

Wedge

Elements are in two-ship wedge with the trailing element lead 3.5 - 3 NM back, offset as required to maintain visual. Number two flies off of number one, maneuvering with cutoff as necessary to maintain position. Number three flies off of number one, maneuvering as required to maintain visual. Number four flies off of number three.

Advantages:

- Very offensive for air-to-air threats forward of the 3/9 line.
- Inexperienced wingmen may find it easier to maintain a visual on lead and stay in formation.
- The formation permits four aircraft to maintain flight integrity under marginal weather or extremely rugged terrain conditions.

Disadvantages:

- Six o'clock lookout may be poor.
- Formation easily detected by single threat.
- The defensive maneuvering flexibility of the flight is very limited.
- Number two must be disciplined and fly no further than 6,000 feet from lead to avoid conflict with trailing element.

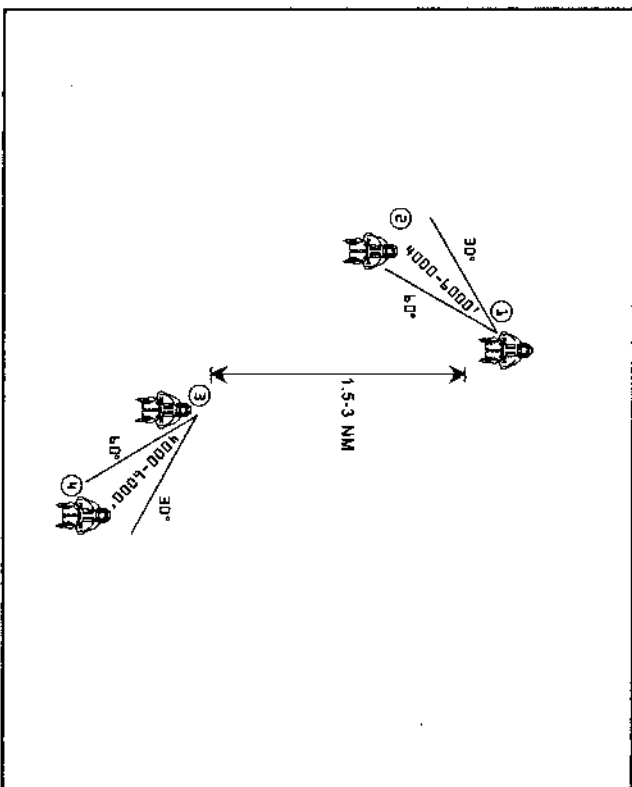


Figure: Four Ship Wedge Formation

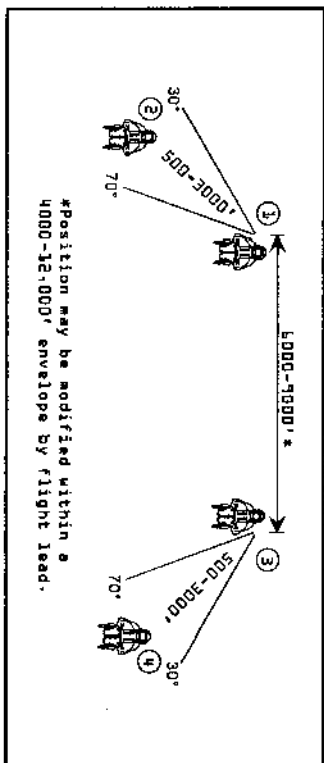


Figure: Fluid Four Formation

Fluid Four

Element leads maintain line abreast formation, while wingmen assume fighting wing. Number three maneuvers off number one as if in line abreast. Number two and number four maneuver off their element leaders to maintain the outside of the formation. Element leads are responsible for deconfliction of elements when crossing the opposing element's six o'clock.

Advantages:

- Inexperienced wingmen are kept close for ease of maneuvering.
- Four-ship maneuverability is good.
- Formation provides concentration of force.
- Easily converts to three-ship when one aircraft falls out.

Disadvantages:

- Adversary can acquire all four aircraft.
- Defensive maneuvering rapidly becomes confusing due to the proximity of aircraft.
- Cumbersome to maneuver at low altitude in rough terrain.

Spread Four

Element leads maintain the same spacing as for fluid four, but wingmen position themselves 0 degrees to 30 degrees back from their element leads and 5000' to 7000' spread (Figure 3.12). Increased lateral spacing for wingmen facilitates maneuvering. Each element uses fluid maneuvering. Number three flies off number one. The elements are not always required to be line abreast. On some occasions they may be briefly in trail.

Advantages:

- Spread formation makes it difficult for an adversary to visually acquire the entire flight at once.
- Firepower is maximized for BVR weapons employment.

Disadvantages:

- Maneuvering is difficult if the line abreast position is maintained.
- Very difficult for wingmen to fly at low altitude.

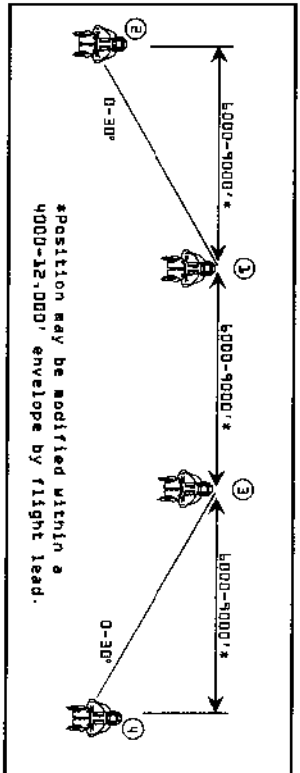


Figure: Spread Four Formation

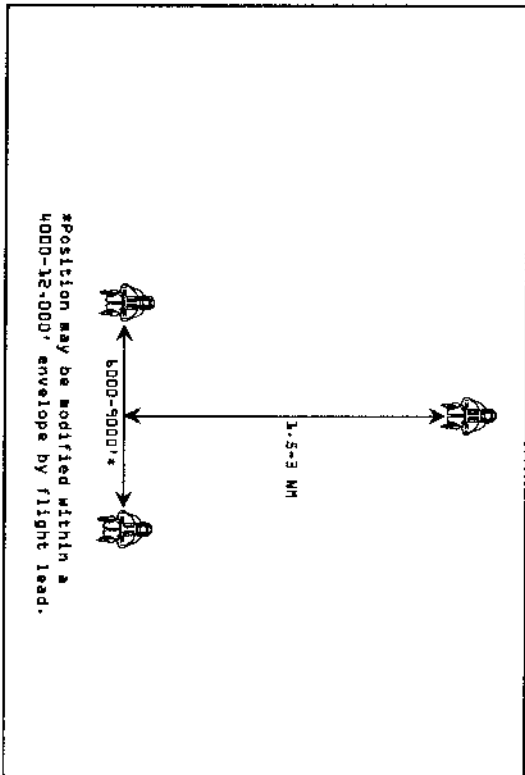


Figure: Three Ship VIC

Three-Ship Formations

There may be occasions when a priority mission requires maximum available aircraft and a three-ship is the only alternative. Mutual support requirements to ensure survivability and recovery are paramount; therefore, a three-ship contingency should be briefed on all four-ship missions. On these occasions, the following three-ship formation discussion is applicable.

Responsibilities:

- Number One - navigation, then radar and visual lookout.
- Number Two - visual and radar lookout, back-up navigation.
- Number Three - visual, then radar lookout.

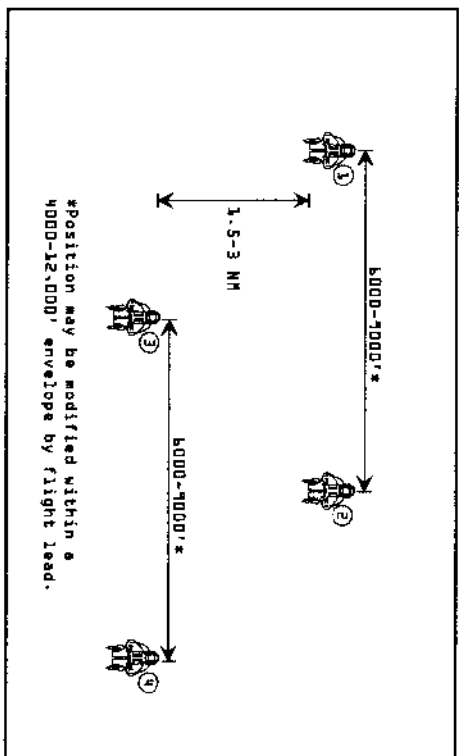


Figure: Four Ship Offset Box

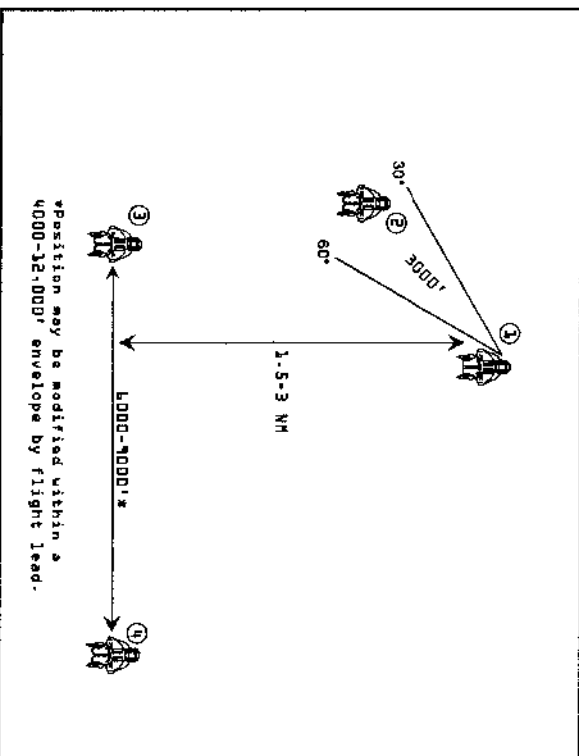
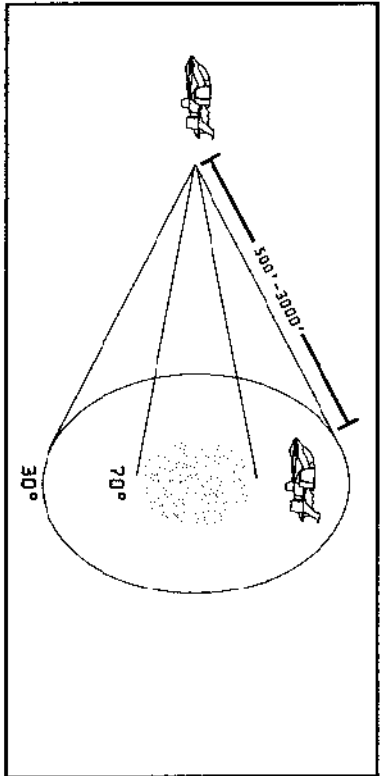


Figure: Arrowhead Formation



Fighting Wing

The four-ship is under control of one flight lead and is employed as a single entity until such time as it is forced to separate into two elements. At no time should an element sacrifice element integrity attempting to maintain the four-ship formation. Each two-ship element should have its own radar and visual plan so that no changes will be required if the four-ship is split into two-ships.

Box/offset Box

In the box formation, elements use the basic line abreast two-ship maneuvering and lookout principles. The trailing element takes 1.5 to 3 NM separation, depending on terrain and weather. The objective of the spacing is to give maximum separation to avoid easy visual detection of the whole formation, while positioning the rear element in a good position to immediately engage an enemy converting on the lead element. Because the F-35 is difficult to see from a direct trail position, a slight offset will facilitate keeping sight of the lead element (figure 3.d). Use of air-to-air (A-A) TACAN between the elements, and the radar in the rear element, will help keep the proper spacing. However, proper emission control may preclude their use in combat. The arrowhead variation makes number two's formation easier, freeing him for more lookout (figure 3.f). NOTE: In an ATC environment, the trailing element should fly 1 NM or less if standard formation is required. Formation maneuvers are initiated by element leaders. Number three maneuvers to achieve prebriefed spacing on the lead element (based on threat, mission, weather, etc.).

Advantages:

- The formation provides excellent mutual support and lookout.
 - The rear element is positioned to engage an adversary making a stern conversion on the lead element.
 - It is difficult to visually acquire the entire flight.
 - Element spacing for an attack is built into the formation.
- Disadvantages:**
- The formation is difficult to fly in poor visibility and rugged terrain.
 - Depending on position, the trailing element may be momentarily mistaken as a threat, especially if staggered too much off to one side.

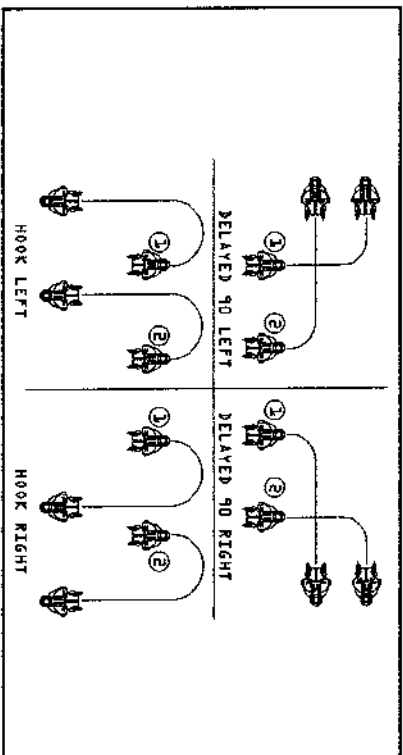


Figure: Delayed 90° and Hook Turns

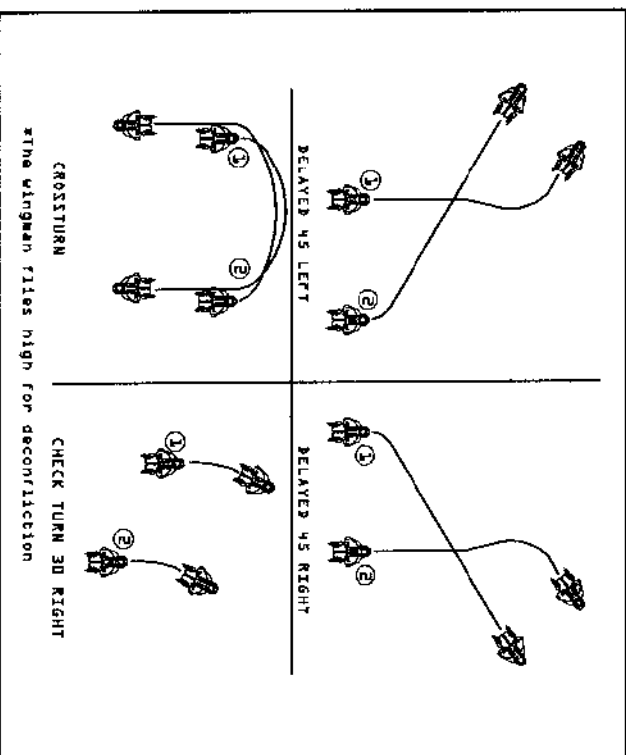


Figure: Delayed 45°/Crossturn/Check Turns

If the attacker is in the defender's plane of turn, the position of the attacker's nose determines the pursuit course. With his nose pointed in front of the defender (such as in the case of a gunshot), he is in lead pursuit. If he points behind the defender, he is in lag pursuit. If he points at his adversary, he is in pure pursuit. Note that an initial lead pursuit attacker could be driven into a lag pursuit course if he has insufficient turn rate available to maintain lead.

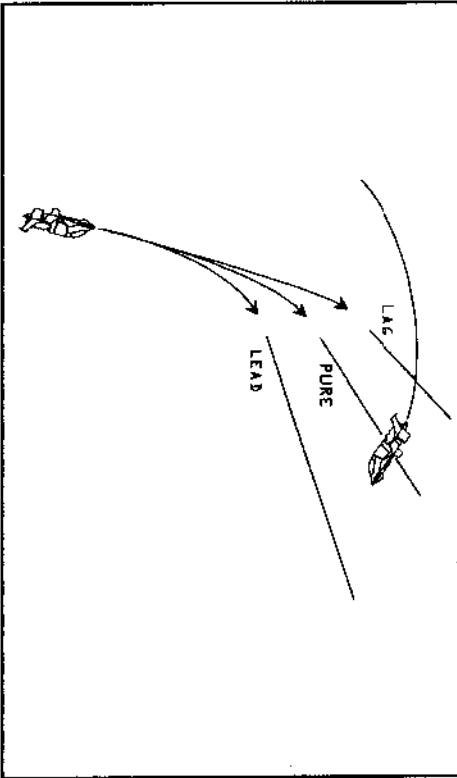


Figure: Attack Pursuit Courses

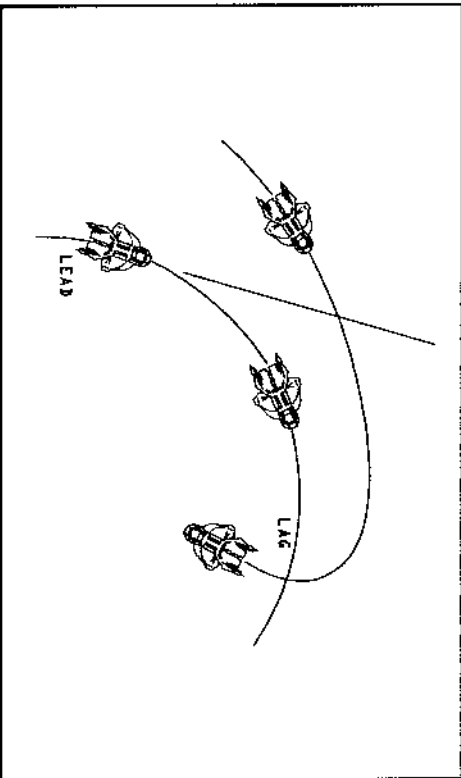


Figure: Insufficient Turn Rate To Maintain Lead (Resulting in Lag)

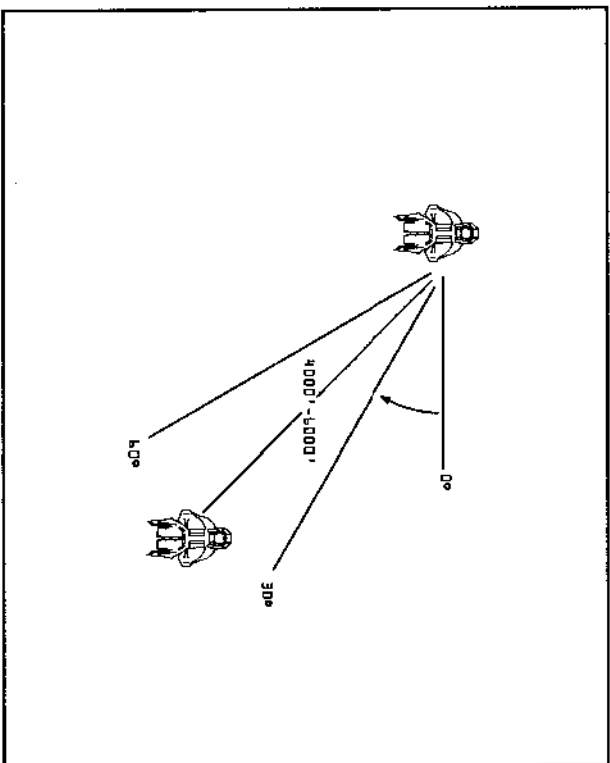


Figure: Two-Ship Wedge

Fighting Wing

This formation, flown as a two-ship, gives the wingman a maneuvering cone from 30 degree aft of line abreast and lateral spacing between 500' to 3000'. Number two maneuvers off lead with cutoff as necessary to maintain position. This formation is employed in situations where maximum maneuvering potential is desired. Areas for use include holding in a tactical environment or maneuvering around obstacles or clouds. This formation is employed by elements when flying Tuid four.

Advantages:

- The formation allows the element to maintain flight integrity under marginal weather conditions or in rough terrain.
- Allows for cockpit heads down time for administrative functions when in a low-threat arena where hard maneuvering is not required.

Disadvantages:

- Poor to nonexistent six o'clock coverage.
- Easy detection of formation by single threat.

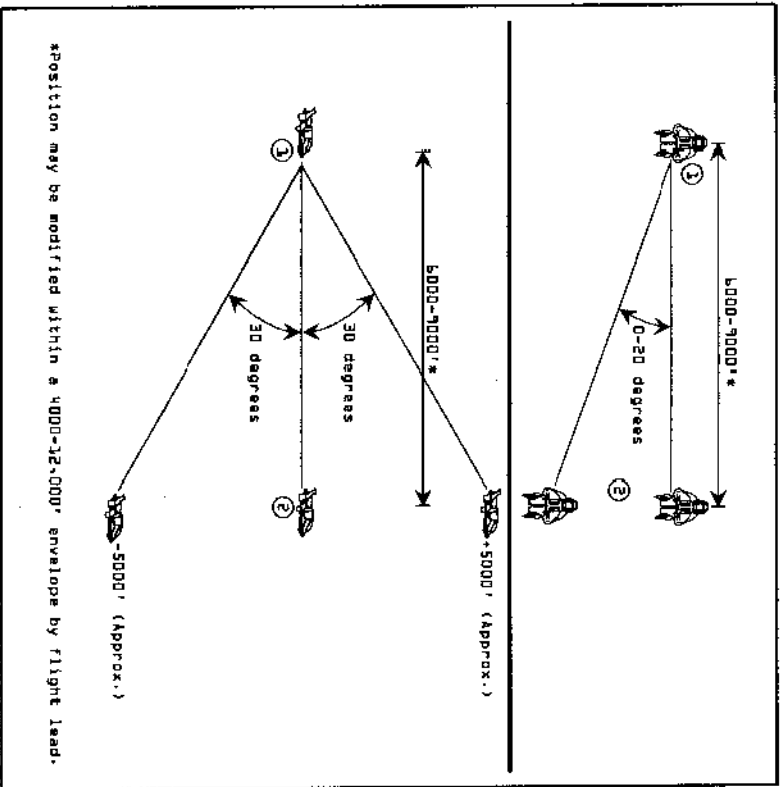


Figure: Two-Ship Line Abreast

Wedge

Wedge is defined as the wingman positioned from 30 degree to 60 degree aft of the leader's 3/4 line, 4000' to 6,000' back (Figure 3.5). The advantages of wedge are that the leader is well protected in the 6 o'clock area and is free to maneuver aggressively. The wingman may switch sides as required during turns. He may also switch sides as required to avoid terrain, obstacles or weather but must return to the original side unless cleared by the leader. The flight lead may extend the formation spacing to 12,000' to meet particular situations or requirements.

The most significant disadvantage of the wedge is that it provides little to no six o'clock protection for the wingman. Lead changes, if required, are difficult to execute.

When the attacker is out of the defender's plane of turn, his pursuit course is determined by where his present lift vector (the top of his canopy) will position his nose as he enters the defender's plane of turn. For example, if forced out-of-plane by a defender's hard turn, an attacker may have his nose pointed behind the defender during the reposition. After gaining sufficient turning room if the attacker pulls far enough in front of the bandit to arrive back in-plane with his nose in front on the defender, then he is in lead pursuit. The same holds true for pure or lag pursuit (Figure 4-4). Whether to establish a lead, lag, or pure pursuit course will depend on the relative position of the attacker with respect to the defender's turn circle (TC). The key at point C is to be sure you will enter the defender's turn circle aft of his wingline with the ability to establish an in-plane, lead pursuit course at point B.

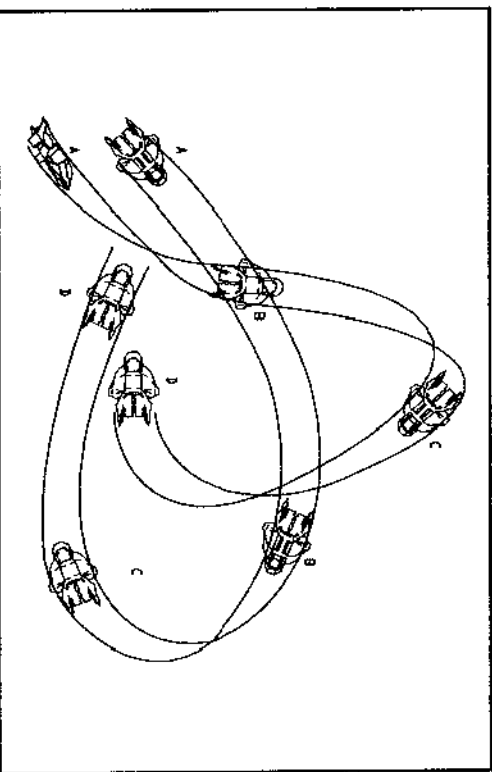


Figure: Out-of-Plane Maneuvering

Weapons Envelope

The vulnerable cone of a defender is defined using range, aspect, angle-off, and pursuit course to approximate the employment envelope for a specific type of ordnance. BFM is used when necessary to decrease range, aspect, and angle-off, or until an attacker is within the bandit's vulnerable cone for the ordnance he plans to employ.

Turning Room

In order to discuss how BFM can solve range, aspect, and angle-off, a concept called turning room and turning circles is used. Turning room is the separation between the two aircraft that can be used to accelerate, to decrease range, or turn and decrease aspect angle and angle-off. A turn circle is defined by aerodynamics and is based on a certain size (the diameter) and how quickly an aircraft can move its nose (turn rate).

This section applies not only to perch sets, but also when you transition from the Long Range offensive sets and decide it's time to give the bandit a shower of RDM (Figure 4-31) from the control position. If the bandit has 300 kts, he can generate tremendous problems and you probably won't maintain the control position. Normally don't try to gun him until he is 250 or less (there are a number ways to tail his airspeed: closure combined with aspect, and looking in the HP). There are two options you have as the attacker at the "fight's on". The first is pull lead and gun him now. The second is to bid to lag and beat his energy down.

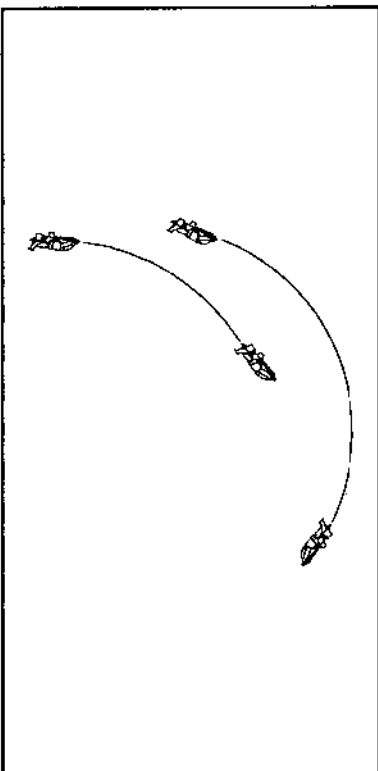


Figure: Closing for Guns

If you elect to pull lead and gun him from the start, prepare for the possible outcomes. If he's a duck and simply puts lift vector on and pulls, he dies. Fight's over in 3 seconds provided your pipper control is on the mark. If not, or he jinks you now have a closure problem and angle problem which you may not be able to solve very quickly especially if you continue to press the attack and follow his jink. The way to keep out of trouble here is to pull lead. If he even hints at a jink it's time to reposition while your still outside 2500'. If you decide to shoot, do so with a lethal burst, then reposition immediately. If the shot is good- call him dead. If it's not- you're already solving the closure problem before it gets out of control.

The other option is to make a bid to lag (Figure 4-32) to beat the bandit's energy down before you gun him. This option is highly recommended for the less experienced, and should be your primary game plan until your proficiency increases. The bid to lag can be accomplished in a variety of ways. The simplest is to ease off of your turn to float back to the bandit's elbow. This will keep energy up so you can pull your nose to lead at your discretion. Power can stay in mil. It also keeps your nose in a threatening position to the bandit and prevents him from selecting AB (If he does shoot him with the missile). You may also elect to reposition using a slight out of plane maneuver. This is acceptable and does kill closure rapidly, but may also send a non-threatening message to the bandit by going out of plane while his energy is still up. Executed correctly this technique is fine, but make it quick, snail, and crisp. Remember this is two handed BFM, AB may be required but not usually on the first move.

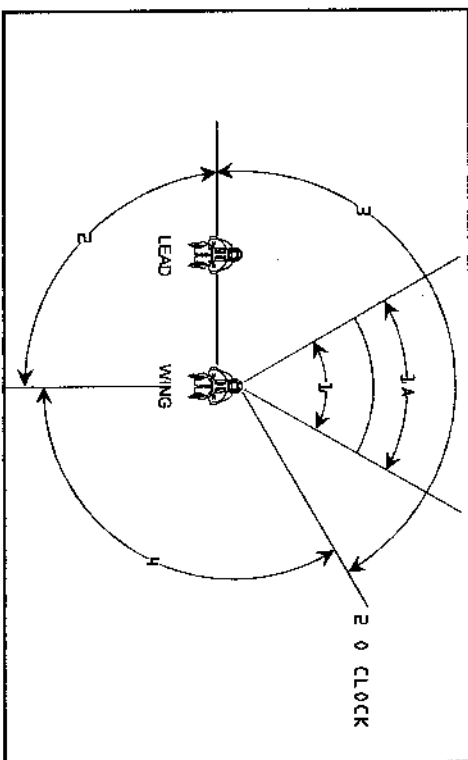
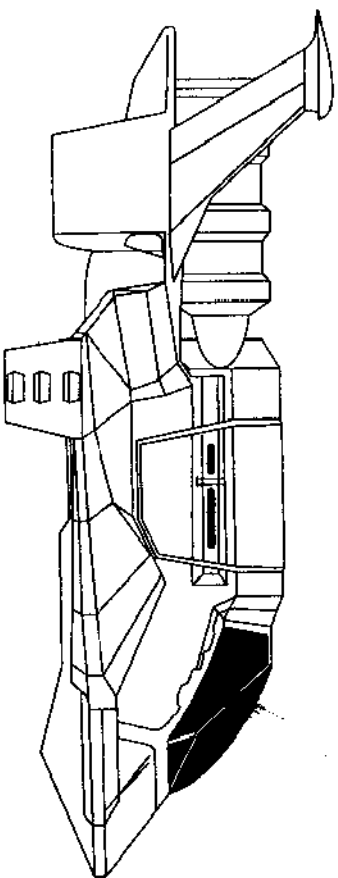


Figure: Lookout Responsibilities

Although the pilot has a myriad of responsibilities, he can only perform one task at a time. Therefore, he must employ a time sharing plan to quickly and efficiently accomplish many tasks. The following is an example of a time share plan for lookout responsibilities. The airspace around the aircraft is divided into sectors and each sector is assigned a priority based on lookout responsibilities (Figure 3-4). This plan is developed from a perspective of number two in a four-ship, but the principles apply to all positions in the flight. Sector 1: This is the hub of the cross-check. It is divided into two parts. Sector 1 is NEAR ROCKS; the rocks that will attract your flight path in the next 30 to 35 seconds. This sector is the highest priority sector and is the center of the cross-check. NEAR ROCKS are the ones that present an immediate threat. Sector 1A is FAR ROCKS, the terrain that will affect our future maneuvering. Pilots that look ahead at the FAR ROCKS are smooth in their maneuvering to maintain position or navigate because they see the mountain peaks and valleys in time to make small corrections. Sector 2: Besides avoiding the ground, the next most important area for lookout space is inside the flight's six o'clock. Sector 2 allows number two to monitor his formation position and check lead's six o'clock. Sectors 1A and 2 make up the basic cross-check NEAR ROCKS, FAR ROCKS, CHECK SIX. Sector 3: Once these responsibilities are completed, other areas can be brought into the cross-check. The next sector is inside the flight ahead of the 3/4 line. Searching this area can detect bandits in a conversation, as well as SAMs that may be fired from the front quadrant. Sector 3 is lower priority than Sectors 1, 1A and 2; therefore, it should be searched less frequently. NEAR ROCKS and FAR ROCKS must be checked during each search cycle. The frequency of search is dependent on pilot task saturation. Sector 4: When proficient enough, expand the search to a 360 degree lookout by picking up Sector 4. Sector 4 is outside the flight's ahead/behind the 3/4 line. This sector is the lowest priority; the wingman owes it to his flight lead to provide inside the flight lookout before dedicating time to this sector.

COLONIAL RAPTOR

CR-SCP1WT757



FLIGHT MANUAL

WARNING

PERFORMANCE INFORMATION DERIVED BY EXTRAPOLATION
BEYOND THE LIMITS SHOWN ON THE CHARTS SHOULD NOT
BE USED FOR FLIGHT PLANNING PURPOSES.