see" the same way that you do. How often have you taken a photo from an airplane, only to discover later that the photo doesn't look anything like what you remember seeing? This is the first rule of photography – reality, as seen by your camera, is quite different from what you see with your eyes. If you frame all your photos without taking this into account, you will always get disappointing results.

One big difference between what you see and what the camera sees is that a camera doesn't have a brain. Your brain interprets, supplements, and/or enhances the image it receives from your eyes. Also, a camera has a much more limited range of focus, exposure, and composition than you do. Your eyes, in conjunction with your brain, create scenes that are impossible to reproduce in a camera.

Also, remember that your eyes are more sensitive to contrast than to color. Since low-angle sunlight gives more contrast than when the sun is high in the sky, photos taken in the early morning or late afternoon look more textured and detailed due to the longer shadows. However, large shadows can hide what we are looking for, so you must strike a balance between getting photos with great contrast and missing potential targets in the shadows.

When you look at something, your field of vision is a rectangle with rounded corners (almost a wide ellipse). We see the world panoramically. Most of the time, the camera doesn't "see" a scene in this way. So it is your job to take the panorama and translate it into an image that is suited to the mission. You can do this by using guidelines for composition.

OBJECTIVES:

1. Discuss and demonstrate how to compose a photo, including: {O-2204}
 - a. Focal point and the "rule of thirds"
 - b. Filling the frame, including the three general rules for framing
 - c. Near-vertical and oblique photo formats

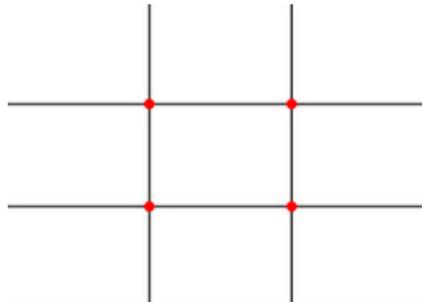
3.1 Isolate the Focal Point

The focal point is the main subject of a photo, such as a downed aircraft in a field or a breach in a levy. It is the main point that the viewer's eye will be drawn to when looking at the picture.

This is why it is so important to know exactly what the customer wants to see in the photos you will be taking on a particular sortie. If you don't know what you are supposed to be taking a picture of, it will be difficult or impossible to emphasize the right element in your photos. This can lead to a disappointed customer, and that customer may decide CAP doesn't know what they're doing.

As a general rule you only want a single focal point in an image. But sometimes the photo will be required to show multiple focus points. For example, the customer may want to know the condition of two roads leading into a damaged power plant. In this case, you must compose the picture so that each road can be clearly seen.

A useful rule to use in this case is the "Rule of Thirds," where you mentally draw two horizontal and two vertical lines through your viewfinder so that you have divided the scene into thirds. This breaks up your image into nine zones, with four interior corners where the lines intersect (red dots):



If you place points of interest in the intersections (power points) or along the lines that your photo becomes more balanced. Studies have shown that when viewing images that people's eyes usually go to one of the intersection points most naturally rather than the center of the shot – using the rule of thirds works with this natural way of viewing an image rather than working against it.

In the case of a single focal point, such as the downed aircraft, placing the aircraft along these lines (or near the center) will result in a satisfactorily composed photo.

3.2 Framing

You should always minimize the amount of dead (non-mission related) space in a photo. Once you have decided on the focal point, don't relegate it to a small portion of the picture. In aerial photography, this is most easily accomplished with a combination of proper aircraft positioning, framing and use of the zoom lens.

If you need to place the horizon in the photo to establish perspective, never let the sky take up more than the top one-third of the image (note that this also satisfies the rule of thirds). And try to keep the horizon straight in the photo. You can correct for a slightly angled horizon in your editing software, but each time you rotate the photo you degrade the photo slightly.

Filling the frame is very important when taking a digital photo. If the target is too small in the frame you lose important detail because you wasted a lot of pixels on extraneous details.

In CAP aerial photography, we try to follow three *general* rules for framing:

- Frame the photo so the target fills most of the frame (at least 75%)
- Frame the photo so no aircraft parts (i.e., wingtip, strut, window sill or wheel) show; don't rely on software to crop your photo
- Whenever possible, position the aircraft so you can frame the target without using the zoom feature. When this isn't possible, use the zoom to improve the framing or to concentrate on a specific portion of the target (e.g., damage to one section of a power plant or a crack in a bridge support).

Practice

An inexpensive way to practice framing is to take photos of objects from a vehicle. Preferably, have a friend drive along a freeway where you can safely drive ~ 55 mph; this most closely simulates the speed effect you'll experience during flight. Pick out "targets" of varying sizes along the roadway and photograph them, practicing the three rules for framing. After you get proficient at proper framing, take 2-3 photos of the same object as you pass; this also simulates what you'll be trying to accomplish while on imaging sorties.

3.3 Depth Perception

Sometimes when you frame your shot, the target appears small in relation to its surroundings. This may be due to your height above the target and your angle to the target. If the target is so small that it appears "flat" in your viewfinder, it is likely that the photo won't be useful to the customer. In these cases, reduce altitude (within FAA and CAPR 70-1 regulations) and/or increase your angle to the target (e.g., using the 45° Angle to Target pattern, discussed later). Placing the target in the foreground of the image will add to a sense of depth and perspective.

Also, remember that you can take as many digital pictures as your media card(s) can hold. If you have any doubt about a picture's quality or suitability for the mission, take more photos of the target from different angles and heights or try different focal points.

3.4 Depth of Field

Depth of field refers to the region of proper focus available to you in any image. When you focus the camera, there is some distance in front and behind your subject that will also be in focus. This region of sharp focus is called depth of field, or sometimes depth of focus.

Three factors contribute to the depth of field available to you for any picture:

- The aperture of your lens is the first major factor affecting depth of field. The smaller the aperture (higher the f-number), the greater the depth of field will be.
- Focal length is a measure of your lens's ability to magnify a scene. The more you magnify your subject, the less depth of field you have available. If you zoom in with a telephoto lens the depth of field drops dramatically.
- The distance from the subject determines how much depth of field you can get in your scene. If you shoot a subject that is far away, the depth of field will be much greater than it is for a subject close to the camera.

For aerial photography purposes, the Earth is flat so you don't have to worry about depth of field:

- Even at 1000' AGL you are so far away from your target that any aperture is sufficient to get everything in focus
- This helps, because you'll want to shoot at the largest aperture possible in order to get short shutter speeds

3.5 **Vertical and Oblique Photos**

Some customers may ask for photos using the terms “oblique” or “vertical”. Oblique means taking a photo with an angle between 3 and 90° from the vertical and vertical refers to photos taken with an angle between 0 and 3°. [NOTE: The FEMA image uploader (see Chapter 10) uses the terms “Aerial Oblique” and “Aerial Nadir”]

If a customer uses these terms in describing the types of photos they want, the AP needs to know what they mean and use this knowledge when framing questions and evaluating answers (see Chapters 3 & 6 and Attachment 1).

The Bird's Eye (Overview) pattern (see Chapter 6 and Attachment 2) is an example that can be used for near-vertical photos, and the other patterns can be used for oblique photos.

Near-Vertical Photos

CAP aircraft don't have the specialized equipment and mounts needed for a truly vertical shot, so our “vertical” photos are really “near-vertical” photos. However, these types of photos will produce results considerably different from oblique photos, providing an almost map-like image which gives an overview of a target and its surroundings (e.g., entry and egress routes and nearby infrastructure). It also serves to provide a rapid means of assessing natural and man-made damages.

In straight and level flight, taking photos from the rear photo window will only allow about a 45° angle; to get a greater angle the MP will have to bank the aircraft slightly (e.g., using the Bird's Eye or Overview imaging pattern).

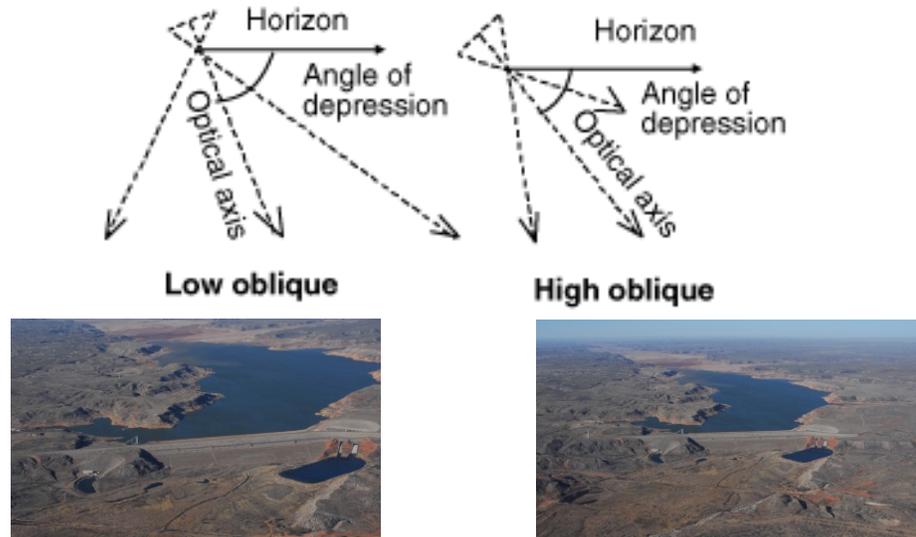
Advantages

- Vertical photographs present approximately uniform scale throughout the photo, so making measurements (e.g., distances and directions) is easier and more accurate.
- Because of a constant scale throughout a vertical photograph, the determination of directions (i.e., bearing or azimuth) can be performed in the same manner as a map. This is not true for an oblique photo because of the distortions.

- Because of a constant scale, vertical photographs are easier to interpret than oblique photographs.

Oblique Photos

Oblique photos can be further described as “low” or “high” oblique. In low oblique photos the horizon isn’t visible; in high oblique the horizon is visible. Low oblique photos use 45-60° camera depression angle and high oblique uses ~ 30°. [Depression angle refers to the angle between the optical axis of the camera and the horizontal.] CAP customers usually ask for low oblique photos.



Low oblique photos only cover a small area, but they do present the photo in detail and present a more natural view. High oblique photos cover a larger area and present a detailed view, but only in the foreground (the detail falls off as you get closer to the horizon).

Advantages

- An oblique photograph covers much more ground area than a vertical photo taken from the same altitude and with the same focal length.
- If an area is frequently covered by cloud layer, it may be too low and/or impossible to take vertical photographs, but there may be enough clearance for oblique coverage.
- Oblique photos have a more natural view because we are accustomed to seeing the ground features obliquely. For example, tall objects such as bridges, buildings, towers, trees, etc. will be more recognizable because the silhouettes of these objects are visible.
- Objects that are under trees or under other tall objects may not be visible on vertical photos if they are viewed from above. Some objects, such as ridges, cliffs, caves, etc., may not show on a vertical photograph if they are directly beneath the camera.

3.6 Overlapping Photos

There will be times when you want to shoot a target (e.g., a dam) that just can't be captured with a single photo. By shooting a series of overlapping photos, you can use special stitching software to create panoramic photographs.

It is best to shoot with shorter focal lengths (e.g., "landscape" mode) as this wider angle lets you shoot fewer frames, which is necessary when shooting from a moving aircraft. Fewer frames also means you have less chance of making a mistake, and fewer frames means less "seams" in your panorama (and more seams increase the chance of more artifacts in your photo).

You may also be asked to take a continuous series of photos with overlap (usually around 15%) so the customer can create a panoramic view (e.g., a river). In this case don't use a landscape mode; shoot normally (discussed below).

Fortunately for CAP purposes, you don't have to worry about panning the camera to get your shots – the movement of the aircraft does the work for you. You just hold the camera still while the target passes before your lens, taking photos with the proper overlap. Most stitching software recommends a 15-30% overlap between photos. [Some cameras have a panoramic assist mode that will give you on-screen cues as to how much you need to overlap.]

There are several variables to consider when shooting overlapping photos, so practice is essential. One task you must master is how to take a shot while looking ahead to where you'll take your next shot, in order to obtain the proper overlap between photos. If you're shooting a specific target (e.g., a large dam) perform a planning pass by the target to determine how many shots you'll need and look for markers that will assist in obtaining the proper overlap between shots.

Another task to practice is controlling exposure if the scene isn't evenly lit (i.e., there are fairly dramatic changes in lighting between one frame and the next). If your camera has an exposure lock feature, you can lock your exposure after the first frame to ensure subsequent shots are exposed with the same values (a panoramic assist mode does this for you).

Don't forget to take periodic breaks! Short breaks reduce fatigue and allow time to review your photos for framing and focus.

How Much Ground Do You Cover if You Take a Photo every Five or Ten Seconds?

1 Knot = 1.6878 ft. /s

Knots	Ft./Sec	Photo every 5 seconds covers:	Photo every 10 seconds covers:
100	167.7	839 feet (0.138 NM; 0.159 SM)	1688 feet (0.278 NM; 0.320 SM)
90	151.9	760 feet (0.124 NM; 0.143 SM)	1519 feet (0.250 NM; 0.288 SM)
80	135	675 feet (0.111 NM; 0.128 SM)	1350 feet (0.222 NM; 0.256 SM)
75	126.6	633 feet (0.104 NM; 0.120 SM)	1266 feet (0.208 NM; 0.239 SM)

4. Camcorders

Airborne Photographers should study this chapter if they have to take video using a digital camcorder. However, since the great majority of CAP missions are photo missions, *this information is presented for information only and is not a required part of your training.*

Camcorders come in two basic types, analog or digital, either of which is fine for CAP purposes. And like digital cameras, there is a large number of each type of camcorder to choose from. For this review, we will cover the basics using the Canon Optura20 as an example. Since camcorders have more features than digital cameras, it is even more important that you read the User's Manual.

OBJECTIVES:

This chapter is for Reference Only

4.1 Basic Terms and Features

4.1.1 Lens and Zoom

Unlike digital cameras, camcorders normally just list the zoom power. For example, the Optura20 has a 16x optical (320x digital) zoom lens; behind this lens is a 1/4" CCD with 1.33 million pixels (690,000 pixels for videos and 1.23 million for still photos). [Note that when you are saving stills to a memory card, the zoom drops slightly (e.g., from 16x to 15X on the Optura20).]

Like we discussed in the section on digital cameras, you should turn off the camcorder's digital zoom feature for CAP missions.

4.1.2 Viewfinders

Like digital cameras, camcorders let you to frame your picture using a viewfinder and an LCD screen. Remember that the optical viewfinder doesn't show the entire scene.

Most camcorder viewfinders have a diopter adjustment. This works the same as discussed in the chapter on digital cameras.

4.1.3 Batteries

Camcorders consume even more power than digital cameras. You need to use high-performance lithium ion or NiMH rechargeable batteries and you really need a spare set. Also, an AC adapter is an even more important accessory for a camcorder; you will need it to conserve your batteries when you view, edit or transfer photos.

4.1.4 Tape Format

Camcorders record on several different types of film, such as MiniDV, Digital 8, MicroMV, DVD and HD. Each is discussed later.

Like digital cameras, many newer camcorders allow you to record still and moving photos onto a memory card. Most use the newer Secure Digital (SD) and/or Multimedia Card (MMC) formats, while some use the Sony Memory Stick or the SmartMedia. The size comparisons covered for the digital cameras are the same. However, if you intend to record moving photos onto the cards you need large capacity cards and spares.

4.1.5 Connections

Most camcorders include USB, FireWire, S-Video, Microphone, A/V (headphones), and DC-in ports. These connections allow video (or stills) from a camcorder to be viewed on a monitor or transferred to a computer. [Note: Editing digital video on a computer is not covered in this text.]

4.1.6 Image Stabilization

Camcorders with an image stabilization feature helps to reduce (but not completely eliminate) camera shake that is most noticeable on telephoto photos. This will give you noticeably better results when recording from aircraft.

The two most common types of image stabilization in use are:

- *Electronic Image Stabilization (EIS)* uses one of two methods to reduce shake. The digital method increases the size of the image by digitally "zooming" in on the image so that it is larger than the CCD; this decreases picture resolution somewhat. The other method uses electronic motion sensors to sense the motion of the camera; this may slow the autofocus function and may cause a slight "jump" at the beginning of a scan.
- *Optical Image Stabilization (OIS)* uses a lens/prism assembly moves in opposition to camera shaking. This results in little or no change to camcorder efficiency or quality.

Although image stabilization adds to the cost of the camcorder, it is a very valuable feature. If you have a choice, choose OIS.

4.1.7 Autofocus

Although autofocus (AF) lenses can be a help in shooting a target from a moving aircraft, you will encounter problems unless you fully understand how they work.

Most autofocus devices assume that the area you want in sharp focus is in the center of the picture. If the area you want to focus on does not remain in the center of the frame, autofocus is not useful. Some camcorders allow you to center the subject matter in the autofocus zone and then lock the autofocus on this area; you can then reframe the scene for the best composition.

Autofocus systems have other weaknesses. Most can be fooled by reflections and by flat areas with no detail. Most autofocus systems also have trouble determining accurate focus when shooting through glass (e.g., an aircraft window). And, finally, autofocus devices (especially under low light) can keep readjusting or searching for focus as you shoot, which can be quite distracting.

However, for most CAP uses autofocus is a valuable feature. Just be sure to shoot through an open window and keep the target centered in the frame. [Note: Many camcorders have an 'infinity focus' feature that helps alleviate this problem.]

4.1.8 Video Resolution

The term resolution refers to the ability of an imaging system to capture fine details; the higher the resolution, the sharper the photos. In digital video, resolution is calculated differently than it is for digital cameras.

The vertical resolution of a digital video image is determined by the number of scan lines in the image. The horizontal resolution is the rate at which the moving beam can turn on and off to paint "dots" of color on the screen (this can happen only so fast because it takes time for the circuits to switch from black to white).

4.1.9 Still Photos and Short Movies

Most digital camcorders let you take still photos. This is a handy feature if you need to take "snap photos" from your tape to e-mail, print small (4" x 6") prints, or view on a computer.

In addition to still photos, you can also record short movies to the camcorder's memory card. On the Optura20, you can choose between 320 x 240 and 160 x 120 resolutions, with each movie being limited to 10 and 30 seconds, respectively. Movies are saved in AVI format, using the M-JPEG codec.

4.2 Media File Formats

4.2.1 Video 8 (analog)

Video 8 was developed for the camcorder market in the late 1980s. The tape is 8mm wide and has recording times of 90 minutes.

4.2.2 Hi8 (analog)

Hi8 produces better quality images in playback (significantly higher quality than VHS and is on a par with S-VHS), and has a 90-minute maximum recording time. Hi8 is considered to be the better analog format.

4.2.3 Digital8

Digital8 camcorders record digital video onto analog (non-digital) 8mm videotapes, giving users all the advantages of digital video while still using inexpensive analog tapes. These camcorders are bulkier than DV camcorders.

Digital8 camcorders will run tape at a faster speed when recording on Hi8 tapes digitally, providing for approximately 40 minutes of digital recording on one 60-minute Hi8 tape.

4.2.4 MiniDV

Of all the small consumer video formats currently available, the small MiniDV format is by far the best. MiniDV tapes are inexpensive (60 minute tapes are available for around \$4), available in a variety of lengths, capable of recording high quality video with 500-line horizontal resolution (about twice the resolution of VHS and 8mm video and 25% better than S-VHS or Hi-8), reproduce colors better, and produce clearer images with less static. DV utilizes a compression system such that very high quality images can be recorded onto tiny tapes (a typical 60-minute tape holds 13 GB of data). Sound is of a very high quality, too, with 12-bit and 16-bit encoding being the norm - well up to CD audio quality.

MiniDV tapes are compatible with most video editing software applications, and can also be played directly from MiniDV VCRs.

4.2.5 MicroMV

MicroMV was launched by Sony in late 2001, and record to a smaller format of digital tape than even DV (about 70% the size). This format is completely different

to any of the existing formats in that it records an MPEG2 file, with a maximum recording time of 60 minutes.

MicroMV tapes are more expensive than DV, and the MPEG-2 video produced by MicroMV camcorders is not compatible with many video editing software applications.

4.2.6 3" DVD

Some camcorders use 3-inch Mini DVD-R and DVD-RAM discs instead of digital videotape. While the prospect of being able to record video and then play it directly from a DVD player is appealing, this format has a couple of drawbacks. DVD-R discs must be specially formatted by the camcorder before they can be played back on a DVD player, after which they are locked and no more information can be stored on them. DVD-RAM discs can be reused, but they are expensive and their format makes them incompatible with some home DVD players.

4.2.7 Microdrive

Some camcorders have built-in hard drives that allow recording standard or high definition videos. However, they are not as durable as solid state media and require a separate hard drive or DVD burner to store (archive) video.

4.2.8 SSD

Solid state drives are the alternative to hard drives, and function a lot like flash memory. However, they have lower capacity than hard drives.

4.2.9 HD

The newest medium has become the standard, High Definition gives a substantial improvement in video quality due to higher resolution, broader color space and advanced compression algorithms. There are currently several competing media types. Camcorders often give you the option of using HD or standard recording.

4.3 Taking Movies with a Digital Camera

Most digital cameras come with some sort of movie mode that allows you to record a short video that can be played back on the camera, a monitor or a PC.

Some cameras set a fixed limit on how long you can record video, while others are only limited by the amount of memory on your media card.

Depending on the camera, the can be recorded in several formats (e.g., MPG, AVI, MOV or Full HD). Even though you can usually choose the resolution, even the biggest movie will still be fairly small on the monitor.

Additionally, not all cameras have a microphone, so you may not be able to capture sound with your video.

4.4 Connecting to the Aircraft Audio System (Intercom)

It is essential to have a means of providing a running audio commentary of what you are filming with the camcorder. A couple of methods are discussed below.

4.4.1 Place an External Microphone in your Headset Earpiece

The preferred (and easiest and least expensive) method is to connect an external microphone to your camcorder's microphone input, and place the (small) microphone in your headset's earpiece. You simply speak into your headset microphone and your conversation is transmitted to the camcorder. A store such as Radio Shack should have a microphone that will connect to your camcorder's mini 1/8-inch stereo plug.

Note that any other conversation coming over the aircraft intercom will be picked up by the camcorder. This isn't necessarily a bad thing, but intercom conversations must be controlled so that it doesn't interfere with your commentary

4.4.2 Adapter Cable

An alternate method is to use an adapter cable plugged into the aircraft's intercom system via your headset.

If this accessory is not available with your camcorder, you can make one using parts available at most audio stores. As an example, you can get the following parts at Radio Shack:

- Six feet of shielded audio cable (P/N 42-2444)
- One in-line 40 dB attenuating adapter, phono jack to two-conductor 1/8" phone plug (P/N 274-300A)
- One 1/8" right-angle adapter (P/N 274-372A)
- One adapter miniature 1/8" phone jack to standard 1/4" phone plug (P/N 274-325C)

The right-angle adapter is connected to one end of the six-foot audio cable: this is the camera input end.

The in-line attenuator is connected to the other end of the six-foot cable, and the 1/8" to 1/4" adapter is plugged into the other end of the in-line attenuator: the attenuator/adapter end is connected to the aircraft intercom system through your headset connection.

NOTE: It is important that you test this connection with your headset. Some active noise reduction (ANR) headsets interfere with the operations; test your headset with ANR on and off to see which works.

4.5 Techniques

Take a close look at a number of recent-model video camcorders and you'll notice that although many vary in their outward appearance, they have remarkably similar functions. Every compact cam is designed for hand-held usage, as well as having a zoom lens. Most of them will allow the user to over-ride automatic functions like focus, exposure and white balance, too. An increasing number of models sport fold-out color LCD screens in addition to their built-in viewfinders, and offer the ability to add titles, fades and digital picture effects to recordings. Many models allow users to record from external sources just as you would with a VCR, too.

With a basic set of skills it's possible to shoot video on virtually any target.

4.5.1 Learn your Camcorder Features

It's important that you get to know what your camcorder can and cannot do, and then set it up to meet your needs. The best camcorder in the world will give you excellent pictures and sound, but it can't think for you. Most budget-priced late models have automatic control of focus, iris (exposure) and white balance (color temperature). So, to begin with, switch off everything automatic and learn what the effect is.

4.5.2 Supporting the Camcorder

It's best to grip the camcorder firmly around the body and keep your elbows tight to your sides when using the viewfinder. Don't rest your arms or elbows against the aircraft frame, as this will transmit aircraft vibrations to the camera. If you wish to pan, you'll find that you can achieve reasonable stability by literally swiveling your hips as you pan. Smooth pans can't be achieved without the camcorder being held rigidly against the body.

For ground photos, the best means of acquiring stable photos is to use a tripod. A good tripod will enable you to set up very smooth pan and tilting photos.

Though never intended as such, the folding LCD screen can be used as an aid to stability. By holding the camcorder firmly around the body in the manner already described, it's possible to get some nice smooth photos by carefully holding the LCD screen with the left hand. With practice you'll be able to swivel the screen as you crouch down or stretch up and maintain good framing. Holding the camcorder in this way can also result in a smoothing-out of walking photos. Again, always shoot with the lens fully zoomed out for the best results.

4.5.3 Zoom

Professionals are trained to use zooms only when they have a relevance to the shot and sequence. Another reason is that many camcorders have low-cost lenses, so any zooming will often show up the inadequacies of the lens. Usually, photos will be framed with the lens zoomed out fully.

Getting a close shot usually involves the operator physically moving in closer to the target (e.g., circling close to the target and/or descending) rather than zooming in on the target. With the lens set to full wide, you'll find the general depth of focus is better, too; something that's immediately noticeable when zooming around aimlessly, as can be seen in many videos which have been shot at parties or at air shows. However, since CAP is limited to at least 1000' AGL (and often

higher if the airspace is restricted or crowded), knowing how to zoom correctly may be the only way to capture the desired level of detail.

It's a good idea to treat the video camcorder very much like a still camera; look at the scene, select the shot, frame it and then hit the record button. If you need to zoom, adjust the zoom until the image is "shaky" and then back off until the image becomes stable. Once you're happy that you've captured all you need, count to three and pause the camcorder; always give a breather at the beginning and end of the shot, as it helps in finding scenes and during editing.

4.5.4 Focusing

If conditions allow you to set the camcorder's optical system to manual focus, you'll notice a marked improvement in the overall quality of your video. This could be the case when you are circling a damaged power plant. But if you're shooting in a situation where there are rapid changes beyond your control (such as shooting along a flooding river), it's best to rely upon the camcorder's auto-focus capabilities. Just remember that the auto-focus is constantly evaluating the nature of the image arriving through the lens, and will generally use the center of the image as the reference point.

When attempting to zoom in to a target using auto-focus, you may notice the target tends to go in and out of focus as you're zooming. And once into your close-up, you have to wait for the image to sharpen into focus. This is due to the action of the auto-focus system working constantly to analyze the image even as you are zooming. To prevent this, place the camcorder in Standby mode (before recording) and:

- a. Switch off the auto-focus
- b. Zoom in on the target (full zoom)
- c. Adjust the focus manually
- d. Zoom out and frame your starting shot
- e. Start to record and commence your zoom

You'll find that not only will the shot be sharp all the way down the zoom (depending upon your camcorder's optical system), but the shot will also be sharp at the end of the zoom.

Most camcorder lenses have zoom controls that are extremely sensitive, allowing the operator to start a zoom slowly and then speed up according to need. Low-cost camcorders don't have this feature and very smooth zooming comes only after a lot of practice.

4.6 Getting the Video to the Customer

Although video from a camcorder can be downloaded into a computer the file is very large, which makes it difficult to transmit to a customer over the internet. With the advent of greater bandwidth and on-line storage or sharing sites, it is becoming easier to make videos available to our customers on-line.

If you cannot deliver the video via the internet (e.g., cloud services), the next best way is to copy the video to a large-capacity USB flash drive and deliver it to the customer. Short JPEG movie clips may be transmitted e-mail.

Many new camcorders record on an internal hard disc, and many also allow recording on large-capacity removable media such as an SD card or memory stick. These camcorders can either record video in High or Standard Definition; for CAP purposes Standard Definition is sufficient (unless the customer asks for HD).

Still photos (JPEG) taken on the camcorder's media card are handled just as if they were taken on a digital camera.

As a last resort, you can take the camcorder to the customer and play the video on a monitor.

Note

Video taken for an Air Force Assigned Mission (AFAM) **must be deleted** from the camcorder(s) and computer(s) once the mission is completed. Check with the Incident Commander before deleting.

Intentionally blank

5. Between Missions: Keeping the Camera and Accessories Mission Ready

The Airborne Photographer needs to know how to properly store and maintain the camera/camcorder and accessories between missions, so they will be ready on short notice.

You never know when you'll be called for a video imaging mission, so you need to assume it will come at the most unexpected and inconvenient time. Therefore it is important that the equipment you need will be ready to go.

Each camera and camcorder should be kept in a camera bag, along with its accessories. As a minimum, your camera bag should contain spare batteries, a battery charger, cables and accessories, lens cleaners, spare media cards or tapes, and user manuals. Additionally, your camera/camcorder should have a sturdy wrist or neck strap attached (try and explain how you dropped an expensive digital camera out the aircraft's window!).

You should create a one-page "camera set-up" card to put in your camera bag. This quick-check item should list normal camera settings (e.g., exposure mode, resolution and quality), checking the batteries, checking the media card, checking cleanliness, checking the filter installed, etc. If you wish, you could also list the camera bag inventory on the reverse. Once completed, trim and laminate the card and keep it in the camera bag.

Don't store your camera where it will be exposed to extreme heat or cold, or near a strong magnetic field (e.g., TV set or radio).

Don't put moth balls in your camera bag; take the camera out of storage every 4-6 weeks to help prevent mold and mildew.

Inspect the camera/camcorder periodically and inventory the camera bag contents.
Replenish as necessary

OBJECTIVES:

1. Describe the contents of a typical mission camera/camcorder bag. {P-2203}
2. Describe the storage requirements of a camera /camcorder/GPS and its batteries, and discuss how to properly charge a battery. {P-2203}
3. Discuss how to clean a camera lens, lens filter, LCD screen and viewfinder.
Clean a camera lens filter, LCD screen and viewfinder. {P-2203}
4. Discuss the purpose and use of UV and polarizing filters. {P-2203}
5. Discuss the storage and backup of media cards. {P-2203}

5.1 Batteries

Most manufacturers suggest removing the camera (and portable GPS) batteries if the camera/GPS is not used for two weeks or longer. Even modern batteries can leak or corrode (especially when discharged), and sometimes small amounts of this material can coat the electric contacts, which can render the camera inoperative.

Don't mix fresh and used batteries in the camera, and don't mix different kinds of batteries (e.g., two regular alkaline and two rechargeable batteries, or to NiMH and two lithium ion rechargeable batteries).

Be careful to insert the batteries (+ and - ends) according to the camera's polarity diagram, which is usually depicted on the inside of the battery cover. When you insert batteries, turn on the camera – it should start normally and shows a full charge. Otherwise, turn off the camera and check that the batteries are inserted properly.

Don't leave batteries plugged into a battery charger; once the batteries have been fully charged, remove them from the charger and store them at room temperature.

Use a charger that is designed for the battery: NiMH batteries should only be charged in a charger designed for NiMH batteries, and high-capacity batteries need a high-capacity charger.

Use standard chargers rather than "rapid" chargers; rapid chargers tend to undercharge batteries by as much as 20%. Choosing the wrong charger can make a big difference; the worst chargers (in terms of completeness-of-charge) produce "charged" batteries with only half the stored energy of ones charged with the best chargers.

Once charged, Lithium Ion batteries don't lose very much of their power while being stored; single-use Lithium Ion batteries are essentially unaffected by sitting unused for several years. However, NiMH batteries don't maintain their charge as well; their charge gradually dissipates while sitting on the shelf. Get in the habit of recharging batteries when you're done shooting, and always have at least two fully-charged sets of batteries: one in the camera and one in the camera bag so you're always ready for a mission. Also, it is best to charge batteries as a set so that they grow old together.

Use the AC adapter when you perform extensive editing on pictures stored in your camera or when you're downloading your photos through the camera's cable connector.

Assign someone to check the batteries and charge them as needed (maybe in conjunction with one of your periodic meetings).

5.2 Lenses and LCD/Viewfinder

The lens, LCD, and viewfinder must be kept clean and protected from scratches. Ensure lens caps are kept in place anytime the camera isn't being used, and that the cap is secured to the camera with a strap. Cleaning supplies (as recommended by the manufacturer) should be kept in the camera bag.

5.2.1 Cleaning the Lens

The best way to ensure a clean lens is not to let it get dirty in the first place! Always keep a lens filter over the lens, and use the lens cap when the camera is not in use.

Read your camera's and lens user manuals! Many recommend that you do not try to clean the lens but instead take it to a dealer or other professional.

Most lenses are coated with a micro-thin anti-reflection coating. Although lens coatings are resilient, they are still relatively easy to permanently scratch. Once a lens is badly scratched, its sharpness is diminished and the image contrast is reduced. A scratched lens is quite costly to repair; in fact, it's generally less expensive to replace the lens than to try to repair it.

Each time the lens is cleaned there is the risk of tiny abrasive particles present in the tissue, creating microscopic scratches in the coating. For this reason a lens should not be routinely cleaned (the way you regularly wash your hands, for example); *a lens should only be cleaned when you see dirt or dust on the lens surface.*

Small quantities of dust on a lens will not appreciably affect photo quality, but fingerprints or oily smudges are a different matter. If not promptly removed, the acids in fingerprints can permanently etch themselves into a lens coating.

And believe it or not, there is a right way and a wrong way to clean a lens. Clean it correctly and you'll maintain peak optical performance; clean it the wrong way and you could scratch the lens.

- a. Carefully blow off any dust or dirt, using a blower brush or (very carefully!) compressed air. If you use a brush, do not let the fine bristles of the brush touch your hand or fingers; oil from your skin will be transferred to the bristles and then smeared on the lens.
- b. Dampen a lens tissue with lens cleaner and very gently rub the lens in a circular motion. While very gently rubbing, turn or roll the tissue slightly so that any dirt will not be rubbed over the lens surface. [Note: Never drip lens cleaner directly on a lens; it can easily seep behind lens elements and create a major problem.]
- c. Gently wipe the lens surface from the edges toward the center of the lens, with a lifting rather than rubbing action. A micro-fiber cleaning cloth is a good alternative to lens tissue and requires no lens-cleaning fluid. Do not reuse cleaning tissue, and keep any micro-fiber cleaning cloths in their original containers to keep them clean. Micro-fiber cloths are washable and can be tossed in with your laundry periodically. [Don't clean a lens with silicon-treated lens tissues or the silicon-impregnated cloths commonly sold for cleaning eyeglasses as the residue may permanently discolor the coating. And don't use a cotton T-shirt or other fabric, which may have embedded grit in the material.]

5.2.2 Condensation

Condensation or raindrops on the lens can distort or even totally obscure an image. When a camera is taken from a cool area into warm air, the lens frequently fogs up; this can be a real problem in cool climates when camera equipment is brought inside after being outside in the cold for some time.

Even though moisture may be wiped off the lens, the lens may continue to fog up until its temperature equals the surrounding air.

Condensation can also take place within a camera or camcorder and cause major problems. For this reason, most camcorders have a dew indicator that detects moisture or condensation within the unit and shuts it down until the moisture has evaporated. A message such as "DEW" will typically be displayed in the viewfinder.

To control the effects of condensation, you should allow 20-30 minutes warm-up time whenever you bring a camera or camcorder from a cold to a warm environment. Also, putting the camera in a plastic bag will help prevent the lens from becoming foggy; if condensation does form, it will do so on the bag instead of the camera. [Note: *Do not* store your camera in a plastic bag; the case can deteriorate.]

If condensation occurs, remove the memory card and battery from their compartments and keep the doors open until everything dries out, and remove the lens cap. Don't take the camera or camcorder out into the cold again until the condensation is gone because the moisture may freeze, causing permanent damage.

5.3 Filters

As a rule, filters are of little use with a digital camera except as a means to physically protect your lens. Consider using a Skylight, 81A or UV filter, shooting your pictures through it and removing it only when you're using another filter for special effect. [A damaged filter is much cheaper to replace than a lens.](#) Protection of this type is particularly important when the camera is used in high winds where dirt or sleet can be blown into the lens.

5.3.1 UV Filter

Today's coated lenses don't transmit UV light, so a UV filter doesn't add much functionality. UV filters do slightly enhance image color and contrast, and can reduce haze in distant scenes; this can bring the scene being photographed more in line with what the eye sees. Video cameras tend to be rather sensitive to ultra-violet light, which can add a kind of haze to some scenes. *This is the preferred filter for CAP purposes, and mainly serves to protect the camera lens without degrading quality or interfering with the camera's automatic functions.* Always use a multicoated filter, which helps reduce glare and helps with light transmission (which results in a brighter image).

5.3.2 Polarizing Filter

A polarizing filter is one that only passes light vibrating in a certain direction, which is good for eliminating reflections from shiny surfaces such as glass or water. Most autofocus cameras use polarization tricks as part of the autofocus system. If needed, always use a 'circular' polarizing filter because 'linear' polarizing filters cannot be used effectively with most auto-exposure and autofocus cameras. To use a polarizer, attach it to the end of your lens and rotate it until the reflections are gone.

For CAP purposes, polarizing filters are usually only helpful when you are shooting over or by water. You get a two-stop light penalty with a polarizer, and it may be difficult to get a fast enough shutter speed when using the polarizer. Only use a polarizer if you get more benefit from the polarizing action than the quality loss from the longer shutter speeds required because of the light loss.

5.4 Media Cards

Keep your media cards (the one in the camera and the spares) empty whenever possible. You don't want to grab the camera for a mission, fly to the target, and then discover that the card is full of photos from a previous mission.

Keep in the habit of transferring photos to a PC promptly, and then format or erase the card before putting it back into the camera or into the camera bag as a spare. Regularly formatting your memory cards will help prevent them from becoming corrupted. This is especially important because of the requirement to delete all Air Force Assigned Mission (AFAM) photos after the mission is closed.

Avoid leaving media cards in direct sunlight, and don't put them in your pocket or other places where they can get bent or crushed.

Never write on media cards or put any kind of sticker on them to label their contents. This can damage the card or the camera.

Note: A handy item to include in your camera bag is a small, inexpensive media card reader. These USB-connected readers enable you quickly and easily transfer images from many types of media cards to a computer/laptop or other device. For example, if you need to transfer your photos to a USB flash drive, simply connect both your media card reader and the flash drive to the computer/laptop and insert your media card into the reader. Since both the reader and the USB flash appear as computer drives, you can transfer the photos directly to the USB flash drive.

6. Preparing for an Imaging Sortie

The key to a successful imaging mission is preparation, planning, patience and practice!

Airborne Photographers must know how to prepare for an imaging (photo or video) sortie. The great majority of our imaging missions are “fly back” missions, where we take photos or video, return to base, and then transmit the photos/video to our customer. Missions where we take photos and transmit them from the aircraft (the older Slow Scan and the new Satellite Digital Imaging systems) require specialized equipment and training. However, the way we plan and take the photos is the same whether it is a fly back or ADIS/GIIEP mission. [Unique aspects of ADIS and GIIEP missions are discussed in separate documents.]

OBJECTIVES:

1. Discuss the basic difference between a “fly back” and ADIS/GIIEP missions.
2. Discuss the importance of determining exactly what a customer expects and needs from a particular imaging mission.

Using the *Customer Imaging Request Checklist*, discuss the importance of determining exactly what a customer expects and needs from a particular imaging mission. {O-2210 & O-2215}

3. Concerning an aircrew briefing for an imaging mission, discuss:
{O-2210, -2215 & -2217}
 - a. Why it is important to be aware of the information necessary to complete a successful mission, just as mission staff
 - b. Crewmember responsibilities during each phase of the flight
 - c. Factors to consider when determining sortie duration, including rules of thumb for the time it takes to assess the target, fly imaging patterns, review photos and re-shoot one photo
 - d. Effects of weather on an imaging sortie
 - e. The importance of the Target Control List, Photography Log and Target Cards {O-2216}
 - f. Special requirements for video sorties

Obtain a briefing for an imaging sortie that includes both the “Four Square” and “Bird’s Eye (Overview)” imaging patterns. {O-2210}

4. Using diagrams, describe the basic types of imaging flight patterns and when they are used. {P-2208}
5. Discuss the importance of communications between the pilot and AP and between the log keeper and AP, when proper communication is of the greatest importance, and the types of adjustments you may have to tell the pilot to make to properly frame a target. {P-2208}
6. Discuss factors that can affect the success of an imaging sortie, including: {O-2210 & P-2209}
 - a. Artificial Deadline or Impatience
 - b. Vibration
 - c. Visibility
 - d. Focus
 - e. Wind
 - f. GPS Satellite Signal Reception
7. Using the *Imaging Sortie Checklist*, discuss: {O-2210 & O-2218}
 - a. Equipment inventory
 - b. Camera and portable GPS setup, including how to synchronize a camera’s clock with a stand-alone portable GPS
 - c. Preparing the aircraft

6.1 Briefings

It is vital that the crew knows what the target is and what the customer wants, so make sure that the customer has described both in order to avoid confusion and cause the sortie to be re-flown because the results weren't what the customer expected. For example, the customer may ask you to take pictures of a levee and, if there are any signs of flooding or seepage, to capture photos that show the extent of the leakage. Also, the customer may dictate very strict requirements for an imaging sortie, telling the crew what altitude to fly and the precise angle for the photos or video. The customer may also require more than one picture be taken from each direction or angle. Whatever the requirements, CAP aircrews can deliver the desired results by getting a thorough briefing, which in turn allows you to properly plan the sortie.

Sometimes the customer won't spell out how they want the pictures taken, nor will they tell you how many pictures to take. The orders you receive may just say "Take pictures of the tornado damage" or "Get pictures of the Lake Meredith dam." In these cases, the mission briefer (or aircrew) must ask enough questions to ensure the customer gets what they really want.

Note: Sometimes the customer really doesn't know exactly what they want, and truly mean for the crew to "Take pictures of the (whatever) damage." In these cases, the staff and imaging aircrews will use their knowledge of aerial imaging and damage assessment to bring back pictures that will meet and usually exceed the customer's expectations.

Normally the mission staff will have obtained all the information the aircrew needs and has prepared a thorough briefing. However, an imaging aircrew needs to know all the information that is needed for a successful mission (and a satisfied customer) so they can ask for any information that is missing from the prepared briefing.

6.1.1 Determine the Customer's Needs

You must know the purpose of the sortie and what the customer expects to see as a result. The end use of the photos or video will determine what equipment the aircrew needs to accomplish the mission, how they will set up the camera/camcorder, and how they will plan and fly the sortie. Just as importantly, understanding the customer's objectives is vitally important for customer satisfaction; if we don't deliver they may never request CAP's assistance again!

Mission command or staff is normally responsible for getting enough information from the customer to conduct a thorough aircrew briefing, and satisfy the customer's needs. Some customers know exactly what they want and give CAP a complete and detailed request. Some customers either assume you know what they want or don't give you enough information in the first place. Some customers don't really know what they want, but if the final product doesn't meet their (unvoiced) expectations they will be dissatisfied with CAP. So it is up to the CAP to ensure they have enough information to plan and brief the imaging mission.

Details you need include (the checklist is in Attachment 1):

- a. What and where is the target? Get the exact location of the target(s). Even though the customer just gives you a name or location (e.g., the “Lake Meredith” dam or the “southwest part of Pampa”), try to define the target location by at least two forms of navigational information such as Lat/Long and VOR radial/DME. Also ensure that you get a good verbal description of the target.

Note: Two useful tools associated with coordinates are the COsports.com *Latitude / Longitude Coordinate Converter* that allows you to convert between the three commonly used unit types (www.boulter.com/gps/), and the *iTouchMap.com* that allows you to find the Lat/Long of a point or address or show a point on the map using the known latitude and longitude (www.itouchmap.com/latlong.html).

- b. How the target and surrounding features should be photographed. Some questions to ask are:
 - 1) Is the target a single feature or facility, such as a building? If so, do they want as close a picture as possible (e.g., completely filling the frame)?
 - 2) Does the customer want to see the target and its environs to allow a larger perspective?
 - 3) Does the customer want to see roads and/or power lines leading to or from the target? If so, how far out from the target? You need this information to determine if you can get the desired results in one photo without losing the desired level of detail. You may have to take several photos to get the desired results.
 - 4) Does the customer want to see the extent of flooding below a dam or levee, or the entire trail of debris from a tornado?
 - 5) Does the customer want wide photos followed by close-ups?
 - 6) Does the customer want the photos taken from a certain altitude (AGL) or from a specific angle to the target? Or is it OK to change altitudes and/or zoom as necessary to get the best shot? This will affect how you plan and fly the imaging pattern.
- c. Does the customer care about lighting conditions over the target area? The customer may not want photos taken under a heavy overcast, or in early morning or late afternoon light. Note: Commercial aerial photography flight times are usually limited to between three hours after sunrise and three hours before sunset; this ensures the sun angle is at least 30° above the horizon.
- d. What information do they want to accompany the photos (or be included in a video’s audio commentary)? Accompanying information may include:
 - 1) Altitude (MSL or AGL, or both?)
 - 2) Latitude and Longitude (GPS format OK?)
 - 3) Time (local or Zulu; cameras and GPS are usually Zulu)

- 4) Distance from target (nautical or statute miles?)
 - 5) Direction to target (e.g., looking South)
 - 6) Angle to target (e.g., 45°)
- e. What photo format do they want? Do they want JPEG or an uncompressed RAW photo, or both (RAW + JPEG)? This also helps you determine how large (or how many) media cards you will need for the sortie.
 - f. What quality do they want (e.g., highest, medium or low)? This also helps you determine how large (or how many) media cards you will need for the sortie.
 - g. Do they mind if you crop photos, if needed? This will help you determine if a particular photo you took is acceptable. If your photo contains part of the wheel, wing tip or strut but is otherwise OK, and the customer doesn't mind you cropping the photo, then you won't have to re-shoot the picture; just crop the photo once you're back at mission base.
 - h. Do they mind if you edit photos, if needed? This will also help you determine if a particular photo or set of photos you took is acceptable. If your photo was taken under cloud cover or some other condition that affects lighting, but is otherwise OK, then you won't have to re-shoot the picture; just edit the photo once you're back at mission base (assuming the customer doesn't mind you adjusting image brightness or contrast).
 - i. Do they want you to add text or symbols to the photos? This may include some of the information listed above, along with arrows or circles.
 - j. How do they want you to name the photo files? Be specific, especially as to the sequence of information contained in the file name. For example: Date (dd/mm/yy) / mission number / sortie number / photo (sequential) number. Remember that photos/files uploaded to the FEMA Image Uploader should not be renamed.

NOTE: Most customers don't want us to edit (or even crop) photos!

- k. How do they want you to deliver the photos? This is usually done by upload into the FEMA Image Uploader, but it may be done by direct transfer. *Mission staff should ensure they know how to access the photos.*
- l. If the customer wants you to e-mail the photos this may affect file format and quality (file size) settings. If you do e-mail the photos, ask what information the customer wants in the "Subject" and "Remarks" areas of the e-mail. What is the e-mail address of the customer or customers? Do they want you to cc: or bcc: anyone? Do they need to enter your e-mail address in their "anti-spam" software so it isn't blocked? Do they want you to call before sending the photos, and if so, what is the phone number (plus a backup)?

NOTE

The customer may ask for GPS coordinates to be written in the degrees/minutes/seconds format (not the GPS format).

6.1.2 Staff Briefing

Primarily IC/PSC and Briefers; IC/OSC and AOBD kept informed.

Once the mission staff is satisfied they have determined the mission objectives, they will finalize their target control list and put together the briefing package for the aircrew(s). The staff should also be careful not to pair an inexperienced pilot with an inexperienced photographer; one or the other should be experienced in imaging missions. In addition to the briefing items specific to the imaging mission (see above), information should include:

- Terrain, obstacles and ground cover around the target(s).
- Weather (local and target area).
- Hazards to flight and military routes (local and search area).
- Aircraft separation (will others be in the area?).
- Communications call signs, frequencies and procedures.
- Time format (local or Zulu; cameras and GPS should use Zulu).

6.1.3 Aircrew Planning and Briefing

The Mission Pilot and Airborne Photographer should also be aware of the information necessary to complete a successful sortie, just as mission staff (see above). This allows the aircrew to know whether or not they got a complete briefing, and acts as a backup to mission staff. This information also is a factor in deciding how the AP will set up the camera or camcorder. The *Imaging Sortie Checklist* (Attachment 2) will help you in this process.

The AP and the Mission Pilot must work closely to ensure a successful imaging sortie. Planning the type of pattern(s) to be flown (see below for examples) and reviewing the communications between the pilot and AP go a long way in assuring a successful outcome. Preferably, a third crewmember should be included to keep a photo log and assist the crew by monitoring the scene during shooting and/or communicating with ground assets.

Make certain that each member of the crew knows their responsibilities during each phase of the flight. The AP is normally the Mission Commander when the aircraft is in the vicinity of the target, while the Mission Pilot retains responsibility for the safety of the flight as Aircraft Commander.

Part of the planning should include, where possible, Google *Earth* images of the target area; this helps the crew familiarize themselves with the target and surrounding terrain.



When planning, allow time to look over the target during and after the ID pass to decide what the best altitudes, angles and directions you'll need to fly to get the best photos. Also remember that the more pictures you take the better chance you have of getting the required photos; therefore, allow for plenty of time over the target. Then plan extra time to review the photos and reposition the aircraft to re-shoot one photo. A good rule of thumb is to allow:

- 5-10 minutes to assess the target during the ID pass
- At least 15 minutes to fly an imaging pattern (the Bird's Eye may take more time to determine the proper altitude for the shot)
- 5 minutes to review the photos
- 15 minutes to re-position the aircraft to re-shoot one of the photos

Note: [To file an FAA Flight Plan for an imaging sortie where you'll be spending considerable time flying photography patterns, you can adjust your "Route of Flight" to reflect this.](#) FSS works off of VOR radials so when you determine your pattern entry point pick out a close by VOR and determine the radial (and distance) from that VOR. For example: KDTO ADM 207 radial 11.3 miles / +1.5 FUZ 360 radial 50 miles / KCWC. This reads "Takeoff from Denton, arrive at the entry point (ADM VOR 207 radial 11.3 miles), delayed 1.5 hours in the imaging patterns, come out of the grid at the exit point (FUZ VOR 240 radial 50 miles), and land at Kickapoo."

If the customer really doesn't know exactly what they want (e.g., they just want you to perform damage assessment and take video or pictures), plan extra time after the ID Pass for an assessment survey of the damage; the crew will then decide what pictures are needed and how to get them.

Plan to check fuel status (at least hourly) to determine if a refueling stop will be necessary to safely complete the sortie. Also plan to check altimeter settings hourly.

Weather can be more of a factor in video imaging than in other missions (e.g., overcast or high clouds can affect the quality of your photos). Get as much information as you can, especially in the target area. If a front is passing through, it may be best to delay launch in order to improve your chances for a successful imaging mission.

Determine Photography Log and/or Target Card requirements from the target list. Even though the crew may have to prepare the target cards themselves, the short time expended on this effort can save more than 30 minutes by the end of the sortie. Brief the log/card keeper on data needed and how the Mission Pilot and AP will communicate this information. If necessary (e.g., you don't know what damage to expect over the target area), discuss whether or not to draw a sketch of the damage to aid in planning your imaging patterns.

Target cards are a good adjunct to the target list given to each aircrew; these are 3x5 index cards (or similar) with the common name of each target written on them, preferably in sharpie or magic marker to make them more legible. Some Target Cards may also have the coordinates of the target written beneath the target name for reference purposes. These cards can be used instead of, or to supplement, an aircrew's Photography Log. [Target Cards are especially useful when there are a large number of targets to be taken in quick succession, where keeping a log is very difficult or impossible.](#) Additionally, a single sortie card should be included with the mission and sortie number(s) written on it.



Sample Target Card

The AP will photograph the applicable Target Card just before taking pictures of each target. This replaces (or supplements) Photography Log entries.

Note: When taking hundreds of photos in a single sortie, you won't have time to check a log or use target cards. You just have to rely on the GPS (or data logger) to input coordinates into each photo's EXIF file.

If shooting video, determine what needs to be included in the commentary and discuss how to set up the Audio Panel and Intercom during the run in order to minimize extraneous conversation (including ATC communications).

As with all CAP mission planning, the Mission Pilot and/or Observer must get enough information to fill out the sortie Planning and Briefing information in WMIRS:

- Objectives and deliverables
- Route of flight (see the Note, above)
- Direction of tracks, track spacing, search altitude and airspeed
- Hazards to flight and military routes (local and search area)
- Aircraft separation
- Weather (local and area of operations)
- Communications call signs, frequencies and procedures
- Actions to be taken on objectives and deliverables
- Estimated time of departure and time enroute
- Hazards and emergency/alternate airfields
- Whether using Local (preferred) or Zulu time (synchronize crew watches)
- Type and location of ground assets, and how to contact them and when

Notes:

- Ensure your 'Route of Flight' clearly describes your intentions; include any fuel or rest stops
- Double-check your estimated time enroute, fuel reserve and estimated fuel burn
- Review your planning aids (target cards, marked-up charts and notes) for accuracy and legibility

6.2 Imaging Flight Patterns

6.2.1 Types of Imaging Patterns and Use

The *4-Square* imaging pattern is one of the standard imaging pattern for most missions, as it is the simplest and most stable pattern that results in very good photos.

The *Bird's Eye* (Overview) pattern is another standard pattern that is used to show an overview of a target or when photos need to show detail between structures (e.g., between buildings or between trees). This pattern is also useful when you need to take a continuous series of vertical-angle photos, such as along a levee, road or coastline. This pattern is also used when the customer wants to use georeferencing.

The *Circling* pattern is more difficult to master, particularly if the photographer is shooting out the right-side window. This pattern is good for taking quick shots of multiple targets, and can be used if a quick survey of wide-spread damage is needed by staff to determine resource needs and plan more detailed sorties.

The *45° Angle* pattern is used when the customer specifically asks for these types of photos.

See Attachments 3-7 for imaging pattern planning sheets to use on imaging missions.

Both the Mission Pilot and the AP must be familiar with how any particular imaging pattern will be approached and flown; that's why planning is so essential to a successful mission. Once you decide on which type of pattern to use, fill in all the data you need (e.g., Lat/Long of all entry and turning points) to fly the pattern using the GPS and/or VOR.

6.2.2 Basics Steps of an Imaging Pattern

Aerial Imaging flight patterns are always flown at 1000' AGL or higher.

How the Mission Pilot maneuvers the aircraft into the proper position for each shot is very important. The approach to the pattern should be slow and stable, and the AP must be given enough time to analyze current conditions and set up for the photo or video imaging run.

Every imaging pattern starts with an "ID Pass" that allows you to verify the target and note its coordinates. Examine the target, its surroundings, and lighting conditions. *Verify that what you see is what you planned for and that you can properly frame the target*; if not, have the Mission Pilot pick a safe location to loiter and re-plan how to perform the imaging run (e.g., determine the altitude, angle and directions you need to get the best photos) and how you wish to frame your photos.

If you are performing damage assessment and didn't know the extent or type of damage to expect when you left on the sortie, the ID Pass will be followed by a recon survey. The circling flight pattern (below) is a good pattern to use to survey of damage. Also, you may want to sketch the damage to help you decide what photos you need and what imaging flight patterns to use. Note: You may need a combination of flight patterns and/or need to make several runs to capture all the damage. Be sure to check your fuel status as you may need to refuel and return to complete your sortie, and update Mission Base on your new sortie time assumptions.

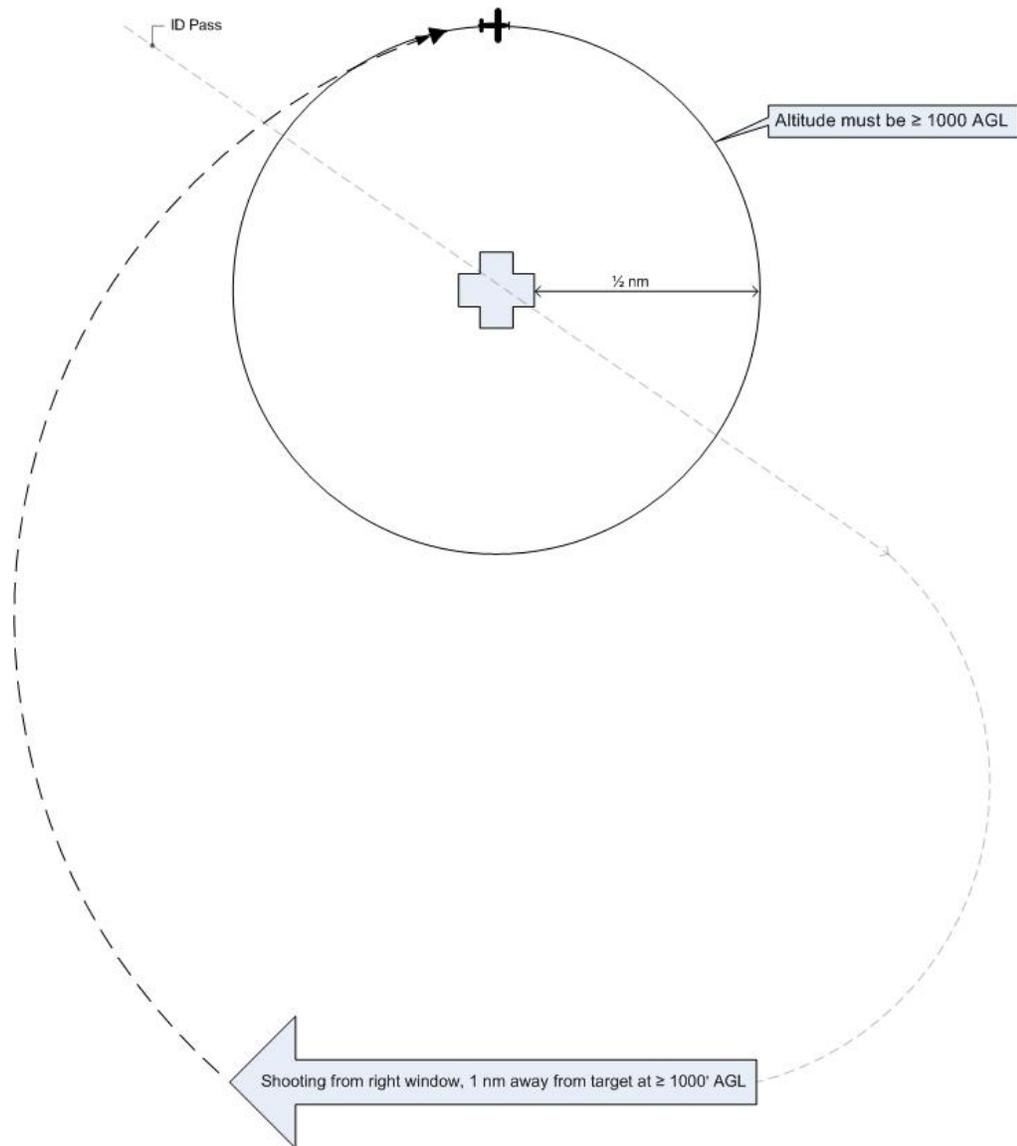
After the ID Pass (and damage survey, if needed), fly the patterns as shown below. Remember to fly slowly enough so the photographer can get several photos from each angle or side.

Photo examples of each type of the following imaging patterns can be found in the Airborne Photographer Course Slides.

Note

The patterns shown below imply use of the cardinal compass points, which is the norm. However, crews may adjust the patterns to face whatever directions work best for the specific circumstances.

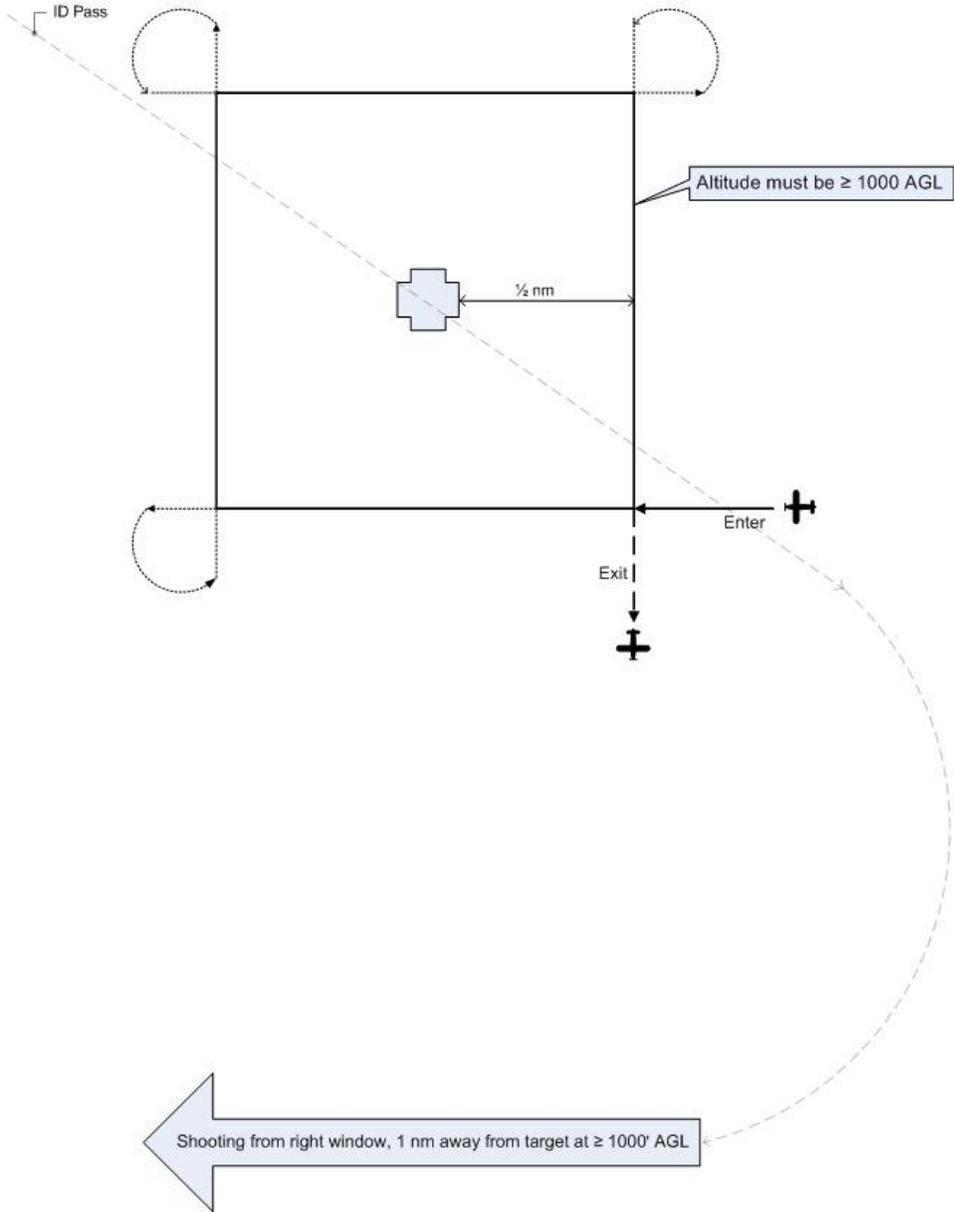
6.2.3 Circling Imaging Flight Pattern



Note: The AP should be looking north. The pattern shows an entry for aircraft shooting from the right side of the aircraft; for aircraft shooting from the left side, simply reverse the entries.

Note: The circling portion of the pattern is shown at the CAP lowest allowable altitude (1000' AGL). Actual (higher) altitude depends upon customer needs and the AP's discretion.

6.2.4 4-Square Imaging Flight Pattern



This is a more stable variation to use in place of the circling pattern.

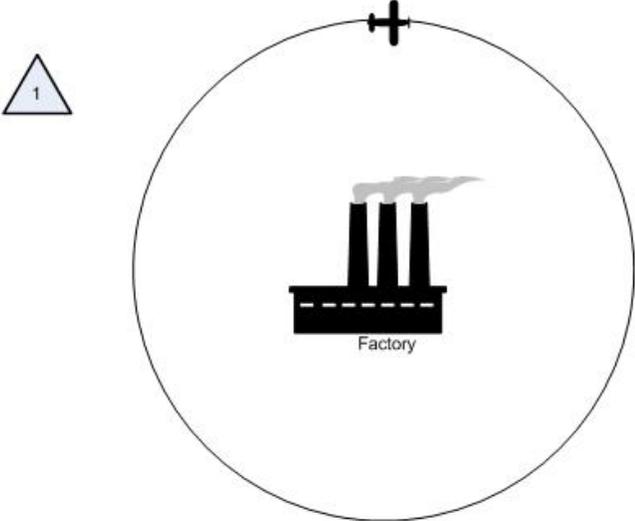
Note: The pattern shows an entry for aircraft shooting from the right side of the aircraft. For aircraft shooting from the left side, enter at the lower left and exit at the lower left.

Note: The pattern is usually flown to the cardinal points (i.e., north, south, east and west), but actual orientation depends upon the target layout and the AP's discretion.

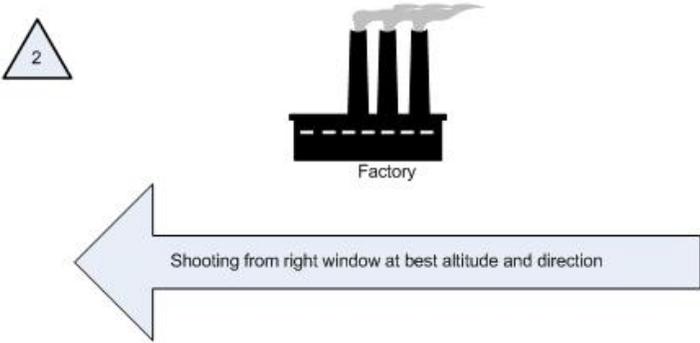
Note: This portion of the pattern is shown at the CAP lowest allowable altitude (1000' AGL). Actual altitude depends upon customer needs and the AP's discretion.

6.2.5 Bird's Eye (Overview) Imaging Flight Pattern

Bird's Eye (Overview) Imaging Pattern



Circle target to find the altitude that will permit horizontal framing and determine the best direction from which to take the imaging photo



Approximately 75 knots (not $\leq V_x$), 10° flaps, 10° bank and full opposite rudder

An imaging mission may require an overhead view (bird's eye view) of a target such as an unimproved runway or infrastructure such as water treatment or power plants. These photos may also be used if the customer wants to geo-reference the target. The intent is to get a photo looking "straight down" on the target. In this case the crew may have to fly higher than the circling/4-square imaging pattern height; altitudes of between 2500' and 4000' AGL (or higher) are typically needed to get a bird's eye view of a large target area.

Basic steps:

- a. Fly the “ID Pass” to verify the target and note its coordinates. Examine the target and its surroundings, and decide how to frame your photos.

Use this opportunity to determine if your altitude will allow you to frame the entire target area in one shot. Climb or descend as necessary to determine the correct altitude.

Note: You may be tempted to turn the camera vertically in order to get the target area in one photo – don’t. This type of shot often truncates the ‘far’ side of the photo (i.e., it looks as if it’s thinning or “falling away” in the finished photo). Instead, climb higher so you can take the photo while holding the camera normally (horizontally).

- b. Note the direction that will result in the best shot. In this type of imaging sortie you may only need a good shot from one direction (as opposed to taking photos from at least four cardinal points in the circling or 4-square pattern).
- c. Once you’ve established the correct altitude and direction of flight, the pilot will maneuver onto the desired heading at least one mile away and stabilize the aircraft at approximately 75 knots with 10° flaps.

Note: Slowing down and putting in 10° of flaps allows for better control of the aircraft when the pilot begins banking for the photo run. This minimizes the amount of bank necessary to give the AP an overhead view of the target, and makes it easier to put in up to full opposite rudder in order to maintain heading while banking. [If you are shooting out of the front right-side window and have it open, this speed and flap setting may cause the window to partially close. Have the back-seat crewmember hold the window open in this situation.]

- d. As you approach the target, the AP will inform the pilot to get into position. The pilot will then put in approximately 10° bank and hold opposite rudder to maintain the heading. The AP will continuously communicate with the pilot to ensure the desired heading and angle to the target.

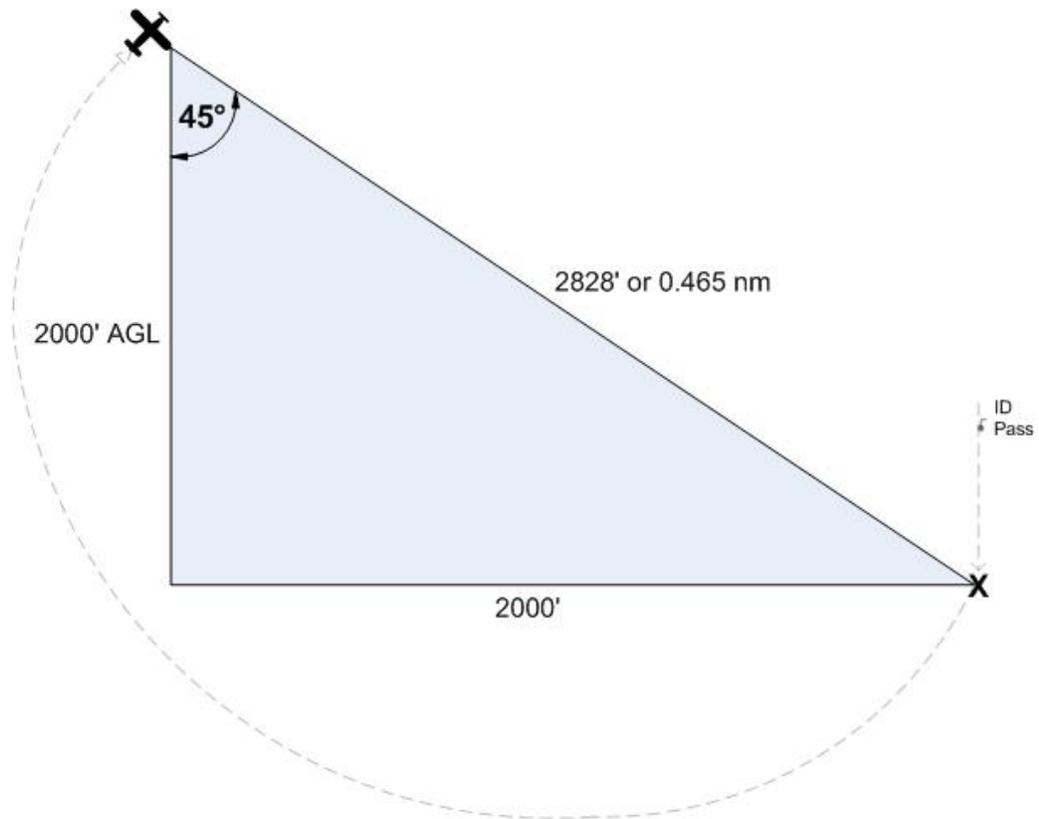
Note: The pilot may notice that she is losing some altitude while banking for the photo run. The altitude loss should be minimal for the time it takes to get the shot, so no effort need be made to maintain altitude during this time.

- e. Once the AP takes the shot, inform the pilot so that she can return to normal flight attitude. The AP will then review the results to see if another run is required.

NOTE: This type of pattern may be modified to provide vertical shots of “continuous” targets, such as the area behind walls or levees or along a road or a coastline.

6.2.6 45° Angle to Target Imaging Flight Pattern

45° Angle to Target Imaging Pattern 2000' AGL Example



Height (AGL)	NM for 45° Angle
1000	0.233
1500	0.349
2000	0.465
2500	0.582
3000	0.698
3500	0.815
4000	0.931
4500	1.047

An imaging mission may require photos of a target from a specific angle, most often 45 degrees. The diagram and table below shows how to obtain the proper angle. The customer may specify the altitude, and all the crew needs to do is consult the table to see how far from the target they need to be in order to establish a 45° angle. If the customer doesn't specify the altitude, then the crew will have to determine what altitude/distance relationship is required to frame the target properly.

Basic steps:

- a. Fly the "ID Pass" to verify the target and note its coordinates. Note the direction that will result in the best shot. In this type of imaging sortie you may only need a good shot from one direction.
- b. Enter the target's coordinates into the GPS as a waypoint and select it. This will allow you to determine the correct distance to the target per the table. [Note: Even though the table gives distances to the 1/1000th of a nautical mile, for practical purposes getting the distance to the nearest 1/100th nm will suffice.]

Determine if the altitude you planned for (e.g., 2000 AGL) will allow you to frame the entire target when shot from the required distance (as determined from the table). If not, you will have to select another altitude/distance relationship to frame the shot.

- c. Once you've established the correct altitude, the pilot will maneuver onto the desired heading and stabilize the aircraft at approximately 75 - 90 knots.
- d. As you approach the target, the pilot will give a countdown so the AP will be prepared to take the photos when the aircraft is at the proper distance from the target.
- e. Once the AP takes the photos, inform the pilot so that he can return to normal flight attitude. The AP will then review the results to see if another run is required.

6.3 Flexibility and Improvisation

Although the imaging patterns we discussed will cover many situations faced by CAP serial photography crews, new and different circumstances will arise that require the mission staff and aircrews to adapt the basic patterns to new challenges.

For instance, the *Nikon D90 Checklist and Operations* manual developed by National HQ includes guidance and tips for taking photos with a consistent pointing angle (45°) using a monopod, using a remote timer to take multiple, overlapping photos in a specific sequence (e.g., every four seconds), and a table for finding the best point angle and focal length to produce a specific image size (at ground level).

Examples of the need for flexibility and improvisation include massive hurricane damage (e.g. Katrina, Ike and Sandy), the Deepwater Horizon oil spill, and extensive flooding damage along the entire length of the Mississippi River.



Hurricane Sandy as captured by NOAA GOES-13 Satellite

The most extreme example is Hurricane Sandy. Over 100 aircrews from three Civil Air Patrol regions conducted post-hurricane aerial photography missions covering more than 300 miles of coastline from Cape Cod, Mass., to Cape May, N.J. The aircrews took more than 140,000 photos over the course of several days for the Federal Emergency Management Agency, which used the photos for damage assessment (FEMA shared the photos with other federal agencies as well as affected state and local Emergency Services agencies). CAP aircrew took photos of effectively every square inch of the effected coastline.

The Maine Wing's Incident Commander (Col Dan Leclair) stated that this was a "cultural change" in how CAP takes pictures, as they had to photograph everything, regardless of whether there was damage or not. This allowed FEMA to readily pinpoint the areas of greatest need. The aircrews rose to the occasion

by flying grid patterns similar to those CAP follows in conducting SAR missions and taking overlapping photos along each leg of the patterns.

Another example of flexibility and improvisation occurred during the Mississippi River flooding in 2011. CAP Louisiana Wing was tasked to take photos of the levees on each side of the river for the length of the state. They responded by modifying the overhead (bird's eye) imaging method, flying along the levee and taking continuous, vertical, overlapping photos to show the condition of the levees and discover any seepage under the levees.

The adoption, about one-third of the way through the mission, of Target Cards provided a significant reduction in manual photo processing workload and was identified as a best practice for future missions.

The skills you learn and perfect during your training and qualification as Airborne Photographer will serve as a launching point whenever a new and different circumstances arise, allowing you to provide valuable input into the mission planning process and giving you (and the mission pilot) the ability to improvise in order to satisfy new and unexpected requirements.

6.4 Crew Communications in Imaging Patterns

The first pass by the target is very important. This is the time to determine if you are at the correct altitude for best results; that you are at the correct distance from the target; if you are flying at the correct speed; and whether or not you need to (and can) use the zoom to properly frame the photo. If any of these conditions aren't met, have the pilot turn around, correct the problem, and redo the first pass.

The Mission Pilot must be as close as possible to the target (horizontally at ≥ 1000 AGL) while still allowing the AP to properly frame the target. *If you are at the right distance from the target but can't quite get the entire target (e.g. a runway) in the frame, gain altitude rather than moving away horizontally.* If you are too far away from the target, move in horizontally.

The MP must strive to keep the AP in the proper position for a shot. Small adjustments, not obvious to the pilot, must often be made to get the right angle or position. Lifting the wing, moving the strut out of the frame or making minor course (heading) changes are the most common adjustments. The pilot must be aware these maneuvers may be necessary, and the AP must know how to direct the pilot. Keep the directions clear and simple: "Lift your wing" or "Move the strut forward" or "Left 10°" tells the pilot all she needs to know. The pilot also needs positive feedback, especially if you are shooting out of the right-side windows; use simple words such as "Good, good" to let the pilot know they're on the right track and speed. Finally, tell the pilot when the adjustments are no longer required by saying something like "OK, I have the photos".

NOTE

Sometimes wind direction/speed forces the pilot to tilt the wings or crab so much (in order to maintain the planned flight path) that the AP can't properly frame all of the photos as planned. In this case, try taking the photos from another direction (e.g., from the northwest rather from the north) or note the difficulty and discuss it during debriefing.

The AP also has to clearly and concisely communicate her intentions and actions to the log keeper. Also, if the AP will be taking several photos per leg, she should tell the log keeper “the following photos will be taken looking east (or looking northeast or looking between the northern-most buildings), then call out “shot 1, shot 2, etc.” This allows the log keeper to quickly and accurately log the photos.

The AP must decide whether the pictures satisfy all mission requirements. Don't be afraid to admit that you didn't get a particular shot, and ask the Mission Pilot to reposition for another try. Never hesitate to make another pass or to reposition the aircraft to ensure a good photo, and don't let any other crewmember rush you. Remember, you should take as many photos as you think you need to fulfill mission requirements – there's plenty of room on your storage media, and [the extra time you spend doing this on-scene is much less expensive and time-consuming than having another sortie go back to the target because you didn't get quality photos.](#)

Effective crew communications also depends on a thorough understanding of the operation of the aircraft Audio Panel and Intercom, especially when there is a third crewmember on board to keep the Photo/Recon Log or Target Cards. Plan how you will set up these instruments during all phases of flight, particularly when you are in the target area. [Additionally](#), the third crewmember (normally a Mission Observer in the right-front seat) maintains the MO/MS duties of scanning, log keeping, and tracking radio calls and reports, but [should also monitor aircraft altitude and speed because the MP can get very busy positioning the aircraft for the AP.](#)

6.5 Factors Affecting Success of the Sortie

6.5.1 Artificial Deadline or Impatience

If you don't plan for enough time to assess the target after the ID Pass, properly fly the imaging patterns, review the photos, and possibly re-shoot a photo before returning to base, you can create an “artificial” deadline that may cause you to hurry your shots and risk returning to base without all the quality photos you were tasked to get. The result can be an unsuccessful sortie that will have to be re-flown.

For example, assume your target is 50 nm from mission base and you're tasked to take photos from above (Bird's Eye) and from all sides (4-Square). You should plan for a transit time of one hour and allow at least 50 minutes for assessing the target, obtaining the photos, reviewing the photos, and possibly re-shooting one photo. Instead, you decide upon a total sortie time of 1.5 hours (an artificial deadline), launching at 1100 and returning to base by 1230. Now everyone (crew and mission base staff) is locked into the 1.5 hour sortie. You and your crew has it in their minds that they have to be back at base by 1230 so the next sortie using your aircraft can launch on time.

If you're successful, you've saved 20 minutes. However, if you are so mindful of being back by 1230 that you don't take time to review your photos before turning back to base you risk returning without all the quality photos you were tasked to obtain. Another crew will have to go back to your target to obtain the photos you failed to get. Instead of taking an hour and fifty minutes to obtain the photos, it will now take at least three hours to get all the photos!

6.5.2 Vibration

Vibration comes from the airplane, its engine and air turbulence. To reduce the effects of vibration, hold your camera properly and don't rest any part of the camera or your body against the airframe. In particular, keep your arms and elbows from coming in contact with the window sill or armrest. Ideally, the only part of the airframe that will be in contact with your body is the seat cushion.

Normally the camera is set for the Automatic (or Program) mode, letting the camera set the shutter speed and aperture. However, if you need to use the Manual mode, keep this in mind:

- Shutter speed is the biggest contributor to sharpness. Since CAP imaging sorties are conducted at 75 - 90 knots from at least 1000 feet AGL, the *minimum* shutter speed should be 1/250 second.

6.5.3 Visibility

It's best to wait for the best visibility instead of shooting through thick haze or other obscuring conditions. Even on clear days visibility is rarely unlimited, so you always have to adjust to actual conditions over the target.

Haze and fog are the most likely limits to visibility you have to deal with. Ways to deal with these are:

- When you fly over the target during or after the ID pass, see if there is a difference between looking straight down at the target and looking at a slant angle. With haze, lower angles to the target are often better. With fog, the reverse may be true.
- Set your digital camera to its highest contrast. Look at your histogram, if available; you'll be surprised at how it tends to bunch up in the middle (implying low contrast) even if things look normal to you while flying.

Note: If allowed by the customer you can use a photo editing program to increase contrast and cut through haze. The easy way is to use "Auto Levels" which will take the dull grays and expand them to blacks and whites; you can also use the "Levels" command and manually move the blacks and whites or adjust the mid tones.

- UV and haze filters don't always work well in aerial photography so don't rely on them (except to use a UV filter to protect the camera lens).

6.5.4 Focus

Even though you're flying at 90 knots your distance from the ground (altitude) stays roughly the same. Normally, the camera's autofocus works fine in the Automatic and Program modes. If this isn't providing the proper focus you can try the "S" AF position; this focuses each shot perfectly, even if you change the zoom setting. **Note:** Certain low-light or atmospheric conditions, such as a heavy overcast and/or high-humidity air, can prevent the camera's autofocus from working properly.

If you're using Manual focus with a fixed focal length, be aware of "lens creep". You can prevent lens creep by lightly holding the lens barrel with your finger or by using a wide rubber band to hold the lens (see Chapter 1).

6.5.5 Wind

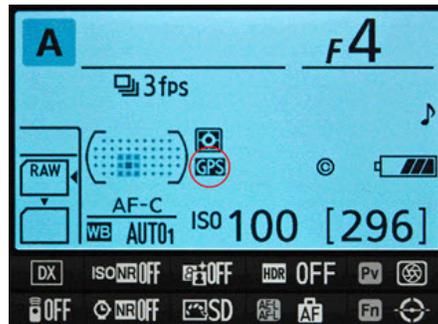
The wind will knock your camera around if you let a telephoto lens extend even a little bit out the window. You have to make a conscious effort to lean back away from the window to keep your lens inside.

6.5.6 GPS Satellite Signal Reception

The GPS attached to your camera must receive adequately strong signals from a minimum number of GPS satellites (usually three or more) in order to work properly. If the GPS drops below this minimum while you are taking photos, any images you take will not be geotagged and thus will require processing by mission managers in order to make them useful to the customer.

Therefore, it is very important that you verify proper GPS reception before you begin taking photos and periodically checking GPS signal reception while you are taking photos.

GPS status is shown on the camera control panel by the **GPS** icon:



GPS steady on: Proper connection and satellite signal reception

GPS flashing: GPS is searching for signals; images will not include GPS data.

No **GPS** icon: GPS hasn't received from the GPS unit for at least two seconds; images will not include GPS data

Additionally, there are two steps you can take during your sortie to increase the chances of fixing non-geotagged images:

- a. Use a GPS data logger as a backup to the GPS (see section 8.2).
- b. Take a photo from the aircraft before takeoff. [Pick a prominent spot](#) that is easily identified by someone looking at your departure airport in *Google Earth* or *Map*. The idea is to enable mission staff to obtain the coordinates (latitude and longitude) of your photo, which in turn enables them to link the photo to the GPS point in the web-based FEMA Image Uploader application and geotag any photos taken during your sortie that weren't geotagged by your camera's GPS. [Examples include the end of a particular runway, an intersection between two runways, or the intersection between a taxiway and the runway.]

6.6 Inventory Equipment and Check Camera Settings

These checks are also listed in Attachment 2.

6.6.1 Inventory

Perform an inventory to make sure you have everything you need to accomplish the mission. At a minimum check for:

- a. Camera/GPS/data logger batteries charged (including spares). [Note: If batteries get too cold they will weaken and even stop working. If it's cold keep the camera and batteries with you; don't leave them in the airplane overnight. If it's really cold, carry the spare batteries in your pocket where your body will keep them warm.]
- b. Large-capacity memory cards, including spares (you should include a large flash memory drive for extra storage, and a media card reader).
- c. Filters (as needed). A UV filter should normally be installed to protect the lens.
- d. Condition of the camera strap and lens cap.
- e. Flat rubber band (and spare) to prevent zoom lens creep.
- f. Photo Log or Target Cards, Recon Sketch Sheet, and Photo Pattern Planning sheets, along with a good clipboard.
- g. Cleaning supplies.
- h. If you're using a camcorder, ensure you have the microphone adapter.
- i. If you intend to stop away from mission base between sorties, take the battery charger along (also a media card reader if it will be needed to transfer photos to a customer).
- j. Seat cushion to improve your position when shooting through the rear left photo window.
- k. A light jacket or XXL black T-shirt or equivalent to use as a "portable darkroom" for reviewing photos on the LCD screen.

6.6.2 Adjust Camera, GPS and Data Logger Settings

- a. Turn on the camera and look for a full battery charge, sufficient space on the media cards, and other settings as listed below.
- b. Set the exposure mode, usually Auto or Program. Also, determine whether you will be shooting normally (single frame) or if you need to set the burst (continuous) shooting mode.
- c. You may turn off the color LCD to save batteries. However, you will need the LCD to review your photos before leaving the target area.
- d. Disable (turn off) the digital zoom.
- e. Disable (turn off) the flash.
- f. Disable (turn off) the AF-Assist Lamp. Usually located near the lens barrel, an Autofocus Assist Lamp assists focusing when taking photos in low-light conditions. When the shutter-release button is depressed half-way, a light beams from the camera to illuminate the area where the camera is focusing. However, the lamp's short range is useless for taking photos from

an aircraft. If you are shooting through a closed aircraft window (you shouldn't), the lamp may confuse the camera's focus.

- g. Disable (turn off) Digital (electronic) Image Stabilization. [Note: This doesn't apply to Optical Image Stabilization, whether lenses or sensors.]
- h. Check or set photo type, resolution and quality depending on how the photos will be used. *With large-capacity media cards, the best choice usually is RAW + JPEG* (JPEG Fine if taking hundreds of photos).
 - 1) If you know that the customer won't want to examine the target in great detail, you may choose lower settings. If you only intend to e-mail the pictures (or the photos are only going to be viewed on a monitor or posted to a Web page), you can use lesser quality settings if you don't want to bother to resize or compress the photos before they are sent to the customer.
- i. If having the shortest time possible between pictures is important, you can shorten (e.g., by about 0.5 seconds) or deactivate the instant photo review function that automatically displays the image on the LCD immediately after it's taken. This saves time between photos and also saves your batteries. This can be used in addition to selecting the camera's burst (continuous shooting) mode.
- j. Set the Diopter Correction. Look at something within shooting range, raise the camera's viewfinder to your eye, and adjust the diopter until the scene or the focus brackets are sharp.
- k. Connect the portable GPS unit to the camera and ensure it locks onto the satellites. Check spare batteries. In the camera setup menu, select "Use GPS to set camera clock". [May have to calibrate the GPS compass if has moved over 100 miles from its previous location; N/A for the D200]
- l. Check the GPS data logger batteries and check for synchronization.

Synchronize GPS and Camera

Carefully read the user manual for the GPS that connects to your camera, particularly the section concerning synchronization between the GPS and camera.

If you are using a GPS that doesn't connect to your camera, you must synchronize your camera's time (UTC) to that of the GPS and ensure that the GPS is in the "tracking" mode (this is usually the default mode on a GPS). This allows the mission staff to correlate sortie photos with the GPS photo track.

Note

Most GPS/ data loggers have detailed instructions for synchronizing time between the device and a camera. *Always refer to your device user manual first.* The discussion below provides a generic method of synchronization between a stand-alone GPS and your camera; refer to Chapter 8.

The camera's clock is adjusted to match the GPS clock, not vice versa. Most GPS devices will automatically reset their internal clocks to match that of the satellites. Turn on your portable GPS and go to the page where the time is displayed (assume that it shows 11:22:02), then go to the setup screen in your camera where you set the time. It doesn't matter if your camera displays seconds or not; just set it to the next highest minute (11:23

in this example) and wait for the GPS to reach that time. When it does, save the camera time. Be quick.

Be aware that some GPS units don't support the display of Daylight Savings Time. In you live in a locality that does and if it's in effect, the time that displays on your GPS will be one hour behind (or ahead of) the actual local time. Don't be alarmed by this and don't think that you need to set a 3600 second offset or set your camera's time back an hour to account for it. Just ignore the one hour error because it's not really an error; GPSs always use UTC time -- the local time that a GPS displays is for human eyes only. Since camera clocks drift, it's a good practice to do this fairly often and before you take any pictures.

6.7 Prepare the Aircraft and Equipment

- a. Clean the aircraft windows before you leave, and make sure you have cleaning supplies on board. This is for safety reasons, not photography purposes, as you should avoid shooting through windows. Windows are made of Plexiglas and are not flat. With telephoto lenses they often will cause distortion that makes the photos wavy.
- b. If you will be shooting out the right front window of the aircraft, remove the window holding screw. Be careful to retain the screw's bushing or washer as you remove the screw; place the screw in a secure container (e.g., a 35mm camera plastic film case works great, or use a small zip-lock bag) and put it where you can find it later (e.g., the aircraft glove compartment or in the camera bag).
- c. Enter target waypoints into the GPS before startup. DO NOT wait until you're taxiing out for takeoff; the sterile cockpit is in effect while taxiing and all eyes must be looking outside the aircraft for collision avoidance.
- d. Set up the Audio Panel and Intercom. Check the operation of the intercom (all positions) and perform a communications check of the CAP FM radio from all positions.
- e. If applicable, turn on the laptop and check for full battery charge and proper settings.
- f. Check the imaging equipment. If you will be shooting video, test the camcorder and audio connection for proper operation. Take a photo from the aircraft before takeoff. Pick a prominent spot that is easily identified by someone looking at your departure airport in Google *Earth* or *Map*. Also take a photo of a target card that has the mission and sortie numbers on it.
- g. Arrange your equipment for easy access, but ensure lightweight objects such as charts and logs are not lying loose where they can be blown about the cabin when you open a window to take pictures.

7. Conducting an Imaging Sortie

The key to a successful imaging mission is preparation, planning, patience and practice!

Airborne Photographers must know how to conduct an imaging sortie.

You've spent lots of time planning the sortie and preparing your crew and equipment, so don't jeopardize the success of the sortie by rushing to obtain the photos. It isn't "We've got to get these pictures back ASAP," but rather "We've got to get high quality pictures back ASAP." [Take the time to do it right, and take the time to review the pictures before returning to base.](#)

OBJECTIVES:

1. Discuss safety concerns specific to imaging sorties. {O-2211 & O-2215}
2. Using the *Imaging Sortie Checklist* (Attachment 2), discuss: {O-2211}
 - a. Transit to the target area
 - b. Approaching the target, setting up equipment, readying Log/Target Cards
 - c. ID Pass
 - d. Damage assessment survey
 - e. Preparing to enter the pattern
 - f. Taking the photos
 - g. Determining success or failure
 - h. After-sortie actions
 - i. Debrief, including the Debriefing information in WMIRS {O-2211 & O-2219}
3. Demonstrate actions during transit, target approach, the ID Pass, the survey, preparations to enter the imaging pattern, taking photos, determining success or failure, after-sortie actions, completing the Debriefing section in WMIRS and receiving a debrief. {O-2211 & O-2219}

4. Discuss practical concerns to be aware of when using a camera on a sortie.
5. Discuss the importance of reviewing your photos during the sortie.
6. Use a photo browser to review the photos and determine whether or not they meet mission objectives and requirements. {O-2211 and O-2205}
7. Discuss the importance of a thorough and honest imaging sortie debriefing. {O-2219}

7.1 Safety

The great majority of the safety precautions for an imaging mission were learned during Mission Scanner qualification. Some safety concerns that are unique to imaging sorties are:

- Fatigue from using the camera or camcorder. Looking through a viewfinder for extended lengths of time can quickly lead to fatigue, air sickness or vertigo. Take frequent breaks and look out the window toward distant objects to relax and refresh your vision (and yourself).
- Don't startle the pilot by abruptly moving your seat back. If you are taking photos from the right front seat, you will need to move your seat back to get into position to take photos. Be sure and warn the pilot before you do this, and be aware that it can affect the aircraft center of gravity.
- Taking photos during significant turbulence or taking "look down" photos that require the pilot to fly the aircraft with a large bank angle can cause fatigue, air sickness or vertigo. Take frequent breaks under these conditions.
- Taking photos through the photo window or an open right-side window can cause loose items to fly about the cabin. Having an open aeronautical sectional fly in front of the pilot's face isn't a good idea. Secure all loose items before opening the window.

7.2 Phases of an Imaging Sortie

The *Imaging Sortie Checklist* (Attachment 2) is a mission-specific checklist. See the *Flight Guide* (Attachment 2 of the Mission Aircrew Reference Texts, Volumes I & II) for a general, comprehensive mission checklist.

Note: This discussion covers sorties taking a small number of photos; adjust as necessary for sorties taking hundreds of photos.

7.2.1 Transit to the Target Area

- a. Once you're out of busy airspace, relax the sterile cockpit rules but maintain situational awareness.
- b. Double-check navigational settings to be used in the search area.
- c. Review search area terrain and obstacles.
- d. Update in-flight weather (maybe file a PIREP).
- e. Review methods to reduce fatigue and prevent air sickness/vertigo or high altitude effects during the sortie.
- f. Crew members keep their seat belts and shoulder harnesses on unless such wear interferes with duties; the pilot wears them at all times.

Note

Don't set the camera on the glare shield or on a seat in direct sunlight. Image noise doubles with every 6-8 °F increase in the temperature of the camera sensor.

7.2.2 Approaching the Target

- a. Turn on exterior lights to maximize your visibility so others can "see and avoid." [Note: You may need to turn off the strobe lights so they will not affect the photos, particularly in low-overcast conditions.]
- b. Review sortie objectives and crew communications, and set the audio panel and intercom for imaging pattern communications.
- c. Double-check radio and navigational settings and check navigational equipment against each other (detect abnormalities or failures).
- d. Ready the Photography Log and/or Target Cards.
- e. Remember hourly updates - Altimeter setting (closest source) and fuel assumptions, and times to report "Operations Normal."
- f. Turn on camera (and photo tracker, if used) and ensure they lock on and are tracking. If your GPS isn't connected to the camera or you're using a photo tracker, verify it is locked on and tracking. [If the GPS isn't providing accurate data you (and mission staff or customer) won't be able to determine the latitude, longitude and altitude from the EXIF file. This also means this information won't be displayed with photos uploaded into WMIRS.]
- g. Take a test photo to ensure your camera settings give you a quality image; adjust settings if necessary.
- h. Stabilize at 'Target ID Pass' heading, altitude and airspeed at least two miles out. This allows time for everyone to get set for the photo or video run, and gives everyone the opportunity to see what visibility and turbulence conditions will be encountered over the target area. Implement sterile cockpit rules.
- i. Log the time (and Hobbs) and report "In the Search Area."

7.2.3 The ID Pass

- a. When you pass over the target, log the latitude and longitude and verify you have the right target. If you have DME, log the radial and distance.
- b. The Mission Pilot may enter the coordinates into the GPS as a 'User Waypoint', and display this waypoint in the navigation mode. This will give the MP an additional means to ensure accurate distance from the target during passes.
- c. Examine the target, its surroundings, and lighting conditions. *Verify that what you see is what you planned for and that you can properly frame the target*; if not, have the Mission Pilot pick a safe location to loiter and re-plan how to perform the imaging run (e.g., determine the altitude, angle and directions you need to get the best photos) and how you wish to frame your photos.
- d. If needed, perform a damage survey and plan the imaging pattern(s) necessary to fully document the damage. Reassess your fuel status and plan a refueling stop if needed. Update Mission Base on your new sortie time assumptions.

7.2.4 Prepare to Enter the Imaging Pattern

- a. Fly at least 1000' AGL.
- b. Ensure you're flying slowly enough to allow the AP to get several photos from each angle or side of the imaging pattern (usually 90 knots).
- c. Verify the GPS/photo tracker is still locked onto the satellites.
- d. Ensure the camera's neck or wrist strap is secured and the lens cap and hood are removed. If the lens cap has a strap attaching it to the camera, hold it in your hand so that it will not be blown in front of the lens while shooting; if it has no strap, store the lens cap in the camera bag or put it in your pocket. Also, check the rubber band used to prevent zoom lens creep.
- e. If you're using a camcorder, make sure you have connected the microphone cable to the intercom system. If you're using an automatic noise reduction (ANR) headset and know this feature interferes with the video's audio commentary, turn ANR off.
- f. Check that the camera is on, as it may have automatically turned itself off; a quick touch of the zoom switch will wake the camera. [Don't confuse this with the 'sleep' mode where the camera turns off the LCD to conserve power.]
- g. The third crewmember readies the Photo Log. It is important to keep a log of the photos you take, as it is not always obvious what and how you were looking at a target after the fact. Which way was North? Was that access road oriented E-W or ENE-WSW? Good communications between the AP and the Photo Log keeper will ensure you have all the information you need to explain your photos. If you are using Target Cards along with or instead of a Photo Log, take a photo of the applicable Target Card.
- h. Secure loose items (e.g., charts) in the cabin and then open the window.

7.2.5 Preparing to Take Photos or Video

- a. Steady the camera and begin by taking a photo of the target card, if applicable
- b. Choose a comfortable, sustainable posture. Use a seat cushion, if necessary, to ensure you get the best possible angle to shoot through the photo window. Keep your body from contacting the aircraft (i.e., don't rest your forearm or elbow against the window frame). [If you're sitting in the front right seat, slide the seat back so that you are centered in relation to the window (let your pilot know before you slide your seat backwards or forward.)]
- c. Use both hands. Put one hand through the grip (especially true for camcorders) and use your free hand to help support the camera.
- d. Use the optical viewfinder, pressing the camera to your head and holding it against your nose or cheek with both hands (but make sure your fingers don't cover the camera's light sensor or brush against the camcorder audio plug).

7.3 Taking Photos

Some imaging patterns begin with a "panoramic view" of the target. The aircraft will be at 1000' AGL and one nm south of the target, with the pilot flying so that the AP is looking to the North. Once this image is captured you move in for close-up

photos (not <1000' AGL) of the target, usually (not always; it depends on the situation) from each of the four cardinal points (North, South, East and West). This and other imaging patterns were discussed in the previous chapter.

As the aircraft closely approaches the point where you intend to shoot, begin framing the shot; normally this means centering the target in the viewfinder. Some missions require different framing, as dictated by the circumstances or by the customer. For example, a damage assessment of a power plant may require you to capture the plant plus a road leading into the plant from the northwest. In this instance, you would place the plant in the lower right corner of the frame in order to capture as much of the road as possible.

When you near the shot point, you should pre-focus on the target for faster camera response (may use the AF-L/AE-L button); focus on an object that is currently the same distance away as the target will be once you are lined up (i.e., in the same plane as the target). Once the target moves into frame, press the shutter button the rest of the way down to take the photo.

You should take several photos on each leg of the imaging pattern (if your camera's shutter delay allows). This increases the chance you will get an excellent photo of the target. [If proper exposure is a concern, consider bracketing.]

Keep the Photo Log keeper aware of what you are shooting, as you planned before the sortie. It is easier on the log keeper if you tell them when you will be taking several photos per leg. On each leg, tell the log keeper the following photos will be taken "looking east" or "looking northeast" or "looking between the northern-most buildings," then call out "shot 1, shot 2," This allows the log keeper to quickly and accurately log the photos.

If you are going to take photos of different targets on the same sortie and aren't using target cards, take a picture of the aircraft wing, wheel, or interior between targets to act as a "target separator." If you're using target cards, write the target of opportunity's name on the back of one of the pre-made cards.

Periodically verify that the GPS (and photo tracker, if used) is locked onto the satellites and tracking.

Periodically take breaks to reduce fatigue and prevent air sickness or vertigo.

Using the Zoom

Optical zoom should be used sparingly, but it can be a tremendous help in composing a shot because you'll rarely be in exactly the best location to take a photograph. Let the zoom improve your framing, either by bringing the target a little closer (optically) or backing off a bit. [Getting closer is the obvious attraction of any zoom, but zooming out can be very helpful by, for example, revealing a road that may be used by emergency vehicles to get to the scene].

Zoom in until you get the frame you want or until the image in the viewfinder begins to shake; if the image starts shaking, zoom out until the image becomes steady. [Note: Be careful not to zoom in and out too much when using a camcorder. You can pause the camcorder, zoom in or out to compose the next shot, and then start recording again.]

Note: If you do use the telephoto lens to zoom in on a target, we recommend you take several photos to increase the chance that you will get a properly focused photo. Also, you should carefully review the photo(s) before moving on to ensure the photo is sharply focused. If available, use the camera's magnifier function when reviewing the photos.

Minimize zooming during low light conditions.

7.4 Using a Camera on a Sortie – Practical Concerns

Digital camera have multiple controls (e.g., switches and buttons) that can be miss-positioned as they are placed into and taken out of a camera bag, handled during operation, or placed in your lap when not in use. Other routine factors can also affect the camera's operability during a sortie. Finally tasking pressure must be recognized and dealt with by the crew. Being aware of these possibilities increases your ability to take quality photos on every sortie.

[Remember to take frequent breaks to prevent fatigue, air sickness or vertigo.](#)

7.4.1 Settings that can be Accidentally Changed during Use

To identify controls that you could accidentally miss-position during a sortie, place your hands on the camera you will use and look at the controls within reach of your fingers. Also, take the camera out of its bag and look at the controls you could accidentally re-position during this maneuver. For example:

- You could accidentally change the position of the camera Focus Mode Selector with your left hand. If you accidentally change the focus mode to 'Manual' the camera won't autofocus.
- You could accidentally change the position of the lens Autofocus or Optical Stabilizer switches with your left hand.
- You could accidentally loosen or disconnect the GPS cable from the camera cable port when pulling the camera out of its bag.

7.4.2 Other Items to Periodically Check during Use

Placing the camera into its bag, removing the camera from its bag, handing the camera to another crew member, placing the camera in your lap, and normal handling during a sortie can cause other problems. For example:

- To protect the lens' UV filter from scratches and smudges, put the lens cover on whenever you're not using the camera. To prevent losing the lens cover, put it in your pocket whenever you remove it from the camera. Always have cleaning supplies handy to remove smudges and debris.
- The GPS signal can be lost for many reasons. Develop the habit of checking the signal between shots, or periodically when you're taking multiple, sequential shots. If you're losing the signal frequently, check the GPS batteries or check for over-heating (i.e., the GPS placed on the aircraft glare shield on a hot, sunny day).
- The lens Focal Length setting can change during route photography or aerial mapping. Develop the habit of monitoring for lens creep (discussed in Chapter 1).

7.4.3 Tasking Pressure

Immediately after a disaster, the need to quickly take a large number of photos during a SAR or DA sortie will put great pressure on a crew. Several factors that must be considered are:

- Weather: It takes time for the weather to clear enough for a photo sortie after a disaster (e.g., tornadoes and hurricanes, heavy rain causing

flooding, or a chemical spill or plume). All local and state agencies will want to get up as soon as possible, but the crew needs to assess the situation carefully. The *crew must consider current and predicted conditions* covering the entire timeline of the proposed sortie, and make backup plans to mitigate risks (e.g., nearby areas that are clear, and alternate airports). For example, massive flooding in Texas required thousands of photos to allow the state operations center to assess the damage, and follow-up sorties were quickly tasked based on the previous sorties. At the same time, the storms that caused the flooding kept coming in waves, complicating the planning and execution of the sorties. You must be conservative in your planning and during the sortie, and don't hesitate to go to your backup plan if the weather is deteriorating.

- Tasking hundreds of photos per single sortie: The state and federal authorities want all the photos they can get, and won't hesitate to task follow-up sorties to get more or better photos (one tasking asked for "Lots of pictures, hundreds and hundreds. A thousand is not too many."). The resulting task loading for the crew will be very high, so you must guard against trying to do too much in too little time. If necessary, the sortie may need to be broken into two or more sorties to ensure a reasonable workload that will allow the delivery of high-quality photos.
- Fatigue: Taking hundreds of photos in a single sortie requires the crew to plan periodic breaks. This helps prevent fatigue and vertigo, and allows the crew to review the photos to ensure they are properly framed and focused. [Remember that the sortie is not successful unless the very great majority of the photos are of high quality.](#)

7.5 Recording Video with the Camcorder

A typical imaging pattern begins with an overview of the target. The aircraft will be at 1000' AGL and one nm south of the target, with the pilot flying so that the AP is looking to the North. Once this is completed, you move in for close-up video of the target, ensuring you record views from each of the four cardinal points (North, South, East and West). This and other patterns were discussed in the previous chapter.

Begin with a wide-angle (no zoom) setting and start recording about five seconds before reaching the target or start point. When the target is abeam you can smoothly zoom in as needed to frame the shot. Once you have the shot, zoom out for another wide-angle view and stop recording (these wide-angle photos serve to show areas around the target and as breaks between photos).

Play back the video of the overview to make sure you got the video you wanted. Once the video is verified, the Mission Pilot proceeds to the target for the 360° close-up (not <1000' AGL). Zoom in (smoothly) if necessary, but minimize zooming in and out while circling. Once you have finished circling the target, zoom out to wide angle and then stop recording.

7.5.1 Audio Commentary

You should speak your commentary into your headset microphone using conversational speech (i.e., use the same voice level and tempo that you would use in a normal conversation). You should describe to the viewer what they are seeing

through the camcorder. This narrative will give the view all the information they need to understand what they are looking at, along with supporting information such as aircraft altitude and speed, location (e.g., latitude and longitude) and direction (e.g., “looking to the North”), date and time of day, and weather conditions (e.g., clear or overcast).

Do not use abbreviations or acronyms in your narrative; you cannot assume that your customer (or users from another agency) will understand what they mean.

You should begin your commentary by identifying the mission: this is CAP Flight 4239 flying mission number 06M1000, sortie #2. It is 1900Z on December 1, 2005.

Usually a video mission begins with an overview of the target (or target area) that is shot from about one nm south of the target at an altitude of 1000' AGL. If the customer wants you to start with a shot that shows a very large scene, but you can't see the entire scene from this distance and altitude, you will have to move further south and may have to increase your altitude.

You may also use this opportunity to describe some of the video you will be shooting later, such as access and egress roads or flooded areas downstream of a dam or levee. It can also be helpful to point out major landmarks that can help ground teams as they arrive on the scene, and the condition of the roads leading to the target area.

You may describe the overall scene as follows: “We are looking northwards at the fire from about one mile distance, flying at 4400 feet mean sea level or approximately 1000 feet above ground level” (note that it is important to include both MSL and AGL heights so that analysts can relate details of the video to whichever charts or maps they need to use). “The fire area appears to be approximately five miles by three miles. The western edge of the fire appears to be approximately ten statute miles from the town of Pampa. The smoke is drifting in a northwesterly direction. We'll now move in for a closer look.”

As you begin to circle the fire, staying approximately one mile from the edge of the fire, your commentary may go like the following: “We are flying northward at 90 miles per hour and 1000 feet above ground level. Looking eastward, you can see a radio tower just inside the southwestern edge of the fire area. The smoke is obscuring the northwestern part of the fire area. You can see what appears to be a single home in the center of the fire area, engulfed in flames. I am now zooming in to focus on the house. I don't see any vehicles or persons on the ground in the vicinity of the house.”

Your narrative continues as you circle the fire. Besides reporting what you see, report any changes in altitude or wind direction.

These are just examples; you should be thoroughly briefed before you leave, and knowing what is important to report will help you ask questions during the briefing.

7.5.2 Crew Commentary

Using the circling or 4-Square imaging pattern as an example, the Mission Pilot will set up the aircraft with the AP looking one nm to the North. Once the pilot has the aircraft stabilized and wings level she will announce “Aircraft ready.” Once the AP acquires the target and is ready to shoot, he will announce “Video on.” At this time all non-essential intercom talk ceases so as not to interfere with the AP's commentary.

The AP should say "Video off" once he has acquired the video he needs for the overview pass. Once the Mission Pilot enters the close-in circle or 4-Square pattern, the AP announces "Video on" and begins the video and audio commentary. This process is repeated until the video is complete.

NOTE: If communications with ATC are necessary during the video run, the Mission Pilot may isolate herself from the intercom by using the audio panel. However, flying the entire video run in this fashion will interfere with the coordination needed between the pilot and AP. Safety considerations are foremost, but the pilot should try to stay on the intercom with the AP whenever possible. If you are in busy airspace (e.g., Class B) where there is constant chatter on the ATC frequency, the pilot may turn down the aircraft radio so the chatter will be heard as "background" to the AP's commentary; again, safety is foremost and it may become necessary to isolate the AP and use hand signals to coordinate with the AP.

7.6 Determine Success or Failure

The AP usually knows whether she got all the required photos, and the third crewmember can back her up by checking the Photo Log.

- Have the Mission Pilot pick a safe spot to loiter while you check the photos or video, particularly for framing and focus. This should be done periodically when you are taking a large number of photos in succession, and immediately after you have finished taking photos of a specific target, Verify GPS data was recorded with the photos. [While the photo is displayed on the LED screen you simply press the multi selector down to scroll through the photo's information (this function varies with other cameras). If you have difficulty seeing the images on the LCD screen, look at it under a large dark T-shirt, jacket or blanket (i.e., a portable dark room).
- However you do it, you must check your photos because you don't want to fly all the way back to mission base and then discover that you missed a shot, or that your shots weren't framed or focused properly, or that your portable GPS had become disconnected or lost satellite lock while you were taking the photos.
- Plan and re-shoot as necessary.
- Log time (and Hobbs) and report "Out of the Search Area."
- Double-check heading and altitude assigned for transit to next target or return to base. Relax sterile cockpit rules.

7.7 After the Sortie

- a. Make sure you have all your equipment before you leave the aircraft.
- b. Clean the windows for the next sortie.
- c. If no more imaging sorties will be flown in the aircraft, replace the aircraft window screw if it was removed for your flight.
- d. Secure the aircraft.

7.8 Debrief

7.8.1 Transfer and View Photos

Upload your photos (and data logger file, if applicable) to the FEMA Image Uploader or to a computer as soon as possible. Verify that the pictures were successfully and completely transferred by looking at each photo on a monitor before you delete the photos on the media card (required for AFAM). Then determine if the photos meet all the mission objectives and requirements, such as all being geotagged. Refer to Chapters 8 & 9 for details.

Some mission bases will just have you give them the media card and Photo Log (or Target Cards). In this case, be sure to put one of your spare cards back in the camera, check that it is empty, and put the camera back in its bag.

7.8.2 Complete the Debriefing portion of your sortie in WMIRS

- a. Fill in or verify 'ATD' and 'Actual Landing Time'.
- b. The Summary section describes what you accomplished on the sortie.
- c. The Results/Deliverables section can be as simple as "no sightings" or "no damage noted." However, you must list results such as sightings (including negative sightings), the number of photos you took, etc.
- d. The Weather Conditions section can be as simple as entering "as forecast." However, if the weather was unexpected it is important to explain how the weather conditions affected sortie effectiveness. This should include lighting conditions and other factors that affected your imaging.
- e. The Remarks section is for entering any information you think is pertinent or helpful that was not entered elsewhere. It also gives the crew a chance to comment on the effectiveness of the sortie in detail.
- f. The Sortie Effectiveness section involves a quantitative assessment of how well you accomplished your mission.
- g. The Attachments & Documentation section is self-explanatory. Be sure to label any attachments (e.g., mission and sortie number) so they can be related to the mission/sortie if it accidentally becomes separated. Enter a description of what photos or video was taken, and to whom and how they were sent. Ensure all entries and sketches/drawings are clear and legible. Also write "Photo Logs uploaded" if mission base wants copies uploaded to the FEMA Image Uploader.
- h. Ensure the 'Hobbs To/From' and 'Hobbs in Area' entries equal the 'Hobbs Total'.

7.8.3 Check in with the Debriefing Officer

- a. Tell how you did your job and what you saw.
- b. Usually starts with a review of the information you entered in the Debriefing section of WMIRS.
- c. Review the photos (and Photo Logs) or video, comparing them against mission objectives and requirements.
- d. Answer all questions as best you can, and be very honest about conditions and your actions

- e. If you are scheduled for another sortie, find someplace to rest. Close your eyes; you may even want to take a nap if there is time and a place to do so. Also, take in some refreshment to give you sufficient energy for the next sortie.
- f. Ensure that the air crew obtains sufficient rest during crew rest periods, including approval of extensions to the maximum air crew duty period (CAPR 70-1).

7.9 Practice

Taking good photos or video takes practice. Many camera and camcorder models offer so many features that they can be intimidating, so there is no better way to get to know your camera or camcorder than by taking lots of pictures. Also, if many weeks have passed since you last used the camera or camcorder you will forget some of the features and techniques.

Take the camera or camcorder with you each time you fly. Leave the camera in the Auto or Program mode and see what it can do on its own, or test a different feature of your camera each week. The more you shoot, the more you can experiment with everything the camera has to offer. Remember to use the manual!

Another great thing about experimenting with digital cameras or camcorders is the immediacy of the response. The photos or video are right there on the LCD screen so you can check your results in seconds. Both cameras and camcorders can be hooked up to a monitor or TV for more detailed review.

[A good and inexpensive way to practice framing is to take photos of objects from a vehicle.](#) Have a friend drive along a freeway where you can safely drive ~ 55 mph; this most closely simulates the speed effect you'll experience during flight. Pick out "targets" of varying sizes along the roadway and photograph them, practicing framing. After you get proficient at proper framing, take 2-3 photos of the same object as you pass; this also simulates what you'll be trying to accomplish while on imaging sorties.

NOTE: CAP Pilots may fly "Air Force Approved Proficiency Flight Profiles" under the A-12 or B-12 mission symbol in WMIRS, which are designed to prepare crews to fly Air Force missions. The flights should include other mission aircrew as appropriate, and must be focused on the training outlined in the profiles. In particular, Profile #2, *Video Imaging Mission Profile*, is specifically designed for Mission Pilots (and trainees) to work with Airborne Photographers (qualified or trainee). This provides valuable training and proficiency opportunities for both the MP and AP.

8. Transferring and Organizing Photos

Airborne Photographers must know how to transfer their photos onto a computer in an organized manner. Although mission staff often perform these duties, an AP may be the only knowledgeable person at a small base or staging area.

OBJECTIVES:

1. Discuss how to transfer photos to a computer.

Transfer several photos from a camera to a computer using the camera's cable and via a media card reader. {O-2205}

2. Discuss the importance of organizing and renaming photos. Then:
 - a. Set up a mission photo folder and sub-folders on a computer {O-2205}
 - b. Transfer several photos into this folder {O-2205}
 - c. Rename each photo

Note

Keep Air Force Assigned Mission (AFAM) photos in a single, easily identifiable folder in order to facilitate deleting the photos after the mission is completed.

8.1 Transferring Photos into a Computer

NOTE: Best practice is to set up a mission folder (mission number and date) before downloading the photos. See 8.2, below.

There are two ways to transfer photos from most digital cameras onto a computer: attaching the camera directly to the computer (also known as tethering) or using a memory card reader.

Most digital cameras provide a USB cable connection that offers a fast way to transfer your photos (e.g., the D200 USB 2.0 cable can transfer photos at about 5.3 MB/sec.). However, tethering ties up the camera and can deplete the camera's batteries. Some cameras include an AC adapter that can provide power to the camera; if you choose to tether, use the AC adapter during photo transfer sessions.

Most camera manufacturers provide software that helps transfer photos from a tethered camera to the computer. If your camera comes with such software, you should install it before you attempt your first transfer (read the manual). If your camera does not include photo transfer software, or you simply prefer not to install it, you will still be able to transfer photos. Windows includes built-in tethering support to many popular digital camera models, typically via the computer's USB port, and most of the photo editing programs (e.g., *Elements* or *Photo Studio*, discussed in the chapter on "Viewing and Editing Photos") will recognize and accept the pictures directly from your camera.

The easiest and most versatile way to import pictures into your computer is through a USB memory card reader that plugs into a computer USB port; this allows fast and easy downloads from a camera's memory card. The best choice is a USB 2/3 card reader that accepts multiple types of cards.

Some computers (laptops, in particular) come with slots that accept cards directly into the computer or via a PC card adapter. These features essentially function in the same way a card reader does, although much faster.

Another advantage to using card readers is that they enable a crew to drop off their memory card and take the camera back out for another sortie, while the staff processes the photos.

Note

Ensure that any method you use to transfer AFAM photos to your computer doesn't automatically back up the photos to a cloud server. This will complicate deleting the files after the mission is completed, and may compromise the photos if they are accessible by non-mission persons.

8.2 Organizing Photos on a Computer

Once transferred to your computer, your digital photos become computer files. Just as you need to organize word processing files, you need to organize photos as you import them or you will quickly lose track. You should set up your folders under 'My Documents' as Windows is optimized to use 'My Documents' as your root folder.

Note

For photos taken for AFAM, be sure to keep all photos in a single, easily identifiable folder, rather than spreading them between multiple folders (use sub-folders instead). This is done because [all photos taken for AFAM must be deleted after completion of the mission.](#)

8.2.1 My Documents

You can put your photos in a folder anywhere under 'My Documents', but it is best to keep photo files in a sub-folder associated with its top-level mission folder. [It is useful to include the date in the folder names as this makes finding the photos easier, both under Windows and when using most photo browsers and editing programs.] For example:

1. Go to 'My Documents' and locate or create a mission folder (e.g., mission name or number).
2. Create a sub-folder named "XXX Photos" (where XXX is the mission number).
3. Before you import photos from a particular sortie, create a new sub-folder in the Photos folder named "YYY Photos" (where YYY is the sortie number).
Note: This is very useful for photos you intend to upload to the FEMA Image Uploader (Chapter 10), as the desktop image uploader allows you to upload the sortie folder instead of having to select each photo separately.
4. **Note:** As a precaution, particularly if you intend to edit the photos, create another sub-folder named 'Unedited Photos' or 'Original Photos' or the like, then copy the photos from the "Unedited Photos" folder into the sortie photos folder. If you edit photos, edit them from the sortie photo folder, thus leaving the original (unedited) photos untouched. *This method will serve as a backup in case you make a mistake during editing or need to go back to the original, untouched photo for any reason.*
5. Once you have imported your photos (and *before* any editing is performed) combine the stand-alone GPS track with the photos if necessary (see 5.2.2, below).
6. Once you have imported your photos (and completed any editing) you can now rename them (see "Naming Photos").

8.2.2 Combining a GPS Track with Photos

The best way to add positional information is to use a DSLR with an internal or attached GPS. However, you can input positional information into the camera using a portable (stand-alone) GPS data logger while you're taking your photos.

[Preferably, you will use both the GPS attached to the camera and a separate data logger \(example shown below\) during an imaging sortie.](#) The data logger acts as

a backup in case the GPS loses tracking on one or more photos; mission managers can then use the information from the data logger to geotag these images.



When a crew returns from an imaging sortie, they will upload the photos and the GPS data logger file. The uploader application will automatically process the images and display the geotagged images on the web-based application (see Chapter 10).

8.3 Naming Photos

When taking photos for a mission that uses the FEMA Image Uploader, do not rename files or photos as the names will be altered during the uploading process.

Some missions will have specific file and photo naming protocols. If so, follow the prescribed naming protocol. However, if no naming protocol is specified there are some ways that will make it easier to find a particular photo or set of photos.

When you shoot a digital photo the camera assigns it a file name, but the file name is not very descriptive; most cameras give photos sequential alpha-numerical file names, such as DSC_001 or P0000120. But three months after the mission you need to retrieve the photo you took of the damaged power plant; do you think you'll remember that it was photo P0000110? This is why it is essential that you assigning new, descriptive file names to your photos.

Here are some ways that you can name files for easy retrieval:

1. Use something obvious (e.g., the target's name or the mission number and the sortie number).
2. Include a date, even if it is simply the year the photo was taken. This is especially important because each time you save a photo it changes the date in the file details. [When you add the date in the title, place it at the start of the file name; placing the year at the start of the file name and a sequence of numbers at the end makes file names easier to read.]
3. Add a sequence of numbers to the end of multiple photos from the same event. For example, a single photo of a disaster reconnaissance sortie may be Sep04Floods001. More photos from the same reconnaissance would be named Sep04Floods002, Sep04Floods003, and so on.

8.4 Delete or Backup Photos

Photos taken for AFAM missions **must be deleted** from the camera(s) and computer(s) once the mission is completed. Check with the Incident Commander before deleting.

For photos taken for training or other non-AFAM purposes, you should back up and protect your photos using an external hard drive, which provides a dependable

and relatively inexpensive way to back up important photos and video. Most will connect through a computer USB port.

You may also backup photos and video by burning them to a CD, DVD or USB thumb drive.

In addition to the methods discussed above you back up to one of the many “cloud” services. They all provide a limited amount of free storage space, and charge for larger space. Examples include *Google Drive*[®], Microsoft *OneDrive*, *SugarSync*[®], and *Dropbox*[™]. Just be sure you follow the rules on AFAM photos.

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9. Viewing and Editing Photos

Airborne Photographers must know how to review photos on a monitor to ensure mission objectives were met. [Although mission staff often perform these duties, an AP may be the only knowledgeable person at a small base or staging area.]

OBJECTIVES:

1. Discuss how to browse photos on a computer.

Demonstrate browsing photos using a browser and/or editing program. {O-2205}
2. Discuss the importance of saving un-edited photos before editing and not saving the photo as a JPEG until you've completed editing.
3. Discuss how to verify that AFAM photos have been geotagged. {O-2205}
4. Discuss methods of viewing a photo's EXIF file. {O-2205}
5. Describe the sequence for editing photos (information only).
6. Discuss the basics of how to (information only):
 - a. Resize or crop a photo
 - b. Adjust brightness and/or contrast using the photo's histogram
 - c. Add text or symbols to a photo
 - d. Save an edited photo in the desired format at the desired file size

Perform each of these functions using an editing program.

9.1 Browsing Photos

Over time you can accumulate hundreds of pictures on your computer's hard drive, so it is important to keep them organized so you can find a picture you (or a customer) is looking for. That is why we discussed organizing mission photos into folders and carefully naming your photos in the previous chapter. However, it is handy to be able to find and view photos quickly, such as when you want to collect a set of photos that demonstrate how to photograph tornado damage. Photo browsers are an ideal tool for this kind of task.

Photo browsers are programs that help you view, organize and file digital photos in a number of different ways. A photo browser not only helps organize photos, but it lets you see actual photos rather than just their file names. This makes looking for a specific photo in a large collection of photos much simpler. You can get a good photo browser cheaply (or for free), and many photo editors (discussed separately) include a good thumbnail-based file browser.

Remember that photo browsers are designed to support only the photo formats they understand. In other words, they contain the necessary code to decompress a JPEG photo, plus show a thumbnail and large preview, since they support the JPEG format. When an all-purpose photo browser comes up against a RAW file, it may not be able to display it. For the browser to do more than that, it has to be tuned with the RAW formats of specific cameras. Camera manufacturers usually take care of this in the software that is packaged with the camera.

While Windows provides a great basic browser for viewing and organizing photos, if you are planning on managing photos for your unit (or you simply have a lot of photos) you might consider downloading a simple (and free) photo browser or purchasing an photo editing program that contains a browser.

9.1.1 Microsoft Windows

In Windows, selections under the "View" menu enable you to view a folder's photos as filmstrip or thumbnails, not just as file names or document icons. This photo browsing feature includes the ability to view large versions of your photos and look at them in a slide show (using the mouse's right-click function you can also rotate photos, open them in a photo editor, print, or e-mail).

Windows 7 includes the "Photo Viewer". This simple program automatically opens when you double-click on a photo (e.g., from *My Pictures* or *Windows Explorer*) and allows you to scroll through a group of photos (or view them in a slide show), magnify an photo for a closer look, rotate photos, and delete, print or save photos. [Note: You can go to other viewing or editing programs on your computer by selecting it from the "Open" tab.]



Like the Windows Photo Viewer, most other browsers will let you zoom in to check details (usually a magnifying glass symbol). This feature is what most Airborne Photographers will use to review their mission photos to ensure they meet all mission objectives. You will also be looking for proper framing, proper focus, and color and contrast. Again, be sure to review your photos before deleting them from your camera's media card.

9.1.2 Other Free Photo Browsers

Some basic photo browsers can be downloaded from the Web, such as IrfanView (www.irfanview.com), Paint.net (www.getpaint.net), Google Picasa (<http://picasa.google.com>) or Kodak EasyShare (www.kodak.com). These programs support most file formats, have a thumbnail/preview function, allow batch renaming, and have basic editing features (e.g., cut or crop). You can print or e-mail directly from the programs, and most let you make simple edits.

Additionally, most cameras, camcorders, printers and scanners include basic browser and/or editing programs. Most are easy to use and allow you to quickly review photos on your hard drive (as well as download them directly from a digital camera) as moderate-sized thumbnails. They will normally enable you to rename photos, set up new folders, group photos into categories and do some simple processing. Most include many options for printing, including multiple photos on a page and album pages. Scaled-down editing programs may also come bundled with a computer or camera/camcorder, such as Microsoft *Picture It!* or Adobe *Photo Deluxe*. More advanced browser/editing programs may be packaged with your camera or camcorder, such as ArcSoft *PhotoStudio*; this program has many of the advanced features found in Adobe *Photoshop Elements* and Jasc *Paint Shop Pro*.

9.2 Verify AFAM Photos are Geotagged

In order for Air Force Assigned Mission (AFAM) photos to be uploaded using the official CAP programs (CAPUploader and/or WMIRS; see Chapter 10 for details), you need to ensure the photos have been geotagged because the uploader program won't accept non-tagged photos.

Geotagging is the process of adding positional (geographical) identification metadata to various media such as photos or video (metadata is any data that helps to describe the content or characteristics of a file). This data usually consists of latitude, longitude, and altitude (may also contain course and distance) and is included in a photo's EXIF (or XMP) file.

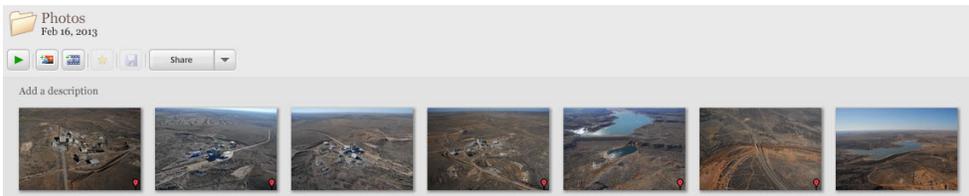
Geotagging photos depend upon a good connection between the camera and the GPS, and reliable GPS data depends upon the unit being locked on to a sufficient number of satellites (usually three or more). If there is a problem with the connection between the camera and GPS, or if the GPS loses lock on a sufficient number of satellites, the AP may not notice the problem and continue taking photos.

Although the AP normally checks the photos before leaving the target area, this may not be practicable when a large number of photos have been taken (think hurricanes Katrina and Sandy). Therefore it is important to quickly scan the photos on a computer to ensure all photos contain GPS information.

Several photo browsing and editing software provide a quick and easy way to scan the photos. Google *Picasa* is a good example, and it's free. To download the program to your computer, go to <http://picasa.google.com/>.

Picasa does not store the photos on your computer. When you open *Picasa*, it simply looks at the folders on your computer and displays the photos it finds. It displays the file types that you tell it to find, in the folders that you tell it to search.

1. Once you have downloaded the photos to your computer, open *Picasa* and locate the photos you want to scan.
2. Scan the photos, looking in the bottom right of the photos for the "Show/Hide Places Panel" icon 



3. This presence of this icon indicates the photo is geotagged. [When a photo is selected and you select the icon on the Picasa command bar, it will display the photo's position on Google *Earth* in a side panel]



Geotagged



Not Geotagged

If you find any photos that are not geotagged, inform mission staff.

Viewing EXIF files

Most DSLRs allow you to view your photo's EXIF data while the photos are still on the camera memory card. On the D200, while the photo is displayed on the LED

screen you simply press the multi selector down to scroll through the photo's information (this function varies with other cameras).

There are several other ways to view EXIF data:

1. In Windows, you simply right-click on the photo and select "Properties" and then select the 'Details' tab.
2. Most photo editing software allows you to view EXIF data (e.g., Adobe *Photoshop Elements* or Google *Picasa*)
3. You can use free online Exif viewing software (e.g., Jeffrey's *Exif Viewer* or EXIF-data.com).

Converting Sexagesimal to Decimal

Some camera GPS input latitude and longitude into the Jpeg EXIF data with its location information in sexagesimal (DMS or base 60) format, which is hard to use in popular mapping libraries as they usually present the information in decimal format.

For example, a damaged cement plant west of Amarillo, TX can be designated in sexagesimal format as 35°12'58.2" (positive value denotes North latitude), -102°05'49.2" (negative value denotes W longitude). So instead of using minutes and seconds to measure the fraction of a degree, a decimal value is used (decimal format); with such a convention the coordinates above are 35.216166°, -102.096966°.

Sexagesimal numbers are converted to decimal format by taking the minutes divided by 60 and the seconds divided by 3600 and adding them together. Using the above example:

Latitude would be $35 + (12/60 + 58.2/3600) = 35 + (0.2 + 0.0161666) = 35 + 0.216166$

Longitude would be $-102 + (5/60 + 49.2/3600) = 102 + (0.0833 + 0.0136666) = 102 + 0.096966$

NOTE: Mapping programs usually make these conversions automatically.

Modifying EXIF files

You can manually insert positional information into photos using commercial software. In other words, you can manually geotag your photos. However, these programs are limited in what kinds of positional information may be added; they usually only allow you to enter latitude and longitude, and sometimes altitude.

Note that these methods aren't useful if you have to modify lots of photos, such as you will have after a major disaster. Additionally, they are most useful for photos taken on the ground.

1. WMIRS allows you to manually enter the latitude, longitude, altitude and direction you were looking when the photo was taken. You do this after you upload and photo and then select the Edit function.
2. Google *Picasa* allows you to enter latitude and longitude by locating the photo's position in Google *Earth*. Select the photo, select the 'Tools' drop-down, select "Geotag" then "Geotag using Google Earth". *Picasa* will let you modify multiple photos that were taken at a single location.
3. There are other free programs available to do the same thing, such as *GeoSetter* (which will also allow you enter an altitude).

9.3 Editing Photos

The Airborne Photographer must master airborne imaging so that the photos do not require cropping or editing in order to meet the customer's needs; this is particularly true when customers want purely unedited photos or for ADIS/GIIEP missions where there is no chance to edit the photo before it is transmitted to the customer.

However, some customers allow (or request) cropping and editing. Mission staff (e.g., IT Officer) may need to edit photos in order to “save” an otherwise marginal photo, adjust a photo so it shows the true color and contrast of a target, annotate a photo, or transform a good photo into a great photo. These skills are also valuable in producing photos for initial and proficiency training.

For CAP customers, we rarely need to get fancy with editing photos (in fact, this can be detrimental). If the customer allows or asks and the photos need editing, try and limit changes to cropping, adjusting brightness and/or contrast (the difference in brightness between light and dark areas), resizing, and annotation (adding text and/or symbols).

There are several low-cost (< \$100) photo editing programs, the best of which are Adobe *Photoshop Elements* and Jasc *Paint Shop Pro*. Also, *GIMP* is a very good free editing program (www.gimp.org), but it needs a RAW imaging converter plugin such as *UFRaw* (ufraw.sourceforge.net) in order to work with RAW photos. As mentioned before, some cameras come with very capable (and free) browser/editing programs such as ArcSoft *PhotoStudio*. Different programs have different strengths and weaknesses, and you may find yourself using more than one program.

Professional-level editing programs such as Adobe *Photoshop* offer a wide range of capabilities, but they are expensive and take quite a while to learn. These extensive and advanced capabilities are not necessary for the basic operations we perform during CAP imaging missions.

9.3.1 Editing Sequence

Editing a photo is best done in a particular sequence (each adjustment is discussed in more detail later).

1. Crop
2. Adjust Contrast and Tone
3. Add Text or Symbols
4. Save in Desired Format

As you edit a photo, one feature serves as your best friend: the “Undo” function found in the “Edit” menu. “Undo” reverses the last editing action you performed on the photo and gives you the freedom to experiment at will. Even if you’ve made ten changes, selecting ‘Undo’ ten times will restore the photo to its original state (unless you’ve saved the photo along the way).

6.3.1.1 Crop

Before you crop, ensure that you are viewing the photo at 100% (e.g., select “View Actual Pixels” or its equivalent).

Cropping is easy to do and it removes extraneous information from a photo so you can emphasize the most important aspect of the photo. It can be accomplished two different ways, but both involve the same principle: “Get close, then closer.”

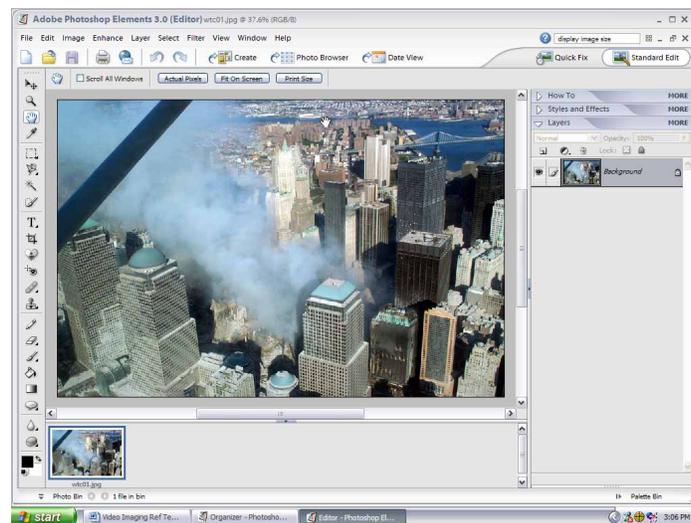
Cropping not only changes the composition of your photo, it removes tones from your photo. If you crop out tones you’re not interested in (e.g., areas of overexposed highlights such as the sky) you will change the appearance of the photo’s histogram and ease the editing process.

Cropping is useful when you want to enhance or center the target in a photo or to trim out unwanted detail, and to crop to standard print sizes. If the camera was slightly crooked when the shutter button was pressed, you may also be able to correct horizon lines that are off-kilter by rotating the photo first, then cropping.

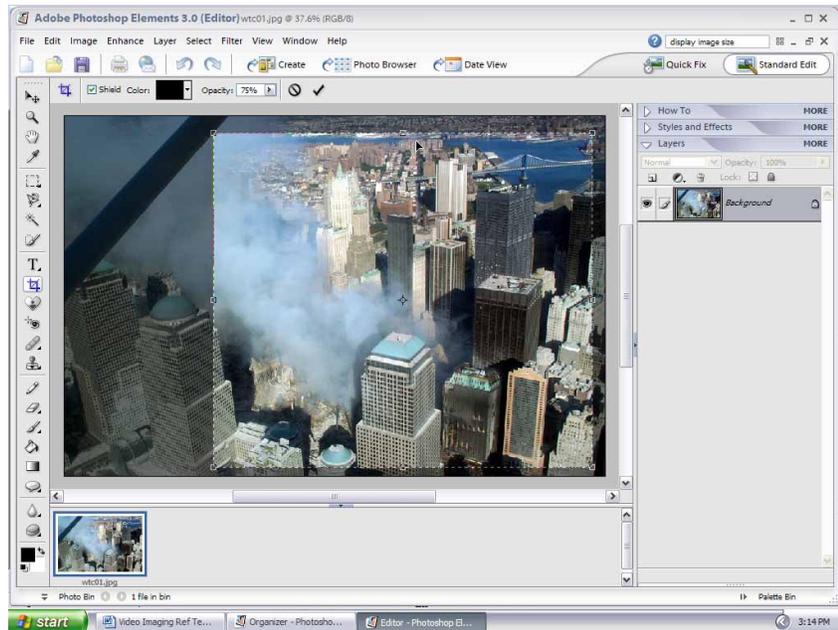
Following are some cropping tips (examples are from *Photoshop Elements*):

- *Don’t mess with success.* If you’ve successfully framed the photo at the time it was taken, don’t automatically feel the need to trim more. Often, leaving the photo just as it was captured by the camera is the best crop of all.

However, if you do want to trim you just open the photo in your photo editing program. In the example we want to crop the photo so the aircraft strut is no longer in the photo.



- *Use the Crop tool’s adjustment handles.* Trying to get the exact crop by dragging the Crop tool with the mouse is difficult, and sometimes impossible due to the invisible grids that govern mouse movement. Instead, just get the picture you want inside the cropping box by clicking and dragging the tool across the photo to create a cropping box that frames the picture. The area that you see inside the crop box will be kept and anything outside the box will be cut away. Next, release the mouse button and make the fine adjustments (height and width) with the adjustment handles on the cropping box.



Another benefit of using the adjustment handles is that it shows you the exact center of the selected photo (usually a + symbol like in the example). The center symbol moves as you move the borders; this allows you to emphasize an object or area by centering it in the cropped photo.

- Straighten crooked horizons. It's not always possible to keep the camera (or aircraft) level when taking a photo. In most cases its appearance can be enhanced by straightening a horizon that is not running parallel to the bottom of the photo. Some photo editors enable you to crop and fix a horizon in one step. Others will require use of the Ruler tool, and then cropping to produce a final photo.

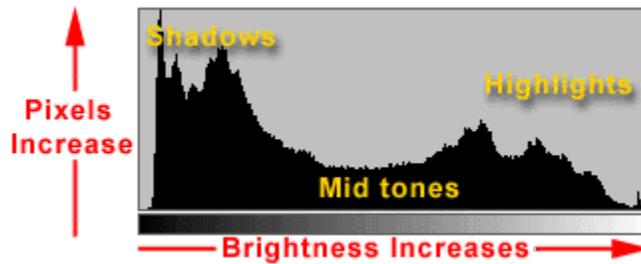
6.3.1.2 Adjusting Contrast and Tone using the Histogram

Often the only adjustment needed can be accomplished by making "Levels" (or tonal) adjustments to the photo's histogram (discussed in Chapter 2).

Tonal correction is the process of ensuring that the contrast in the photo is good (i.e., the blacks, whites and other levels look the way you want them to look). Because colors also have tones, many of the photo's color problems will disappear with tonal correction.

This adjustment is best done with the person who took the photo present, as it quickly enables you to make the photo match the colors and contrasts the Photographer observed at the scene.

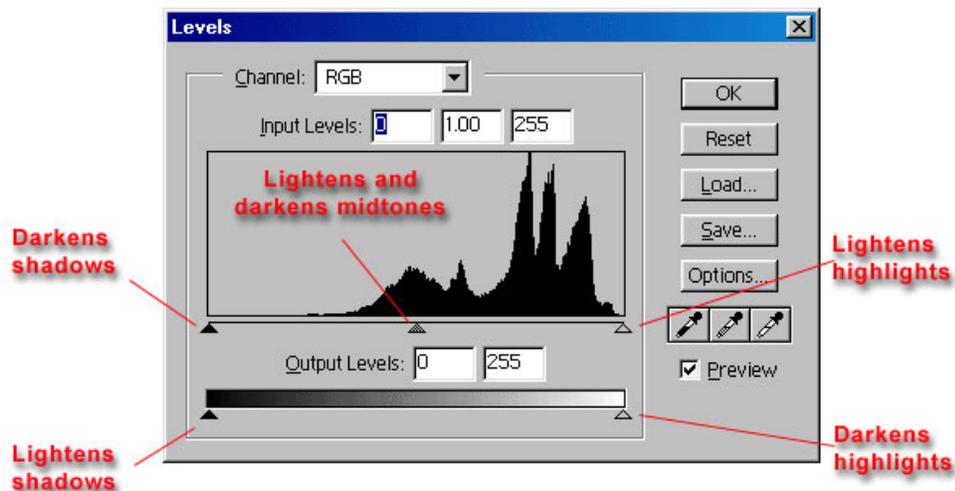
As we discussed in Chapter 2, there's no such thing as a good or bad histogram. However, a histogram that shows a large flat area on either end of the graph is most likely in need of some adjustment (see the example below).



From the histogram you can determine the photo's darkest shadow and brightest highlights, which are called the black point and white point. In fact, it's the range between these two points that defines the dynamic range (also called the tonal range, or contrast) of the photo. If the photo is low contrast, you can also tell if it's low-key or high-key from the histogram. A low key photo has details concentrated at the dark end of the scale while a high-key photo has them concentrated at the light end.

If there is enough detail, even if the photo is somewhat off, it can be corrected in a program such as *Photoshop Elements* using the "Levels" command or in "Picture Window" using the 'Brightness Curve'. These controls allow you to adjust the shadow, mid, and highlight areas independently without affecting the other areas. This lets you lighten or darken selected areas of your photos without losing detail.

In *Photoshop Elements* the 'Levels' dialog box ('Tone Adjustment' in some programs) gives you five draggable triangles to adjust the distribution of brightness in your photo:



The three draggable triangles below the histogram work as follows:

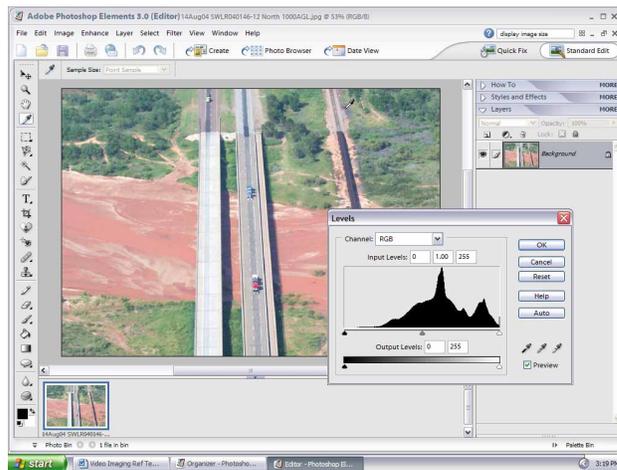
- Dragging the left (black) triangle to the right darkens the shadows
- Dragging the right (white) triangle to the left lightens the shadows
- Dragging the middle triangle (gamma) to the left or right lightens or darkens the photo

The two draggable triangles below the Output Levels gray scale bar also adjust the photo, having almost the opposite effect of the triangles above.

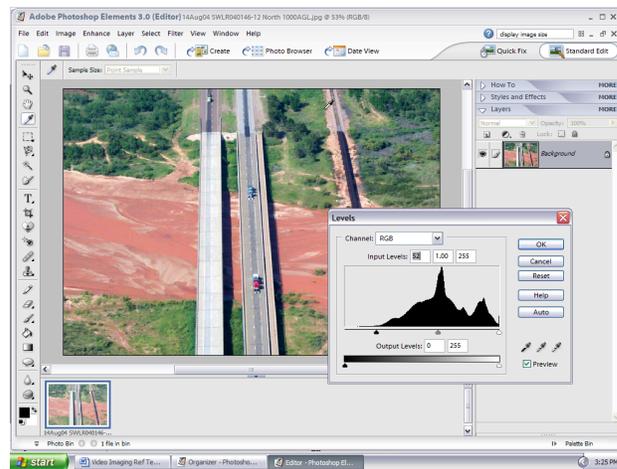
- Dragging the left (black) triangle to the right lightens the shadows
- Dragging the right (white) triangle to the left darkens the highlights

First, make sure the “Preview” checkbox is checked. To make corrections, drag the left slider rightwards to the point where it meets the end of the graph. You will see the change as you move the slider. If present, the photographer can tell you if the photo now matches what he saw when he took the photo.

In the example below, we see a photo with its histogram displayed. Note that the photo is slightly overexposed (the curve drops off before reaching the left side of the graph, indicating that there are few pixels with very dark colors).



Dragging the left (black) triangle to the right darkens the shadows and makes the photo noticeably sharper:



Technically, everything to the left of the new 'black' point is now considered black.

Notice that the middle slider (gamma point) has automatically moved to the right to preserve the relationship between black, midpoint and white. Also notice that the right side has not changed. This is one of the great advantages of the Levels adjustment – it allows you to edit different parts of the tonal range independently while preserving the tonal relationships in the photo.

If you also need to adjust the ‘white’ point where the curve drops off before reaching the right side of the graph, indicating that there are few pixels with very light colors, the process works the same.

Clicking the “Auto” button in the Levels control box automatically does both adjustments (left and right). However, it’s best not to use this feature as sometimes the rightmost point on the histogram is not what you want as white in the photo, particularly if the photo contains a bright highlight (e.g., sky) or a flare.

Another way to correct an overly dark or overly bright photo is to use the middle slider (gamma control). The gamma adjustment (sometimes called mid tone contrast) changes the brightness of the mid tones of a photo without substantially affecting the highlights and shadows, where simply brightening the photo with a brightness slider tends to wash out the dark regions and increase the intensity of the highlights. Using the middle slider can often bring more detail out of a shadowy area, and you won’t have to worry about your blacks or whites turning gray.

Automatic Enhancements

For CAP purposes, the only adjustment recommended is the tone (or Levels) adjustment discussed above. However, you should familiarize yourself with your editing program’s automatic features in the rare cases where they will be useful. Just don’t overdo it; each adjustment involves data loss.

The automatic enhancement features of a photo editing program can fix many problems quickly. Auto enhancement functions of one type or another are included in nearly every photo editing application. There’s no harm in trying them often, as the “Undo” function allows you to reverse the last editing action you performed.

Below is a short list of the most common auto enhancement features. As you try out these features, improving some pictures and having little or no effect on others, you’ll begin to get a feel for diagnosing photo quality ills and prescribing editing cures.

Check your editing program to see which specific features it offers; they will often be named something similar to the descriptions below. Remember, don’t be shy about trying an adjustment; if it doesn’t work, just reverse it with the “Undo” command (and you have previously saved an untouched version of the photo, haven’t you?).

- Auto brightness and contrast/auto levels. Use auto brightness and contrast (and the similar auto levels) to fix underexposed (too dark) photos, as well as ones with too little contrast which will look dull and muddy. You can also try it with overexposed photos or those with too much contrast, but it’s a lot less effective for those problems.

- Auto color correct/color cast removal. Use this feature to correct color casts, such as the overall blue tinges that can afflict a photo taken in the shade, or the yellow cast of pictures taken indoors without flash.

Auto color correction is less reliable than auto levels, but that's mostly because color correction is inherently tricky. One of the trickier aspects of color correction is the fact that some of the most spectacular pictures look best with their color cast left intact, or even enhanced. Automatic color correction may remove the warmth of the color, when the warmth is what makes the picture look its best. Not all pictures are meant to be free of color casts; the trick is to judge whether a picture appears most pleasing with its color cast retained or removed.

- Auto color enhance/auto hue and saturation. This command increases the saturation, or vividness, of your picture's colors. Sometimes the results are great, sometimes not. This is one feature where the "try it out, undo it if it looks bad" strategy really applies. As a general rule, you can pump up the vividness of colors the most when the picture is to be viewed on-screen only. If the picture is to be printed as well, then consider a more restrained approach, as you may find that the vivid color you saw on your monitor takes on an unnatural, overdone appearance when printed.
- Auto focus. This feature really works in some cases.
- Sharpen. Easier to use than a function like Photoshop's *Unsharp Mask*, the standard "Sharpen" command in many photo editors gives a quick-and-dirty boost to your photo's detail, and may well make it look right for viewing on the Web or in an on-screen slide show.

Avoid sharpening low-quality photos and highly compressed (smaller file size) JPEG photos. Low quality photos often have small imperfections (artifacts) which can become much more apparent when sharpening them. Only apply sharpening after you've performed all your other corrections and edits, because sharpening can be a very destructive operation.

Viewing and Editing RAW Photos

By shooting in the RAW mode, you add an extra step to the editing process. You have to use some form of a raw conversion process, because all the processing that normally happens in the camera is sent to your computer for processing. On the upside, you have more control and flexibility because of this.

Different cameras produce different types of raw files, and there are no generally accepted standards (as there is for JPEG or TIF files). That is why camera vendors bundle a raw conversion program with their cameras.

Previewing

When you import your RAW photos, some applications will allow you to view thumbnails and previews from within Windows Explorer. For example,

dpMagic (www.dpmagic.com) makes a free program for Windows called “dpMagicCommunity” that allows you to view thumbnails inside Explorer (a \$10.00 version adds full-screen previews and histograms, and supports Adobe Digital Negative files). *Photoshop Camera Raw* (built into *Photoshop* and *Photoshop Elements*) supports many camera types and can import RAW files from all the major camera makers. Nikon’s *ViewNX* (<http://www.nikonusa.com/>) allows you to view JPEG and NEF (RAW) files, and edit or convert NEF/RAW files. Also, the free Microsoft *RAW Image Thumbnailer and Viewer* download provides thumbnails, previews, printing, and metadata display for RAW photos from most Canon and Nikon digital cameras on Windows XP.

Browsers are built into most raw conversion programs (e.g., *Photoshop*, *Photoshop Elements*, or the program supplied with your camera such as *Nikon Capture NX*, which can be integrated with *ViewNX*), so you can browse and compare thumbnails of your photos just as you do with JPEG photos.

All cameras store a low-resolution JPEG preview of the RAW file inside the file itself, and many applications can show this preview. Some applications also perform an initial raw conversion that yields a very good photo that you may not have to adjust further.

Editing

If you’re using Photoshop or your camera’s raw converter, you’ll convert your photo files, save them (usually as a TIF or Photoshop file), and then perform any additional edits (if needed) in your normal photo editor.

You usually approach raw conversion the same way you approach any type of photo editing: Begin with cropping, then correct contrast and tone, and then correct the color. [Some converters also let you remove dust and spots.]

Resize Photos

You can reduce file size using the 'resize' feature found in most photo editing software. Plus, many programs give you the opportunity to reduce file size during the “Save” or “Save As” functions. Many editing programs also show you the file size (and sometimes the transfer rate) of the result you have selected when you use “Save As”. *This is a very handy feature.*

If all you need to do with a photo is e-mail it to a customer who is only going to view it on a computer monitor, then you should resize it to a size that will display easily on the typical monitor. Using the “Save As” feature as an example, select the file size somewhere between 300K and 500K.

Note

JPEG and RAW photos create EXIF files, which include camera settings and data from the GPS. [As you manipulate photos you must preserve the EXIF data with your photos.](#) Using the “Save” command is safe, but be careful when you’re going to use the “Save As” command and make sure you don’t select “Save for Web & Devices” (or “Save for Web...”). So, if you’re converting a RAW photo to reduce its size, use “Save As” and select JPEG.

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10. Send Photos to the Customer

Airborne Photographers need to know various methods of delivering photos to a customer. Although mission staff often perform these duties, an AP may be the only knowledgeable person at a small base or staging area.

OBJECTIVES:

1. Discuss the *Image Uploader* program for uploading photos.

Upload a photo using the desktop *Image Uploader* application. *
{O-2213}

2. Discuss methods for sending photos by other means:
 - a. Direct delivery
 - b. FTP
 - c. Cloud storage sites
 - d. E-mail

* Photos are no longer uploaded in WMIRS. *Image Uploader* is in beta testing, so uploading a photo to this program is Optional unless you have access to the program.

Note

Do not share photos from an Air Force Approved Mission (AFAM)

10.1 Upload Photos using the FEMA Image Uploader

The Federal Emergency Management Agency (FEMA) Image Uploader was created to provide rapid access to geotagged images on the FEMA GeoPlatform, which provides geospatial data and analytics in support of emergency management. A geospatial platform provides shared and trusted geospatial data, services, and applications for use by the public and by government agencies and partners to meet their mission needs.

The Image Uploader is intended to provide an easy method of uploading photos taken by CAP and then processing and displaying them in a useful and flexible manner. The goal of this program is to keep it simple enough for anyone to use without a lot of training.

There is a web-based application and a desktop application, both allowing for the uploading of images. Mission managers will be provided a password and token (serial number) for the web-based application, usually by the CAP National Operations Center. CAP airborne photography aircrews (or mission staff) will use the desktop application to upload photos and data logger files.

Image Uploader Terminology

Managers will use the web-based application to set up, process and manage airborne and/or ground photography “events” in the web-based application. The terminology is somewhat different from what we’re used to, but an easy way to remember the terms is that:

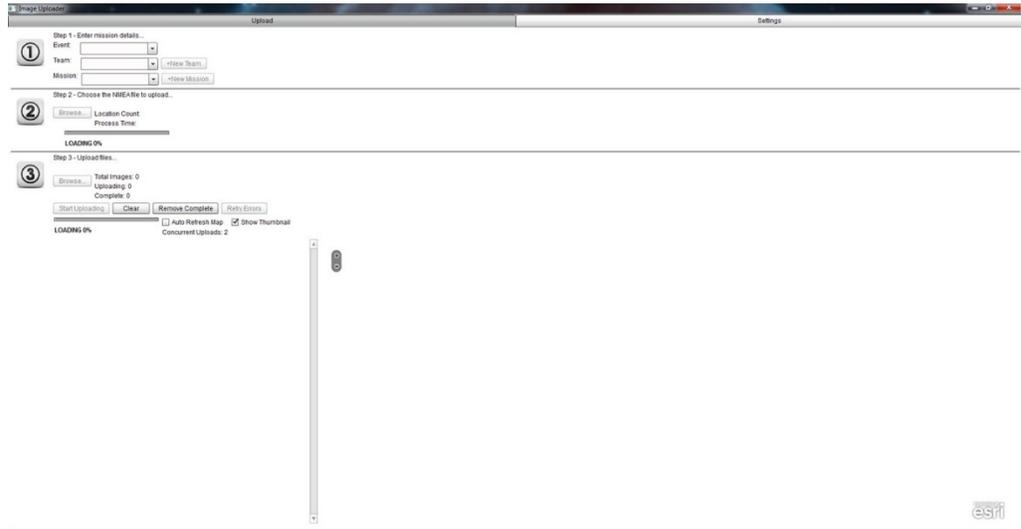
[Events have teams > Teams have missions > Missions have images](#)

- **Event**: An event can be a declared disaster or exercise spanning any amount of land. Each event is organized into the teams and missions that are related to the event. Only managers can enter events.
- **Team**: The crews that will participate in the event. This will be CAP airborne photography crews and/or ground-based photography teams.
- **Mission**: Each team will be assigned a mission (tasking) to take a specific set of images (photos). A mission will not span longer than one day. Staff will strive to give missions a name that is concise yet informative of the source of the images.

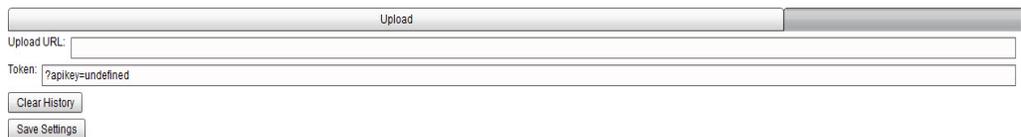
10.1.1 Uploading Images in the Desktop Image Uploader

You will be provided the *ImageUploader* application to install on a laptop or computer (either Windows or Apple). Additionally, Adobe *Air* must be installed.

- a. Open the Image Uploader application and you'll see the following screen:



- b. Along the top you will see a “Settings” tab:



- 1) Click on the “Settings” and you will be prompted to enter an “Upload URL” and a “Token”. The Upload URL is the web site that the photos will be uploaded to and should be provided by staff, along with a Token. The token is the user or wing’s unique key that will be used in place of a login and password for the desktop application. Treat this as if it was your login and password and *do not share the token*.
- 2) Click “Save Settings” once they are entered

- c. Along the top you'll see an "Upload" tab (a map of the event will also appear in the bottom right corner):

The screenshot shows the 'Upload' interface with three steps:

- Step 1 - Enter mission details...**: Includes dropdown menus for 'Event', 'Team', and 'Mission', and buttons for '+New Team' and '+New Mission'.
- Step 2 - Choose the NMEA file to upload...**: Includes a 'Browse...' button, 'Location Count', 'Process Time', and a 'LOADING 0%' progress bar.
- Step 3 - Upload files...**: Includes a 'Browse...' button, 'Total Images: 0', 'Uploading: 0', and 'Complete: 0'. It also has buttons for 'Start Uploading', 'Clear', 'Remove Complete', and 'Retry Errors'. There are checkboxes for 'Auto Refresh Map' and 'Show Thumbnail', and a 'Concurrent Uploads: 2' indicator.

Step 1 – Enter mission details

- 1) Select/enter the event, team, and mission to which you will link the photos you're going to upload
- 2) Use the "Event" drop-down menu to select your event from the list of all active events on the Image Uploader
- 3) Select your Team from the "Team" drop-down menu. *Note:* A new team can be created if it is the first time a crew is uploading images for a specific event. To do so, click "New Team" to the right of the "Team" selection box, enter the team name, and Save the entry.
- 4) Select your Mission from the "Mission" drop-down menu. *Note:* A new mission can be created for any team working a particular event. To do so, click "New Mission" to the right of the "Mission" selection box and enter:
 - Mission Name (should be provided by staff)
 - Mission Date (use the calendar date entry box)
 - Image Type: Aerial Oblique (taken at an angle), Aerial Nadir (taken from straight above), or Ground
 - Save the entries

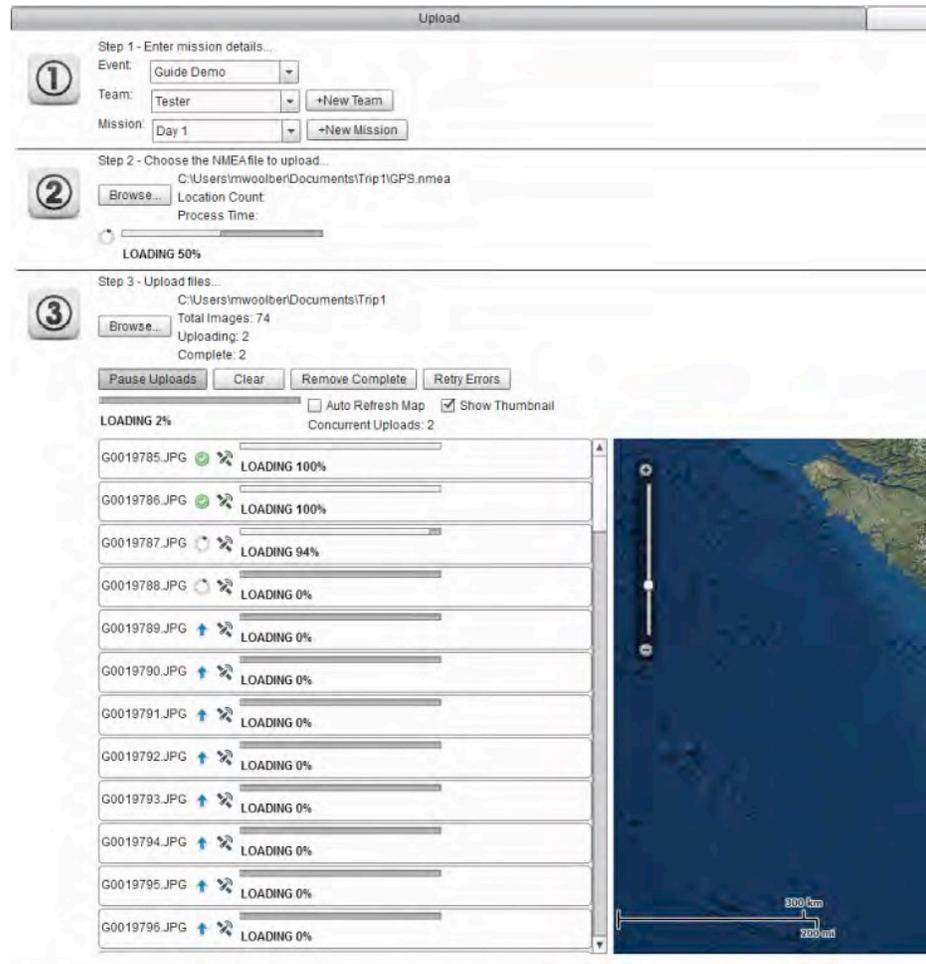
Step 2 – Choose the NMEA file to upload

- 1) Browse to the location of the GPS data logger's NMEA file; NMEA files are commonly named with .nmea, .txt or .log file extensions. [Note: GPX files do not contain the necessary information and are not currently supported.]
- 2) Select the file and click "Open"

Step 3 – Upload files

Note: Do not rename files prior to uploading them, as the names will be altered during the uploading process.

- 1) Browse to the folder containing the sortie photos. Select the folder and click “Open”. [Note: Upload all photos, even if some are not geotagged.]
- 2) Click “Start Uploading”. This will trigger the upload of both the NMEA file and photos.



- 3) Upon completion of the image upload, all images should have a green check mark to the left of each loading bar. At this time, the images can be viewed and processed by staff in the web-based Image Uploader.
- 4) The grey satellite image to the left of the loading bar will change to a green image if the photos are geotagged. [NOTE: When a non-geotagged image is uploaded in the Image Uploader, staff can use the web-based application to process the image and add geotag information. This is why it is important to use a GPS data logger as a backup to the camera GPS. Taking a photo of a prominent spot on your departure airport also helps staff to establish a non-geotagged photo's location.]

NOTE: Units should pre-arrange access to a high-speed internet connection for use during missions that require uploading a large number (hundreds or thousands) of photos. Try a government agency or business with a T1 (or higher) line; these lines carry data at megabits per second, as compared to the kilobits per second on common residential and small business lines. You should be able to arrange to use their internet connection under these conditions, as these types of missions are rare (large-scale disasters such as hurricanes, flooding, or fire) and provide such a valuable community service.

10.2 Sending Photos by Other Means

You may have to resort to sending photos by alternate means; this section covers several methods for doing this. These methods may also be used when you need to send non-AFAM photos, such as for training or collaboration.

10.2.1 Direct Delivery to the Customer

Sometimes the customer needs mission photos as soon as possible but it isn't practical (or possible) to use the ImageUploader. In this case the preferred method is to deliver the photos by aircraft or ground transportation.

We face this situation when hundreds or thousands of photos are required for large-scale disasters such as hurricanes, flooding or fire. Even if internet connections are available, the sheer volume will require hours to upload photos from a single sortie (much more for slower internet services with low upload times).

Depending on circumstances, the most common method of delivery is to transfer your photos to a large-capacity USB drive. Sometimes the customer will meet you (e.g., at an airport FBO) where you will load your photos onto a laptop and then transfer them to the customer's USB drive; this is why it is handy to carry a media card reader in your photography kit).

10.2.2 FTP Site

File Transfer Protocol (FTP) is a standard way of sending and receiving files between your computer and any other computer on the Internet that supports FTP. There are several FTP applications out there that are simple and user friendly such as *FileZilla* (<https://filezilla-project.org/>). This application is open source software distributed free of charge under the terms of the GNU General Public License.

In general, you will connect to the FTP site, enter the Username and Password provided by Mission Staff, navigate to the location where you are to put your photos and drag/drop your photos onto the site.

Sometimes a dedicated website is established for crews to upload their mission photos.

10.2.3 Cloud Services

When using any commercial cloud product to share mission photos, be sure to use the highest privacy settings in order to limit who has access to the photos (authorized personnel only). Do not share photos from an Air Force Approved Mission (AFAM).

Google Drive ®

If you have a Gmail ® account you can upload photos and share them via e-mail invitation. The account is free and includes free storage (you can purchase additional storage).

If you have a Gmail ® account you can upload photos and share them via e-mail invitation. The account is free and includes free storage (you can purchase additional storage).

- a. Select "Drive" from the Gmail tool bar.
- b. Select the "Upload" button.
- c. Select and upload your photos.
- d. Select "Back to Google Drive"
- e. Check the items you wish to share and select "Invite People" from the "Share" drop-down menu.
- f. Enter the e-mail address and write your message, then select "Send"

If the e-mail was sent to another Gmail account they will be delivered into the account. If the e-mail goes to another account, they will receive a link to the uploaded photos.

Picasa™ Web Albums

If you have a Gmail ® (Google) account you can upload photos into albums and share them via e-mail invitation. The account is free and includes free storage (you can purchase additional storage).

Picasa Web Albums offers 1 GB of free storage for photos and videos only (photos under 800 pixels and videos under 15 minutes doesn't count towards storage). You can purchase additional storage; for example, 20 GB is \$5/yr.

- a. Sign in to your Gmail account and select "Photos".
- b. Select the "Upload" button.
- c. Create an album, and select "Anyone with the link" on the Visibility drop-down menu.
- c. Select "Choose photos to upload" and upload your photos.
- d. Select "Home" and then select your album
- e. Select "Share" and enter the customer's e-mail address.
- f. Write a descriptive message, and then select "Send Email"

The recipient will receive a link to the uploaded photos along with the message you entered.

SugarSync®*, *Dropbox™* and *OneDrive

These services also provide free versions with free storage (you can purchase additional storage), and are easy to use. Visit their sites for detailed information.

10.2.4 E-Mail

The simplest way to attach a non-AFAM photo to an e-mail is to open your e-mail program and attach the photo file. However, Windows gives you an easy way to resize (or not) your photos, attach them to your e-mail and send them.

Sending and receiving photos by e-mail can be challenging. Internet Service Providers (ISPs) limit the size of individual files and attachments to 1 or 2 GB (you can usually assume the limit is 1 GB) or if they do make it through the recipient may have problems viewing them, especially if they are using an older computer.

If both your and the customer's ISP allows large file transfers, just ensure the number of photos you're sending in each e-mail adds up to a number lower than the limit.

Many ISPs and/or users have anti-spam software installed. If the recipient tells you they haven't received your e-mail, ask them to ensure their ISP and/or personal anti-spam program is set to receive files sent using your e-mail address.

Before you send non-AFAM photos across the internet, get them into a form guaranteed to be readable on the other end and that doesn't take up too much space. The common JPEG format should be considered mandatory for e-mail; avoid BMP, TIF, or RAW unless your customer has special requirements. If you have picture in something other than JPEG, use your editing or e-mail software to convert it to JPEG before you send it. If the customer just wants photos to view on a computer, limit the file size to somewhere between 300K and 500K. If you have trouble sending or receiving a group of digital photos over the Internet, try sending each photo in a separate e-mail.

If you are sending uncompressed files (e.g., RAW) you can reduce the photo file by "zipping" it using Windows or a compression program such as WinZip or PKZip. However, photo files that are already compressed (e.g., JPEG) won't benefit, and WinZip can even increase the file size.

Attachment 1: Customer Imaging Request Checklist

This checklist assists mission staff in obtaining all the information necessary to determine exactly what a customer wants, and enables the Airborne Photographer and Mission Pilot to know what information to expect (and need) during briefings

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<p>What and where is the target?</p> <p>Define the target location by at least two forms of navigational information (e.g., Lat/Long and VOR radial/DME)</p> <p>Also ensure that you get a good verbal description of the target.</p> <p>Note: If the crew will need to perform a damage assessment/survey in order to decide how to image the damage, at least try to define the general area or boundaries of the suspected damage.</p>	
<p>How should the target and surrounding features be imaged?</p> <p>Some questions to ask are:</p> <ul style="list-style-type: none"> • Is the target a single feature or facility, such as a building? If so, do they want as close a picture as possible (e.g., completely filling the frame)? • Does the customer want to see the target and its environs to allow a larger perspective? • Does the customer want to see roads and/or power lines leading to or from the target? If so, how far out from the target? • Does the customer want to see the extent of flooding below a dam or levee, or the entire trail of debris from a tornado? • Does the customer want wide photos followed by close-ups? • Does the customer want the photos taken from a certain altitude (AGL) or from a specific angle to the target? Or is it OK to change altitudes and/or zoom as necessary to get the best shot? 	
<p>Does the customer care about lighting conditions over the target area?</p> <p>The customer may not want photos taken under a heavy overcast, or in early morning or late afternoon light.</p>	
<p>What information do they want to accompany the photos (or be</p>	

<p>included in a video's audio commentary)?</p> <p>Accompanying information may include:</p> <ul style="list-style-type: none"> • Altitude (MSL or AGL, or both?) • Latitude and Longitude (GPS format?) • Time (local or Zulu) • Distance from target (nautical or statute miles?) • Direction to target (e.g., looking South) • Angle to target (e.g., 45°) 	
<p>What photo format do they want?</p> <p>Do they want JPEG or an uncompressed RAW photo, or both (JPEG + RAW)?</p>	
<p>What quality and size photo file do they want?</p> <p>This is normally the largest and best quality JPEG.</p>	
<p>Do they mind if you crop photos, if needed?</p>	
<p>Do they mind if you edit photos, if needed?</p>	
<p>Do they want you to add text or symbols to the photos?</p> <p>This may include some of the information listed above, along with arrows or circles.</p>	
<p>How do they want you to name the photo files?</p> <p>Be specific, especially as to the sequence of information contained in the file name. For example: Date (dd/mm/yy) / mission number / sortie number / photo (sequential) number or description.</p> <p><u>Note:</u> Files uploaded to the FEMA Image Uploader are never renamed.</p>	
<p>Do they want you deliver the photos?</p>	

<ul style="list-style-type: none">• Usually uploaded to the FEMA Image Uploader.• May be delivered directly.• Do they want you to call before uploading the photos? What is the phone number (plus a backup)? Do they know how to access the photos?• If the customer wants you to e-mail the photos this may affect file format and quality (file size) settings. If you do e-mail the photos, ask what information the customer wants in the “Subject” and “Remarks” areas of the e-mail.	
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Attachment 2: Imaging Sortie Checklist

This is an imaging mission-specific checklist. See the *Flight Guide* (Appendix 2 of the Aircrew Reference Texts) for a general, comprehensive mission checklist

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1. Aircrew Assignment / Briefing

- A. Detailed briefing prior to each sortie; pay attention and ask questions
- B. Include entire aircrew, if space allows, but the Mission Pilot and Airborne Photographer must attend
- C. Ensure you get enough information to thoroughly understand the mission objectives
 - 1) Target(s), including description and exact locations (approximate data if an on-scene damage survey will be required)
 - 2) Terrain, obstacles and ground cover around the target(s)
 - 3) Weather (local and search area)
 - 4) Acceptable lighting conditions over the target (e.g., no clouds or mid-day only)
 - 5) Type of imaging pattern to be used, including altitude and angle to target
 - 6) Hazards to flight, temporary flight restrictions, special use airspace and military training routes (local and search area)
 - 7) Aircraft separation (will others be in the area?)
 - 8) Communications call signs, frequencies and procedures
 - 9) Time format (local or Zulu)
- D. Ensure you understand exactly what the customer wants
 - 1) How the target and surrounding features should be imaged
 - 2) Do they want all photos taken at the same altitude and/or focal length, or is it OK to change altitudes and/or zoom as necessary to get the best shot?
 - 3) What photo format do they want (e.g., JPEG, RAW or combination)?
 - 4) What photo quality do they want? (High, Medium or Low)
 - 5) Do they mind if you crop photos, if needed?
 - 6) Do they mind if you edit photos, if needed?
 - 7) What information do they want to accompany the photos (or be included in a video's audio commentary)?
 - 8) Do they want you to add text or symbols to the photos?
 - 9) How do they want you to name the photo files?
 - 10) How do they want you to send the photos?

2. Plan the Sortie

- A. The Airborne Photographer (AP) and Mission Pilot (MP) plan while the third crewmember listens (may be briefed later)
 - 1) Determine if the weather over the target will meet customer specifications and/or needs
 - 2) Plan the imaging flight pattern(s) to be used and fill in data on an imaging pattern worksheet
 - 3) Consider time over the target, with a margin to re-shoot at least one target plus time to review the photos in flight
 - 4) If needed, plan time to perform a damage survey. Also, decide if this extra time warrants a refueling stop.
 - 5) Discuss and finalize AP/MP communications over the target, including set up of the Audio Panel and Intercom
 - 6) Determine Photography Log (or Target Card) requirements and brief the log keeper
 - 7) If shooting video, determine what needs to be included in the commentary
 - 8) As with all CAP mission planning, identify your routes to and from the target area, define safe minimum altitudes, and identify hazards, obstacles, temporary flight restrictions and special use airspace. Identify all FAA, CAP and participating agency communications requirements and frequencies. Ensure you have the correct and current sectional charts (and IFR charts and plates for unanticipated weather conditions), plus any maps you may need (e.g., road maps, DOT maps or topographical maps). Determine your fuel reserve and determine if you'll need a refueling stop.
- B. Planning and Briefing sections of your sortie in WMIRS
 - 1) Ensure your 'Route of Flight' clearly describes your intentions; include any fuel or rest stops
 - 2) Synchronize watches (time hack)
 - 3) Double-check your estimated sortie time, fuel reserve and estimated fuel burn
 - 4) Review your planning aids (marked-up charts, maps, photo logs, and notes) for accuracy and legibility
 - 5) After the Briefer checks your planning and briefing information, the Flight Release Officer will brief you on any changes and release your flight

3. Inventory and Set Equipment

A. Inventory Equipment

- 1) Camera/GPS/Data Logger batteries (including spares)
- 2) Large-capacity media cards, including spares (you should also include a large USB flash memory drive and a media card reader)
- 3) Filters (as needed); a UV filter should normally be installed to protect the lens
- 4) Condition of the camera strap and lens cap
- 5) Flat rubber band (and spare) to prevent zoom lens creep
- 6) Photo Log and/or Target Cards, Recon Sketch and Imaging Pattern planning sheets
- 7) Clipboard for logs and sketch sheets
- 8) Cleaning supplies
- 9) If you're using a camcorder, ensure you have the microphone adapter.
- 10) If you intend to stop away from mission base between sorties, take the battery charger along (also a media card reader if it will be needed to transfer photos to a customer)
- 11) Seat cushion (to improve your position when shooting through the photo window)
- 12) A large dark T-shirt or jacket or equivalent to use as a "portable darkroom" for reviewing photos on the LCD screen

B. Adjust Camera and Portable GPS/Data Logger Settings

- 1) Turn on the camera and check status. Look for a full battery charge, sufficient space on the media cards, and other settings as listed below
- 2) Set the exposure mode, usually Auto or Program. Also, determine whether you will be shooting normally (single frame) or if you need to set to burst (continuous) shooting mode.
- 3) You may turn off the color LCD to save batteries
- 4) Disable (turn off) digital zoom, the flash, AF-Assist, and digital image stabilization
- 5) Check or set photo type, resolution and quality depending on how the mission. With large-capacity media cards, the best choice usually is RAW + JPEG.
- 6) Set the Diopter Correction
- 7) Connect the portable GPS to the camera and ensure proper connection and satellite acquisition. In the camera setup menu, select "Use GPS to set camera clock". [Note: Calibrate the GPS compass if it has moved over 100 miles from its previous location]
- 8) For a GPS that doesn't connect to your camera, synchronize camera time (UTC) to that of the GPS and ensure the GPS is in the "Tracking" mode.
- 9) Set up the GPS Data Logger per the user manual.

C. Prepare the Aircraft

- 1) Clean the aircraft windows before you leave, and make sure you have cleaning supplies on board
- 2) If you will be shooting out the right front window of the aircraft, remove the window holding screw and place it in a secure container
- 3) Enter any waypoints into the GPS before startup
- 4) Set up the Audio Panel and Intercom. Check the operation of the intercom (all positions) and perform a communications check of the CAP FM radio from all positions.
- 5) If applicable, turn on the laptop and check for full battery charge and proper settings
- 6) If applicable, connect the portable GPS to the camera and check for proper operation
- 7) Check the imaging equipment. If you will be transmitting pictures from the aircraft, take a test shot of the aircraft 'N' number and transmit it to the receiving station; this will test the camera, laptop, cellular card and/or satellite phone. If you will be shooting video, test the camcorder and audio connection for proper operation.
- 8) Take photos of a prominent spot on your departure airport and of a target card that has the mission and sortie number on it. The airport photo can be used by staff to process photos that aren't geotagged.
- 9) Arrange your equipment for easy access, but ensure lightweight objects such as charts and logs are not lying loose where they can be blown about the cabin when you open a window to take pictures

4. Fly the Sortie

A. Transit to the Target Area

- 1) Relax sterile cockpit rules but maintain situational awareness
- 2) Double-check navigational settings to be used in the search area
- 3) Review search area terrain and obstacles
- 4) Update in-flight weather
- 5) Review methods to reduce fatigue/air sickness/vertigo or combat high altitude effects during the sortie
- 6) Crew members keep their seat belts and shoulder harnesses on unless such wear interferes with duties; the pilot wears them at all times.

B. Approaching the Target

- 1) Exterior lights on (maximize your visibility so others can "see and avoid") [You may need to turn off the strobe lights so they will not affect the photos, particularly in low-overcast conditions.]
- 2) Review sortie objectives and crew communications, and set the Audio Panel and Intercom
- 3) Double-check radio and navigational settings, and check navigational equipment against each other (detect abnormalities or failures)
- 4) Ready the Photo Log and/or Target Cards
- 5) Remember hourly updates - altimeter setting (closest source) and fuel assumptions, and "Operations Normal" reports
- 6) Turn on camera/GPS/photo tracker and ensure locked on and tracking
- 7) Take a test photo to ensure your camera settings give you a quality image; adjust settings if necessary
- 8) Stabilize at 'Target ID Pass' heading, altitude and airspeed at least two miles out. Implement sterile cockpit rules
- 9) Log time (and Hobbs) and report "In the Search Area"

C. The ID Pass

- 1) Log Lat/Long (and radial/DME) and verify you have the correct target
- 2) Enter the coordinates as a 'User Waypoint' and display for pilot use
- 3) Examine the target, its surroundings, and lighting conditions. Verify that what you see is what you planned for and that you can properly frame the target; if not, have the Mission Pilot pick a safe location to loiter and re-plan how to perform the imaging run (e.g., determine the altitude, angle and directions you need to get the best photos) and how you wish to frame your photos
- 4) If needed, perform a damage survey and plan the imaging pattern(s) necessary to fully document the damage. Reassess your fuel status and plan a refueling stop if needed. Update Mission Base on your new sortie time assumptions.

D. Prepare to Enter the Imaging Pattern

- 1) Fly at least 1000' AGL during daylight
- 2) Ensure you're flying slowly enough (usually 90 kts) to allow the AP to get several photos from each angle or side
- 3) Secure camera neck/wrist strap and lens cap (check the rubber band used to prevent zoom lens creep, if used). Remove lens hood.
- 4) Ready the Photo Log; if you're using Target Cards, take a photo of the applicable Target Card
- 5) Secure loose items in the cabin and open the window

- E. Taking Photos with the Camera
 - 1) Steady the camera and give the log keeper a heads up
 - 2) Frame and take the photos, keeping the log keeper informed of your photos (or take photos of the applicable Target Cards before shooting other targets)
 - 3) Take short breaks to prevent fatigue/air sickness/vertigo
 - 4) Periodically verify GPS (and tracker) locked on and tracking

- F. Recording Video with the Camcorder
 - 1) Steady the camcorder and set for wide angle (no zoom)
 - 2) Begin recording and commentary about five seconds before the target comes into frame
 - 3) Zoom in (smoothly) when the target is abeam
 - 4) Zoom out about five seconds beyond the target, and stop recording
 - 5) Play back the video before moving in towards the target to make sure you got the video you wanted
 - 6) Minimize zooming in and out while recording
 - 7) Take short breaks to prevent fatigue/air sickness/vertigo
 - 8) Zoom out to wide angle when finished recording, and stop recording

- G. Determine Success or Failure
 - 1) Pilot selects a safe area away from the target to circle the aircraft
 - 2) AP reviews the photos/video on the LCD screen, particularly for framing and focus. Verify GPS data was recorded with the photos.
 - 3) Plan and re-shoot as necessary
 - 4) Log time (and Hobbs) and report "Out of the Search Area"
 - 5) Double-check heading and altitude assigned for transit to next target or return to base

- H. After the Sortie
 - 1) Remove all your equipment from the aircraft, if necessary
 - 2) Clean the windows
 - 3) If no more sorties will be flown in the aircraft, replace the aircraft window screw (if used) and secure the aircraft

5. Debrief

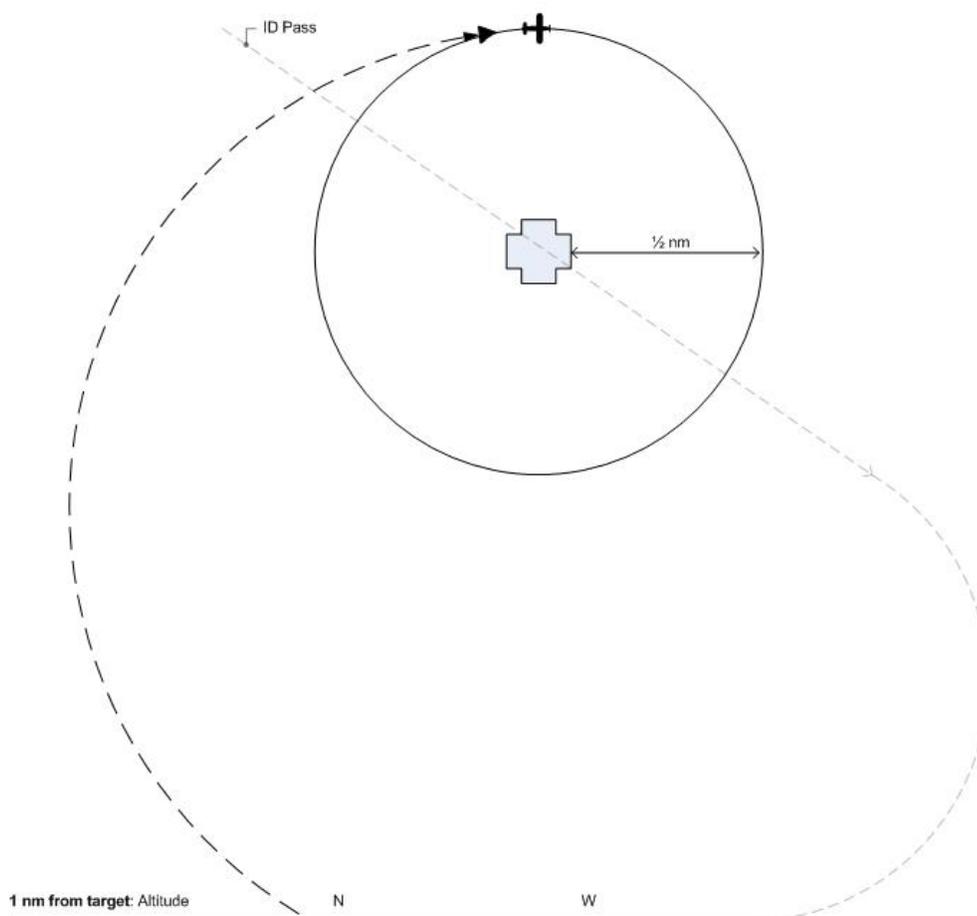
- A. Transfer your photos to a computer as soon as possible, and then verify the pictures were successfully and completely transferred by looking at each photo on the computer before you delete the photos on the media card (required for AFAM)
 - 1) Verify the GPS data was recorded for each photo. If not, inform mission staff.
 - 2) Some mission bases will just have you give them the media card and Photo Log (or Target Cards). In this case, be sure to put one of your spare cards back in the camera, check that it is empty, and put the camera back in its bag.

- B. Take a short break and then meet to complete the Debriefing section of WMIRS
 - 1) Fill in or verify 'ATD' and 'Actual Landing Time'
 - 2) The Summary section describes what you accomplished on the sortie
 - 3) The Results/Deliverables section can be as simple as "no sightings" or "no damage noted." However, you must list results such as sightings (including negative sightings), the number of photos you took, etc.
 - 4) The Weather Conditions section can be as simple as entering "as forecast." However, if the weather was unexpected it is important to explain how the weather conditions affected sortie effectiveness
 - 5) The Remarks section is for entering any information you think is pertinent or helpful that was not entered elsewhere. It also gives the crew a chance to comment on the effectiveness of the sortie in detail.
 - 6) The Sortie Effectiveness section involves a quantitative assessment of how well you accomplished your mission.
 - 7) The Attachments & Documentation section is self-explanatory. Ensure all entries and sketches/drawings are clear and legible and upload into WMIRS. Be sure to label each attachment (e.g., mission and sortie number) so they can be related to the mission/sortie if it accidentally becomes separated.
 - 8) Upload fuel receipt into WMIRS
 - 9) Ensure 'Hobbs To/From' and 'Hobbs in Area' entries equal the 'Hobbs Total'

- C. Check in with Debriefing Officer
- 1) Tell how you did your job and what you saw
 - 2) Usually starts with a review of the information you entered on the Debriefing section of WMIRS
 - 3) Review the photos or video (plus Photo Logs, Target Cards, and sketches), comparing them against mission objectives and requirements
 - 4) Answer all questions as best you can, and be very honest about conditions and your actions
 - 5) If you are scheduled for another sortie, find someplace to rest. Close your eyes; you may even want to take a nap if there is time and a place to do so. Also, take in some refreshment to give you sufficient energy for the next sortie.
 - 6) Ensure that the air crew obtains sufficient rest during crew rest periods, including approval of extensions to the maximum air crew duty period (CAPR 70-1).

Attachment 3: Circling Pattern Worksheet

Circling Imaging Coordinates



Description:		
Mission #:	Sortie #:	Date:
PIC:	Crew:	

Target Coordinates: N	W
Altitude:	Airspeed:
Time of day:	Sunny / Cloudy / Overcast (circle or describe other)

Intentionally blank

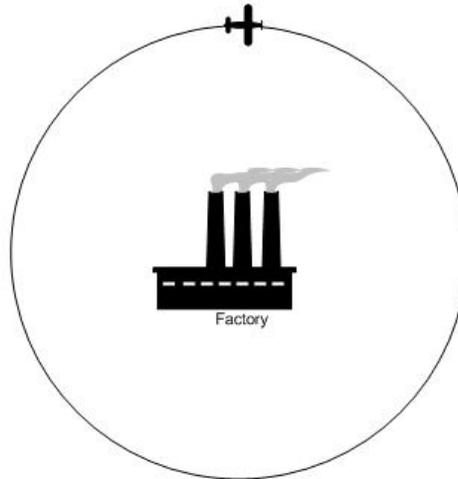
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Attachment 6: Overview Pattern Worksheet

Bird's Eye (Overview) Imaging Pattern Planning and Data Sheet

Mission #:	Sortie #:	Date:
Initial (planned) altitude over target:	Obstacles near target:	
PIC:	Crew:	



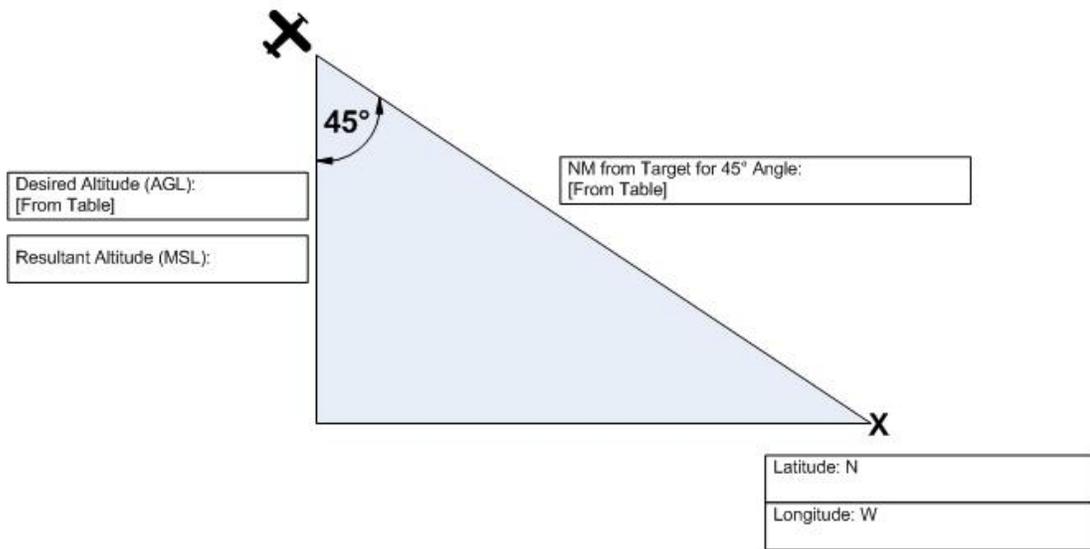
Circle target to find the altitude that will permit horizontal framing and determine the best direction from which to take the imaging photo

Altitude (MSL):	Direction looking for best photo:
Time of Day:	Sunny / Cloudy / Overcast (circle one or describe other)

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Attachment 7: 45° Pattern Worksheet

45° Angle to Target Imaging Pattern Planning Sheet



Height (AGL)	NM for 45° Angle
1000	0.233
1500	0.349
2000	0.465
2500	0.582
3000	0.698
3500	0.815
4000	0.931
4500	1.047

Description:		
Mission #:	Sortie #:	Date:
PIC:	Crew:	

Airspeed:	Time of Day:
Sunny / Cloudy / Overcast (circle or describe other)	

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