549 TASTG PHASE MANUAL
COURSE OV100B00PQ
26 January 1983

TACTICAL AIR COMMAND FORMAL FLYING AND RELATED TRAINING PUBLICATION

PHASE MANUAL

USAF OPERATIONS TRAINING COURSE

OV-10

TACTICAL AIR COMMAND

DEPARTMENT OF THE AIR FORCE
TACTICAL AIR COMMAND
549 TASTG, PATRICK AFB FL. 32925

DEPARTMENT OF THE AIR FORCE
549th Tactical Air Support Training Group (TAC)
Patrick AFB, Florida 32925

COURSE OV100B00PQ

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Phase Manual

AIRBORNE FAC OPERATIONS TRAINING COURSE
OV100B00PQ

1. This phase manual contains information required to complete your training at Patrick Air Force Base. It is not designed to duplicate information contained in Multi-Command Regulation 55-210, flight manuals, or publications. Instructions governing development, publication, and revision of phase manuals are contained in TAC Regulation 8-1.

2. Your ability to perform effectively as a Forward Air Controller is largely determined by your knowledge of fighter capabilities, tactics, limitations, and procedures. This information is available in Tri-Command Manual 3-1, fighter flight manuals, fighter weapons school texts, and numerous other study materials available in all tactical flying units. Assimilation of this data with the material presented in this manual, your academic classes, and individual flight briefing will provide the foundation for your FAC training.

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CHAPTER 1

GENERAL

1-1. Introduction.

a. General. The OV-10 "Bronco" is the first aircraft produced specifically for forward air control. It was initially designed for use in a counterinsurgency environment and to "live in the field" with the troops. However, its ruggedness, maneuverability, and versatility have made it a near ideal machine for use in fighter control, visual reconnaissance, artillery adjustment, convoy escort, resupply, para-drop, and psychological warfare missions. In addition to these classic FAC functions, the aircraft also possesses the capability to deliver suppressive ordnance in an offensive containment role.

b. Course Conduct. Every effort will be made to insure that your assigned instructor has experience in the theater of your end assignment. During the transition phase (Initial Qualification), you will practice previously learned flying skills while developing the specific techniques required for the OV-10. In the tactical phase (Mission Qualification), you will learn the duties of a Forward Air Controller. Upon completing the course you will be designated a Mission Capable (MC) FAC. If your final assignment is to a command other than TAC, you might receive an additional checkride along with theater indoctrination before upgrade to Mission Ready (MR) status.

c. Study Materials. This manual will provide some techniques which you will find helpful in learning to fly and FAC in the OV-10. Specific operating instructions and local area procedures, for the most part, are covered in other publications that you have been issued. Other required reading material can be found in the briefing rooms, the flight opreration center, and the squadron safe. As a FAC you will have to possess working knowledge of fighter capabilities, tactics , and restrictions. Use the available study materials to increase your understanding of all TAC weapons system.

CHAPTER 2

TRANSITION

2-1. Introduction.

a. General. The OV-10 is a great improvement over previous FAC aircraft. With its versatility, twin engine reliability, and outstanding flight characteristics, it has proven to be one of the most reliable and safe aircraft in the inventory. Some of its unique characteristics that you will need to master include:

(1) Power Management Control System (PMCS) nomenclature and lever positioning.

(2) Propeller locking and unlocking.

(3) Ground maneuvering with asymmetrical power, nose wheel steering, and differential braking.

(4) "Pulling" the aircraft off the runway for takeoff.

(5) Engine synchronization during flight.

(6) Back pressure and rudder control for air work.

(7) Pitch versus Power during the landing phase.

(8) Proper application of reverse thrust and brake pressure during landing rollout.

b. Emergency Procedures. Prior to your first flight, you must know all the BOLD FACE emergency procedures and be able to correctly employ them. The IP in the rear seat has few engine performance instruments; he cannot raise the landing gear or start the engines. Get as much cockpit time as you feel is necessary to become familiar with the location and operation of the switches and other controls. Unfortunately, there is no emergency procedure trainer for the OV-10; so it is very difficult to realistically simulate emergency situations and practice responses. It will not be enough to simply memorize the BOLD FACE procedures. You must have thorough knowledge of aircraft systems, the task at hand, and the environment in which you are operating: no emergency ever takes place in a vacuum. Finally, always keep first and foremost in your mind the #1 step for any aircraft emergency- MAINTAIN AIRCRAFT CONTROL - if you forget this one, you can forget EVERYTHING else.

c. First Mission. Emphasis for your first mission will be on checklist procedures, ground operations, aircraft handling characteristics, and local area familiarization. You will receive a supervised preflight and cockpit check plus a supervised engine start of the number one engine. Be thoroughly familiar with the flight manual emergency procedures and this chapter, and have a local area map completed.

2-2. Mission Planning. Review the mission requirements in the syllabus and study the appropriate procedures in the flight and phase manuals as well as TACR 55-210 well in advance of the briefing time. Immediately prior to the briefing, check the aircraft and call sign assignment, weather, alternate airfields, current PIF, NOTAMs, special notices that may affect your mission; compute weapons delivery settings, takeoff data, and EGT limits; and fill out the flight clearance.

2-3. Walk-Around Inspection. Use the abbreviated checklist and know the expanded checklist in the flight manual. Avoid walking through the propeller arcs during preflight and postflight operations.

2-4. Before Starting Engines. Visually clear the propeller prior to turning the battery on and again prior to starting. Set the parking brake by pumping the brakes two or three times, pulling the parking brake handle, releasing the brake, and then releasing the parking brake handle. Prior to setting the parking brake, insure that you are about to pull the brake handle and not the emergency stores jettison handle. Prior to starting, position yourself as far to the left side of the cockpit as comfortably possible so that the IP can monitor the engine instruments.

2-5. Starting the Engines. Visually clear both propellers prior to start. Experience has shown that during the start cycle temperatures seldom exceed 750°. If the temperature does approach 750° at a rapid rate, be prepared to shut down the engine to avoid an overtemp.

CAUTION

During a battery start of the first engine, the interphone system and oil pressure gauges are inoperative. Closely monitor the engine instruments and be alert for any signals from the IP.

The OV-10 engines are started with the props locked in the flat pitch position and must be unlocked before taxiing. The signals for unlocking the props is a forward motion with the palm of the hand. After giving this signal to the crew chief, smoothly retard the power lever to the reverse thrust range and then advance back to ground start. A slight rise in torgue and drop in oil pressure may be noticed during unlocking.

CAUTION

Guard the brakes when unlocking the props. Do not inadvertently release the brakes.

2-6. Taxi. Show the seat pins to the crew chief prior to chock removal. Slowly taxi forward and gently test the brakes and nose gear steering before the first turn. Once clear of the parking area, normal taxi speeds can be maintained by moving the power levers aft toward the reverse thrust range. DO NOT RIDE THE BRAKES. Small turns and directional control can be easily accomplished by using asymetrical power, nose wheel steering, or rudders. Reverse thrust is not very effective at slow speeds unless you are in T.O./LAND. If a tight turn is required, use nose wheel steering and brakes (favoring nose wheel steering). If a full stop is required, MOVE THE POWER LEVERS TO THE FLAP PITCH RANGE AND USE THE BRAKES. These procedures will reduce the cockpit noise level and the possibility of equipment damage or personal injury due to FOD. All ground checks except the taxi check and line-up check will be accomplished with the aircraft stopped and the parking brake set. When stopped, try to keep the props in a no thrust condition (Ground start position approximates flat pitch). This minimizes the chances of the aircraft rolling and reduces the wind blast.

2-7. Takeoff.

a. Before takeoff. While waiting to take the runway, review takeoff data, recheck engine limitations, and mentally review the procedures for abort, blown tire, and engine failure/fire on takeoff.

b. Takeoff. A no-flap configuration is used for normal takeoffs. When cleared to take the active runway, double check that all eight canopy pins are seated, the seat pins are removed, and the riser fittings are attached. Challenge the other crew member to insure that he is ready for take-off. When aligned with the center of the runway, come to a complete stop, pump up the brakes, and complete the line-up check. During the takeoff roll, when take-off distance is not a factor, the stick should be full forward with the aileron into the wind. Monitor the EGT, RPM and torgue to insure that engine limitations are not exceeded. If one engine requires a reduction of power to stay within limits, it is recommended that a power reduction be applied to both engines to prevent an asymmetrical torgue condition. Takeoff speeds will be in accordance with the flight manual.

c. After takeoff and Climb. Normal climb speed for local training is 130 KIAS. Climb power will normally be MILITARY (do not exceed engine limits).

2-8. Cruise. For extended missions, the flight manual must be consulted to obtain best cruise power setting and airspeeds. Synchronize the engines with the condition levers in the NORMAL FLIGHT mode by matching engine RPM to eliminate prop "beat".

2-9. VFP Patterns and Landings.

a. General. The recovery phase of flight has the highest rate of accidents for the OV-10. The following factors have led to most recovery mishaps: Excessive bank angles, low or idle power with props in flat pitch, and high sink rates. All of these can result in unstable, rapidly changing flight conditions which place excessive demands on the pilot and the aircraft. Therefore, it is essential that each pilot thoroughly understand the following points:

(1) Visual Perception. The connotation "VFR" erroneously implies that the pattern is flown using only outside references. There are serious limitations to visual perception which make it absolutely essential to refer to the performance and control instruments throughout the pattern. The properly executed pattern is one that allows sufficient time for a proper crosscheck between these instruments and outside references.

(2) Stall Speed Versus Angle of Bank. As you already know, the greater the angle of bank, the less the stall margin. Refer to the flight manual chart concerning stall speed versus bank angle and power setting for further information.

(3) Power. The more constant the power, the more stable the other control elements become. Use of flat pitch and rapid power changes are unnecessary and can be avoided by planning ahead. In addition, rapid power changes cause abrupt changes in control pressure which can be difficult to counter. Such changes become especially critical during the last portion of the turn to final, during the flare , touch down, and go-arounds.

CAUTION

When flying in the "FLAT PITCH" range, a rapid sink rate can develop for which the only remedy is power addition. With the condition levers in T.O./LAND, movement of the power levers does not result in sound variations normally expected. Be especially observant of airspeed and sink rates. Use the torgue gages when making power adjustments.

(4) In summary, a safe VFR pattern must: Allow sufficient time to plan ahead; permit smooth, precise corrections; and insure a stabilized, power-on final approach.

b. Overhead Patterns.

(1) Normal Patterns (20° flaps). On initial and over the intended touchdown point, break to downwind using a 45° - 60° banked turn. Roll wings level on downwind and maintain a minimum of 120 KIAS until the gear is lowered. Configure for landing abeam the touchdown point and visually check the gear down and all indicators safe. Start the base turn planning to roll wings level on final approximately 3/4 of a mile from the runway at a minimum of 300 ft AGL. Final turn bank angle should normally be between 30° and 45°. Execute a go-around if excessive bank or back pressure is required to prevent an overshoot.

(2) No-Falp Patterns. No-flap approaches and landings are basically the same as normal landings, except that the pattern is slightly wider and the approach speeds are higher. Due to increased airspeeds and larger trim changes, there is a tendency to overshoot the final turn. Plan for this when establishing your downwind position. Due to the higher pitch attitude required to maintain glide path there is a tendency toward drug-in finals. Pick up a visual aim point and hold it.

c. Rectangular Patterns. The VFR rectangular pattern is an optional method for positioning the aircraft on final approach. Some advantages this type of pattern are: less time is used between pattern entry and landing than in the overhead pattern, and a wings level base leg is more controlled than an overhead base turn. Disadvantages are: formation breakup requires more coordination and aircraft must reduce to pattern airspeeds prior to pattern entry. This pattern can be flown at various altitudes and distances from the runway (to comply with local restrictions) allowing glide path interception upon rolling out on final. It is characterized by having a offset downwind leg, base turn, base leg, final turn and final approach. Entry is normally to downwind leg from a 45° intercept. Descent from base altitude may be initiated as required to roll out on final on glide path.

d. Touchdown. Fly the aircraft to the runway, maintaining a constant airspeed and attitude to the desired touchdown point. DO NOT EXCEED SINK RATE LIMITS AT TOUCHDOWN! Do not make large power reductions during the flare. This could result in a dropped-in landing. After touchdown, lower the nose wheel to the runway, exert firm forward pressure on the stick, and maintain aileron into the wind. To insure reverse thrust on all landings, lift the power levers over the reverse thrust gate.

e. Crosswind Patterns and Landings.

(1) Wind Correction. Inadequate wind corrections in the traffic pattern can cause poor downwind placement, angling finals, overshoots, and drifting or crabbed landings. On initial, break to arrive on downwind at the proper distance from the runway, and establish a crab to maintain that distance. Before making the turn to final. consider the distance that you are out from the runway. Realize that when you have covered half of this distance during the final turn, you should also be halfway through the turn. If you are not, you are setting yourself up for a low altitude high G overshoot. If you have turned more than halfway, the result will probably be an angling final. The

first half of the final turn is critical to flying good patterns. It is at this point that the pilot must recognize and correct errors. Poor crosswind landings are usually the result of either transitioning from a crab to the wing low method too late to establish proper alignment and still keep the drift killed, or wind changes on short final. Do not allow yourself to accept drifting or crabbed touchdowns.

(2) Landings. After touchdown, lower the nose, and hold firm forward stick pressure for effective nose wheel steering,and raise the flaps (if used). Hold aileron into the wind throughout the landing roll, and use nose wheel steering and asymmetrical reverse power as necessary to keep the aircraft traveling in a straight line. Without proper control position during crosswind landings, two possible situations resulting from upwind wing lifting can occur:

(a) The upwind brake could lock causing the tire to blow.

(b) The reverse gate could fail to retract if the left wing is upwind. Careful use of brakes will eliminate the first condition, and the second can be overcome by lifting the power levers before attempting to use reverse thrust.

f. Touch-and-go Landings. After touchdown, lower the nose wheel to the runway and exert firm forward pressure on the stick to minimize nose wheel shimmy. If full flaps were used for landing, raise them to half or less prior to takeoff. Smoothly advance the power levers to military (do not throttle burst) and check for proper engine instrument indications. Then follow normal takeoff procedures.

g. Go-Around and Closed Traffic Pattern. Initiate a go-around by smoothly advancing the power levers to MILITARY (observing EGT, RPM and torque limits) and retracting the gear when safely airborne. When cleared for a closed pattern, maintain a minimum of 120 KIAS in the pull-up and on downwind prior to configuring.

h. Single Engine/Simulated Single-Engine Landings.

(1) Patterns. Landing with engine failure or other failed/unreliable systems may be made from random interception of an extension of the final approach. The objective of this type pattern is to get the aircraft on the ground with minimum maneuvering. Since there is not a single, best pattern to fly for all conditions, the pilot must judge the appropriate pattern for the circumstances involved. Factors such as weather, altitude, position, aircraft performance, and failed engine position must be evaluated to determined the most suitable pattern. A "typical" or recommended single engine pattern to be used when conditions are suitable can be found in the flight manual. Any time either pilot determines that the approach or landing is unsafe, an immediate go-around will be initiated using BOTH engines.

(2) Landings. Simulated single engine patterns may be flown to a low approach, touch and go, stop and go, or full stop landing. During the landing roll for a stop and go or full stop, lower the nose wheel to the runway and exert firm forward stick pressure to ensure effective nose wheel steering. Retract the flaps as aircraft control permits.

3. Single Engine Reverse. Single engine reverse thrust can be used to stop or slow the aircraft after touchdown in the event of brake failure or if stopping distance is not a factor. Lower the nose and hold firm forward stick pressure for effective nose wheel steering. Rudders should be returned to the near neutral position prior to initiating nose wheel steering. SLOWLY retard the power lever into the full reverse thrust range and simultaneously use nose wheel steering and brakes for directional control. Closely monitor engine instruments to detect engine bog down during single engine reverse. If you are unable to maintain directional control with single engine reversing, advance the power lever to ground start and use brakes to stop, or if using simulated single engine reversing, transition to normal reverse using both engines.

2-10. After Landing. Flaps may be retracted on landing roll. All other checklist items will be accomplished with the aircraft stopped and the parking brake set.

2-11. Transition Maneuvers.

a. Slow Flight. Slow flight is performed to demonstrate lateral control response at low airspeeds. Place the condition levers to T.O./LAND, retard the power levers, and maintain level flight as the airspeed decreases. Gear and/or flaps may be lowered if desired. Allow the airspeed to decrease to 65 KIAS or until activation of the rudder pedal shaker; whichever occurs first. Add sufficient power to maintain airspeed and altitude while performing coordinated turns. Recover by making a normal go-around.

b. Stalls.

(1) Power-on Stalls. The purpose of practicing power-on stalls is to allow you to experience the full range of stall indications and to demonstrate the lateral and directional control ability of the aircraft in a full AFT stick stall. To enter the stall, place the condition levers in T.O./LAND and set the torque at 900 pounds. Raise the nose to 30° nose high with the wings level, or 20° of bank for a turning stall. Hold this attitude by increasing back stick pressure as the airspeed decreases. Be sure you maintain coordinated flight by cross-checking the slip indicator. Initiate recovery if you encounter an uncontrollable roll, or when the nose starts to drop after reaching full aft stick. Recover by releasing back pressure (or by using forward stick pressure if required) in order to break the stall (Stop the stall buffet) and rolling wings level without adding more power. When flying airspeed is regained (approximately 80 KIAS), smoothly recover to level flight, minimizing altitude loss and avoiding a secondary stall. For both straight ahead and turning stalls, a release of back stick pressure will break the stall. Rudders are extremely effective for controlling roll at low airspeeds because nearly the entire length of both vertical stabilizes is within the propeller airstream.

(2) Traffic Pattern Stalls.

(a) Accelerated Stall. Perform the Descent Check and enter a simulated initial. Simultaneously roll into the break and retard the power. Increase the bank angle and back pressure (considerable back pressure is required) until you get the first indications of an accelerated stall (burble or rudder shaker). At this point, release back pressure and add power as required to break the stall. Roll wings level on a simulated downwind and configure the aircraft for landing.

(b) Nose High Final Turn Stall. Establish base airspeed, retard the power levers to FLIGHT IDLE, and start a shallow bank turn to final with a nose high attitude (simulated wide base). Cross-check the VVI in order to maintain 0-500 FPM rate of descent during the approach to the stall. Excessive sink rates do not allow for approximation of the proper stall indications. At the first indication of a stall, recover by adding power, relaxing back pressure, and rolling wings level using rudder and aileron (minimize altitude lost). Monitor the engine instruments closely to insure that torque and EGT limits are not exceeded.

(c) Nose Low Final Turn Stall. Establish base airspeed, retard the power levers to FLIGHT IDLE, and start a turn to final with a nose low attitude (simulated tight base). Increase bank and back pressure until the first stall indication occurs. Recover by using the same procedures as in the nose high final turn stall.

(d) Landing Attitude Stall. Establish final approach airspeed and a descent rate of approximately 500 FPM to simulate final approach. Slowly retard the power levers to FLIGHT IDLE and raise the nose to simulate flaring high and attempting to hold the aircraft off the runway. At the first indication of the stall, recover by increasing power to MILITARY and going around.

(e) Recovery. During the nose high, nose low, and landing attitude traffic pattern stalls, adding power is essential to recovering from the stall since propeller airflow over the wing generates approximately 40% of the lift. The difference between power-off and power-on stall speeds in the landing configuration ranges between 14 KIAS and 24 KIAS depending on flap position.

2-12. Simulated Single Engine Maneuvering. This exercise will demonstrate the problems that could be encountered should an engine fail immediately after takeoff, and it will provide practice in engine failure procedures and single engine maneuvering. To initiate the maneuver, the IP will simulate failure of an engine. Maintain aircraft control (the rudders are very effective at low airspeeds) and accomplish the flight manual procedures. Check for full power on the good engine and retract the gear. Simulate jettisoning stores (as required) and feathering the failed engine. Single engine flight with external stores retained greatly degrades aircraft performance. Aircraft performance charts should be consulted prior to takeoff to determine the requirement for jettisoning stores should a single-engine situation develope. In most situations the jettisoning of external stores will enhance aircraft performance. It is important not to attempt a permature climb or to raise the nose too high, as this will result in loss of airspeed and degraded aircraft controllability. If you are clear of obstructions and altitude is not critical, lower the nose slightly to aid acceleration. If airspeed decreases to minimum single engine control speed at any time, lower the nose to obtain safe single engine airspeed (altitude permitting). The flaps must be raised as soon as possible in order to accelerate to the best single engine climb speed. Slowly move the flaps up by placing the flap lever to the hold position; then to the up position momentarily; and then back to hold. Repeat these actions until the flaps are completely up. Raising the flaps in this manner will prevent the loss of altitude caused by the abrupt reduction in lift when the flaps are rasied in one movement. Complete the remaining checklist items, accelerate to the best climb airspeed, and start a climb to 1000 feet above the simulated ground level. After level-off, accelerate to a minimum of 120 KIAS prior to maneuvering.

2-13. Confidence Maneuvers.

NOTE: All confidence maneuvers are conducted with the condition levers in T.O./LAND and 1300 # of torque.

a. Chandelle. Align the aircraft with a prominent ground reference and enter a shallow dive, accelerating to 200 KIAS. Begin a climbing turn so that the nose of the aircraft comes through the horizon as the angle of bank reaches 60° and the aircraft heading has changed 30° to 45°. Continue the climbing turn, maintaining 60° of bank (the common tendency is to overbank) until you have turned 135°. Then begin to reduce the bank angle and back pressure as necessary, so that after 180° of the turn the wings are level and the airspeed is a minimum of 100 KIAS. Pause momentarily before lowering the nose to the horizon for recovery. During the recovery the airspeed may decay below 100 KIAS. Clear throughout the maneuver.

b. Lazy Eight. After selecting at least one prominent 90° reference point, lower the nose and accelerate to arrive back at the horizon with 200 KIAS wings level. Begin a slow climbing turn, obtaining 45° of bank at 45° of turn. Continue to increase bank and monitor the pitch angle so that after 90° of turn, the nose is passing through the horizon, the angle of bank is 90°, and the airspeed is a minimum of 100 KIAS. Allow the nose to continue down while shallowing the bank so that at 135° of turn the angle of bank is 45°. Continue to shallow the bank and raise the nose to arrive back at the horizon with the wings level and an airspeed of 200 KIAS. The maneuver is completed with a turn in the opposite direction.

2-14. Aerobatic Maneuvers.

NOTE: All aerobatic maneuvers are conducted with the condition levers in T.O./LAND and 1300# of torque.

a. General. It is suggested that you perform a sequence of aerobatic maneuvers and commence them above 9000 feet AGL to save climbing between maneuvers. Clear the area before each maneuver.

b. Aileron Roll. Attain an airspeed of 170 to 230 knots, pull the nose up to 10 - 20° nose high, and initiate a roll using aileron and rudder. When 3/4 of the roll is complete, use slight opposite aileron pressure to roll wings level in coordinated flight with a minimum of 100 KIAS. Maintain positive "G" throughout the maneuver.

c. Barrel Roll. Select a point on the horizon and dive the aircraft to obtain 230 KIAS below the point. Approaching 230 KIAS, begin a coordinated turn away from the point keeping the nose below the horizon. When 30° - 45° off the point, start a rolling pull-up in the opposite direction, arriving at the horizon wings level. The offset from the reference point determines the size of the barrel roll. Throughout the remainder of the roll, vary bank and back pressure so as to produce a constant rate of nose movement with varying positive "G's". The maneuver is completed after a symmetrical 360° roll, recovering with approximately 230 KIAS.

d. Cloverleaf. Dive to pick up airspeed so that you can recover to the horizon with 230 KIAS. Continue to pull the nose up wings level to 45 - 60° nose high. Pick out a point on the horizon 90° to either side and begin a coordinated rolling turn to put your nose on the point inverted wings level with 100 KIAS minimum. From this position, continue as in a split S, or the bottom half of a loop, arriving on the opposite horizon with 230 KIAS. Fly three more leaves, turning in the same direction each time.

e. Loop, Cuban Eight, and Immelmann. Attain an airspeed of 250 KIAS. Begin each maneuver with a wings level four "G" climb. Maintain back pressure as required to preclude going below 100 KIAS across the top. The aircraft has a tendency to recover by itself at approximately 200 KIAS. Do not allow this. Keep the backside sufficiently steep to reattain 250 KIAS. The immelmann roll should be started approaching 10° to 5° nose high above the horizon. Begin the Cuban Eight roll so as to recover 45° nose low. While performing Cuban eight and Immelmann rolls, use a combination of aileron and rudder while decreasing stick pressure. During the maneuvers maintain slightly positive seat pressure.

f. Vertical Recovery. The vertical recovery will teach you how to recover from extremely nose high, low airspeed, heavy weight situations that are possible during the duress of combat. The instructor will maneuver the aircraft into a nose high attitude and then return control of the aircraft to the pilot. Recover by rolling toward the nearest horizon, maintaining positive seat pressure, adding power as required, and minimizing altitude lost. Be as smooth as possible in all movements of controls. If a spin is entered, recover using the procedure outlined in the flight manual.

g. Split "S". This manuever demonstrates the ability of the OV-10 to turn in the vertical and could be used as an evasive maneuver in tactical situation. Raise the nose approximately 15° above the horizon. With an airspeed of 120 knots, relax back pressure and use rudder and aileron to roll inverted. When wings level inverted, initiate back stick pressure to keep the aircraft on the edge of the "burble" preceding the high speed stall. Recover from the manuever wings level after 180° of turn. Due to the effect of the prop blast over the wings, this manuever can be completed with less altitude loss using power than when using FLIGHT IDLE. If the maneuver is properly executed, you should lose no more than 1500 feet.

2-15. Night Transition.

a. General. During the preflight for night missions check that the external and internal lights are working properly. If the first engine is started on battery power, the external lights will go off until the generator comes on the lines. Taxi with the position lights BRIGHT, the anti-collision beacon OFF, and the landing light ON. If the landing light will interfere with the operations of aircraft on the runway, turn it off and stop if you do not have sufficient illumination.

b. Patterns. A rectangular traffic pattern will be flown when operating VFR at night.

c. Landing. Night Landing present no particular problems if sufficient visual cues are available. More attention to instruments is required; particulary when lack of ground lights and horizon tend to induce disorientiont. The OV-10 can safely be landed on very dark landing fields without use of external aircraft lights. The only requirements are to be able to see the aim point on the intended runway and check VVI for descent rates that comply with aircraft weight and landing field surface.

CAUTION

Do NOT flare high. Remember no flare is required.

d. FOR SAFETY REASONS, THE BATTERY SWITCH AND THE INTERIOR AND EXTERIOR LIGHTS WILL BE LEFT ON UNTIL THE PROPS HAVE STOPPED ROTATING ON ENGINE SHUT-DOWN.

2-16. **FAC Phase Transition.**

a. Optimum Performance Takeoff. The tecnique for an optimum performance takeoff is similar to that used during normal takeoff except for a slower takeoff speed and a higher initial climb angle. The airspeeds are based on minimum safe single engine control speeds and allow very little margin for error. Practice optimum performance takeoffs using airspeeds listed in the Optimum Performance Charts of the Flight Manual. Lower 20^{o} of flaps when accomplishing the BEFORE TAKEOFF checklist. All other procedures prior to rotation will be the same as in a normal takeoff. At five knots below the computed takeoff speed, smoothly rotate the aircraft to approximately 10^{o} of pitch and hold this attitude until the aircraft flies off the runway. When safely airborne, retract the gear without delay (to reduce minimum single engine control speed) and adjust the pitch attitude as necessary to maintain the computed takeoff speed (for example: at 10,500 #, maintain 82 KIAS). After clearing all obstacles (500 feet AGL for training), reduce the pitch attitude, accelerate to computed climb speed, and raise the flaps when above 110 KIAS.

b. Special Patterns. Special patterns can be flown for various reasons: a short runway, obstructions near the runway, or ground fire in the vicinity. Special patterns may be flown from a straight-in approach or the overhead pattern, whatever the situation the following techniques will be of benefit: Plan your approach for either a full flap or half flap configuration, if a min-run landing is desired refer to the performance charts in the flight manual for airspeeds. For training purposes fly final at 85 KIAS for the half-flap approach and 80 KIAS for the full-flap approach. Any maneuvering prior to final should be done at the appropriate final approach speed plus 10 KTS. When full flap patterns are flown, the nose of the aircraft is lower than normal, this may cause your first attempt to appear excessively steep. Full flaps can be selected on downwind or on final but under no circumstances should they be selected in the base turn. Lowering full flaps on downwind has the advantage of providing a tighter turn capability in addition to an altitude safety margin should the flaps split upon being lowered. The disadvantage of lowering full flaps on downwind stems from the loss of single-engine fly-away capability. Should an engine loss occur during a tactical/full-flap pattern the flaps must be raised to half immediately. Lowering full flaps on final alleviates the single engine problems but can induce pitch and airspeed fluctuations. In addition a split flap situation occurring at low altitudes could be fatal. If the sole purpose of the tactical pattern is a min run landing allow sufficient time on final to stabilize airspeed, glide slope and aimpoint. The choice of tactical pattern ultimately depends on the situation and pilot proficiency.

c. Landing from a Special Pattern. At special pattern approach speeds it is very easy to develop a high sink rate on final. Check the VVI to insure that you do not exceed 850 FPM at touchdown. At Patrick, special patterns will often be terminated with min run landings. From a carefully controlled final approach, make a non-flared landing and quickly but smoothly lower the nose to the runway while simultaneously retarding the power levers to full reverse. Monitor the engine instruments and insure that the RPM does not drop below 94 percent. For an actual min run landing, apply optimum braking; however, only light braking is used in training. If a touch and go landing is to be made from a full flap landing, be sure to raise the flaps prior to starting the takeoff roll.

2-17. Advanced Aircraft Handling

a. General. Recommended Maximum Performance Maneuvers for the OV-10, are not intended to serve as Defensive Maneuvers. They are good exercises to develop "Feel" when operating near the stall.

b. OV-10 Handling Exercise (Phase I). Set-Up: 1400 lbs. torque, T.O. and land, approximately 150 KIAS. Roll into a steep banked turn with coordinated rudder and aileron maintaining level flight Apply sufficient back pressure to activate the rudder pedal shaker. While maintaining the pedal shaker, change flight path (pitch angle and direction of turn) with coordinated rudder and aileron. The exercise consists of a series of climbs and descents, turns and reversals, using coordinated rudder and aileron, and varying back pressure as necessary to maintain the pedal shaker. As a guide, the airspeed will vary between 100 and 150 KIAS; however, the exercise should be flown with eyes outside the cockpit. Minimum altitude is 2500' AGL.

c. OV-10 180° Reversals (Phase II). Military Power, T.O. and land, approximately 150 KIAS. Roll into a steep banked turn with coordinated rudder and aileron and apply sufficient back pressure commensurate with bank angle to maintain level flight and activate the rudder pedal shaker. Maintain the pedal shaker throughout the maneuver. A properly executed reversal should result in 180° of turn achieved in approximately 10 seconds, no altitude loss, and approximately 120 KIAS. This maneuver can also be performed as a descending turn or "slideback" by entering the turn slightly nose low and approximately 120° of bank, decreasing bank angle throughout the turn so as to arrive at the 180° point wings level. The altitude loss should be approximately 800' and the turn should require about 9 seconds. This maneuver should be practiced without reference to the instruments. Minimum altitude is 2500' AGL.

NOTE

Military Power should be applied simultaneously with the entry roll to conserve as much airspeed as possible during the maneuver.

CHAPTER 3

INSTRUMENT FLYING

3-1. Introduction.

a. General. The instrument training you will receive is based on the fact that all Air Force pilots are instrument qualified. However, some pilots may find themselves making approaches with unfamiliar equipment, such as the ADF. Therefore, review AFM 51-37 before your first instrument missions so that your instructor can spend more time teaching the characteristics of the aircraft.

b. Flight Characteristics. The OV-10 is very stable, and your first reaction to flying it "on the gauges" will probably be a pleasant surprise. If properly trimmed, it will vary little from the conditions the pilot places it in. Common errors incurred by students include abrupt pitch changes and over-control of power corrections. Heading variations due to asymmetrical thrust usually accompany these power changes. This requires that you devote more time during your cross check to heading control and apply all control inputs smoothly.

c. Equipment. At the present time the OV-10A has TACAN, ADF, ILS, and VOR. Pilots who have been using a flight director or CDI may find ADF course corrections difficult at first; but with practice, they become easy. Study the flight manual and AFM 51-37 for an explanation of instrument indications.

3-2. Start, Taxi, Takeoff. Accomplish a normal preflight, making sure that sufficient FLIP documents are on board for the proposed route of flight Do the BEFORE TAKEOFF CHECK, complete the instrument preflight in the pilot's aid. Perform a normal takeoff, establishing a 130 knot instrument climb using military power. Use 10 percent of the vertical velocity for a level off lead point, and set cruise power using flight manual specifications.

3-3. Instrument Cockpit Check. The instrument cockpit check required by AFM 51-37 adapted for the OV-10 is contained in the 549 TASTS Pilots Aid. Review this checklist along with the flight manual so these checks will not take an excessive amount of time.

3-4. Basic Instruments. Maneuvers that you will practice consist of steep turns, recovery from unusual attitudes, and a spatial disorientation demonstration. Refer to AFM 51-37 for specific procedures.

3-5. Holding. Accomplish holding using flight manual and AFM 51-37 procedures.

3-6. Low Altitiude Approaches. Your instrument training will include TACAN, VOR, ILS, and ADF low altitude approaches and GCAs. Follow flight manual and AFM 51-37 procedures for these maneuvers.

3-7. Radar. The radar approach is probably the easiest approach to fly in the OV-10; however, do not let its ease of flying trap you. Remember that pitch changes are tied to power changes, and when power is changed it often affects aircraft heading. If you walk the throttles (a technique utilized in twin engine, centerline thrust aircraft) to accomplish small changes in power, more attention will be required to the heading indicator than most pilots normally allow.

3-8. Circling Approaches. Being extremely maneuverable, the OV-10 adapts very well to circling approaches. Fly the approach as described in AFM 51-37 and use flight manual airspeeds. Practice circling approaches will normally be flown at circling minimums.

3-9. Helpful Hints. Instrument patterns, including holding, are flown at 150 Kts (approximately 1000 # torque per engine) standard rate of turn is 22^{o} half-standard rate is 11^{o}. ILS descent rate for 3^{o} glide slope is 500' FPM, ± depending on winds. On SSE instrument approaches gear lowering should be accomplished at: Precision approach - Glide slope intercept for ILS, or descent point for Precision Radar Approach; On non-precision (TACAN, NDB, VOR) at the FAF, on surveillance radar approach at begin descent point. To fly an ILS approach you must have the TACAN/VOR switch in the TACAN/VOR/ILS position to get localizer steering, glide slope information, and identifier.

CHAPTER 4

FORMATION

4-1. Introduction. The primary purpose of formation flying in the OV-10 is to expedite going to and from the range or target area. Formation principles learned in UPT still apply; however, some peculiarties of OV-10 formation flying include:

a. The condition levers remain in the T.O./LAND position.

b. High turn rates caused by low true airspeeds require caution during rejoins.

c. Flat pitch can be used to obtain a speed brake effect.

d. Thirty degrees of bank in echelon formation puts the canopy bow between your wingman's eyes and you..

4-2. Ground Operations. After start, the leader will call for flight members to check in on the assigned FM and UHF frequency. Make sure to get the ATIS information on your own and to acknowledge the IFR clearance after flight lead copies it.

4-3. Line-Up and Takeoff. Line-up and takeoff will be in accordance with MCR 55-210.

4-4. Departure and Recovery.

a. Turning Rejoin. After safely airborne and established in a climb, lead should reduce power to approximately 1100 # torgue to expedite the rejoin. When performing the rejoin, you must consider the OV-10's high turn rate. It is very easy to get in front of the leader if too much cutoff is used. Move to a position that puts you on a line that runs from the leader's nose through his wingtip to you. Keep lead on or slightly above the horizon.

b. Straight Ahead Rejoin. Straight ahead rejoins in the OV-10 are very similiar to those in any other aircraft. However, you must be prepared to counter yaw that might develop from asymmetrical thrust created by a rapid power reduction in the latter stages of the rejoin.

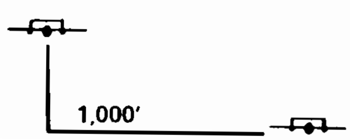
c. Formation Approach. Gear and flap signals are standard. To allow wingmen better power and control response, lead will normally fly no slower than 120 KIAS and attempt to hold a constant power setting of not less than 700 # of torgue. Fly the normal formation position until descent on final then stack level with the lead aircraft.

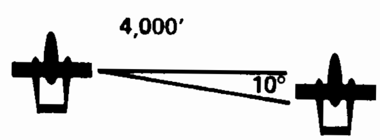
d. Overhead Pattern/Landing. The leader will fly a normal traffic pattern, breaking over the intended touchdown point. The downwind leg should place each aircraft in trail or slightly outside the flight path of the preceding aircraft. All aircraft should have the same base leg position. If you get too close on the downwind, angle away from the runway and fly a normal base leg. As a guide, start your turn to base when the aircraft ahead is at least 90° through his base turn. This will provide the 2000 feet minimum spacing required for landing. You must, however, have the proper base and final airspeeds, or you may close the distance and be required to go around. Each aircraft will use the individual flight call sign when making the gear check. (Pickup 2, Base, Gear down"). Land in the center of the runway and clear to the turnoff side during rollout. Change to ground frequency on your own when clear of the runway.

4-5. Tactical Formation.

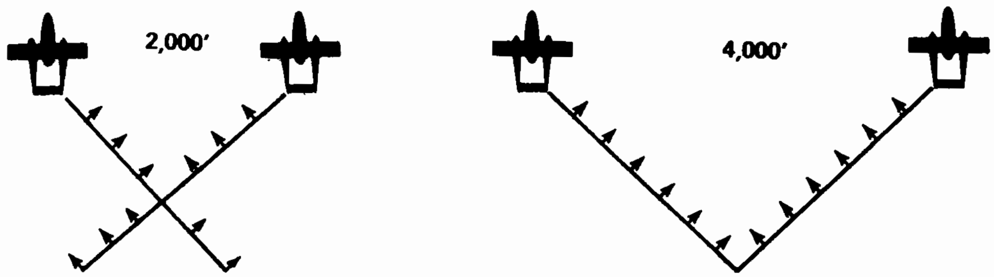
a. General. OV-10 Tactical Formation is designed to provide mutual support by maximizing visual lookout capabilities. This discussion will explain the basics of OV-10 tactical formation position, spacing and maneuvering for two-ship fights. Operational units will add to these basics for their own mission requirements. During training, when operating IFR, all aircraft with in a flight must be within 100 feet vertically and one mile horizontally of lead unless approval for nonstandard formation flight has been approved by ATC.

b. Position. Tactical formation is flown with the wingman line abreast to 10° aft of the lead aircraft with approximately 4000' separation. Vertical separation of up to approximately 1,000' between aircraft is also used, primarily to deny the enemy gunner or fighter pilot a visual on both formation members.





The formation should be flexible, based on pilot skill, weather, terrain, altitude, and anticipated threat. For instance, increasing spacing improves rear hemisphere lookout but sacrifices three/nine O'clock coverage to do so (See Below).



Lookout responsibilities are shown by the arrows above. Since the formation exists to maximize visual lookout capability, the wingman should not sacrifice lookout to fly a perfect formation position. The leader must navigate for the flight and maintain his lookout responsibilities. Techniques which will further enhance lookout include:

(1) Flight members rolling/weaving while maintaining formation. This decreases the "dead area" by providing deeper coverage to the formation's six O'clock and also makes each aircraft less predictable.

(2) Division of lookout - As a rule of thumb, each pilot should spend 70% of time scanning his area responsibility and 30% scanning elsewhere.

(3) Search for ground as well as airborne threats.

c. Maneuvering. Formation maneuvering (turns) will be made at 2-3 g's at a prebriefed airspeed and/or power setting. Turns should be flown to regain the line abreast position as quickly as possible. The wingman's responsibility is to maintain this position but the flight member in front should maneuver to regain formation position if necessary.

Several types of turns will be used to maximize tatical formation flexibility. These turns will be practiced at Patrick using a radio call from lead to initiate the turn but will be flown using the comm-out maneuvering discussed below to allow easy transition to comm-out.

(1) Tactical formation maneuvering is based on the following contract.

(a). The wingman will never exceed 90° from lead's heading.

(b) The flight member in front after a maneuvering turn has the responsibility to regain line abreast.

(c) During a crossturn or weave, the wingman will always cross above lead to deconflict flight paths.

(d) Except for item (b) above it is the wingman's responsibility to maintain line abreast to 10° back and the proper spacing.

(2) The following rules of thumb also apply to formation maneuvering.

(a) A 30° turn is used by lead to intiate a turn in his direction. The wingman assumes the turn will be 90°.

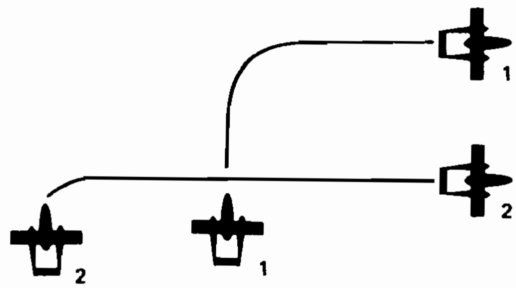
(b) A weave turn is used to signal the wingman to roll out and contiue straight ahead (in turns less than 90°).

(c) The wingman always maneuvers to comply with the basic charter-there are no signals from the wingman to lead.

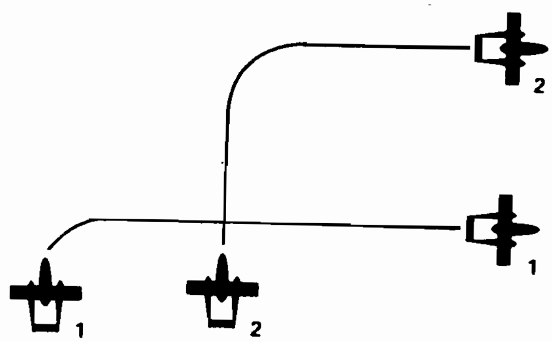
(d) In-place 180° turn away from the wingman, lead simply turns 180°. Since there is no check turn the wingman knows the turn is 180°.

(e) In-place 180° turn into the wingman is accomplished by two 90° turns.

(d) Delayed 90° Turn. Away from Wingman (see below) - After the radio call "Pickup Flight, 90 right, Now" - Number one initiates the maneuver with a check turn away from number two of approximately 30°. The check-turn is an aburpt maneuver performed in three distinct steps; roll-in, turn, and roll-out. Beyond being a basic signal, the check turn serves two purpoeses. The first is to deconflict flight paths, which becomes important in the low altitude environment if #2 is forward of line abreast, and second, to back up the signal, so that of #2 misses the signal, he can detect the 30° heading differential. When #2 sees the signal, he simple turns 90° into the leader. Lead completes the turn by allowing #2 to pass out of sight behind the aircraft boom and then turning to the new heading.

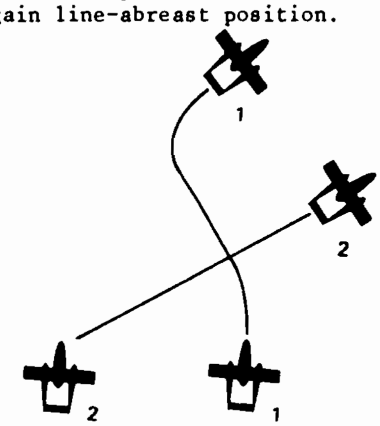


(e) Delayed 90° turn into wingman. Lead simply turns 90° into the wingman. In the low altitude environment, #2 should build the habit of performing a 30° check-turn away from #1. This will show lead that #2 has seen the signal, and serves to deconflict flight paths when lead is forward of line abreast.

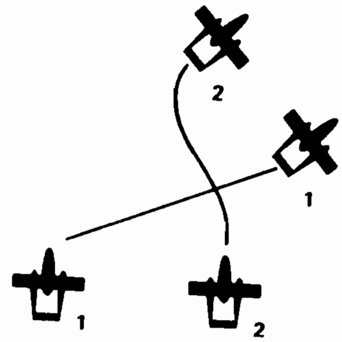


The normal 90° signals can also be used for turns of 60° and 120°.

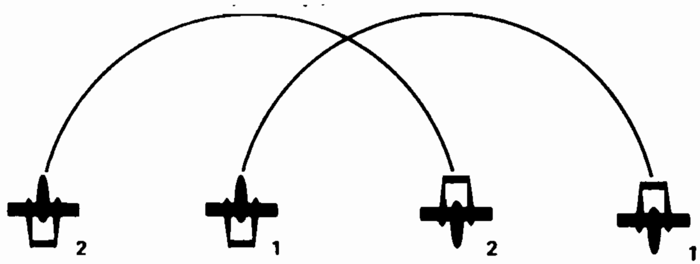
(f) Delayed 45° turn away from the wingman. This turn is initiated with the standard 30° check-turn away from #2. When the leader sees that #2 has turned approximately 45°, he initiates a weave turn in front of #2. The weave turn is distinquishable from the check turn by severity. Instead of the abrupt roll, turn, roll sequence, #1 maintains his turn until required to reverse to gain line-abreast position.



(g) 45° Turn Into Wingman - Lead simply turns 45° into the wingman, who then maneuvers as required to line-abreast to 10° back. The wingman will obviously interpert lead's initial move as a 90° turn and react accordingly. Once lead rolls out after 45°, #2 will be in front of lead's wing line and referring back to his basic charter, will maneuver back to line-abreast. This is done by crossing #1's flight path.

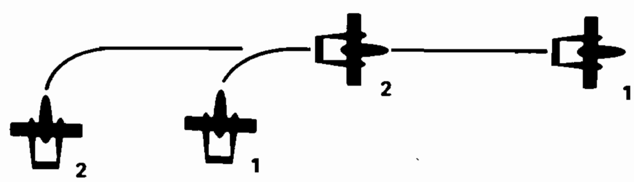


(h) 180° turn away from the Wingman. - It is preferable to make 180° turns away from the wingman whenever possible, both in the terms of time and complexity. Lead simply begins a 180° turn away from his wingman. As soon as lead begins the turn, the wingman initiates his turn. When lead does not roll out after the first 30° of turn, the wingman will know it is a 180° turn away.

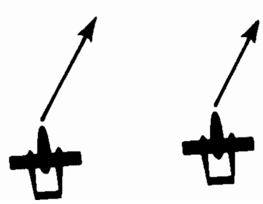


(i) When a 180° turn into the wingman is required, two delayed 90° turns are used. Lead initiates the maneuver with a normal 90° turn into #2. As soon as #1 crosses #2 flight path and #2 has started to maneuver back to line-abreast, #1 initiates the second delayed 90°, using the 30° check turn.

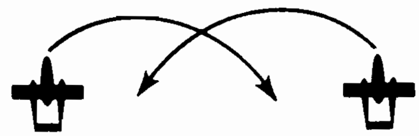
(j) The inplace 90° turn is initiated and flown like the 180° turn described above except the end result puts the flight in trail. A second inplace 90° turn places the formation back in tactical



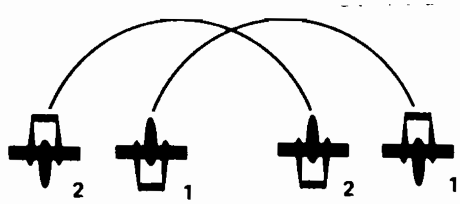
(k) A check turn is used to turn the formation up to 30° from orginal heading. To initiate the turn lead will call "Pickup Flight, check 30° right. Each aircraft will simultaneously turn to the new leading. The aircraft in front should maneuver as necessary to bring the formation back to line-abreast according to the basic contract.



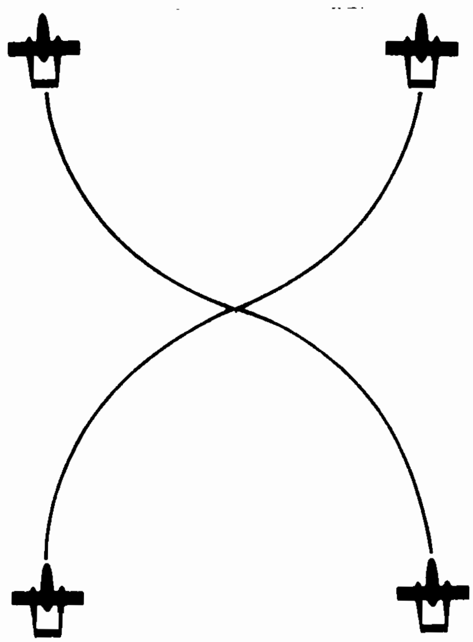
(l) The crossturn allows both flight members to maintain visual contact through a 180° turn but, because of the OV-10 turn radius, may be impractical if the formation is widely split. At distances greater then 2000' both flight members will have to float the turn (which takes time) or could end up losing visual contact during the last part of the turn - not recommended. Se Below.



The cross turn is initiated by the call "Pickup flight, Crossturn, now". Both aircraft turn into the formation, deconflict flight paths, (remember the basic contact) and clear through the turn.



(m) The weave is used for a variety of reasoning including flight lookout, spacing, wingman positioning, etc. The weave is initiated by the call "Pickup Flight, weave" and is flown by both aircraft turning 30° - 45° into the formation, rolling out, crossing, and turning back into the formation after proper spacing has been achieved. The weave continues until the lead calls "stop weave". At that time both aircraft resume original heading in proper formation position.



4-6. Formation Safety. All emergency air aborts will be escorted. The escort aircraft will take up a chase position while remaining well clear of the emergency aircraft. The emergency aircraft will fly in front unless the nature of the emergency requires otherwise (complete electrical failure, radio failure, loss of airspeed indicator, etc.). Flight lead responsibilities will be in accordance with briefed flight lead succession.

4-7. Formation Signals. Standard formation signals are contained in AFR 60-15. In addition, the following special signals apply to OV-10 operations:

a. To signal condition lever advance, place two fingers up followed by a forward motion with the clenched fist.

b. To signal changing to a prebriefed VHF frequency, form a fist with the pointed and index fingers raised to form a "V".

c. For a prebriefed FM frequency, form a fist with the index finger alone raised.

4-8 Changing Lead. Lead change procedures will be prebriefed for each scheduled formation mission.

a. Radio. Normally, a UHF radio call will direct and initiate all lead changes by:

(1) Putting flight in 2-4 ship width route formation.

(2) Specifying who will assume the lead position.

(3) Radio acknowledgement of new lead.

(4) The old lead will assume wingman position as the new acknowledges.

b. Visual. If radio calls are not feasible change of flight lead procedures and signals outlined in AFR 60-15 and TACR 55-210 will be used.

4-9 Night Formation. The OV-10 is not well lighted for night formation work. Additionally, the camouflage is dark enough to make the aircraft almost disappear. Since you can expect fewer visual cues than normal, make all rejoins cautisly and fly at a comfortable distance in fingertip.

CHAPTER 5

NAVIGATION/VISUAL RECONNAISSANCE

5-1. Introduction. If your navigation experience is similar to that of most new FACs, the techniques learned in your FAC training will be new and different. High speed preplanned low level routes, ONC strip charts with timing tick marks, and inertial navigation systems will not be used. Instead, most of the navigation points will not be known until you are airborne, and then medium and large scale area maps will be combined with pilotage and dead reckoning to move from one point to another. Although navigation aids such as TACAN may be available, they will be of secondary importance because Universal Transverse Mercator (UTM) grid coordinates will be used to identify desired points. Geographical coordinates are rarely used by FACs for navigation, but they may be required by the fighters. Since speed cannot be used as a defensive tactic, you may have to navigate in an irregular course at low level using clouds or terrain for masking. This chapter will introduce FAC navigation by discussing map reading, navigation, visual reconnaissance, high and low altitude navigation techniques, and common navigation errors. Be sure to read the applicable sections of TACR 55-210; it contains information not included here.

5-2. Map Reading and Preparation.

a. General. Skill in preparing and using maps is fundamental to success for a Forward Air Controller. You must become proficient in the use of the UTM grid system, and be able to move easily between map and ground references while keeping oriented at all times. Since the FAC has the primary responsibility for seeing that ordnance is delivered on the desired target, you must talk the Army's language and learn the UTM grid system.

b. UTM Grid System. In the UTM grid system, coordinates are always read "Right" and "Up" and are given with the 100,000 meter square identification first (two letters), followed by an even number of digits indicating the exact position of the target within the 100,000 meter square. Refer to the map legend for a more detailed explanation.

c. Types of Maps. The two types of maps used most often for navigation and target reconnaissance are 1:250,000 and 1:50,000 scale. In some areas 1:100,000 and 1:24,000 maps are also available.

(1) 1:250,000 (Joint Operations Graphic - Air). This map, primarily for navigating to and from the target area, shows major geographical features, usually contains aeronautical information, and gives elevations in feet.

(2) 1:100,000. Pictorially the same as the 1:50,000 map, but it contains no aeronautical information and the elevations are given in meters or feet.

(3) 1:50,000. This map, used for pinpointing target locations, shows geographic and cultural features in great detail. It is the primary map employed by the Army for ground operations. Man-made objects depicted on the map might be quite out of date, however, and no aeronautical information is given. Elevations are in meters or feet: check the legend.

(4) 1:24,000. This map is peculiar to stateside flying and contains much cultural detail. The 100,000 meter square identification (i.e. the "MA" of coordinates MA 986732) is not available on the map and must be obtained from other maps covering the same area.

d. Map Preparation. Prepare the 1:250,000 map as you would any other map used for inflight navigation. Be sure to include such items as restricted areas, emergency airfields, TACAN cuts, highlighted UTM grid information, and areas covered by the respective 1:50,000 maps. This information will make it easier to locate and navigate to a set of coordinates and to transition to the 1:50,000 maps when you arrive in the target area. The 1:50,000 maps should be arranged in a logical sequence, each one being individually identified by a code number that relates it to the other charts around it and to its position on the 1:250,000 area map.

5-3. General Navigation. Navigation to the target area is normally accomplished by using a 1:250,000 scale map and a combination of dead reckoning, TACAN, pilotage, and radar (if available). Once in the general target area, locate an easily recognizable point on both the 1:250,000 and 1:50,000 maps and transition to the 1:50,000 map for specific target identification. For ease of transition, the areas covered by the 1:50,000 maps should be outlined on the 1:250,000 map. Start your first navigation ride (NAV-1) by using the 1:250,000 map. Fly at about 140 knots with the condition levers in normal flight. Trim the aircraft for level flight so that you can concentrate on navigation, but do not forget to continue to clear and monitor aircraft instruments. Orbit or backtrack as required to identify points. Keep track of your exact position as you fly by following the aircraft's position on the map.

5-4. Navigation Techniques.

a. Basic Concepts. Although there are as many navigation techniques as there are FACs, the following concepts are common to all navigation and should form the basis for the development of your own techniques.

(1) Always start at a known point. If unknown, your position can be established through the use of TACAN, VOR, radar, or by simply finding the biggest, most easily identifiable feature in the area and locating it on the map. From initial takeoff, you should always know your position on the 1:250,000 area map, and you should be able to plot it on a 1:50,000 map within several minutes.

(2) Never leave a point until you have confirmed it. Confirm it by going from the map to the ground and "triangulating" landmarks that point to the point. Select three unique features of the point from the map and attempt to locate them on the ground. Try to use terrain features such as tree lines, depressions, and lakes. Major roads, railroads, and towns can also be used as they seldom change; but avoid small roads, towns, or structures. However, some roads, although discontinued, still show distinctive features such as bends or curves, and can be used if discernible. To judge distances when attempting to confirm a point, it is often helpful to take an easily identifiable landmark close to the target, determine its size, and then "flip-flop" that distance toward the target to determine exact distances on the ground. For example, if the map shows a 200 meter wide tree line 400 meters west of the target, you can flip-flop the tree line's length two times toward the east and confirm the target's location.

(3) Determine the best route from the point to the target. This may be affected by many factors such as terrain, threat, weather, etc. Since electronic NAVAIDS will probably not be available to assist in navigation, use the methods described in the following paragraphs to navigate to the target area.

(a) Leap Frog Method. The leap frog method of navigation is by far the most effective way to find the target. Leap frogging consists of picking easily identifiable points that are oriented generally in the direction that you want to go, and then flying from one point to the next until reaching the target area. These points will probably not be in a straight line and could involve circuitous routing. Leap frogging insures that you go from one known point to another, and it minimizes the possibility of getting lost. Do not merely head in the general direction of the target without a plan to get there and an idea of what you will see enroute. Unprepared dead reckoning often results in target overshoots and disorientation.

(b) Field of Vision/Double Field of Vision. To make leap frogging work, it is important that your next point be within your field of vision from the start point. Your field of vision is dependent on altitude, inflight visibility, terrain, and your visual acuity. Picking a point on the map with identifiable features that you can expect to see from your present position will minimize the use of dead reckoning. In some cases there may not be any prominent features within your field of vision. However, if you double your field of vision on the map and then can find a usable leap frog point, fly halfway there and attempt to locate the point. If you are unable to find it, turn around and go back to the last point or to where identifiable points exist. By using the double field of vision method, you increase your leap frogging ability while still not losing sight of the starting point.

(c) The Cardinal Reference System. There is another way to locate points when there are no significant landmarks in the area. It is called the Cardinal Reference System because it is based on flying North/South or East/West ground tracks into the target area. For example, plot the target coordinates on your map. Take your pencil and draw a North/South and an East/West line through the coordinates. Now, starting at the target, look along the lines you have drawn for the closest identifiable landmark (see Figure 5-1). Once you have a landmark on both the E/W and N/S lines, go to the furthest landmark, locate it on the ground, and fly from it toward the target (use ground track if able). When the landmark on the perpendicular reference passes through your wing tip, roll wings up and the target should be under you.

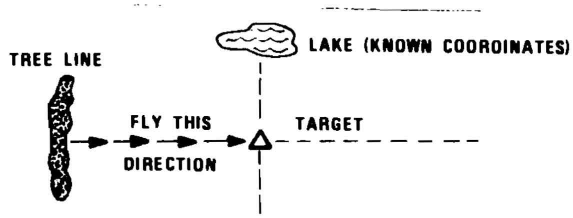


Figure 5-1

The Cardinal Reference System is also an excellent technique for determining the coordinates of a target found during visual reconnaissance. First, memorize the target area so you can find it again once you look away. Then, position yourself on either side of the point with a cardinal heading through the point. Look through the wing tip (better visibility than the nose) to see if you can locate, identify, and plot a prominent landmark. Repeat this process for the other cardinal heading through the point and you will have pinpointed the target coordinates in just a couple of minutes (Figure 5-2a). When there are no suitable landmarks within your field of vision, fly in a cardinal direction until you pass something, plot its coordinates, and then reverse heading back to the target area. Repeat this process on the other cardinal heading. The Cardinal Reference System has many variations. For example, if no suitable E/W or N/S references are available, other prominent landmarks can be used. Plot the heading from the landmark to target, and then fly that heading to target. When over the target, look off the wings to see if another landmark is available to fix your position (Figure 5-2b). Working in perpendicular references (nose and wings) minimizes errors. References at 10 or 11 o'clock are difficult to visualize and may cause 200+ meter errors.

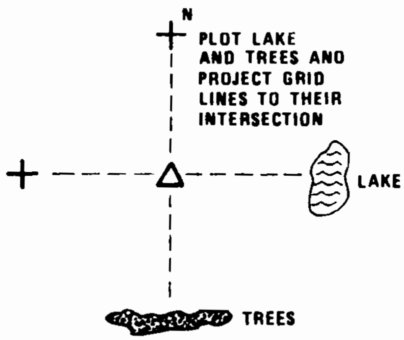


Figure 5-2a

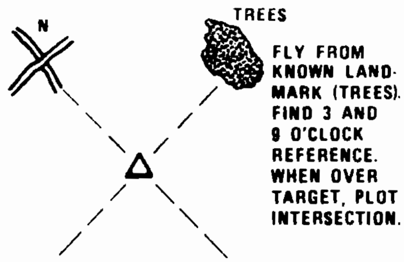


Figure 5-2b

The use of these techniques minimizes the time spent trying to triangulate with few available landmarks. They can also be used to quickly fly within 1000 meters or so of the target prior to the use of detailed map reading for pinpoint target location.

b. Night Navigation. The principles of night navigation are no different from those just discussed for day navigation. Checkpoints will differ, however, depending on lighting conditions. Under a full moon, most of the daylight references such as fields, roads, stream patterns, and towns will appear much as they do during the day. But on a dark night, they will seem to disappear, or at least only be recognizable using different clues. For example:

(1) Bodies of water will reflect light and normally appear lighter than the surrounding land. Man-made structures along the shore will often be illuminated, and the lights will be reflected in the water. Breaking surf, large streams, and canals can normally be spotted by their distinctive patterns; but small streams will not be visible.

(2) Straight stretches of main roads are usually visible at night. If illumination is not sufficient for you to see the roads themselves, the road patterns may be deduced from automobile headlights, ground lights, or towns.

(3) Airports, radio towers, and other specially illuminated objects become particularly noticeable at night.

5-5. Visual Reconnaissance. Once you have become proficient in the basics of navigation, the next step is to develop good techniques of visual reconnaissance (VR). In conducting VR, you are basically an intelligence collector who performs area surveillance and route reconnaissance.

a. Area Surveillance. By becoming extremely familiar with a specific area of responsibility, the FAC can detect changes produced by enemy activity. To take advantage of the element of surprise and minimize the threat of hostile fire, plan to use a surveillance pattern which will thoroughly cover the area and not present a predictable flight path. Look at suspected enemy activity areas first in order to give minimum warning of your approach. When you observe something of note, avoid circling the immediate area, as this is a dead giveaway of your interest.

b. Route Reconnaissance. You may be asked by ground forces to aid in selecting a route of advance. Look for signs of enemy activity, suitability of terrain, conditions of lines of communication, and locations of obstacles.

c. Use of Binoculars. Since ground fire may require high altitude VR, it is necessary to develop proficiency in the use of binoculars. Even at 1,500 or 2,000 feet the human eye cannot distinguish many details needed for proper VR. Trim the aircraft and be prepared to fly using only rudders. Make sure the binoculars are properly focused by testing them on the ground before the mission. Eye strain may be caused by improper parallax in the binoculars; Try another pair. Use of the glasses for relatively long periods (10-15 sec) rather than repeated short intervals will help you spot targets and obtain more accurate VR data.

d. What to look for. Essential Elements of Information (EEI) that you will be required to report are determined by the theater intelligence staff. EEIs usually consist of the following type data:

(1) Primary buildings/structures, description, size, and function.

(2) Types of defensive weapons observed, number, location, and accuracy.

(3) Vehicles, personnel, livestock, and construction.

(4) Power facilities.

(5) Security/concealment.

(6) Topography/obstacles.

(7) Moving targets - location, heading, and speed.

(8) Weather.

5-6. High Altitude NAV/VR Techniques. Survival in a low threat environment may require a VR altitude of 10,000 feet or more. Use of binoculars at this altitude will be mandatory for accurate observation of ground targets. Navigation using the 1:250,000 map becomes necessary due to the wide field of view available. All of the techniques that you have learned can be applied to high altitude NAV and VR. Remember, maneuvering and altitude are the FAC's best defenses in a low threat environment.

5-7. Low Altitude NAV/VR Techniques.

a. General. Low altitude navigation may be employed in either a high or a low threat area. It can be used to provide surprise for the air strike or protection for the FAC. The two types of low level missions are preplanned and immediate.

b. Planning. The most critical factor in a successful low level navigation mission is pre-flight planning. Most inflight problems (restricted visibility, unknown winds, turbulence, limited nav aids, and map limitations) can be minimized by thorough mission preparation, including map study of specific target areas. When possible, plot the courses to be flown, number turn points, and mark the time or distance increments. The best method for low level navigation is to continuously update the aircraft's position through constant map reading.

c. Route Selection. Tactical navigation between friendly areas of operation and unfriendly or contested areas should be planned utilizing a route which affords secure areas in the event of an emergency. Intelligence personnel should be consulted to determine the threat along the route. Roads, railroads, and rivers make excellent low altitude navigational aids; but they also are used by the enemy, so plan to cross them at right angles whenever possible. Never fly along or circle over such lines of communication. Radio aids may be used to cross check your position, but their reliability at low altitudes is marginal. Because route selection in hostile territory requires detailed planning and close study of the terrain, the following factors must be considered when planning the flight:

(1) Troop concentrations, radar detection capability, population centers, and AAA defenses.

(2) Terrain masking capability.

(3) Sufficient course changes to avoid disclosure of the objective.

d. Initial Point (IP) Selection. The most important check point is the IP for your run into the target area. It should be selected with care to insure ease of identification. A prominent feature that will be easy to locate while flying low level should be used. The selection of the IP must remain flexible. Do not hesitate to use a zigzag or terrain following course as the final leg to the IP if this course will provide effective navigational aids.

e. Map Preparation. Symbols, markings, and information placed on the map should be neat and legible. Exercise caution to insure that a prominent terrain feature is not hidden or obliterated by annotations. One method of map preparation is given below:

(1) After carefully selecting the best route, check points, and turn points, mark them on the map(s).

(2) All check points and turn points should be numbered consecutively from point of departure to destination.

(3) Targets, initial points, landing zones, and drop zones affecting the mission should be labeled.

(4) Timing marks should be placed on the map by annotating the desired TOT (if required) first, and then working backward to the starting point. Two minute markers should be used on the 1:250,000 map, and one minute markers should be used on the 1:50,000 map.

(5) Additional information that may be placed on the chart for each leg of the route include: Heading, time, height of highest obstacle, and total elapsed time from low level start point.

(6) Minimum obstacle clearance areas should be hatched or color shaded onto the maps.

f. Inflight Procedures and Techniques.

(1) Attention should be divided between keeping the aircraft on the required parameters, monitoring position, cross checking aircraft systems, and clearing.

(2) Flying the route may be accomplished by treating each leg as a separate navigation problem and utilizing the following procedures:

(a) Determine the heading and altitude for the next leg before reaching the turn point.

(b) Monitor the time over the check point. If the check point cannot be found, turn to the next heading on time.

(c) Note or record the time in relation to the flight plan in minutes and seconds ahead or behind schedule.

(d) Compute a new airspeed to correct for time differences over one minute.

(e) Determine the ETA to the next check point.

(3) Unknown Position. If you become disoriented:

(a) Climb to the Emergency Safe Altitude (ESA) for the leg. The climb will be made on course or toward a known area (as terrain obstacles permit), and will continue until ESA is reached or a positive fix is obtained. While higher altitudes increase the field of vision, they also make the aircraft more susceptible to enemy detection and ground fire. You should descend as soon as your position is fixed.

(b) After establishing a fix by locating an outside reference on the map, intersect the next check point and cross-check the route timing, making any adjustments required.

5-8. Common Errors in Navigation. A FAC who cannot accurately navigate is not only of limited value, but can also be dangerous to those who have to work with him. The goals in learning to navigate are to quickly arrive in the target area and effectively mark the target for the fighters. Several common errors can hinder you in performing these tasks:

a. Failure to use all available references to insure you have the correct target. Be sure that the "big picture" as well as surrounding features confirm that you have the correct point.

b. Selecting check points too far apart. Choose the closest feature or landmark that meets your needs.

c. Overflying check points because you have underestimated the aircraft's speed. This is especially likely to happen during early missions with the 1:50,000 and 1:24,000 maps.

d. Flying too close to or too far away from the planned route.

e. Excessive altitude changes. Make sure the aircraft is trimmed and do not make "unconscious" power changes without retrimming. Slight amounts of altitude variation are expected.

CHAPTER 6

ORDNANCE DELIVERY

6-1. Introduction. This phase of training will acquaint you with the ordnance delivery capabilities of the BRONCO. Your first rides, which will be on the controlled range, are intended to teach you to deliver ordnance accurately and safely. Additional rides on the tactical ranges will allow simulation of combat conditions to include controlling actual fighters. To do this effectively requires knowledge of the characteristics of the weapons and of the operation of the sight and the aircraft. Be familiar with the contents of this chapter, the applicable portions of the flight manual, the Dash 34 Weapons Manual, and all range procedures and restrictions prior to your first ordnance delivery mission. Be sure to read the applicable sections of TACR 55-210; it contains information not included here.

6-2. Ground Operations.

a. Preflight and General Description. Preflight the ordnance with the Dash 34 checklist. On the mission briefing card, write what ordnance is loaded on which stations. Do not write the ordnance loads under the Station Select Switches in the cockpit.

(1) Suspension and Release Systems. All armament station pylons contain Aero 65 bomb racks. The rack in the sponson stations (1,2,4,5) provide 14 inch suspension capability for stores weighing up to 600 pounds. The center station (3) is equipped with Aero 1A adapters, providing an alternate 30 inch suspension capability. The centerline station will accept a single store weighing up to 1200 pounds at design "G" loading. Most conventional weapons are loaded directly onto these racks.

(2) Bomb Racks. The AF/B37K-1 practice bomb container can carry four bombs or flares, and it releases in the order of right rear, left rear, left front, right front. In addition to the Dash 34 preflight items, check the security of the bomb lugs and sway braces.

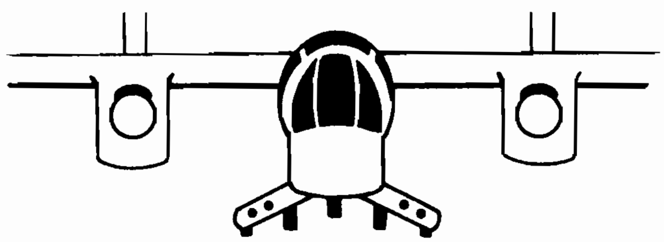


Figure 6-1

(3) Sponson Guns. Two M-60 7.62 MM machine guns are installed in each sponson. Their rate of fire is 550 RPM, and they are normally loaded with 25 rounds per gun. To prolong barrel life, it is recommended that you do not exceed a 125 round burst (14 seconds) per gun. Preflight the guns using the Dash 34 checklist.

(4) Rocket Launchers. The LAU-68 rocket launcher will be loaded with inert rockets for scorable range missions and white phosphorus rockets for tactical range missions. The two different warheads that are availalbe (MK-1 and MK-151) require slightly different mil settings. Check for the type that is loaded on your aircraft during preflight. When the launcher receives a firing signal, it will step and fire from the tube numerically following the tube that the station selector was set on when the firing signals was initiated. Preflight the launcher using the Dash 34 checklist.

b. Ground Operations. Pre-start, and post-start procedures are the same as those used in formation. Prior to arming, be sure to set the brakes, recheck all armament switches OFF, and set the power levers to Ground Start. When the arming crew approaches the aircraft, go HOT MIKE, make an intercom check, keep your hands visible, and maintain a continuous watch of the arming crew chief. Should he signal for engine shutdown, feather both propellers immediately.

6-3. Switch Settings.

a. General. Never mechanically set a switch. Refer to the mission data card and think about what you are doing. Make a habit of changing sight and switch settings only on downwind. Prior to setting the switches for any delivery, check to insure that all switches are OFF and SAFE. Remember that the Master Arm Switch must be ON for normal release of all ordnance. The trigger fires only the M-60s. All other ordnance is released by use of the pickle button. Note the position of the pickle button on the control stick grip. It may be located in a position different from what you have been accustomed to.

b. Bombs. First set the appropriate stations to drop, then select arm-nose and tail. In the event of an inadvertent release when the station select switch is placed in drop, this sequence will insure that the bomb is dropped safe.

c. Rockets. Set the appropriate station to fire.

d. Strafe. Place the gun fire switch to ready. When pointed at the target, turn the Master Arm Switch ON and squeeze the trigger. This will close the bolts and charge the gun. Turn the Master Arm Switch OFF. Charging takes approximately three seconds. The guns are ready to fire once the Master Arm Switch is repositioned to ON.

6-4. Optical Sight.

a. General. The OV-10 sight is illuminated and non-computing, with available depression up to 270 mils. The recicle consists of a 2 mil pipper with quarter markings at 12, 3, 6, and 9 o'clock, forming 50 mil and 100 mil circles (see Figure 6-2). Directly above the sight is the depression lever with the associated indicator marked with graduations in mils times ten.

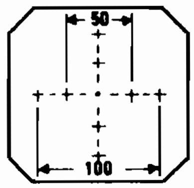


Figure 6-2.

b. Operation. The sight is turned ON by turning the reticle brightness knob out of the OFF detent after placing the filament select switch down to the number 1 position. The filament bulb is suspended from the bottom of the sight in a rectangular box with an easily removable cover for bulb replacement. If filament #1 has burned out, decrease intensity prior to selecting filament #2. A polaroid lens hinged behind the sight can be flipped up to screen out sunlight for a sharper view of the reticle.

c. Sight Check. The sight can be checked to see if it is depressing properly by turning it ON and setting in zero mils. Look through the bottom 50 mil marker and note where it rests in relation to something in front of the aircraft. Set in 50 mils and the pipper should now be depressed to the 50 mil reference point. Return the setting to zero mils, and you should have the sight on the original position. This check should be accomplished after starting #1 engine and before starting #2 in order to give line personnel access to the cockpit from the right side if any repairs or adjustments are needed. If aux power is available, the sight check can be accomplished prior to engine start.

6-5. Scorable Range Procedures.

a. General. After rejoin, check the aircraft in front of you to insure that no ordnance has fallen off. Formation and entry onto the range will be as briefed. Lead will normally put the flight in echelon prior to initial and will break abeam the range tower. Do not overfly the main range tower or any occupied flank towers. Spacing will be five seconds or as briefed. The normal sequence of events is: dive bombing, rockets, low angle bombing, and strafing. Radio calls will be made turning base, rolling in, and if you are off dry. Make a habit of checking cockpit instrument indications and station select switches each time you are on downwind. Monitor your internal fuel. In combat, rapid fuel depletion may be the only indication of a hit in the fuel tanks.

b. Arming. The Master Arm Switch will be turned ON only when the nose of the aircraft is below the horizon, pointed toward the target area, and the preceding aircraft is clear. It will be turned off during recovery as the nose of the aircraft comes up to the horizon.

c. Runaway Guns. If you have runaway guns, keep the aircraft pointed down range at an uninhabited area until the guns stop firing. Do not allow the aircraft to go below safe delivery altitudes. Follow the instructions in TACR 55-210.

6-6. Range Departure and Recovery. When strafe is accomplished as the final event, the last pass will be dry. Switches will be positioned to OFF/SAFE prior to initiating the final pass. Pull the trigger when pointed at the target to insure the guns are safe. After pull-off, lead will call, "All switches OFF or SAFE, ____ lbs fuel remaining." All other aircraft in the flight will make a similar call. The rejoin will be as briefed. As the last aircraft joins the flight, the pilot will examine the other formation aircraft to check for hung or unexpended ordnance. The last flight member will then join and stack slightly high so that lead can check his aircraft. Recovery will be as briefed.

6-7. After Landing and Dearming. Aircraft intending to dearm will take the first available slot closest to the runway. Set the parking brake, recheck the armament switches OFF, go HOT MIKE, and show your hands prior to allowing the dearming crew under the airplane. In the event of a jammed gun, the arming crew chief will signal for engine shut down of the engine closest to the machine guns so the jam can be cleared. The engine will be re-started on the crew chief's signal. Ensure a fire bottle is in place.

6-8. Basic Theory.

a. Ballistics. Before you can accurately strike the target, you must know where to place the aircraft in space so that the path of the ordnance will be as desired. This path is predominantly determined by gravity, propellant forces, and aircraft movement.

(1) Gravity. Gravity is a constant and measurable force that imparts a curved flight path to any projectile leaving the aircraft.

(2) Propellant Forces. The amount of propellant force determines the velocity of the projectile relative to the vehicle from which it is released. With the gun, the exploding propellant imparts a speed of 2750 feet per second to the bullets as they leave the barrel. The 2.75 inch rockets accelerate to 2600 feet per second while the rocket motor is burning. These propellant forces also impart a direction to the projectile which is dependent on where the gun or rocket is pointed when fired.

(3) Aircraft Movement. The ordnance will have a velocity and direction prior to release which is equivalent to the flight path of the aircraft. Once released, the ordnance will travel a path determined by a combination of aircraft movement, propellant and gravity forces, and air resistance. If the ordnance is pointed away from the aircraft's flight path at release, such as in uncoordinated flight, the actual path of the ordnance will be somewhere between the fuselage reference line and the aircraft's flight path. The greater the propellant force, the more the projectile's path will favor the fuselage reference line. Knowing the velocity and direction of the aircraft, the acceleration force and direction of the ordnance, the force of gravity, the effects of air resistance, and the dive angle, we can mathematically predict the ordnance impact point when release is at a given slant range.

b. Aerodynamics. Since we want to have our sight on the target at the time of release, we must depress the sight below the flight path so that it indicates where the ordnance will hit under a given set of conditions. The amount the sight is depressed is called the depression angle, and it is measured in mils.

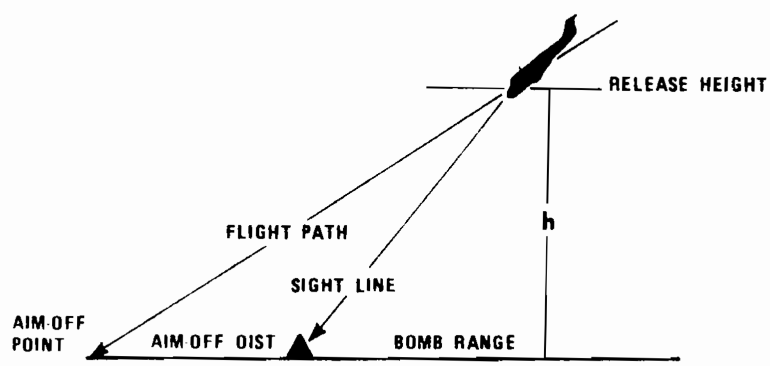


Figure 6-3

Figure 6-3 depicts the picture at ordnance release. In discussing procedures leading up to this point, let us follow a typical high angle release. For the purpose of discussion, we will assume that the aircraft is at the proper dive angle, accelerating to the proper airspeed, and that winds are not a factor. Your main concern is tracking. With the aircraft in a dive, the pipper will appear to move forward across the ground directly along the track of the aircraft. The sight can be compared to a spotlight attached to the nose of the aircraft. As long as the mil setting remains constant, the sight (or spotlight) will be pointed downward from the aircraft at the same angle. As the aircraft flies along a dive angle toward the target, the sight picture (pipper) moves forward and closer to the target. (Figure 6-4)

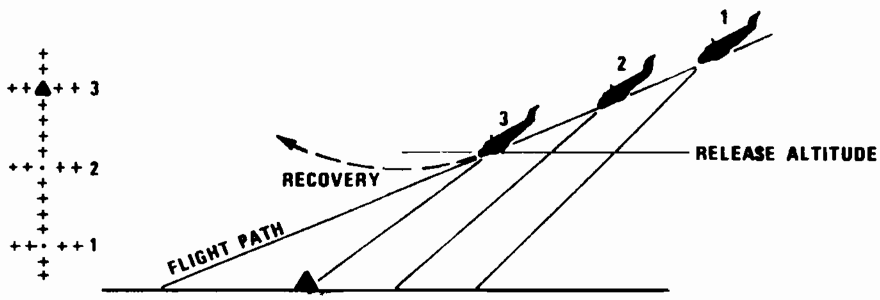


Figure 6-4

On a perfect pass, the pipper should arrive at the target at release altitude.

c. Wind Correction.

(1) General. The presence of wind greatly increases the complexity of the ordnance delivery problem. The simplest method to use in compensating for wind drift is to compute the amount of projectile drift using the Dash 34 crosswind factor, and then shift the release aimpoint (RAP) that many feet from the target into the wind. The pipper should be on the wind correct RAP at release. For example, assume a run-in heading of 235 degrees and an airmass wind of 360 degrees at 10 knots.

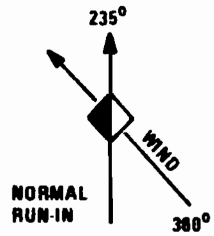


Figure 6-5

The upwind release aimpoint (RAP) is at 4 o'clock to the target. Using a wind correction factor of 11 ft per knot, you must offset a distance of 110 feet (wind velocity 10 knots). The RAP with this wind is 4 o'clock for 110 feet.

(2) Wind Correction Techniques. The two methods of wind correction used to place the pipper at the proper RAP are the Fully Drifting and Crab methods. The Fully Drifting method involves having the aircraft heading parallel to the desired run-in line. Release is made with the aircraft fuselage pointed at the RAP and parallel to the run-in line. This causes the ordnance track to pass through the target at an angle to the run-in line. Ordnance release occurs at a point upwind of the target. The Crab method involves having the aircraft ground track parallel to the run-in line. The crosswind effect is cancelled by the aircraft heading; thus, at release, the fuselage and pipper are pointed upwind at the RAP. The aircraft's ground track and ordnance track pass essentially through the target. Either the Crab or the Fully Drifting methods may be used when there is a crosswind component as they both accomplish the same goal: To orient the ordnance track through the target at release.

(a) Fully Drifting Method. Arrival at the proper RAP during a pass using the Fully Drifting method requires planning and adjustments on base leg. Roll-in should be planned so that roll-out, with a heading parallel to the run-in line, is displaced upwind of the run-in line. As a rule of thumb, the pipper at roll-out should be offset short of the RAP and upwind 2-3 times the correction built into the RAP. For example, if the RAP has been calculated to be 150 feet at nine o'clock, the pipper should initially be 300-450 feet left of the run-in line. This correction will allow for the drift of the aircraft from roll-out through release. While on final, monitor the movement of the pipper to ensure that it moves up to the RAP at release. It may be necessary to make corrections for tracking errors or wind shifts by changing your heading and using bank and "G" forces while on final. Because the Fully Drifting method requires a heading parallel to but upwind of the normal run-in line, the initial aim-off point (AOP) will also be upwind of the RAP, and it will drift downwind during the pass. The key here is to establish the AOP, insure that the dive angle remains correct, and then maintain or adjust your heading to insure proper pipper drift.

The Fully Drifting method is preferred for high angle deliveries. However, if you can accurately determine the ground track (for example low dive angles/altitudes), the Crab method is a simpler way to compensate for the winds.

(b) Crab Method. This method requires that your heading be offset into the wind sufficiently to stabilize the ground track. All of the reference points used during the pass will be identical to those used in the Fully Drifting method, except the AOP will not drift left or right because the aircraft heading adjustments cancel the crosswind effect.

(3) Wind Factor. The winds to use in computing the RAP are those existing above release altitude. Wind drift on the aircraft is not an instantaneous phenomenon, but a time delayed force. The delay in the application of the wind's full force can take up to 500 feet in a 30 degree pass. Therefore, use a combination of the winds at and above the precomputed release altitude to determine the proper crosswind correction factor.

6-9. Specific Ordnance Deliveries. (See the appendix for examples of typical patterns.) In applying the general principles to specific ordnance deliveries, our discussion will be directed to high angle bombs, rockets, low angle bombs, and strafe.

a. High Angle Bombing. (See Appendix A-4) A dive angle of 30 degrees or more is used for high angle bombing. Of all the release parameters, proper dive angle is probably the most difficult one to achieve. A difference of five degrees in dive angle is difficult to judge and can result in an error of 100 feet in bomb impact.

(1) Downwind. On downwind leg insure that all switches are safe, then set the proper mils and place the armament switches as desired. The following procedure will be followed to insure that the proper switches are selected:

(a) On the station mode select panel, select the station with bombs and place the switch down to the drop position.

(b) Place the bomb-flare switch up to the NOSE & TAIL position.

(c) Do not place the Master Arm ON until on final with the nose of the aircraft pointed at the target and the aircraft ahead clear.

(d) Once the switches are set, the pickle button will release a bomb each time it is depressed. Remember, the bomb button is NOT THE NOSE WHEEL STEERING BUTTON.

(2) Base. The base leg begins the delivery pass. Insure that the power levers are set to about 1200# torque in order to maintain an airspeed of 140 knots. Remember, mismatched torque settings may induce yaw in the delivery. Then check for base leg placement. On a no wind day, the base leg should be spaced as shown in Figure 6-6 for a typical 45 degree pass.

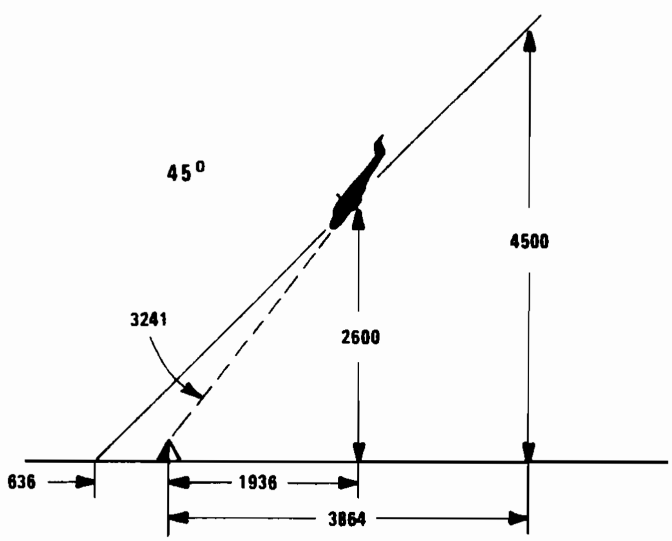


Figure 6-6

(3) Final. The base to final turn is the pivot point of the entire pass. Executed properly, it will help you obtain proper tracking on final and pipper placement at release. Visualize the initial pipper placement. On a no-wind day it will be 6 o'clock to the target. The end result of the final turn is to align the aircraft directly parallel to or over the run-in line with the nose at 12 o'clock to the target. As you roll in, call the range officer for clearance. The roll-in is accomplished with reference to the nose of the aircraft, not the pipper. Due to depression, the sight will swing excessively during turns. This is known as pendulum effect (Figure 6-7). Use the sight only when wings level on final.

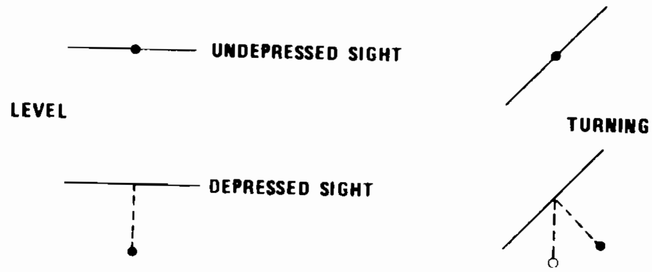


Figure 6-7

Once on final, the pipper should drift toward the release aim point (RAP) as airspeed increases. Total tracking time should be 5 to 6 seconds. Monitor the pipper movement, altitude, and airspeed while descending on final. At the precomputed release altitude depress the pickle button.

(4) Recovery. The pull-off after release is just as important as any other step in the delivery pass. As soon as the bomb is released, begin a 4 "G" wings level pull to avoid descending below the minimum altitude. As the nose of the aircraft comes toward the horizon, turn the Master Arm Switch OFF (after each release). As the nose of the aircraft comes above the horizon, look for the aircraft immediately ahead in the flight and initiate a turn, adding power to climb back to downwind leg.

CAUTION

Adding power prior to bringing the aircraft nose to the horizon could possibly over-torque the engines.

b. Rockets. (See Appendix A-1, A-2, and A-3) The target used for rockets on the scorable range is the same as that used for bombing. Safe all switches on downwind and begin as in dive bomb by setting the proper mils. Then move the appropriate station select switch up to FIRE. Place the Master Arm switch to ARM when the nose of the aircraft is pointed in the general direction of the target and the aircraft in front of you is clear. Base leg, final, and recovery techniques are identical to those used in bombing with a few exceptions:

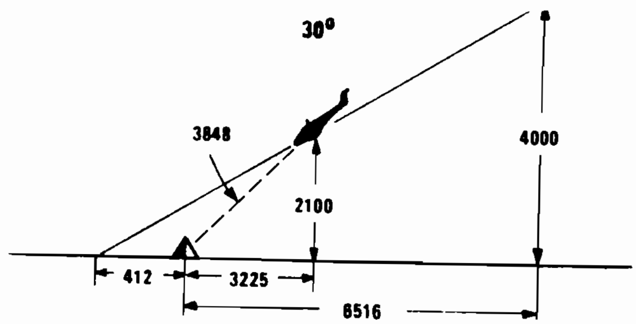


Figure 6-8

(1) Wind offsets are only 1/3 as much as those used in dive bomb.

(2) The main concerns are where the rocket is pointed and what the "G" loading is at release. If the pipper arrives at the release aimpoint within 200 - 300 feet of the release altitude, do not attempt to hold the pipper on the target through negative "G" waiting for the release altitude. Firing slightly high will not cause a large error; but bunting the aircraft will. So meet the parameters as closely as possible, and a good sight picture should still produce a good rocket score. (See Figure 6-8) for a typical Pass).

(3) Recovery. As soon as the rocket is fired, begin a 4 "G" wings level pull to avoid descending below the minimum altitude. As the nose of the aircraft comes toward the horizon. Turn the Master Arm Switch OFF (after each release). As the nose of the aircraft comes above the horizon, look for the aircraft immediately ahead in the flight and initial a turn, adding power to climb back to downwind leg.

CAUTION

Adding power prior to bringing the aircraft nose to the horizon could possibly over-torque the engine.

c. Low Angle Bomb. (See Appendix A-5) Low angle bombing is more challenging because it is difficult to accurately obtain a 10 degree or 20 degree dive angle. Also, an error in dive angle will cause larger miss distances since a mil subtends a larger distance at lower dive angles. The disadvantages of low angle bombing include difficulty of target acquisition, exposure to enemy fire, and possible flight through the bomb frag pattern. During training, you will use the same target for low angle bombing that was used for high angle bombing and rockets. By flying either a 10 or 20 degree pattern, you will be simulating a MK-82 Low Drag delivery.

(1) Downwind. Safe all switches and then set the switches and power the same as for dive bomb. Do not forget to change the mil setting. Figure 6-9 depicts a typical low angle bomb pass.

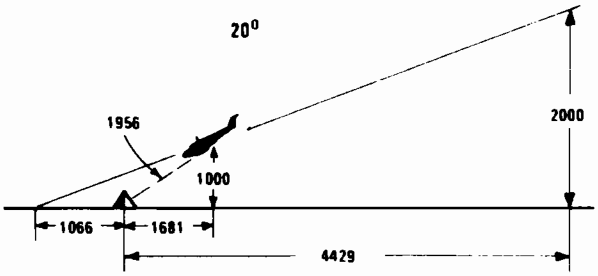


Figure 6-9

(2) Final. The turn to final should be essentially level in order to obtain the proper aim-off distance. Tracking on final is normally done using the Fully Crabbed method. The pipper should track toward the target or RAP.

(3) Recovery. Initiate your recovery with a straight ahead climb, turning the Master Arm OFF and climbing to downwind as described in the section on dive bombing.

d. Strafe. (See Appendix A-6) Strafe should be employed in a low altitude release to be most effective because 7.62 MM bullets will not penetrate heavy protective cover. The strafe target is normally a fighter drag chute. The foul line is 2000' in front of the target and is perpendicular to the run-in line. Normally the aircraft's left guns will be loaded with 50 rounds (25 rounds each gun), and qualification is in accordance with TACR 55-210.

(1) Downwind. While on downwind, safe all switches, set the computed mil setting, and place the appropriate gun switch to the READY position. The Master Arm may be placed ON when the nose of the aircraft is pointed at the target and the preceding aircraft is clear of the line of fire. From downwind to final the pattern parameters are identical to those used in the low angle bomb pattern.

(2) Final. The final approach is flown with a minimum dive angle of five degrees. Align the aircraft on final with the top 25 mil marker approximately on the target.

(a) Charging the Gun. The first strafe pass is a "charging" pass. The pipper should reach the target as the aircraft approaches the foul line. Just prior to reaching the foul line, place the pipper on the target, relax stick pressure to allow the pipper to remain on the target momentarily, and squeeze and release the trigger. On the charging pass you will feel the gun bolts come forward with a "thunk". Once the guns are charged and the Master Arm is turned OFF for three seconds or longer, the guns will fire when the Master Arm is again turned ON and the trigger is squeezed.

(b) Firing Pass. On the first firing pass, fire a short sighter burst of approximately 1/2 second duration to get an idea of how closely the guns are aligned with the pipper. If the guns are not properly aligned, pipper placement will have to be adjusted. Most pilots use either neutral elevator trim or 1-2 degree nose down for firing. Which method you use depends on whether you wish to add pressure to the stick during firing in order to hold the pipper on the target, or whether you find it more comfortable to just relax pressure to accomplish the same objective. Use of the yaw damper is also a matter of personal taste. While on downwind, turn the yaw damper ON. If the sight remains steady, the damper should be good. With the damper ON, the rudder pedals will be much stiffer, but most of the little bobbles caused by turbulence will be dampened out. On the other hand, the rudder pedals are more sensitive and are capable of delivering quicker corrections with the damper OFF. Similar to rockets, 7.62 MM ammunition has the advantage of propellant force. The guns fire primarily in the direction in which the nose of the aircraft is pointed. Use rudder and aileron to fly the pipper to the target. Avoid holding the pipper with heavy inputs of rudder and bank while firing.

(c) Wind Correction. There are two basic methods for crosswind correction: The Crab and the Wing Low methods. For the Crab method you must angle into the wind in order to fly a track straight to the target. As the foul line is approached, it may become necessary to reduce the crab slightly and allow the pipper to drift over the target. The Wing Low method is identical to the crosswind landing technique. The aircraft is banked into the wind and the fuselage is aligned straight ahead by using opposite rudder. The aircraft track is identical to a no wind condition.

(d) Recovery. Recovery from a strafe pass is very important. 7.62 MM bullets are light and ricochet easily. Do not fire past the foul line, and begin a firm, positive climb straight ahead as soon as the firing pass is completed. As in all other events, turn the Master Arm OFF when the nose approaches the horizon.

(5) Error Analysis (STRAFE ONLY). Strafe has some peculiarities which will be discussed here rather than in the following section on error analysis.

(a) Improperly boresighted guns can cause the bullets to miss the target although firing parameters have been met.

(b) When you shoot, there should be a grouping of bullets through the target rather than a long string running up to the target. Not holding the pipper on the target while firing will cause the bullets to "walk" through the target.

(c) If you are firing too far from the target, the bullets will impact short due to gravity drop. If you fire consistently over the target, your dive angle is too shallow (if you are firing in the vicinity of the foul line).

6-10. Error Analysis. For all events it is important to understand what errors can be made and how each affects the impact point of the ordnance. Six areas will be covered in our discussion of error analysis: dive angle, altitude, airspeed, "G" loading, failure to maintain coordinated flight, and releasing in a bank.

a. Dive Angle. If release is accomplished at a steeper than desired dive angle, a long impact will result. This is caused by a reduction in the angle of attack, resulting in more effective sight depression. The pipper will arrive at the target later than planned. Even if effective depression remains the same, releasing at the preplanned altitude with a steeper than planned dive angle will result in reduced slant and horizontal range, causing a long impact. The reverse is true in a shallow dive: Depression is effectively decreased, an early sight picture is received, and a short impact results (see Figure 6-10).

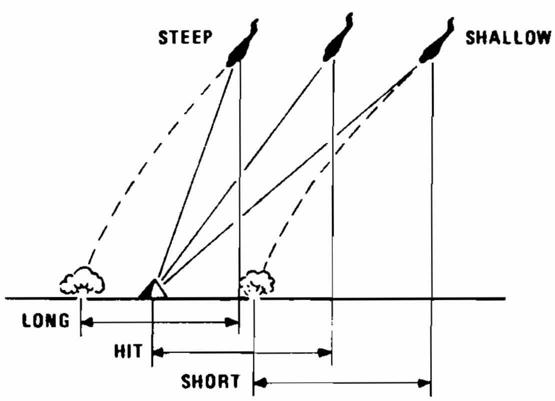


Figure 6-10

The extent of the long or short error due to improper dive angle varies with the event and the number of degrees deviation from the preplanned dive angle. Below are some examples of errors due to dive angle:

Event	Deviation	Result
Dive Bomb	5^{0} shallow	100 ft short
	5^{0} steep	78 ft long
Low angle bomb	1^{0} shallow	81 ft short
	1^{0} steep	39 ft long
Rockets	5^{0} shallow	5 ft short
	5^{0} steep	5 ft short

b. Altitude. Ordnance release at lower than the preplanned altitude will result in a long impact because the slant and horizontal ranges will be reduced by a greater amount than the bomb range is reduced. The reverse is true for releasing higher than planned (Figure 6-11).

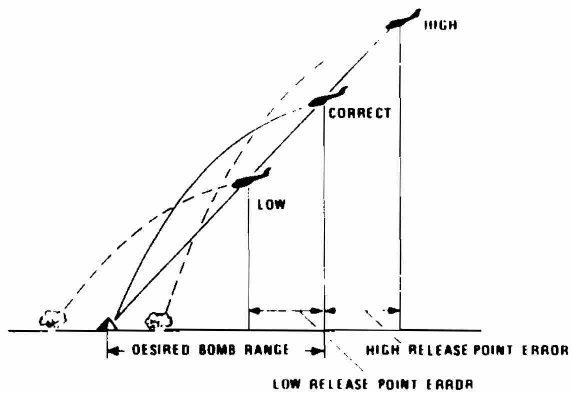


Figure 6-11

Below are some examples of errors due to improper release altitude

Event	Deviation	Result
Dive bomb	200 ft low	32 ft long
	200 ft high	42 ft short
Low angle bomb	100 ft low	52 ft long
	100 ft high	54 ft short
Rockets	200 ft low	8 ft long
	200 ft high	8 ft short

c. Airspeed. Since sight depression remains constant, an increase in airspeed will decrease angle of attack, increase effective depression, and cause a long bomb. An increase in airspeed also decreases the time of flight and thereby reduces the effect of gravity. The converse is true for a decrease in airspeed (Figure 6-12).

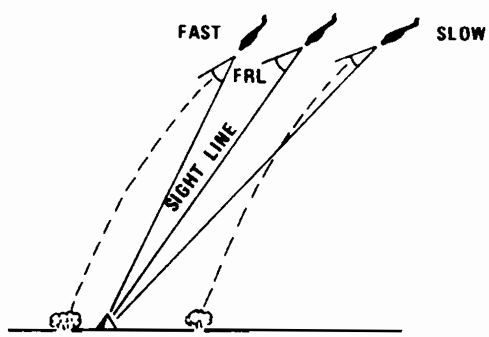


Figure 6-12

d. "G" Loading. Ballistics tables are based on a release "G" force equal to the cosine of the dive angle. Increased "G" increases the angle of attack, decreases effective depression, and causes the bomb to be released at greater slant and horizontal range, thus resulting in a short impact. Decreased "G" works conversely. In addition to changing the angle of attack, holding a bunt or increased "G" forces for any length of time can significantly change the dive angle. This in turn affects required sight depression.

e. Failure to maintain coordinated flight. Releasing in a skid causes a miss in the direction of the skid: Skid left - ball left - miss left. Skidding can be caused by improper trim or by the application of rudder during tracking. This can be a problem, especially in high angle events, where the pilot unconsciously applies rudder in an attempt to move the sight laterally to the target.

f. Releasing in a bank. If release is made in a bank with the pipper on the target, the bank, through pendulum effect, will reduce the effective sight depression. This will result in a short impact and a lateral error in the direction of bank (Figure 6-13).

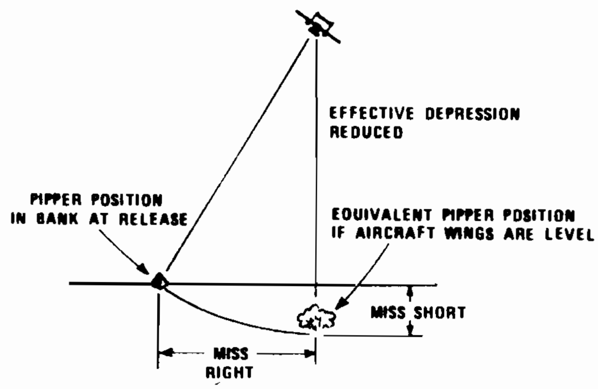


Figure 6-13

The magnitude of the short error increases as the bank angle increases, but will be relatively small for bank angles of 15 degrees or less. The opposite effect is noted for lateral error (in the direction of bank) which increases rapidly with bank and reaches a maximum error near 60 degrees of bank.

g. Summary. These errors and their effects must be thoroughly understood by a pilot prior to flying a ground attack mission. When all of the parameters have not been met, timely error analysis and last minute corrections can considerably improve accuracy. For example, rather than accepting the error generated by a steep dive angle, you can pickle a little early and create an offsetting error. Corrections of this nature can often mean the difference between an acceptable and an unacceptable score.

6-11. Tactical Deliveries.

a. General. The tactical rocket deliveries that can be employed by the FAC are the high and low altitude stand off marks and the loft rocket. The purpose of each is to provide increased survivability for the FAC. The high altitude stand off delivery will greatly increase the slant range between you and the target, while the low altitude and loft deliveries provide both terrain masking and increased slant range. Each of these deliveries will be discussed in this section, but a discussion of the integration of these deliveries with fighter and FAC tactics must be left to classified briefings and texts.

b. High Altitude Stand Off Rockets. When practicing high altitude stand off deliveries on the scorable range, you must:

(1) Decide what delivery parameters to use (dive angle, airspeed, etc.).

(2) Determine the horizontal range required to place you in the proper position to use these parameters.

(3) Study the range map for landmarks to use in positioning yourself at the proper horizontal range for release.

A typical pattern might be flown at 10,000 feet AGL and 140 knots. From this position you could roll into a 30° pass, release at 9,000 feet and 200 knots, and have 15,231 feet slant range between you and the target. The purpose of releasing only 1000 feet below roll-in altitude is to avoid excessive tracking time. Tracking time creates a predictable flight path and helps solve the gunners' tracking problem. While flying on the scorable range, refer to your heading instruments for pattern parameters as the visual cues normally provided by the conventional range layout might not be available. Firing in a 30° dive from 9,000 feet provides excellent slant range for light to medium non-radar AAA avoidance; but the use of this tactic in a SAM environment might place you in greater jeopardy than if you operated within the range of the AAA. In most instances, use of high altitude stand off marking in a SAM environment is not recommended. Also, employing the high altitude stand off mark in a tactical situation makes exact mil settings useless. You will have to rely on the use of an average mil setting or the position of the target relative to the nose of the aircraft to estimate rocket range, and adjust your delivery for varying altitudes, airspeeds, and dive angles.

b. Low Altitude Stand Off Rockets. These deliveries are designed to place a mark in the target area while employing terrain masking for threat avoidance. They are practiced first on the scorable range and then on advanced ASC missions. Your attack might be planned to include a run in from an IP to a preplanned release point if orbiting at or near the release point is impractical. Planning for this attack should begin on the ground before the mission briefing. Once the target area is fixed, determine the delivery parameters you will use for the attack. Draw an arc around the target equal to the horizontal rocket range for the planned delivery. If you fire at the target from any point on this arc using the prescribed parameters, the rocket should hit the target. Once you have drawn the arc, recede to a prominent landmark or terrain feature that can be easily identified from low altitude. This will be the IP for the run in to the delivery point (edge of the arc). The IP should be selected close enough to the delivery point so that wind drift will not cause excessive variance from your preplanned run in. If you can select a prominent landmark over which to begin the delivery maneuver, it will make the run in easier. Fly from the IP until you reach the delivery landmark, and then begin the maneuver to place the aircraft at the desired delivery parameters. If no landmark is available, you must fly a predetermined time and airspeed. When the time expires, begin a maneuver to attain the predetermined firing parameters at the selected firing point on the arc. Needless to say, heading control and precise use of timing are essential for an accurate mark in unknown territory. If you cannot come close to the predetermined attack parameters, the mark will probably be of little use to the fighters. Once you fire, immediately break down and away from the attack heading in order to egress at minimum altitude. Attempt to determine the accuracy of the mark and issue corrections to the fighters if possible. The high threat overlay can be used to quickly figure run in headings, distances, and times. You should become proficient in its use before attempting to employ it on ASC and CMP missions.

c. Loft Deliveries. An additional stand off delivery that can be used is the loft rocket. The range of a rocket using this delivery is most directly affected by loft angle. Other factors such as release airspeed and altitude are not as critical as they are in conventional nose low deliveries. The two major planning factors required for an accurate loft delivery are geographic launch point location and launch azimuth accuracy. Historically, launch attitude (loft angle) has not been difficult to attain. However, at typical launch ranges, a five degree heading error can result in a 650 meter miss distance. However, if you can launch at the correct range and within two degrees of the desired heading, the mark will probably be a usable aid for target acquisition. When planning for a loft rocket delivery, an overlay or distance hack on your line up card will suffice for determining launch position (given launch parameters). Rotate the card around the target to find a geographic reference for launch. Measure the heading or find another reference between the geographic launch point and the target that can be used as an "aim point," or sight reference that the rocket should overfly. Align the aircraft on the proper heading and towards the geographic launch point. <u>Do not</u> make last minute jinks to try and fly directly over the launch point. Keep the correct heading and fire toward the "aim point" (if available) when abeam or over the geographic launch point. After launch, immediately initiate a recovery to avoid a low altitude power-on stall.

6-12. <u>Night Ground Attack</u>. The purpose of the night mission is to give you an opportunity to practice rocket delivery techniques under flares. A separate flareship will not be used since the OV-10s can carry rockets, flares, and logs. Some special considerations for night include:

a. Use of standard TACR 55-210 procedures.

b. Not turning the rotating beacon on until after the flight is armed, and turning it off prior to dearming. This will prevent the arming crew from becoming disoriented.

c. Completing the Before Takeoff check and turning on the landing light after arming. When the last aircraft in the flight is armed and his landing light is on, flight lead will call for a change to tower frequency.

d. Use of standard runway line up and takeoff spacing. As number two joins, lead will turn his rotating beacon OFF and dim his nav and formation lights. This will continue until the last aircraft joins. The last aircraft will leave his rotating beacon, nav and formation lights BRIGHT and ON.

e. Prebriefed flight break up and range entry. Once the flight has split up, turn the rotating beacon ON and the NAV and formation lights to BRIGHT.

f. Paying close attention to switch positions since you might be alternating ordnance deliveries. Although the positions of the armament panel are illiminated, the switches are not. Double check all switch setting. Be sure to position the bomb-flare arming switch to the nose/tail position. If you do not arm the flares and logs, they will drop safe.

g. Do not attempt last minute switch corrections. If you are set to fire a rocket and the aircraft ahead does not get flares off, do not attempt to change switches to drop flares if you are on base or final. This is a good way to drop a flare and fire a rocket at the same time.

h. Before nose low rockets can be delivered after sunset, you must have; At least one flare illuminating the target or two ground markers (log or smudge pots) in the target area.

i. Standard range exit. When the mission is complete. Perform an ordnance safety check and call "Switches Safe" and pounds of fuel remaining when requested by flight lead.

j. Use of standard dearming procedures. The rockets, flares, and logs are live ordnance and must be treated as such.

CHAPTER 7

FAC PROCEDURES AND TECHNIQUES

Section A

Introduction

7-1. General.

a. Overview. You are now entering your most challenging phase of training: airstrike control. Close air support tactics have evolved through experiences in World War I, II, Korea, and SEA. Target destruction/neutralization is the ultimate goal; but survivability of the strike force, location of friendly ground forces, weapon delivery accuracy, aircraft performance characteristics, and countless other factors determine the manner in which the strike is to be accomplished. Consequently, it is impractical to attempt to suggest definitive tactics and techniques for all target situations that a FAC might encounter. The information contained herein is not intended to be either restrictive or all inclusive. No one manual could address all the facets of the diversified nature of the FAC mission or the multiple roles he must perform. However, certain basic techniques have proved fundamental and usually apply in varying degrees to most tactical situations.

b. FAC Knowledge. The single most important aspect of any mission is the application of the FAC's knowledge and professionalism. To work effectively, a FAC must thoroughly understand his aircraft's capabilities and limitations, as well as the aircraft and ordnance capabilities of the fighters that he is controlling. The FAC must also understand the threat that he anticipates facing while controlling the airstrike. Whenever possible, thorough premission planning will help you to plan tactics to avoid flying into the threat envelope. As a FAC you must be thoroughly familiar with all aspects of the ground situation, including terrain and weather. Premission study of applicable 1:50,000 scale maps is not only desirable, but essential. In addition to being totally aware of the ground situation, the FAC must be intimately familiar with the TACS system if he is to be responsive to the ground units that he has been tasked to support.

c. FAC Responsibilities. The FAC controls the airstrike and is in command of the entire tactical air situation in his area of responsibility. This does not detract from the fighter flight lead's responsibilities or choice of tactics; but the ultimate command of the airstrike must come from the FAC. His task is to employ the fighters to gain maximum effectiveness without compromising safety or incurring unnecessary threat exposure. The FAC must maintain positive command and control at all times.

7-2. Communications. Due to the nature of the FAC's responsibilities, communications are a primary factor in all missions. Although the O-2/OV-10s at Patrick do not have the entire radio package found in most operational FAC aircraft, the IPs will attempt to simulate the radio traffic that you might encounter operationally. The management of five radios will probably be one of the largest problem areas that you will encounter when you begin "real world" operations. The possibility of comm-jamming in virtually every theater is also a factor that not only must be considered, but planned for. Therefore, the use of COMSEC measures is mandatory in most tactical situations in order to limit interception, jamming, and intrusion. One such example of COMSEC procedures is the use of an abort code word rather than a call such as "ABORT YOUR PASS," which could easily be transmitted by enemy forces.

Section B

Low/Medium Threat Close Air Support

7-3. General. This section will discuss the basic tactics and procedures used in low/medium threat close air support (CAS). Although each situation will require modification of these basic principles, they will remain fundamentally the same worldwide. Your effectiveness as a FAC depends not only on your flying proficiency, but also on your ability to adjust tactics to meet the fluid tactical situation.

7-4. Mission Planning.

a. Intelligence. Mission preparation begins with the FAC's background study of the area in which he will be working. This must include the ground situation and the specific disposition of both enemy and friendly forces. Intelligence will provide the latest situation updates plus known or suspected threats, evasion areas, proposed friendly operations, and suspected enemy actions. Intel may also ask you to check for Essential Elements of Information (EEI). Because of the speed and altitudes at which FAC aircraft fly, they are perhaps better equipped than most fighter aircraft to provide timely and accurate information to intelligence agencies.

b. Weather. Another area of mission planning is the evaluation of the effect that target weather can have on your mission. Clouds or reduced visibility can preclude successful mission accomplishment by delaying target identification, thus forfeiting the element of surprise, or increasing aircraft vulnerability if a second pass is required. Another important factor is the restriction to dive angles caused by low ceilings. This increase the possibility of flying through friendly frag patterns. The FAC may decide that the best course of action is to divert the fighters back to the ASOC if the target area weather leaves too much to chance.

c. Terrain. Coupled with the evaluation of target weather is an assessment of terrain features and how they may be used to your best advantage. Terrain features can have a significant bearing on the selection of delivery modes and release parameters. Terrain masking may be employed to inhibit SAM launch, preclude detection by early warning radar, or allow the achievement of tactical surprise. Significant terrain features such as rivers or geological irregularities are also valuable in helping establish the location of friendly and enemy forces.

d. Planning Factors. Normally you will know the type of fighters and their ordnance from the mission fragmentary order. You can often preplan a direction of attack and pull off by utilizing the forecast weather, terrain study, enemy threat, and ground unit disposition. Best and immediate bail out areas can usually be determined in advance, as well as the best recoevery base. You must also consider suspected or confirmed enemy ground fire to determine your best observation position, as well as the fighter run in heading. More specific emphasis will be given to this area later. Insure that you have current maps, overlays, CEOIs, and authentication tables. Premission study of available recce photos is invaluable. Often these photos will reveal ground features that are readily visible and that may be used to establish common references between the FAC and fighters. Additionally, you should preplan the route in and out of the target area, as well as fuel consumption and bingo levels, Although many aspects of the mission may change between premission planning and actual employment, advance planning and target area study will provide a more informed basis for decisions that have to be made in the air.

e. Mission Planning. Because of the absence of an intelligence shop, fragmentary order, and established ground order of battle at Patrick, it is essential that you discuss each mission with your instructor prior to flight, preferably the day before. You will also need to determine the range and fighters that you will utilize and plan for their integration. Telephonic contact must be made with fighters not flying out of Patrick. A face to face briefing with those staging from Patrick is required. Directly prior to the mission, the IP will provide a specific scenario briefing, threat information, and detailed mission data such as call signs of the ASOC, GCI, and ground units. It is your responsibility to devise comm jamming counter measures procedures and abort instructions if required. Your IP will brief you on the need for authentication and encription as well as some of methods used here to simulate these functions. Although not practiced here at Patrick. Actual authentication tables are used routinely throughout the operational FAC units.

7-5. <u>Mission Coordination</u>.

a. After Takeoff. Contact the ASOC after takeoff and give them your call sign and simulated mission number. The ASOC will then come back with fighter information, ground FAC call sign and frequency, last reported target weather, and any other pertinent information. Be prepared to authenticate all transmissions. At this point, perhaps it would be wise to point out that one of the FAC's best friends is a grease pencil and plenty of canopy to write on. By putting the information obtained from either the ASOC, CRC, Group FAC, or fighters on the canopy, it is readily available at a glance and allows you to keep your eyes out of the cockpit. Ensure that all classified data is erased prior to leaving aircraft. If you have to contact a simulated GCI site, give them your call sign, mission number, and the mission number of the fighters that you will be working with. You may also be asked to give your altitude and the point and altitude to which the fighters are to be vectored. Teh fighters will contact CRC for positive control to the designated rendezvous or contact point, where the FAC will assume control. CRC is primarily concerned with directing flights to and from the target area and advising of possible enemy air activity. Other facilities which may assist the FAC or fighters are the Control and Reporting Posts (CRP), Air Support Radar Teams (ASRT), AWACS, and ABCCC.

b. Ground Commander. The next contact you should make will be with the ground commander or ground FAC, using the frequency given by the ASOC. His information will be the most accurate and timely that is available, and should supersede all previous data on the ground situation. This contact will usually be on FM, and this means line of sight communication. Although FM provides excellent range over the flatlands of Florida, the terrain found in Europe, PACAF, and certain areas of the CONUS will severely limit its range. Additionally, low ingress altitudes will reduce FM capability; but you can help combat this by turning off the automatic squelch.

7-6. Specific Ground Commander Coordination. The inflight guide has an excellent ground commander coordination checklist, and some of its areas will be expanded below.

a. Friendly Location. Friendly location is perhaps the single most important piece of information that must be determined by the FAC and relayed to the fighters. Coordination for this information can begin on the ground through the GLO and ASOC. Initial contact with the ground commander or ground FAC will take place while enroute to the target area. Use the checklist in the inflight guide to begin coordination for the airstrike. The friendly location may be identified by a reference to a prominent landmark, through the use of smoke or mirrors, or by having the ground FAC talk you into the target. You must also determine what kind of protection the friendly forces have: whether they are dug in, in armored vehicles, or in the open. This is important because it alters the minimum safe separation distances for ordnance delivery. In many instances, the ground unit may have forward observers well in advance of the FEBA, perhaps even in enemy territory, who can provide accurate information on enemy force disposition. They may also be able to give ordnance corrections and BDA.

b. Total Situation. When contacting the ground forces for a situation update, ask not only for the current situation, but also for their short range tactical objectives. From your airborne platform, you may be able to view enemy activity and areas of concentration that are unknown to the ground forces commander. Since FAC coordination is not a one way street, provide any information to the ground commander that may affect his tactical situation. He should provide information on the location and activity of any known AAA and SAM defenses and results of previous strikes. Do not forget to consider the possibility of enemy counterair activity.

c. Artillery Capabilities. A basic understanding of artillery capabilities and operation is fundamental to conducting safe and effective joint operations. Artillery weapons include mortars, cannons, and missiles with a variety of fuzes and warheads capable of chaff, marking, or suppressive fire. Artillery can provide very accurate fire to the maximum range of each weapon, with errors less than one-half of one percent of the range fired. For example, the probable error is 42 meters for a 155mm howitzer firing at a range of nine miles. In using artillery, you must consider the following points:

(1) Does Situation/Time Warrant Artillery Support? Pilots are hesitant to fly into known artillery areas, but the use of suppressive artillery fire against anti-aircraft sites is an invaluable aid. Be sure to use a restrictive fire plan to ensure safe operation. Remember, if the battery won't shut down and a safe restrictive fire plan is not possible, an airstrike may not be possible.

(2) Types/Ranges of Available Artillery. Current artillery information is available from premission planning data, the ASOC, and the ground commander. Needless to say, the ground commander whose area of responsibility the artillery is firing into will have the most current information. It is essential that you be familiar with the artillery available and its associated ranges.

(3) Battery Location/Gun Target Line/Max Ord. Army units will normally not give their unencoded location, and they will usually move frequently. To the maximum extent possible, plan your axis of attack around known GTLs. If a safe axis is not available because of fighter ordnance requirements, you must attempt to obtain a check fire prior to the airstrike. There are four basic fire restriction plans which may be utilized: Further description of these plans is available in TACM 3-1.

(a) Plan A. Coordinated Fire Support on Adjacent Targets - Lateral Separation. Plan A provides coordinated air and artillery strikes against two targets in close proximity. Lateral separation is effected by restricting the fighter attack to parallel the artillery line of fire. In this pattern, the FAC will provide the attack flight with restricted headings, repositioning areas, and holding points.

(b) Plan B. Coordinated Fire Support on the Same Target - Altitude Separation. Plan B assumes the CAS target is in close proximity to the artillery target and that the artillery is using low angle fire. Clearance from the artillery trajectory is provided by lateral separation and recovery altitude restrictions. Other restrictions normally include: No change in artillery trajectory; no over-flight of the gun-target line by the fighters (except at the impact point); and final attack headings for the fighters restricted to an area within 45 degrees either side of a line perpendicular to the gun line. When adherence to these restrictions is not possible, clearance from artillery can be provided by the use of minimum altitudes which are above the max ord or frag pattern, whichever is higher.

(c) Plan C. Coordinated Fire Support on the Same Target - Timed Separation. Plan C is employed to allow the fighter to fly above the frag pattern and/or trajectory of an incoming round. In this case, the clearance element is time. The batteries fire at specified intervals determined by the ALO/FAC in conjunction with the FSCOORD. Either the FAC controls the artillery by calling "Fire" for each volley after visually clearing the fighters, or at selected predetermined intervals the battery is automatically cleared to fire. The attack aircraft adjust their turn to final to arrive over the target/release point after the artillery impact and within a specified time interval. Restrictions include: no shifting of fires, agreed upon time intervals, radio calls, lost communications procedures to stop artillery fire, abort restrictions for the fighter, and heading limitations which avoid the gun-target line. Time separation planning is also applicable to example plans A, B, and D.

(d) Plan D. Coordinated Fire Support on Adjacent Targets - Altitude and Lateral Separation. Plan D is the most restrictive fire plan because vertical and horizontal separation are required. The plan provides the fighters with flak suppression when the CAS target is located between the artillery battery and enemy anti-aircraft positions. The vertical restriction is a maximum altitude directly over the CAS target and under the gun-target line. This restriction provides both horizontal and vertical clearance. The FAC will coordinate the gun-target lines, the max ord, the altitude of the projectile over the CAS target, and the maximum altitude restriction (applicable over the target) with the strike aircraft, and will normally restrict their attack headings to plus or minus 45 degrees of a line perpendicular to the gun-target line.

(4) Check Fire. If none of the above restrictive fire plans prove adequate, a check fire may be required. If so, it should be delayed until the last possible moment, and timing coordination becomes essential. One instance where a check fire might be required is when you have fighters ingressing at extreme low altitudes over impacting friendly artillery. This is what is meant by part E of the inflight guide - Provide fire plans that allow for maximum effectiveness of artillery and air.

d. Clearance to Expend. The importance of obtaining ground commander clearance cannot be overstressed for the reasons outlined in the previous paragraph. The ground situation is not static, and targets and friendly positions are always changing. Advise the ground commander when ordnance delivery is about to begin and when it is terminated. See if the ground commander or his forward observers can give ordnance corrections in the blind on FM. You must be responsive to the Army's requirements, and adjust the airstrike to fit their concept of ground forces employment. Common problem areas in ground commander coordination include failure to obtain strike clearance and failure to advise fighter aircraft of friendly positions. The catastrophic results that can occur as a result of these errors cannot be overemphasized.

7-7. Rendezvous. The rendezvous portion of the airstrike is the simple art of the FAC and the fighters meeting at a predetermined area on the planned radio frequency. Time permitting, the ASOC ALO, and GCI site will coordinate the scheduled inbound fighter times and your desires for rendezvous location. In Europe and Korea, prominent ground references have been established as orbit and contact points to help expedite the rendezvous. Several points at Avon Park have been similarly designated and should be used if available. Another rendezvous method is the use of TACAN cuts. A FAC must insure that the fighters do not inadvertently overfly the enemy locations due to faulty rendezvous information. On Avon Ranges you can use Orlando (Ch 59), Vero Beach (Ch 120), and Pahokee (Ch 71) TACANs to coordinate rendezvous points. It is important that you choose a TACAN station that not only insures reception, but also is best suited for the rendezvous. As an example, assume that your target is on Foxtrot range and your fighters are holding in the northern extension. To effect the rendezvous, one plan might be to direct them to track south on the 180^{0} radical from Channel 59 (ORL), and to proceed no further south than a specific DME to avoid overflying the threat. You must also provide them with specific directions for use when they reach the clearance limit (i.e., orbit at a specific altitude, etc.). As a back up, you may also use TACAN air to air coupled with UHF/ADF to effect the rendezvous. Common student errors in the rendezvous include unnecessarily delaying the fighters at the orbit point and wasting time due to the lack of a plan of action. You can copy the fighter's lineup and start the initial briefing while the fighters are proceeding to the rendezvous point. This may help expedite the strike. Another common problem is being out of position as the fighters approach the rendezvous point (i.e., do not have the fighters trapped at your six o'clock as they approach your position). As the fighters begin approaching your location, start looking for them in the forward quadrants of your windscreen. Insure that you have positive altitude separation. Do not forget to direct the fighters to hold in an area that is out of the threat. All too many times the fighters are allowed to fly over the threat while the FAC is trying to begin his briefing.

7-8. Fighter Briefing. When you obtain the fighter lineup, determine the minimum safe separation distances for their ordnance and its compatibility with your targets. Listen to the amount of play time the fighters have. The occasion may arise where fighters must be sequenced according to play time in order to insure target destruction.

7-9. Initial FAC Briefing.

a. General Target Description. Use a general brief description of the target(s) to be attacked; for example, "500 troops in the open and 50 APC's."

b. Ground Fire. This is a very important part of the briefing because the fighters must be able to fit their tactics to the tactical situation. Specific locations will be given later in the briefing, and only general terms should be used now: Confirmed 12.7 and 14.5, possible SA-7.

c. Friendlies. Brief only general data such as number, type, cover, etc. Specific location should be covered when the fighters are in the target area.

d. Elevation/Obstructions. Target elevation and any obstructions such as mountains, power lines, etc.

e. Weather/Winds. Weather and winds will obviously affect the patterns to be flown. Additionally, new generation fighters may require the altimeter setting for their computerized weapons delivery systems.

f. Immediate Bailout/Safest Bailout/Best Recovery Base. Immediate bailout is a heading the fighter can take if he has to eject now. Safest bailout heading is one that he can follow if he can fly for at least several minutes. Try to make the headings close together if possible. Do not describe the best recovery base if the fighters are familiar with it.

g. Sequence of Delivery/Fuzing/Number of Passes. Tell the flight lead how you want him to expend his ordnance. Base your decision on target type and location. Update this information each time you change targets.

h. One of the main student problem areas is missing items, or giving insufficient information. Also, students often give too much information in the wrong areas, and take too much time to pass the information to the fighters. The following sample briefing will give you an idea of what is really required:

FAC: Sluf Ø1, are you ready to copy initial brief?

FTRS: Roger

FAC: Your target is 500 troops dug in; you can expect 12.7, 14.5 in the area, with possible SA-7's, friendlies are 2 clicks north of the target; target elevation is 80 feet, weather is 5000 scattered, 7 miles visibility, winds out of the east, 10 knots; immediate and safest bailout is north over friendlies, best recovery base is Patrick, CH 97

FTRS: Roger

FAC: I'd like three passes with two bombs per pass and instantaneous fuzing.

From this you can see it is possible to give all the required information in a very short time and be ready to proceed with the specific briefing.

7-10. Specific Briefing.

a. Distance/Direction References. There are many ways to fill this requirement. When rocket conservation is not a factor, you can fire two rockets on a cardinal heading and establish a distance between them. The importance of a common reference is obvious when you direct the fighter to hit 500 meters east of an impact. If the fighters do not know what 500 meters looks like on the ground, your directions will not be very useful. Prominent landmarks such as runways, roads, rivers, and cultural patterns can be used to establish common distance/direction references. Try to pick something that at least comes close to the actual distance and direction you give it.

b. Specific Target and Friendly ID. These two items are coupled together because they constitute the essential information required for an effective airstrike. In many cases there is little margin for error when identifying friendly locations. You may have the impression that all that is required is to put a mark on the ground and tell the fighters to hit your smoke. To a certain extent, a marking rocket can eliminate a lot of verbage and rapidly provide a common reference point between you and the fighters. Imagine, however, a target where artillery and other ordnance is going off almost constantly. Your smoke rocket will disappear in the dust of battle. Also, the situation may arise where you have no more rockets, and must talk the fighter into the target. Always talk the fighters from large references down to small specific targets, and use landmarks that will be visible from high altitudes. If the fighters have you in sight, one technique you can employ is to use clock positions from either your location or the fighter's. The use of prominent landmarks is often a good place to start. Always talk specific distances and directions: you do not go "up" a road - you go north along the road 500 meters. The use of smoke or mirrors is an effective way to positively ID friendly locations, and you must insure that all flight members positively acknowledge sight of friendly locations. Occasionally, friendly forces will be far enough away so that they are not a factor. If this is the case, tell the fighters the general direction of the friendlies and that they are not a factor.

c. Ground Fire ID. Show the fighters where known threats are located. The same techniques can be use here as you would use to specifically identify the target or friendly location.

d. Attack Restrictions. At this point your expertise as a FAC begins to come into play. You must weight such factors as weather, ordnance, friendly position, and the threat in order to arrive at the most expeditious and effective method of attack.

(1) Random Attacks. Whenever possible, give the fighters clearance for random attacks. You can acticipate that the fighters will be flying curvilinear or jinking finals, and this will complicate your task of determining safety for the friendlies. Clear the fighters only when you are certain they have the correct target. Remember: NO TACTIC IS VALID IF USED CONTINUALLY - BE UNPREDICTABLE.

(2) Restricted Run Ins. The proximity of friendly forces may preclude the use of random attacks, and restricted attack headings will be required. Should this be the case, one option that is often overlook is the reciprocal attack or butterfly pattern, where fighters can attack from either side of the target. Because of the threat, you might want to break the fighters over the friendlies whenever possible to minimize their exposure. To arrive at the best attack heading, other factors such as fighter accuracy and safe separation must also be considered.

e. FAC Holding Position/Altitude. Advise the fighters where and at what altitude you will be holding, update this information throughout the airstrike if you move.

f. Final Clearance. Prior to the expenditure of any ordnance, you must obtain ground commander clearance. Additionally, if your target is within the minimum safe separation distance for the ordnance being used, advise the ground commander and allow him to make the final decision to expand. Should he still desire the fighters to drop, obtain his initials. A common error is to forget to obtain ground commander clearance.

7-11. <u>Conduct of the Mission</u>. At this point you are ready to begin the actual mission. The fighters have been briefed and you have obtained ground commander clearance to begin the attack. When the fighters are in a position to see the target area, advise them that you will be in for the mark in X seconds (15 to 30 seconds normally). Although you should strive to get an accurate mark, the purpose of using a smoke rocket is to provide a common reference for you and the fighters, not to destroy the target. After shooting the rocket, observe where your smoke hit and maneuver away from the threat envelope. Always try to give the fighters corrections from your smoke to the target.

7-12. <u>Observation Position</u>. There are many factors that must be considered when determining observation position, and there are as many observation position techniques as there are FACs. Basic patterns are given in TACR 55-210 and MCM 3-1, and these are based on the four requirements for observing an attack: (1) Always be in position to see the target; (2) Always be in position to see the fighters; (3) Remain out of the threat; and (4) Always be in a position to rapidly mark the target. If you can fulfill these requirements, other factors such as minimizing midair collision potential, checking fighter alignment on final, and giving ordnance corrections will come naturally. Perhaps the most common mistake made while observing an attack is allowing your aircraft to drift into the threat. When weather and visibility are not a factor, make sure to orient your observation position well clear of the threat envelope while maintaining positive fighter control. Use of vertical separation is also a possibility. Do not inadvertently enter a tight spiralling descent over the target. Realize that your observation position must be fluid and adaptable to the threat, fighter tactics, and friendly requirements. Always tell the fighters where you will be holding. There is nothing more distracting to a fighter pilot than to finally identify the target, roll in, and find the FAC in his pipper. Give your position as a quadrant in relation to the target.

7-13. <u>Mission Execution</u>. Never give clearance for the fighters to drop until you are sure that they have the proper target and are adhering to required attack restrictions. If they call "In" without you being sure that they are properly aligned with the target, tell them to "Continue" until you are sure. Then clear them hot. Also, do not give late ordnance corrections to #2. Should lead destroy the target on the first pass, be ready to move #2 to a secondary target. Always try to keep the "big picture" when controlling an airstrike. Avoid flying too close to the target and being unable to keep the fighters in sight. After completing the mission, pass the BDA to the ASOC and the fighters if time and the tactical considerations allow.

7-14. Low Threat Summary. This section has presented the fundamentals of low threat airstrike control. You must be prepared for the mission, be flexible and responsive to fighter and Army requirements, and you MUST maintain control.

Section C

High Threat Procedures

7-15. General. In most areas of the world today the airborne FAC can expect to operate in a multiple threat environment consisting of SAM's, AAA, and enemy aircraft. If the FAC is to be effective and survivable, appropriate tactics will have to be employed. However, the general planning and coordination of a mission in a high threat environment is very similar to the low threat procedures outlined in the previous section. In a high threat environment, the FAC must be cognizant of two critical factors needed for survivability: Minimum exposure time and maneuverability. You will be unable to attain a high airspeed, and as a result, maximum use of terrain masking, weather, and low altitude maneuvering will be required. This section will address single and two ship FAC tactics and mission planning considerations.

7-16. Mission Preparation. Enemy defenses should be the driving factor as you plan the mission. Anticipated target areas will probably be characterized by a diversified, overlapping, and highly complementary layer of air defense. The requirement to know the capabilities and limits of each threat is obvious. Intelligence will supply current threat information as well as the other basic information listed in the low threat portion of this manual. You should plot, or at least be aware of, the envelops of each.

a. Weather. Target weather study is important and all aspects addressed in the low threat portion apply, additional considerations are the effects of the weather on each threat.

b. Navigation. Navigation has to be carefully planned for every high threat mission. You must be familiar with all major terrain features in the area and plan your ingress and egress routes to optimize both effectiveness and survivability. In the multi-threat environment, the FAC does not have the luxury of orbiting over or even in close proximity to the target area. Constant position awareness is essential. There may be occasions when a FAC can operate above the threat envelope and utilize high altitude stand off marking; but this option is effectively eliminated in an area defended by radar SAMs.

c. The Frag. Another area of mission preparation must be the fragmentary order and the associated SPINS (special instructions). All aspects of the mission, such as fighter information, target data, strike frequencies, and typical low threat information are contained in the Frag. Additional factors that may be included are orbit points, contact points, abort code information, and comm jamming countermeasure procedures.

7-17. Inflight Coordination. All inflight coordination is the same as detailed in the low threat section. Special considerations for high threat operations include reduced radio ranges due to low operating altitudes, the use of secure radios when available, and the threat of comm jamming and intrusion. In a high threat environment you must keep radio transmissions to a minimum because of the frequency scanning capability of most jamming equipment. The effectiveness of jamming is directly related to output power, range, and terrain.

a. Target Location. For high threat missions, the target could be a general area or kill zone, or specific point targets that are highly visible. The airborne FAC will probably be unable to visually acquire the target from his holding position and therefore must rely on the ground FAC for accurate target description. In some cases, the ground FAC will observe the target and give final attack clearance.

b. Visual GCA. For the actual expenditure of ordnance, NATO handbook ATP-27 addresses the "visual talk in method." This is accomplished by either the ground FAC or airborne FAC, and it resembles a GCA to the target. An example might be a transmission from you to the lead fighter as he pops: "Come right 10 degrees, target is 2 o'clock low, vehicles on road".

c. Map Study. The fighters and the FAC both are faced with serious target acquisition problems if forced into low altitude operations. Assuming good communications capability, the FAC has the advantage of being able to study real time target data and plan an optimum attack for himself and the fighters. However, the FAC might be the fighter's only source of accurate target data.

7-18. High Threat Briefing Format. The need for passing only essential information through the use of short transmissions has resulted in an attempt to establish a world standardized FAC-to-fighter briefing. To minimize radio traffic, the FAC should attempt to give only one item at a time and to make it as concise as possible. He must insure that the fighters are receiving his briefing, but it need not be verbally.

a. Briefing Format.

(1) Initial Point (IP). At Patrick we have established IP's for both the North and South ranges. It is probable that such points will be fragged or identified by the frag in most theaters of operation. You must insure that both you and the fighters are referring to the same point.

(2) Mag Heading to Target. At Patrick there is only one degree of magnetic variation on the ranges, and this makes it easy to derive the mag heading from the IP to the target.

(3) Distance. Distance is given in nautical miles.

(4) Target/Elevation. Give a brief target description and the elevation. (Example: Three tanks 20 meters north of an east-west dirt road; elevation 80 feet).

(5) Restrictions. Restrictions on the fighters depend on the tactical situation. Attack heading restrictions might be imposed because of terrain, artillery, weather, or location of friendlies. If the attack is unrestricted the FAC will so state.

(6) Clearance/Abort Instructions. If the flight is cleared to expand without specific additional clearance, the word "HOT" and the final control or strike frequency and abort code will be stated. If final clearance is required, the word "COLD" and the frequency and code word will be stated.

(7) Offset/Coordinates. With computer equipped fighters, you may be required to give either IP/target coordinates or offsets from a known point. (i.e., F4 WRCS offsets; A7 six digit target geo refs and elevation.)

(8) Additional Information. This can include any other information that is relevant to the mission (i.e., threat location, target location in relation to a ground reference, etc.)

b. Sample Briefing. A typical briefing is as follows: Q - 330^{o} - 10.5 - 5 tanks moving south- 100 feet - unrestricted - HOT AJ - quad 23 two klicks north.

7-19. Fighter Attack. After briefing the fighters, several techniques can be employed to sequence their attack. One is to have the fighters call departing the IP and then hack your clock accordingly. Another method is to dictate a TOT at "X" minutes after a hack. Whichever method is employed, it is essential that you use proper timing to insure that your mark impacts just prior to the fighters beginning their attack. Time of flight of the rocket and FAC run in must be completed. If you are going to error, attempt to have the mark on the target slightly early. Late marks might delay target acquisition and result in a dry pass.

7-20. Target Marking.

a. Low Altitude Stand Off. For this mark, the FAC makes a low level run in to a firing point and, if able, provides the fighters a correction from the mark to the target. The mark should be timed so that it becomes visible to the fighters just before they begin their attack. Two marks may be used to bracket the target area or to provide a distance/direction reference.

b. Loft Delivery. Another method of marking the target area is the nose high loft delivery. To use this method the FAC runs in at low altitude, pulls to a predetermined nose high attitude, fires, and egresses while the rocket is still in flight. Ranges of over four nautical miles are possible, and rocket time of flight may be as long as 45 seconds. Locate an easily distinguishable ground reference, determine firing heading, and utilize the loft angle that will provide the deired range.

c. Artillery. Although impossible to utlize at Patrick, another option is to employ army artillery to mark the target. Their accuracy will probably be consistently better than you could provide. Again, these marks should be timed so that they become visible to the fighters just before they begin their delivery.

7-21. Other Considerations.

a. Threat Suppression. Attempt to employ any available support for threat suppression. You might use artillery, area munitions, wild weasels, standoff jamming, chaff, and IRCM.

b. Comm Jamming. Chattermark procedures include changing to a prearranged frequency when significant comm jamming is encountered. It may be possible to talk through jamming or utilize alternate radios. Another option is to employ the aux receiver in fighters that have the capability.

c. Airspace Saturation. In a high threat area you can anticipate numerous helicopters, fighters, artillery strikes, and other FACs all operating at low altitude. Lookout and visual search will be required to prevent midair collisions.

7-22. Dual FAC Mission. The high threat FAC mission has a higher probability of success if two FACs are employed: One as a low or forward FAC, the other as an attack coordinator.

a. Low FAC. The low/forward FAC (FFAC) coordinates and obtains all target information. He can be a ground FAC, a helicopter FAC, or a conventional airborne FAC.

b. High FAC. The high FAC (Forward Attack Coordinator - Airborne/FAC-A) does the required coordination with the TACS elements, briefs the fighters, and maintains an orbit well back from the FEBA. The division of duties between the two FACs allows them to control numerous sets of fighter aircraft in a short period of time using high threat tactics.

c. Typical Mission. Typical duties of each FAC are outlined below, but may vary depending on the tactical situation.

(1) Low FAC (FFAC).

(a) Obtains a briefing from the ground forces on the tactical situation, friendly locations, known threats, target locations, artillery capabilities, and other target area information.

(b) Determines attack restrictions.

(c) Passes information to high FAC (FAC-A).

(d) Marks target or coordinates artillery marking of target.

(e) Provides BDA.

(2) High FAC (FAC-A).

(a) Requests fighter support from the ASOC.

(b) Rendezvous, briefs fighters, and releases fighters to depart IP.

(c) Plans the fighter attack based on information from the low FAC, and passes fighter info to the low FAC.

(d) Passes fighter run in time and IP departure time to low FAC.

(e) Acts as overall mission commander.

7-23. Hi/Low Communication. The low FAC will normally do all ground commander coordination on FM. Coordination between the high and low FAC could be on FM, VHF, or possibly HF. The high FAC will brief the fighters on rendezvous frequency and clear them to the strike frequency prior to or as they depart the IP. The only transmissions that the low FAC/fighters should make on strike frequency are those concerning timing, corrections from marks, aborts, or immediate threats. You must keep radio transmissions to a minimum and adhere to chattermark procedures.

a. Common Problem Areas. Problems usually encountered include the high FAC failing to pass fighter run in time to the low FAC, or calling the fighters as departing the IP when in reality they are well past the IP. One method to insure that the fighters have switched to strike frequency is to require the fighters to give a time call, i.e., "90 seconds from target." This call also serves as a back up for the low FAC to plan his ordnance delivery.

b. Clearance to Expend. The ground/low FAC may give the high FAC clearance for the fighters to drop, or he may withhold final clearance until he ascertains that they positively have a visual on the target. The choice largely depends on the tactical situation and the location of the friendlies. Whichever method is to be employed, if it is not in the Frag, then the low FAC must inform the high FAC so he can pass it to the fighters.

CHAPTER 8

MOUNTAIN FLYING

8-1. Introduction. This may well be one of the most important chapters of this manual if your mission requires flying in mountainous terrain. Too many pilots have lost their lives by not observing the basic rules of mountain flying. Studying the following sections on weather, flying techniques, and rules of flight should enable you to safely complete your mission while avoiding the treachery of mountainous terrain. Nothing written, however, can substitute for several flights with an experienced mountain flier. If possible, obtain first hand experience by flying with a pilot familiar with the terrain over which you will be operating.

8-2. Mountain Weather. Perhaps the reason that so many "flatland" pilots get into trouble in the mountains is their ignorance of the peculiarities of mountain weather. The following discussion will outline the basics of mountain meteorology, and will hopefully make you a safer pilot.

a. Density Altitude. Density altitude is a measure of the actual "thickness" of the air. It is dependent on the prevailing atmospheric pressure, temperature, and humidity. On a hot day, the air becomes effectively "thinner" or lighter, and its density is the same as that of air that would normally be found at a higher altitude. The increase in density altitude on a hot day is one hazard of mountain flying because it reduces aircraft performance by:

(1) Providing less dense air to the engine and therefore reducing available horsepower.

(2) Causing the prop to take less of a "bite" out of the air, thereby reducing propeller efficiency.

(3) Producing less lift from the wings because lighter air exerts less force on the airfoils.

This reduction in overall aircraft performance affects you in the following manner:

(1) Lesser climb rates.

(2) Lower service and absolute ceilings.

(3) Slower cruise and climb speeds.

(4) Longer takeoff rolls.

It is possible to determine your density altitude by setting the altimeter to 29.92. Take the indicated altitude and the ambient temperature and set them in your flight computer to read density altitude. For example, if the elevation read is 6,000 feet and the outside air temperature is 80^{o}F, your density altitude is 8,600 feet.

b. Winds. Winds and turbulence are "weather" in the mountains just as rain, snow, clouds, or thunderstorms are in normal flatland flying. The reason for this is the way in which air flows over the mountain. It approaches the mountains and is forced up by the terrain, resulting in great amounts of turbulence and disruption along the ridge line and for many miles downwind. If the foothill ridges have winds that are 35-40 knots, you can expect 80 to 100 knot winds along the tops of the mountains. The turbulence associated with these winds can be very disruptive for the OV-10. For this reason, it is not a good idea to fly over ridges if the forecast winds for your maximum altitude are 30 knots or more. Thirty knots is 3040 feet per minute, and this could be a very healthy downdraft if you happen to get caught flying too close to the ridge line. If you have a choice, stay on the downwind side of the valley between the mountains, and only cross a ridge line if you have a minimum clearance of 2000 feet or 50 percent of the height of the mountain. More will be said on ridge crossing in the section on flying techniques. If you ever land at an airport in the mountains, you may find a wind sock at either end of the runway. This is because of the extreme effect mountains have on the direction and velocities of local winds. Careful judgment of prevailing conditions is necessary before attempting to land at one of these airports. Try flying in the morning or late afternoon when the air is cooler and less turbulence is created.

c. Mountain Wave. When the winds are blowing perpendicular to a mountain range, and the velocities are above about 20 knots, a mountain wave might form. Figure 8-1 shows a typical mountain wave situation. Notice that the three visible indications of a mountain wave are lenticular clouds, rotor clouds, and cap clouds.

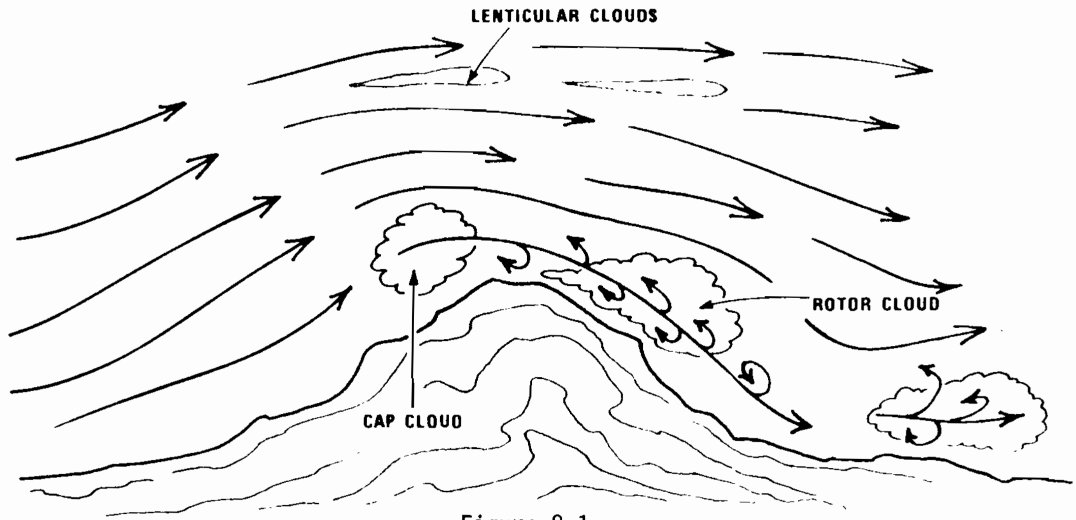


Figure 8-1

Sometimes, when the moisture content of the air is low, a mountain wave might exist without the formation of the typical clouds. The existence of a mountain wave indicates the presence of turbulence which might vary from light to extreme, and can extend for hundreds of miles downwind and last for hours. It is possible to forecast mountain waves with some degree of accuracy. If the surface winds at stations near the mountain bases are 15 knots or more, plan on avoiding the mountains or flying at least 50 percent higher than the peaks you will be crossing.

d. Clouds. In the mountains clouds can be very misleading. Even a well defined ceiling with good visibility (greater than five miles) underneath becomes dangerous because the clouds do not maintain their height above the ground, but above mean sea level. If you are flying up a valley under an overcast, you might find yourself hemmed in with no room to turn around as the valley becomes more narrow and the floor rises to the clouds. Trying to fly through mountains with ragged ceilings is even more dangerous. One of the ragged ends might obscure a mountain behind it. There is also the danger of ice. The lifting action of mountain airflows can cause heavy icing in the clouds near the mountain tops. It might be hard to climb out of the ice due to power limitations, and even harder to descend due to MEA constraints.

8-3. Mountain Flying Techniques.

a. Power and Airspeed Control. Due to higher density altitudes, every ounce of power will be important to accomplish the mission. Keep your airspeed up and do not hesitate to jettison your stores if necessary. If you get caught at low altitude with no place to go, use the best climb speed until you have cleared all obstacles and have a safe operating altitude.

b. Climb Techniques. In mountainous terrain the actual "level flight" horizon is not well defined. When you fly toward higher terrain, the tendency is to fly nose high. The reverse is true when flying toward lower terrain. What you see in the distance is what you get. Check the map and compute your rate of climb per mile to see if you will make it over the next ridge. Above all, always maintain a position from which a turn downhill can be made. If you get caught in down drafts, have a power loss, or cannot make it over the top with sufficient clearance, this could be a life saver.

c. En Route Flying. Knowing your position is very important while navigating in the mountains. Not only will it let you know the terrain elevation, but it will help you determine courses of action if you have to descend immediately. Most TACANs do not work at low altitudes in the mountains: You must use your map. Remember that roads, railroads, and streams generally follow the path of least resistance: Use them if in doubt as to the best way to go.

d. Ridge and Canyon Flying. Before attempting to cross a ridge, check for the presence of a mountain wave and high winds. Always fly toward the ridge at a 45^{o} angle so that a turn away can be made if necessary. As you approach the ridge, if less and less of the terrain on the other side can be seen, you are too low and will not be able to cross safely. Always keep a downhill path open, and make your decision to abort early enough so you do not get caught in the turbulence close to the mountain. If you encounter a headwind coming over the ridge or through the pass, expect maximum down drafts as you make your approach. If there is a tail wind, the down drafts will appear after you have crossed the ridge. Getting caught in a down draft is not critical if you maintain aircraft control and fly at full power using the best climb airspeed. When flying in a canyon, always favor one side, preferably downwind. If a turn becomes necessary, your turning radius will be less into the wind, and you will have distance and elevation to play with by sticking to the side of the canyon. If the weather is marginal, never fly through a canyon because power lines have a way of attacking light aircraft that get stuck under the weather. Five miles visibility should be the minimum acceptable when flying below the mountain tops.

8-4. Rules for Mountain Flying. The following guidelines should be followed when operating in mountainous terrain:

a. Always remain in a position that will allow you to turn and fly downhill.

b. Plan your flight for early morning or late afternoon to reduce the effects of turbulence.

c. Consider the effects of increased density altitude and lower margins of performance.

d. Always know your position.

e. Check the weather carefully. Winds at ridge level of 30 knots or more can cause severe turbulence problems. Expect greater velocities over the ridge than at a few miles away.

f. Always keep an out available: Approach a ridge at a 45^{o} angle; fly along the downwind side of canyons; cross ridges with plenty of altitude.

g. Do not fly closer than necessary to abrupt changes in the terrain. Expect down drafts on the sides of ridges and peaks.

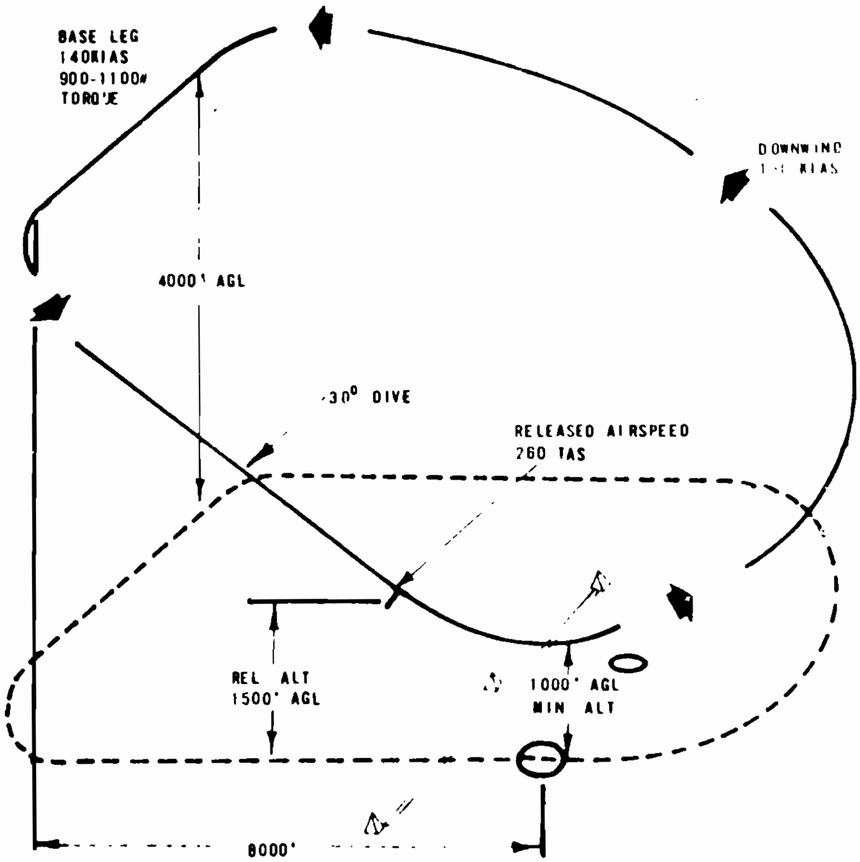
h. The normal horizon is near the base of the mountains.

i. When descending, do not go above maneuvering speed.

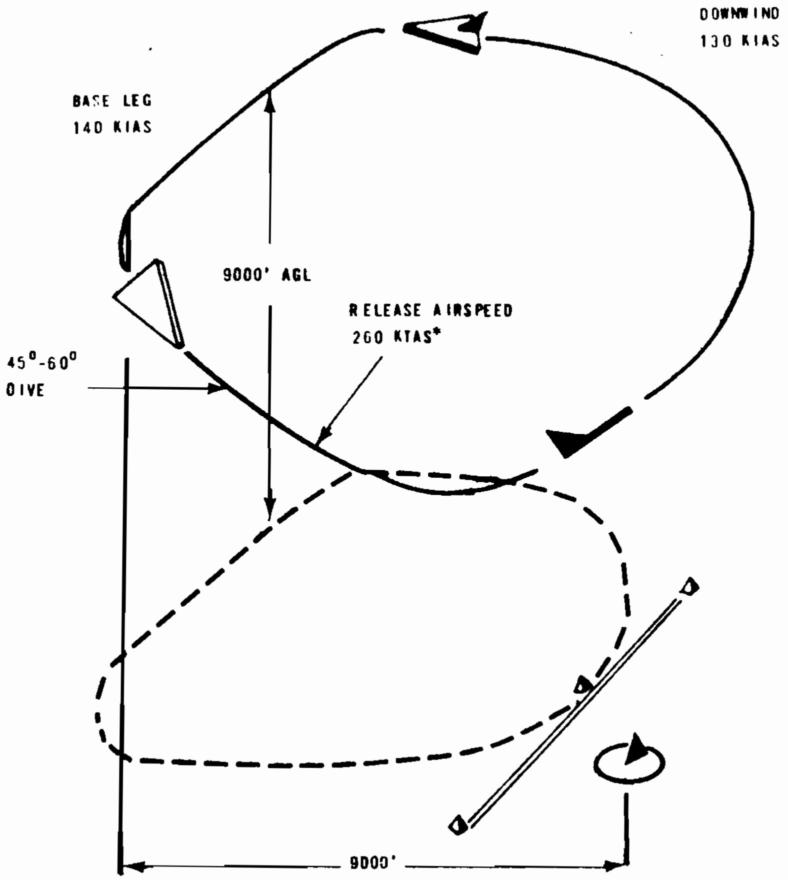
j. Stick to your preplanned flight plan. Let someone know if you deviate.

APPENDIX

AIR TO GROUND ROCKET PATTERN OV-10 (TYPICAL)



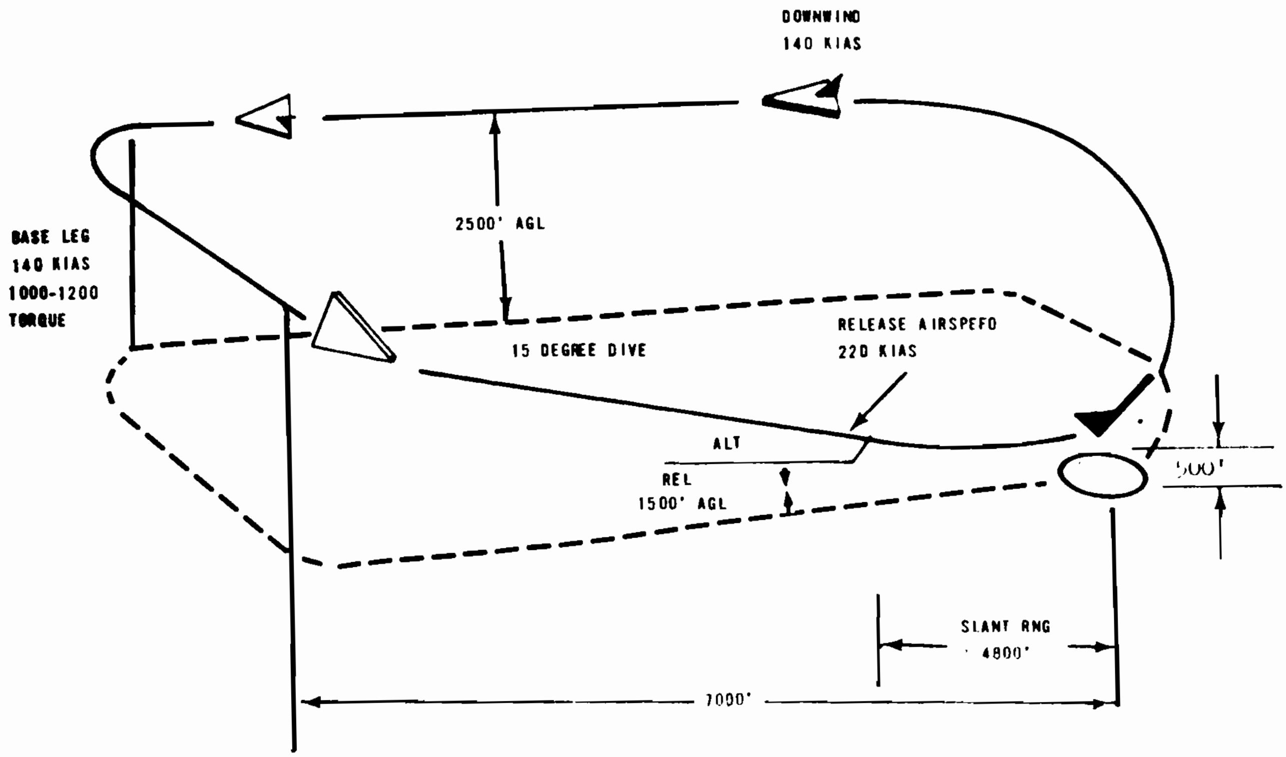
HIGH TACTICAL ROCKET PATTERN OV-10
(TYPICAL)



*NOTE: RELEASE WITHIN 2000' OF ROLL-IN ALTITUDE
Minimum of 5 seconds wings level on final for all tactical deliveries

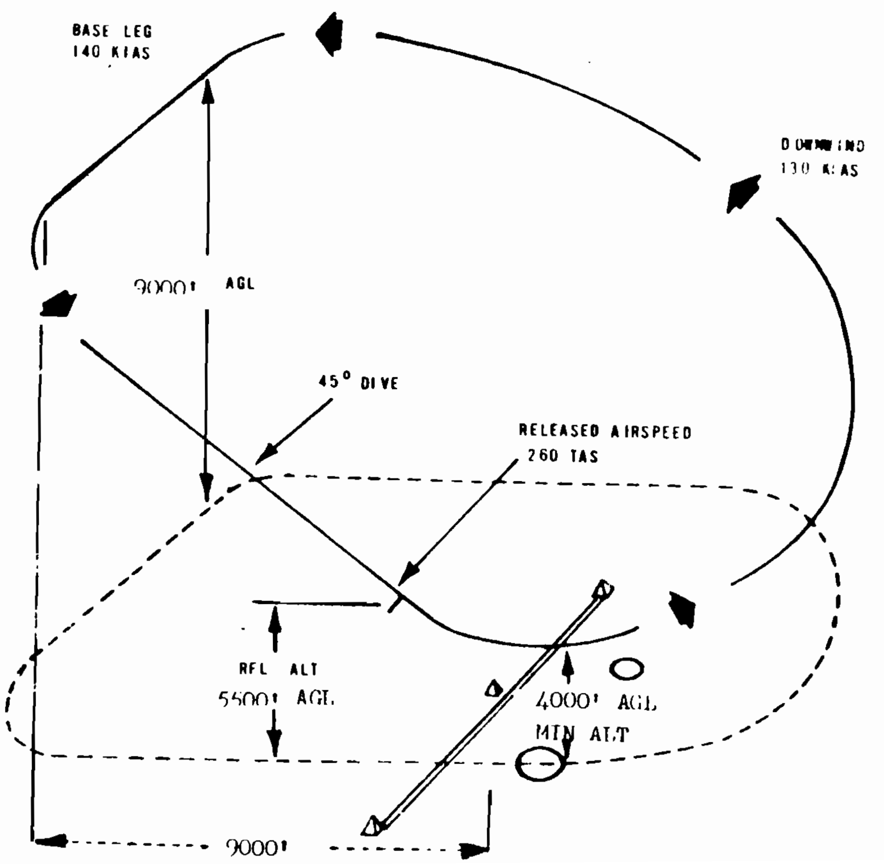
APPENDIX

LOW ANGLE ROCKET PATTERN OV-10
(TYPICAL)

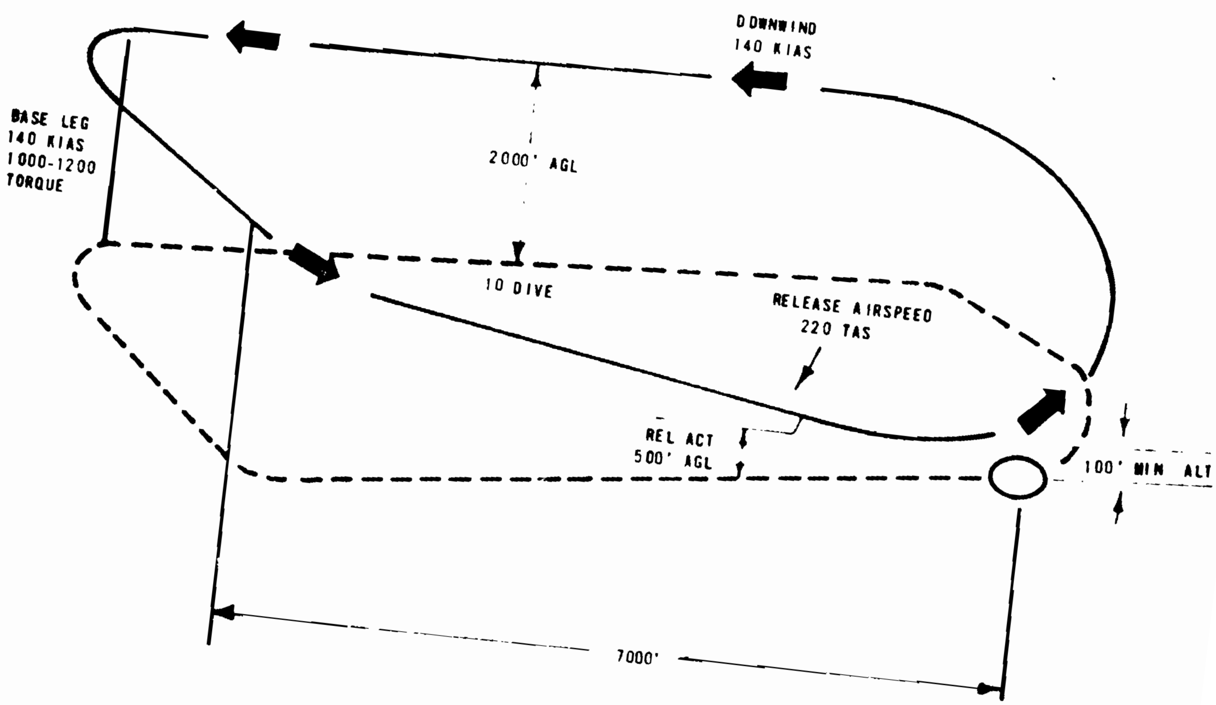


APPENDIX

HIGH 45° DIVE BOMBING OV-10
(TYPICAL)



LOW ANGLE BOMB PATTERN OV-10 (TYPICAL)



APPENDIX

STRAFE PATTERN OV-10
(TYPICAL)