LESSON PLAN

PART I
COVER SHEET

LESSON TITLE: Threat Sensor Types and Characteristics

TRAINING METHOD: Lecture and Discussion

ORGANIZATIONAL PATTERN: Topical

REFERENCES: Technical Report JCCD 94-1, Air Base Camouflage, Concealment, and Deception Guide, January 1994

AIDS AND HANDOUTS:
- Attachment 1: Generic Attack Scenarios
- Attachment 2: Lay-Down Attack Profile
- Attachment 3: Level Approach Fly-Up or Bump-Up Attack Profile
- Attachment 4: 180-Degree Approach Pop-Up Attack Profile
- Attachment 5: Limiting Visual Detection, Recognition, and Weapons-Release Ranges For Conventional Weapons
- Attachment 6: The Electromagnetic Spectrum

LESSON OBJECTIVE: Given a lecture on Threat Sensor Types and Characteristics, the student must correctly answer questions covering Threat Sensor Types and Characteristics (all or some) of the samples of behavior listed below:

SAMPLES OF BEHAVIOR:

1. Identify the characteristics of three different attack profiles.

2. Determine the advantages the human eye has over other threat sensors.

3. Identify point and area targets.

4. Determine various sensor type characteristics.

5. Determine factors to figure target acquisition times.

6. Identify the threat performance limits of the various threat sensors.

SUGGESTED COURSE(S) OF INSTRUCTION: CCD Planner's Course
CCD Trainer's Course

Supersedes RTP K5, 8 November 1996
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Pages: 43/Distribution: F

STRATEGY: This lesson should typically follow RTP K3 on the four basic principles and assumptions of CCD. The target audience of this lesson are people assigned tasks as part of the CCD planning committee. As planners, they require the depth of knowledge necessary to understand the "science" of CCD in addition to CCD measures (CCDM's) such as netting, decoys, etc. The instructor must be thoroughly familiar with the threat aspects in the references used to develop this lesson. There may be students attending the class having more knowledge than the instructor in certain areas of this lesson. The instructors should expand their base of knowledge and interact with the students, allowing them to share their experience with others. If instructors portray being subject matter experts, they may miss an opportunity to gain experience the students have to offer.

LESSON OUTLINE:

MAIN POINT 1. THREAT SCENARIO

a. Threat Assumption
b. Priority of Targets
c. Area And Point Targets
d. Target Sets

MAIN POINT 2. AIRCRAFT ATTACK PROFILES

a. Approach Cues
b. Approach Methods
c. Delivery Profiles

MAIN POINT 3. TARGET ACQUISITION TIMES

a. Conditions
b. Detection

MAIN POINT 4. TARGET ACQUISITION SENSORS

a. The Un-Aided Eye
b. The Aided Eye: Electro-Optical Systems
c. Video
d. Forward Looking Infrared Receivers (FLIR)
e. Radar Systems

PART II
TEACHING PLAN
INTRODUCTION

ATTENTION:	Knowing the threat to your installation or deployment location is the key to building and implementing a successful CCD program.
MOTIVATION:	You and other base CCD personnel have the responsibility to reduce the ability of threat systems to deliver weapons accurately on their targets; your resources.
OVERVIEW:	In this lesson we will discuss: 1. Threat Scenario 2. Aircraft Attack Profiles 3. Target Acquisition Times 4. Target Acquisition Sensors
TRANSITION:	First, let’s discuss the threat scenario.

BODY

MAIN POINT 1. THREAT SCENARIO

We must fully understand the threat to our air bases; otherwise, we may implement inappropriate or unnecessary CCD measures. Ultimately, this would waste equipment, money, personnel, and other essential resources. Let's begin by discussing basic threat assumptions:

- Threat assumptions
- Priority of targets
- Area and point targets
- Target sets

a. THREAT ASSUMPTION

Although you should obtain specific threat information for your air base, you should assume the following threat for all bases.

1) ATTACKER KNOWS BASE

First, planners assume the attacker knows the coordinates and characteristics of the base and is able to navigate to its general vicinity.

2) ATTACK AIRCRAFT ARE PRINCIPAL THREAT

Secondly, for the near future, a principal threat to air bases is manned attack aircraft with target acquisition aids operating in the visual thermal infrared (IR) and radar bands. These acquisition aids are explained later in the lesson.

3) PGM POSES SIGNIFICANT THREAT

Our third assumption is that medium and short-range weapons such as precision guided munitions (PGM) or tracking missiles poses a very significant threat.

4) GROUND THREAT NOT ADDRESSED

Our fourth and final threat assumption is that ground-based, special purpose forces also pose a threat. However, defensive actions pertaining to them are not addressed in this block of instruction.

b. PRIORITY TARGETS

The main mission of the attacker will be to destroy or at least neutralize our flying forces. They may prioritize targets in a specific order such as:

- Unprotected aircraft
- Runways and taxiways
- Aircraft shelters and parking areas
- Command and control buildings or bunkers
- Munitions storage areas
- POL storage areas
- Other logistics supplies, equipment, and vehicles

c. AREA AND POINT TARGETS

Each of these targets will be identified in advance as either an area or a point target.

1) AREA TARGET EXAMPLES

Area targets are large and cover a particular area, but not specific targets. Examples are munitions' storage areas, POL tank farms, and revetted aircraft parking areas.

2) POINT TARGET EXAMPLES

Point targets are specific targets such as shelter or bunker doors, vehicles, and smokestacks, or a specific aircraft parked on the flightline.

3) STRATEGY FOR TARGETING

Therefore, the CCD strategy and the objectives of that strategy must reflect how different targets are typically targeted in terms of aim point, delivery, and weaponry.

4) REASON FOR DISTINCTION

Why bother to make the distinction between area and point targets and the CCD measures used? Because, to be effective, our CCD measures must cause the attacker to shift their point of aim only slightly on point targets. If we succeed, they will miss the target.

5) AIM SHIFTS

However, slight aim point shifts on area targets will not significantly increase the survivability of the targets. This is particularly true when the enemy uses munitions such as cluster bombs, mines, or a series of bombs.

6) INCREASES SURVIVAL

Therefore, considerations should include CCD measures that shift the aim point slightly on hardened point targets, perhaps by as little as 50 feet. This will increase its survivability dramatically.

d. TARGET SETS

Each hostile enemy force tends to select targets based on their own capabilities. For instance, an enemy that has very few flying hours per year and uses older weapon systems will generally have a different way of attacking their targets than a force with a high level of proficiency and precision guided munitions.

1) ATTACK PATTERNS

The attack patterns they practice flying and the ordnance available will also significantly influence target selection. For instance, US forces are highly trained with the best weapons available. We can go after point targets or area targets.

2) CAPABILITY ESTIMATES

However, if an enemy does not possess precision weaponry, their targets are limited to area bombing rather than point targeting. Obtain estimates of your enemy's capabilities from your local intelligence agency.

MAIN POINT 2. AIRCRAFT ATTACK PROFILES

A pilot will select an approach to his intended target based on several factors. Once in the target area, the pilot then chooses an attack profile. We will cover each of these profiles, but first, let us see how the pilot gets to the target area.

a. APPROACH CUES

When approaching the airbase, hostile aircraft will use the topography, or cultural surroundings, for orientation in finding the target area.

1) ORIENTATION CUES	Upon detecting and finally recognizing the installation, the aircrew will again use orientation cues to attempt to identify important individual targets to engage.
2) ATTACK CORRIDORS	Attack corridors or approach directions to a base are very limited. Topography and surrounding terrain limit the many potential approaches to the base.
a) LIMITATIONS	Why? Because local air defenses and terrain limit attacks from certain directions. The attacker would not fly over known air defense sites, nor would they highlight their aircraft by flying directly over mountains or ridge lines.
b) AVENUES OF APPROACH	Therefore, well-defined avenues of approach will cause the CCD planner to orient the use of CCD in those directions using only partial coverage. However, there is some risk when you use only partial coverage. It may not always work well enough.
c) FORCED VUNERABILITY	Another objective along these lines is to implement CCD to force the enemy into a vulnerable situation with active air defense units.

	INSTRUCTORS NOTE: Attachment 1, Part IV, is a generic example of the three attack profiles. There will be many variations to this pattern. Show students the approximate time in the flight path the delivery of weapons will take place.
b. APPROACH METHODS	Before the enemy aircraft can reach the target area, the pilot will probably approach the target area using either the terrain-following approach or the low-level constant altitude approach.
1) TERRAIN FOLLOWING	In the terrain following approach, the aircraft approaches at low altitudes, about 200 to 500 feet above ground level (AGL). At speeds of about 400 to 500 knots, the pilot follows the terrain features.
a) ADVANTAGE	The advantage of the terrain-following approach offers tactical surprise and minimizes exposure to air defenses.
b) DISADVANTAGE	The big disadvantage to the pilot, but major advantage for the camouflage, is that low-altitude terrain following gives the aircrew less time to acquire their target.
2) ALTITUDE & RELEASE POINT	In a level-approach profile, the altitude and point of release are extremely variable depending upon the weapon type and air defenses.

a) MAINTAIN CONSTANT ALTITUDE	The aircraft typically flies at speeds ranging from 450-500 knots. Aircrews maintain a near constant altitude, however high or low it may be above the ground, throughout the approach.
b) LEVEL FLIGHT	In the level approach, weapons are generally delivered in level flight, or in a shallow dive, with wings level.
	INSTRUCTORS NOTE: Use Attachment 2, Part IV, as a visual aid to help show the lay-down attack profile.
c. DELIVERY PROFILES	Intelligence sources will let you know what we can expect for aircraft delivery profiles. The delivery profile is based on aircraft and weapons type, the target, and air defense capabilities. The three most common attack profiles are the lay-down, fly-up, and pop-up profiles.
1) LAY DOWN PROFILE	In a lay-down profile, the aircraft approaches on a relatively straight path at altitudes of about 100 to 300 feet AGL.
a) MUST RECOGNIZE TARGET EARLY	Detection and recognition of the target must be made early. At least one prominent orientation point along the flight path is essential to lead the pilot to the specific target of interest.

b) DIFFICULT DELIVERY	At high speeds and low altitudes, this is a difficult delivery with only limited accuracy. This profile is usually used with multiple bombs.
	INSTRUCTORS NOTE: Use Attachments 3 and 4, Part IV, to help students visualize the following two approaches.
2)FLY UP AND POP UP PROFILES	In the fly-up or pop-up profiles, the aircraft rapidly climbs from low-level flight starting at a predetermined pull-up point offset from the target or using data from the weapons delivery system.
a) USE SPECIFIC DIVE ANGLE	The pilot can either approach the target using the level approach or take a 180-degree approach where they can look out the side of the canopy at the target area and search for the target of interest. For either approach, they will then attack the target using a specific dive angle.
b) MINIMIZE EXPOSURE, LIMITS TARGET ACQUISITION TIME	In practice, the planned approach may be a variant of these flight profiles. The pop-up and fly-up profiles minimizes an aircraft's exposure to air defenses. It also limits the amount of time the aircrew has to acquire the target.

MAIN POINT 3. TARGET ACQUISITON TIMES

Now that you understand the approaches to the target area and the attack profiles that are used, the next step is to understand the amount of time that a pilot has to acquire the target.

a. CONDITIONS

In addition to visibility, stress plays a large role in the accuracy of a pilot acquiring a target.

1) STRESS FACTORS

The aircrew may only have 3 to 5 seconds to acquire the target on the final attack approach. Additional stress during target acquisition comes from, high-G forces, radical maneuvers, defending against other aircraft, and operating the weapon and sensor systems of the aircraft.

> **INSTRUCTORS NOTE:** Use Attachment 5, Part IV, and explain the relative information on the limiting factors for visual detection, recognition, and weapons release ranges, for conventional weapons.

2) OPTIMUM CONDITIONS

The values shown here are based on optimum visibility conditions and for an aircraft traveling at about 485 knots.

b. DETECTION

The critical ranges for target detection is between approximately 5,000 and 12,000 feet, depending on the aircraft altitude during the start of the attack.

1) HIGHER ALTITUDES	For the higher altitude attack profile, the target detection range must be at least 12,000 feet. This is when the pilot first sees that a target is present.
a) RECOGNITION	They should be able to recognize the target when approximately 7,000 feet out from the target.
b) WEAPONS RELEASE	Finally, once they have detected and recognized the target, they usually release their weapons at approximately 5,000 feet out from the target.
2) LOWER ALTITUDES	However, in the two low-altitude profiles, for the attack to be completed on the first approach, the pilot requires approximately 5,200 to 6,800 feet minimum detection ranges.
a) DETECTION AND RECOGNITION	In addition, both detection and recognition must occur by the time the aircraft is within 5,000 feet of the target, when using the terrain following profile.
b) WEAPONS RELEASE	Therefore, for the two low-altitude profiles, release of conventional weapons usually occurs at between 1,600 to 2,700 feet.
3) AIRCRAFT RECOGNITION RANGE	The speed of the approaching aircraft impacts the ability of a base to defend itself, as well as the ability of the pilot to recognize a target.

a) SLOW AIRCRAFT RANGE

A slower aircraft can fly closer to a target before releasing its weapons; however, it faces a greater probability of being destroyed by base defenses.

b) FASTER AIRCRAFT RANGE

Similarly, faster aircraft are more difficult to detect but must also make a decision on target recognition from a greater range.

c) RANGES VARY FOR POP UP PROFILE

The detection and recognition ranges vary considerably for the pop-up profile, depending upon the altitude reached and flight speed in the pop-up maneuver.

MAIN POINT 4. TARGET ACQUISITION SENSORS

Effective CCD design against enemy target-acquisition capabilities is based on a ‘mirror-image’ procedure that assumes the future threat to be similar to current U.S. military capability. There are five types of sensors that are the basis for the most prominent target-acquisition devices:

- visual sight (the eyes, aided and unaided)
- electro-optical systems
- video
- forward-looking infrared receivers (FLIR)
- radar systems

Let’s start with <u>the most effective</u> means for detecting, recognizing, and identifying targets, the human eye.

INSTRUCTORS NOTE: Use Attachment 6, Part IV, to assist in explaining the electro-magnetic spectrum and its military use. Depending upon the audience, you may want to avoid discussing the exact numbers used on the spectrum, such as the exact frequency or the wavelength range within a sensor operation. This information is for the instructor’s background and advanced level teaching.

a. THE UN-AIDED EYE

The enemy's dependence on and use of their unaided eye will remain a primary threat for many years to come. This tells us as camofleurs that no matter what else all of the sensors are telling the pilot, they will first believe their own eyes. The eye's resolution, field of view (180 –degree horizontal, 130 -degree vertical), and dynamic light-sensing range, coupled with the reasoning capabilities of the brain provide a combination of capabilities unmatched by any other sensor.

1) CCD CONFUSES THE EYE

Pilots put their utmost trust in what their eyes see; not to be fooled, takes an extremely well trained pilot with tremendous experience. As camoufleurs, we want confuse what the eye sees compared to what the threat sensors are telling the pilot. (Ball Systems Engineering Division, 1991).

2) UNAIDED EYE DEPENDS ON MANY FACTORS

Detection of a target by the unaided eye depends on many factors including lighting conditions, target size, target versus background contrast, and atmospheric visibility.

3) VISUAL RANGE

Based on target size alone, the eye should be able to detect an aircraft shelter entrance 30 by 100 feet at a range of approximately 32 nautical miles.

4) BACKGROUND CONTRAST

Another, and perhaps more important factor in determining target detection is target versus background contrast. (We discuss this area in detail in a different block on tonedown operations.)

b. THE AIDED EYE ELECTRO-OPTICAL SYSTEMS

Numerous electro-optical sensing devices enhance the ability of the eye to detect and recognize targets. These devices extend the observer’s capabilities by forming an enlarged image of the target at the observer's eye. This done by extending the eye’s range into the ultraviolet range, the near-infrared (IR) region, or finally, by responding to very low illumination or light levels. Looking at wavelenghts in the electromagnetic spectrum, let us move downscale from the range of the human eye and glance at the ultraviolet range.

1) SNOW AND ICE REFLECTANCE	The ultraviolet (UV) range (0.25 to 0.4μm) affects the CCD planners in winter environments with snow and ice. Snow reflects UV light strongly. In contrast, typical white pigments such as paints, vinyl siding, and camouflage screening have a high degree of absorption. UV sensors will see them black against snow.
2) HIGHER DEGREE OF ENERGY REFLECTANCE	Currently, a higher degree of energy reflectance is needed in paints and camouflage nets. This will not only allow them to remain effective after their finish becomes dull or dirty, but also help reduce the contrast between the painted or camouflage object and it's background.
3) AIRBORNE RECON AIRCRAFT	Airborne reconnaissance aircraft are the most typical threat that operates in the UV range of the spectrum.
c. VIDEO	The conventional TV camera operating in the visible human eye band is the most prominent system for daytime target acquisition.
1) TV NEEDS LIGHT	Such systems require a minimum illumination level and will not perform well at times of poor light, such as in the early morning, evening, during heavy overcast, or in fog.

2) TV SENSOR

A TV sensor, operating on an ideal day, with no atmospheric interference such as clouds, fog, smog, or rain, can detect a 16-foot high object at a range of almost 23 nautical miles (42 km). This is based on target size alone, and not accounting for other detection factors, such as the reflectance of the object. This is a unlikely situation because atmospheric interference will usually play a role.

a) EYE DEFECTS GREATER RANGE THAN CAMERA

This example points out two very important drawbacks to the use of TV systems. First, under less than ideal illumination conditions, the eye, because of its dynamic range, can detect a target at a greater range than a TV sensor. Target size is not the major limiting factor with the detection range of the TV sensor. The lack of illumination, and atmospheric interference in transmission, usually limits the detection range.

b) BLACK AND WHITE

The second drawback is that TV systems are normally black and white displays, removing many of the color cues the human eye uses to acquire the target.

c) MAGNIFYING OPTICS	Now, if this same TV system includes magnifying optics, the performance for detecting small objects is enhanced. Once again, this is only effective if we do not take into consideration the impact that the atmosphere has on detection.
d) AFFECTED BY ATMOSPERIC INTERFERENCE	The atmosphere (clouds, fog, smoke, smog, rain, dust, etc.) will limit the effectiveness of video sensors.
3) VISIBILITY FORCASTS	Planners should use the Air Weather Service (AWS) visibility observations to forecast expected atmospheric interference. Use this information to compute a rough estimate of the target acquisition range for the unaided eye or TV sensors. Poor illumination, clouds, and other line-of-sight obstructions can often significantly reduce visual observation ranges.
4) OPERATE IN VISUAL AND NEAR IR BAND	The next range up the scale is the infrared (IR) band. Image intensifier (II) devices can operate in the visual and near IR band. This allows the observer to see under very low, nighttime illumination conditions.
a) II DEVICES INTENSIFY LIGHT	In enhancing vision at night, these devices require some source of illumination. If the image intensifier (II) receives even the smallest amount of light, it intensifies the light so tremendously, it appears to be daylight in the observed area.

b) EXAMPLE OF II CAPABILITIES	To demonstrate an example of the capabilities of image intensifiers, imagine sitting in a closet that is pitch black, without even the smallest of amount of light. The intensifiers would not work in this situation because there is no light for the imager to magnify. If you drilled a 1/4" hole in the wall, allowing daylight from the room to enter the closet. You could use the image intensifier in this case, the closet would then appear filled with daylight and you would see everything in the closet. This illustrates the capability of image intensifiers.
c) NOT USED ON HIGH-SPEED AIRCRAFT	II devices have a range from 300 to 3000 feet. This distance is too short for high-speed aircraft, and therefore are not practical on these platforms.
d) LLLTV	When coupled with conventional television (TV) camera devices, the assembly is known as Low Light Level TV (LLLTV).
e) ENHANCES STARLIGHT	The LLLTV device will enhance target acquisition in starlight conditions.

d. FORWARD LOOKING INFRARED RECEIVERS (FLIR)	If there is not enough light, then thermal infrared (IR) sensors are required. Let us go further up the spectrum and move into the infrared region. Thermal IR systems do not depend on ambient light and provide an alternative for nighttime attacks.
1) THREE RANGES	Experts divide the IR portion of the electromagnetic spectrum into three ranges: • near (0.68 - 2µm) • mid (2 - 5µm) • far (8 - 14µm)
a) NEAR IR	Sensors in the near IR range receive radiation <u>reflected</u> from the targets. This incident radiation may be from the sun, moonlight and starlight, or from artificial light sources.
b) MID-AND FAR IR	Sensors in the mid and far IR receive thermal radiation <u>emitted</u> from the targets themselves.

c) LASER SYSTEMS	The first sensor in the infrared region we will discuss are lasers. All lasers operate in the IR portion of the electromagnetic spectrum of 0.85, 1.06, and 10.6 µm. Scientists categorize laser threats to fixed facilities into two groups: • laser guided weapons • laser scanning or laser radar (LADAR) devices
2) MOUNTED ON AIRBORNE PLATFORM	The laser-guided weapons are a serious threat to mission critical facilities because of their precision delivery. Used for precision guidance, a laser, either mounted on an airborne platform or ground based, directs a laser beam at the selected target.
a) SCANS FOR LASER BEAM	During initial weapon launch, the receiver system on the weapon scans in a search pattern until it finds the laser beam of energy reflected from the target.
b) WEAPON RIDES BEAM	Once the beam is found, the guided weapon "rides" the laser beam formed by the reflected laser energy, and follows it all the way into the target.
c) TOSSING INTO BASKET	Pilots refer to this as "tossing the weapon into the basket" of the area where the beam is designating a target.
d) NEED NOT BE COLLOCATED	The launch platform for the weapon and the laser need not be collocated.

e) EXAMPLE

For example, a forward air controller may have a laser generator. Because the controller is closer to the target they can get a visual sighting on it, whereas the tactical fighter in the air may not be able to. The controller then points the laser beam at the target, contacts the fighter aircraft, and gives coordinates of the approximate area to launch the laser guided weapon. The weapon searches for the beam generated from the air controller, and follows the beam to the target.

3) LADAR SYSTEMS

The second of the two laser systems is laser radar (LADAR) systems, which identifies targets, rather than shooting a beam for a weapon to ride on. LADARs operate similarly to microwave radar with a range limit of 2.5 miles or less due to atmospheric interference at these higher frequencies. Compared to other detection systems, LADAR is a less proliferated threat.

a) LADAR IMAGES

Finally, LADARS are capable of producing images of almost photographic quality.

b) RANGE OF USES

Advances in technology have led to a range of uses including target designator, range finder, multispectral scanners, and Doppler LADAR (laser counterpart for radar).

c) LIMITATIONS

Limitations of either of the two laser systems are line-of-sight, power of the radiating source, and atmospheric interference of the laser radiation.

4) FLIR

Continuing within the infrared region, let us talk next about infrared receivers. Today, most thermal IR systems operate in the 8 - 12 µm range of the electromagnetic spectrum. For historical reasons, these systems are often called forward-looking infrared receiver, or FLIR. During FLIR's early years they could only look forward of the aircraft they were mounted in.

a) HIGHER TEMPERATURE REQUIRED

For the receiver to detect an object, the object must have a radiation temperature different from its background. Additionally, the radiation temperature must also be a higher temperature than the minimum range that the sensor can detect.

b) DETECTS TEMPERATURE DIFFERENCE

Modern FLIR systems can commonly detect targets with as little as a 0.1 degree Celsius difference in temperature; however, FLIR requires a 0.6 degree Celsius difference in order to clearly detect the target.

c) POINT IN ANY DIRECTION	While the normal position the FLIR is pointed forward of the aircraft in the direction of travel, systems are available that can be pointed in virtually any direction beneath and around the aircraft.
d) NO ILLUMINATION REQUIRED	Finally, since FLIR systems require no illumination, they operate passively under all day and night conditions. They can usually see through some haze and conventional smoke from smoke generating devices. However, they cannot see through natural fog and clouds, so they do not provide an all-weather capability.
e. RADAR SYSTEMS	Let us finish our threat sensor discussion by moving down the electromagnetic spectrum again, into the microwaves, or radar range. Most tactical radar systems operate in the microwave portion of the electromagnetic spectrum (7 to 18 GHz).
1) NAVIGATION TARGETING, AND ACQUISITION	We use radar for navigation, acquisition, and targeting functions. It is an active radiating system. Radar senses characteristics, depending on how well the transmitted energy bounces off objects and returns to the receiver on the aircraft.
a) LOWER RESOLUTION THAN IR	Generally, radar systems have a lower resolution and resulting image than thermal infrared imagers.

b) LONG RANGES	An advantage of radar is that we use it to acquire targets at long distances and in adverse weather. Additionally, radar can provide location information, map terrain, and measure relative speed.
2) CCD CONCERNS	Everyone involved in CCD should be concerned with the capability of radar to provide: • navigation • weapon guidance • ground surveillance and target acquisition
a) REFLECTED, ABSORBED, OR SCATTERED	Radar is one of the most effective and widely used all-weather surveillance and target-area sensors. It has been used successfully since World War II. Radar systems operate by emitting pulses of radio waves. When pulse energy arrives at the targeted object, it is reflected, absorbed, and scattered.
b) REFLECTED ENERGY	A portion of the reflected energy returns to the receiver. The receiver senses, amplifies, translates, and displays the information in the return signal on a radarscope.
c) RCS DETERMINES ENERGY	The amount of energy ultimately returned to the transmitter strongly depends upon the Radar Cross Section (RCS) of the target.

d) RADAR SIGNATURE	Simply stated, the RCS is the radar signature of an object. Every object has the ability to return power to the radar antenna. The radar cross section is a measure of that power. Therefore, the power reflected and returned to the receiver is directly proportionate to the RCS of the target.
3) DECREASE RCS	How do we decrease the RCS of our resources? The RCS of the target is highly dependent on the size, shape, and construction materials of the target. Another consideration is the smoothness of the target. A shiny or smooth reflective surface will provide a stronger RCS than a flat, matte, or rougher target surface.
4) TYPES OF RADAR SYSTEMS	Pulse radar systems determine range by transmitting a pulse and measuring the time between the pulse and its return to the receiver. There are several types of pulse radar systems: • low • medium • high
a) LOW PULSE	Low-pulse radars operate between 30 and 4,000 pulses per second, and provide accurate range data.

b) MEDIUM PULSE	Medium-pulse repetition frequency radars operate in the 10,000 to 30,000 pulse per second range. They are a hybrid of the low and high-pulse repetition frequency radars. They can calculate the distance range of the target and calculate radar - target range change rates.
c) HIGH PULSE	Doppler radars have high-pulse repetition frequencies and measure changes in the distance of the target. Therefore, these systems can distinguish between a moving and a non-moving target.
5) MICROWAVE RADARS	Microwave radars are used primarily in fighter bomber and reconnaissance aircraft. The reason for this is that the lower frequency it operates at allows it to have a longer effective range than the millimeter wave radars. Microwave radars are not considered more effective or lethal than millimeter wave (MMW) radars; they only serve a different purpose.
6) GUIDED MUNITIONS	Millimeter wave (MMW operates at 35 to 94 GHz). The most lethal application of MMW radars, is to terminally guide munitions. The majority of these weapons are currently used in anti-armor roles.
a) STANDARD NETS	Every camoufleur needs to know that MMW radar can penetrate older standard DOD (Type I-III) camouflage nets.

b) CCD SELECTIONS	The frequency or the wavelength of a threat radar can be critical to the CCD selection process. Certain CCD equipment and techniques, such as surface roughening, and radar absorbing material are specifically designed to be effective against particular radar wavelengths.
c) COUNTERING RADARS	If we hope to counter the radar threat, we must consider operating frequencies, atmospheric interference, and target-to-background characteristics.

CONCLUSION

SUMMARY:

A critical range for target detection is approximately 5,000 to 12,000 feet. The eye and modern threat electro-optics, FLIR, and radar devices can detect targets at ranges far beyond this; therefore, CCD implemented to reduce contrast is essential for critical base elements.

CCD designs should delay target detection long enough to preclude accurate delivery of conventional weapons. They also delay detection and identification at greater distances for delivery of precision guided and other standoff weapons.

Area and point targets are classes of targets that require different CCD objectives that reflect how enemies typically target these classes.

REMOTIVATION:

Survivability of your installation dictates the strategy you use against the attacker be consistent with the threat. Never fail to consider the vulnerability of each target.

CLOSURE:

This concludes this lesson.

TRANSITION:

(Develop locally to transition to the next topic.)

PART III
EVALUATION

STUDENT PERFORMANCE STANDARDS

TEST ITEMS

1. LESSON OBJECTIVE: Identify point and area targets.

QUESTION: (Multiple Choice)

Which of the following is NOT a correct statement?

a. Runways and taxiways are area targets.
b. A refueler vehicle is a point target.
c. The smokestack on the roof of a building is a point target.
d. The air traffic control tower is an area target.

Key: d. The air traffic control tower is an area target.

REFERENCE: Main Point 1

2. LESSON OBJECTIVE: Determine various sensor type characteristics.

QUESTION: (Multiple Choice)

Which device will enhance target acquisition in starlight conditions?

a. LLLTV.
b. Conventional TV camera.
c. Doppler radar.
d. MMW radar.

Key: a. LLLTV

REFERENCE: Main Point 4

3. LESSON OBJECTIVE: Determine factors to figure target acquisition times.

QUESTION: (Multiple Choice)

Which of the following stated target acquisition factors is NOT true?

a. The aircrew has only 3 - 5 seconds to acquire the target on the final attack approach.
b. Detection and recognition must occur by the time the aircraft is within 5,000 feet of the target for the terrain following approach.
c. For a higher altitude weapon release, the detection ranges are less than lower altitude releases.
d. High-G forces, radical maneuvers, and attending combat factors, put pilots under great stress.

Key: c. For a higher altitude weapon release, the detection ranges are less than lower altitude releases.

REFERENCE: Main Point 3

4. LESSON OBJECTIVE: Identify the threat performance limits of the various threat sensors.

QUESTION: (Multiple Choice)

Which of the following is FALSE?

a. Lasers operate on line-of-sight targeting.
b. Atmosphere interferes with laser radiation.
c. MMW radar cannot penetrate older style DOD camouflage screening.
d. Millimeter wave (MMW) radars are used in terminally guided munitions.

Key: c. MMW radar cannot penetrate older style DOD camouflage screening.

REFERENCE: Main Point 4

5. LESSON OBJECTIVE: Determine the advantages the human eye has over other threat sensors.

QUESTION: (Multiple Choice)

Which of the following is NOT an advantage the human eye has over other threat sensors?

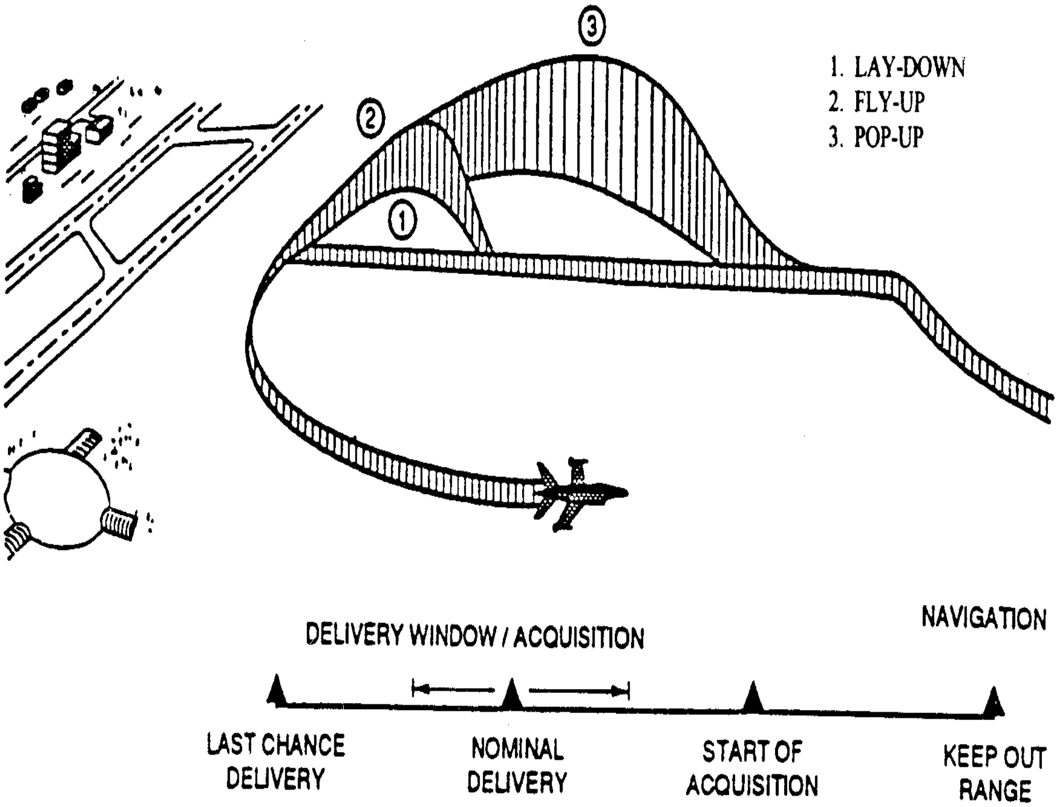
a. Poor light-sensing range.
b. Resolution (how clear is the image).
c. Direct coupling with the reasoning capabilities of the brain.
d. Field of view - 180 degrees horizontal and 130 degrees vertical.

Key: a. Poor light-sensing range.

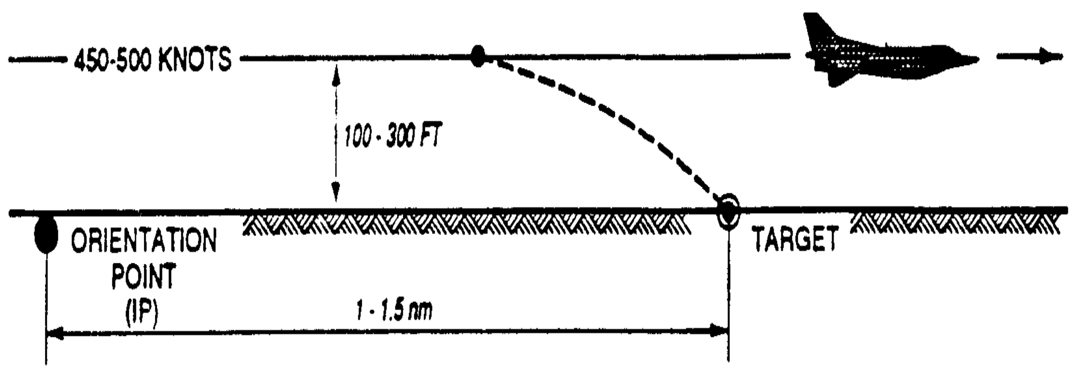
REFERENCE: Main Point 4

PART IV
RELATED MATERIALS

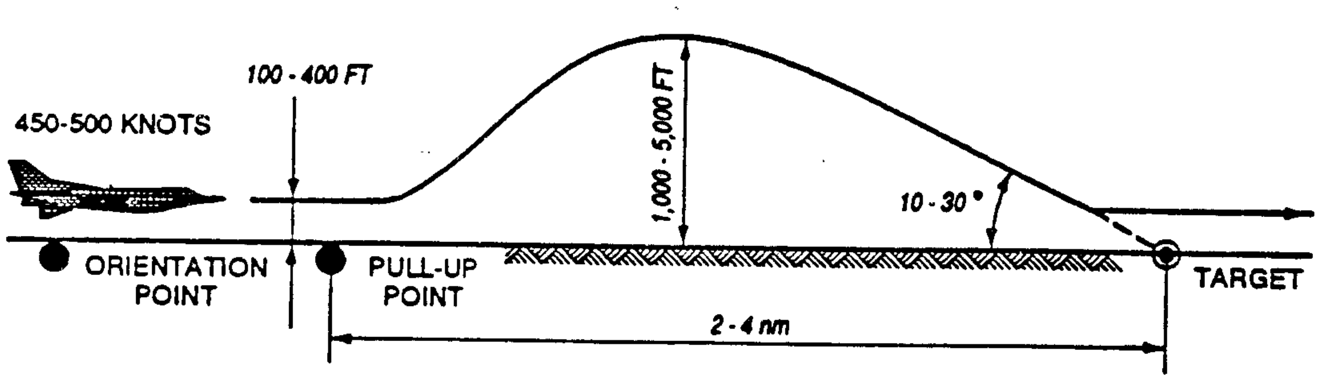
Attachment 1: Generic Attack Scenarios
Attachment 2: Lay-Down Attack Profile
Attachment 3: Level-Approach Fly-Up or Bump-Up Attack Profile
Attachment 4: 180-Degree Approach Pop-Up Attack Profile
Attachment 5: Limiting Visual Detection, Recognition, and Weapons-Release Ranges for Conventional Weapons
Attachment 6: The Electromagnetic Spectrum



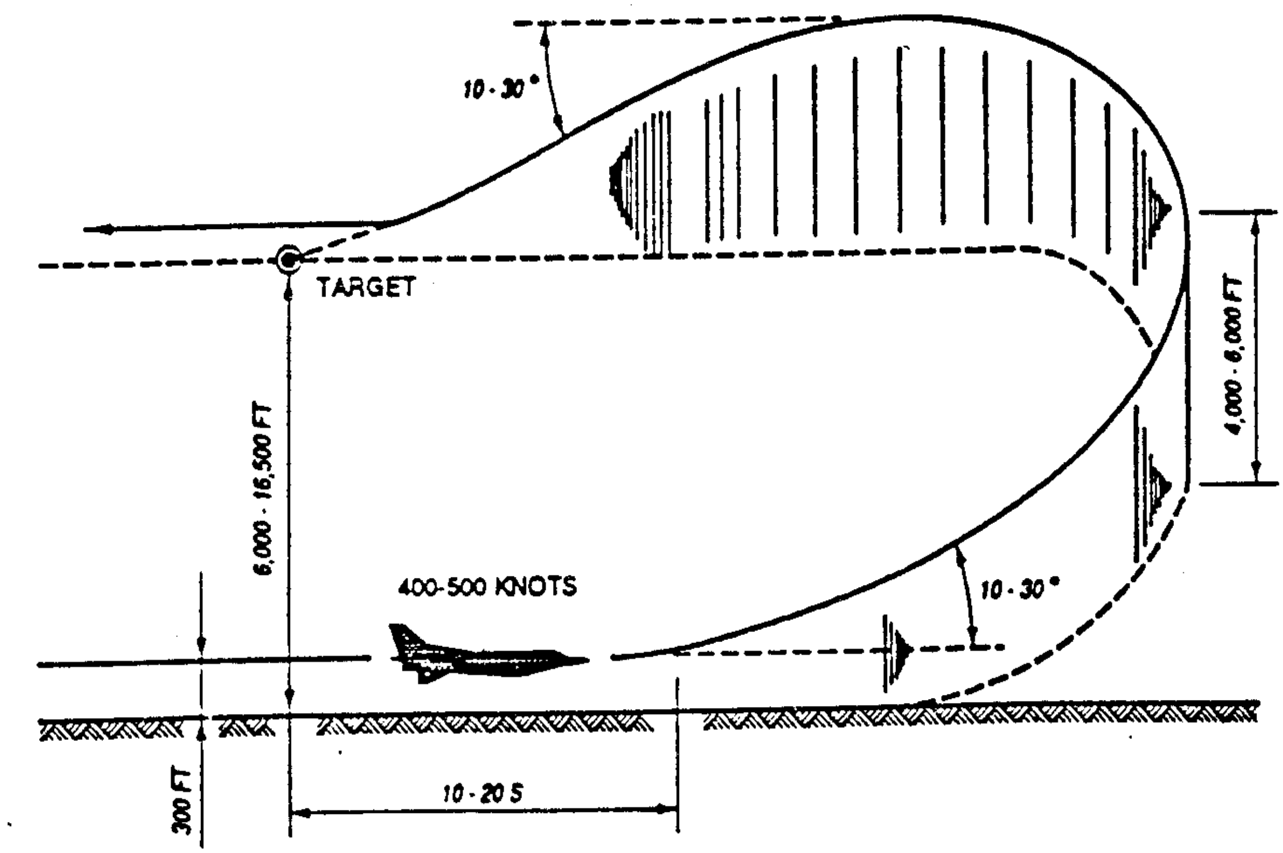
ATTACMENT 1:GENERIC ATTACK SCENARIO



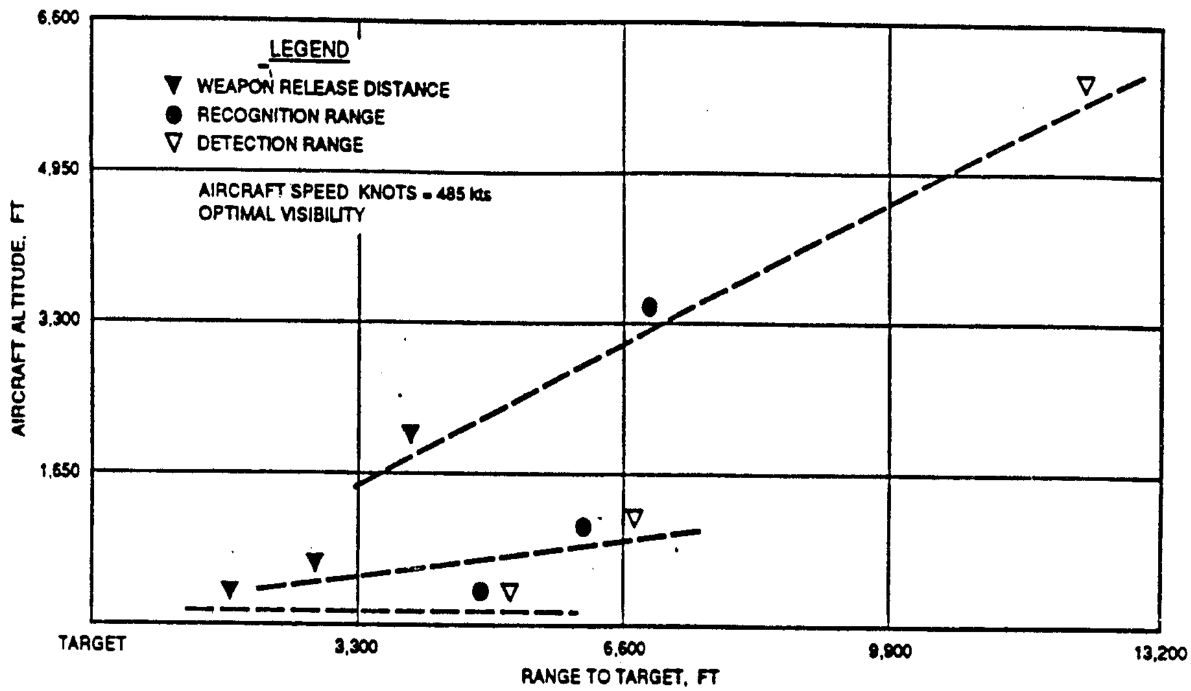
ATTACHMENT 2: LAY-DOWN ATTACK PROFILE



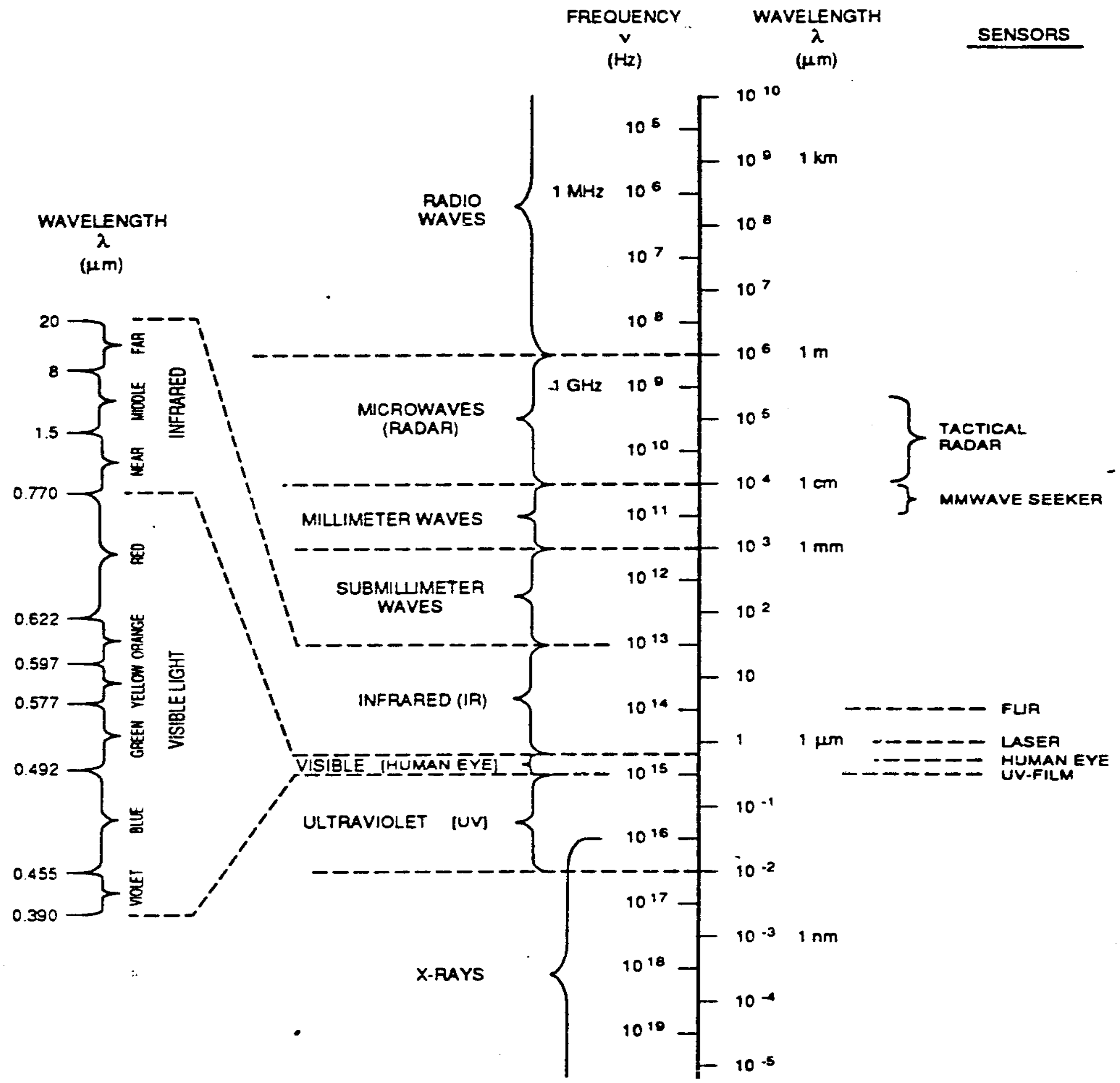
ATTACHMENT 3: LEVEL APPROACH FLY-UP OR BUMP-UP ATTACK PROFILE



ATTACHMENT 4: 180-DEGREE APPROACH FLY-UP OR BUMP-UP ATTACK PROFILE



ATTACHMENT 5: LIMITING VISUAL DETECTION, RECOGNITION, AND WEAPONS-RELEASE RANGES FOR CONVENTIONAL WEAPONS



ATTACHMENT 6: THE ELECTROMAGNETIC SPECTRUM

TRAINING PACKAGE COMMENT REPORT

RTP # ________________ **RTP DATE: _______________**

For an *immediate response* to your questions concerning subject matter in this Readiness Training Package (RTP), contact the Office of Primary Responsibility (OPR)TSgt Ron Childs of the Contingency Training Section at DSN 523-6458 between 0700-1600 (CT), Monday through Friday. Otherwise, write, fax, or E-mail the OPR to make comments, suggestions, or point out technical errors in the areas of: references, body information, performance standards, test questions, and attachments.

NOTE: Do not use the Suggestion Program to submit corrections for printing or typographical errors.

Comments:____
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