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EMPLOYMENT FUNDAMENTALS T-38C/INTRODUCTION TO FIGHTER FUNDAMENTALS (IFF)

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Chapter 5

BASIC SURFACE ATTACK (BSA)

5.1 Introduction. BSA is the building block for all air-to-ground missions. This chapter addresses surface attack definitions, premission planning, delivery parameters, controlled range patterns, and weapons delivery. Refer to Figure 5.1.

5.2 Surface Attack Definitions. Several surface attack terms must be understood for the fighter pilot to fly the attack and arrive as close as possible to the planned weapons release window. While these concepts are introduced and defined here, specific mechanics and further discussion of how to use them starts at the "Roll-in" section later in this chapter. For more information regarding the calculations and T-38C specifics, refer to Technical Order (T.O.) 1T-38C-34-1-1, *Air Crew Weapon Delivery Manual*.

5.2.1 **AIM Off Distance (AOD).** AOD refers to a distance beyond the target that is predictable for any weapons delivery. That distance is the no-wind projected flightpath of an aircraft (where the aircraft would hit the ground if the pilot did not recover) in a dive delivery.

5.2.2 **AIM Off Point (AOP).** AOP is the point on the ground, long of the target, to which the aircraft must fly during the weapon's delivery pass. The AOP provides a ground reference to fly the aircraft to until a track reference can be set.

5.2.3 **Dive Angle.** Dive angle is the planned angle of dive for weapons delivery.

5.2.4 **Initial Pipper Placement (IPP).** IPP is the angle from target to a point in the HUD in mils at track altitude.

5.2.5 **Initial AIM Off Angle (IAA).** IAA is the angle between the AOP and the target at track altitude. IAA is setting the FPM a planned number of degrees above the target at track altitude.

5.2.6 **Initial Target Placement (ITP).** ITP is the angular "distance" measured from the horizon to the target in degrees (adding IAA to the planned dive angle at track will always yield ITP). It is an excellent reference for knowing what type of wire you are on, but it is NOT a "track reference" and cannot be "set" at track altitude.

5.2.7 **Mil.** Mil is a term commonly used by pilots as an abbreviation for mill radian (1/1,000th of a radian). Mils are used to measure sight depression or relative positions and sizes of objects as seen through the HUD. One mil is equal to 1 foot at a range of 1,000 feet. Another useful relationship is approximately 1° equals 17.45 mils. "Mils" are also sometimes used to reference the delivery parameters on the lineup card.

5.2.8 **Minimum Release Altitude (MRA).** MRA is a contingency altitude. It allows the fighter to be fast, steep, or both (up to a limit), and still satisfies safe escape, safe separation, and fuze arming criteria. Units may compute MRA differently to reflect mission design series (MDS)-specific considerations.

5.2.9 **Planned Release Altitude.** The expected release altitude based on attack planning and assumptions.

5.2.10 **Percent Bomb Fall Line (%BFL).** Percent BFL is an alternate HUD track reference. In principle, it is exactly the same as IAA and serves the same purpose. The only difference is that the angular distance from the FPM to the pipper is described as a

percentage of total BFL. It is similar to IPP in that it is setting the pipper a known amount of mils below the target.

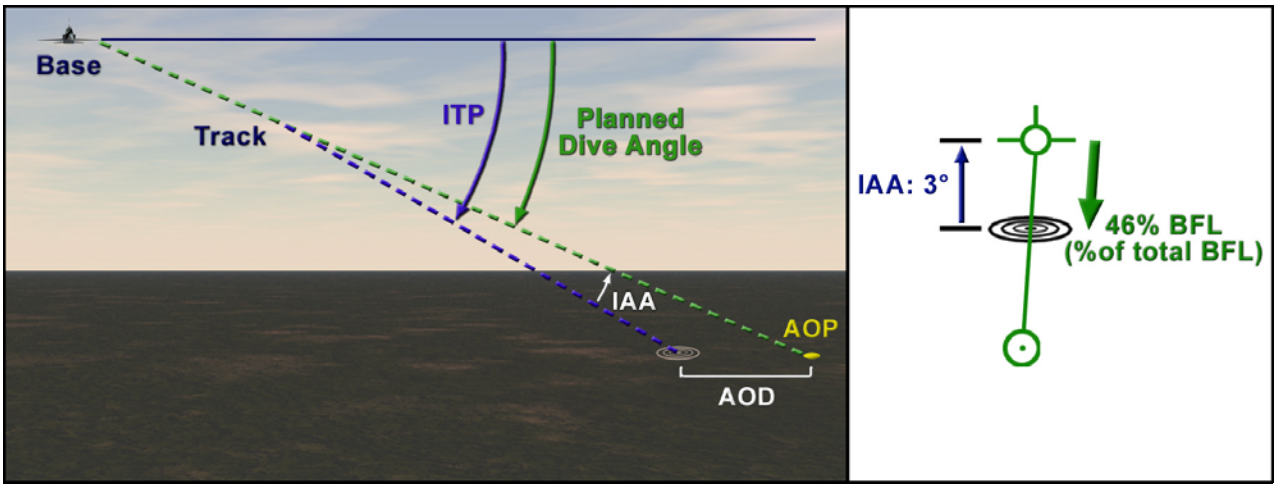
5.2.11 **Release Altitude.** Release altitude is the altitude above the ground at which weapons delivery is accomplished.

5.2.12 **Track Reference.** Track reference is a position or point in the HUD that is used to maintain or correct the aircraft to the planned wire. Some common track references used in weapons delivery are IAA and BFL (IPP).

5.2.13 **Tracking.** Tracking refers to a portion of any dive weapons delivery that is devoted to the final alignment of aircraft sighting systems with the target. The amount of time associated is referred to as wings-level or tracking time.

5.2.14 **Track Altitude.** Track altitude is the preplanned altitude at which your HUD track reference is valid. BFL and IAA relationships are only valid at track altitude.

Figure 5.1. Basic Concepts.



5.3 Mission Planning/Preparation. BSA mission planning starts with and is based on the type of weapon used and the target. The use of a BSA conventional or tactical pattern simplifies most of the planning by removing the target "weaponeering" and allows pilots to practice various methods of attacking the target safely.

5.3.1 **Weather Planning.** Check the ceiling height to evaluate possible delivery options both below and above the weather. Check the winds at the surface and at the track altitudes of each delivery planned and have that ready for the brief. Upper-level winds can have a dramatic effect on weapons delivery. Prevailing visibility and sun angle will affect ease of target and landmark identification. A call to the range should be made to get an eyes-on assessment of the weather and pass the delivery and target plan to the ranger. Additionally, aviation hazard advisory system should be checked prior to the brief and updated at step.

5.3.2 **Target Study.** Review slides, pictures and diagrams of the range, target area, and planned targets for the mission. Note the position of the range tower, prominent visual features, and any avoid/noise sensitive areas. Check range NOTAMs if applicable and always reference the range regulation.

5.3.3 **Attack Planning.** IFF student missions will be flown IAW the preplanned attacks in the in-flight guide. Review the attacks planned for your mission. In addition to the pattern

altitudes and airspeeds, commit to memory the information related to each individual event, to include: track altitude, ITP, IAA, %BFL, AOD, planned release altitude, and MRA. These numbers can be placed on a line-up card for reference in flight. Also, each pilot must be familiar with the training rules in AFI 11-214.

5.4 Ground Ops. Confirm the weapons menus are set up correctly to include delivery parameters and break X altitude. Target coordinates and target elevation should be verified (or entered if required) on the ground. Set the altitude warning to radar altimeter ("RALT"), and choose a warning altitude that won't distract from the mission but will provide timely SA and aid in ground collision avoidance (refer to the squadron standards). In the upfront control panel (UFCP) "HUD" menu, ensure that you select Drift (DRF) mode and *not* Drift-Cut-Out (DCO) mode.

5.5 Range Entry. Prior to entering the range, flight lead will call the range operator who will provide range entry clearance, the current altimeter, which targets are available, and additional information IAW range regulations. Every member of the flight is responsible for understanding this information and will acknowledge with position number after flight lead reads it back to the ranger. The ranger may also provide current weather and wind information. Build SA on the actual winds compared to the forecast you used to plan your attacks. As you approach the range, check the winds at departure altitude on the multifunction display (MFD), listen to the surface wind call from the ranger, and look for smoke or dust clouds from vehicles for additional surface wind SA. Expect to enter the range in either route or tactical formation.

5.5.1 **FENCE-IN.** An air-to-ground (A/G) fence check will normally be accomplished before entering the BSA pattern. While it may vary from flight to flight, it should include selecting A/G master mode constantly computed impact point (CCIP), constantly computed release point CCRP, or as briefed), the target steer point, and weapons program for the first event (A/A TACAN, IFF, and CMD IAW the brief). Set up NAVAIDs to aid in SA on the range course deviation indicator (CDI to run-in heading, captain's bar on crosswind or base heading as a technique). A chaff/flare check may be accomplished as well. DO NOT perform a trigger/pickle check. Leave the master arm switch safe until within the range confines and directed or briefed to arm hot by your flight lead.

5.5.2 **G-Exercise.** The flight lead may or may not perform a G-exercise. A G-exercise may be accomplished prior to entering the range boundaries or once established on the range, IAW the brief or unit standards. (AFI 11-214 does not require a G-exercise.)

5.5.3 **Spacer Pass.** Once the flight is ready to enter the BSA pattern, the wingman will need to achieve a trail formation. A delay of 5 to 7 seconds en route or 2 seconds in tactical will provide for sufficient spacing behind the preceding aircraft.

5.6 Range Comm. With the exception of safety of flight calls (say position or KIO), full call signs will be used when communicating on the range (for example, "VIPER 2'S BASE"). The ultrahigh frequency (UHF) radio will be used exclusively to keep the Range Control Officer (RCO) in the loop with high SA. Very high frequency (VHF) will be used by exception.

5.6.1 **Pattern Calls.** Standard, required pattern calls are: "C/S BASE," "C/S UP" (for tactical pop patterns), and "C/S IN DRY." Flight members will use call sign or formation position as briefed. The calls should be made at the moment you crack your wings to start the turn. All members of the flight must listen carefully prior to transmitting. If another

fighter has called in dry, do not transmit until the RCO has given a "continue dry" (unless the transmission is for safety of flight).

5.6.2 **Base Call Considerations.** The base call will be prefaced with "extended," or "late." These are used to increase the SA of following aircraft for station-keeping purposes. If forced to turn base somewhere other than the briefed ground track, add the appropriate description. The preface "late" is used in the same way as in the landing pattern. If turning base at the correct position but unable to transmit on time due to higher priority comm, delay the base call and preface it with "late."

5.6.3 **"C/S OFF DRY."** "C/S OFF DRY" will be called post safe escape maneuver (SEM) if you rolled in with intent to drop but ended up not pickling. Add the reason for not dropping ordnance to the off-dry call (for example, "EAGLE 2'S OFF DRY, PARAMETERS").

5.7 Range Exit. Flight lead will add "C/S LAST PASS" to his base and in call and "C/S up for the rejoin," after completion of his safe escape. After pickle AND completion of a valid safe escape, turn in the briefed direction and look for the preceding aircraft. Call off with number of aircraft in sight, (for example, "C/S 3'S OFF, TWO AIRCRAFT IN SIGHT…") and begin the rejoin. If not all of the preceding aircraft are in sight, transmit the number of aircraft you do see and continue to fly the briefed ground track, leveling off at your briefed "sanctuary" altitude. Once visual with all of the preceding aircraft, notify lead and continue the rejoin.

5.8 Switches Safe/FENCE OUT. Flight lead will call for the FENCE OUT as a directive call for all flight members to safe the master arm and CMD. Once safed, acknowledge in order by position number. Complete the rest of the FENCE OUT as briefed or directed. Be aware that all of this may be happening during the rejoin; task prioritize appropriately.

5.9 Abnormal Procedures:

5.9.1 **Fallout/Late Join Up.** Have a game plan for how you will execute if any member falls out, both on the ground and in the air. If a flight member joins up late on the range, one technique is to have them hold above your current pattern altitude and flow them in to the last position in the flight.

5.9.2 **Weather.** For a solid deck with good visibility underneath, eliminate the higher events. It gets trickier when there are scattered clouds that you are trying to work around, or the visibility underneath is marginal. Expect dry passes for clouds obscuring the target and more "SAY POSITION" calls. If weather will be a factor on final, or TR's are in doubt, remain high and dry.

5.9.3 **Emergency Procedures (EP).** For any EPs, be ready for a KIO call, including the RCO, and the flight lead to be directive. Most EPs can be handled by elements. Be sure to safe switches during KIO call.

5.9.4 **No Radio (NORDO).** The NORDO aircraft should remain high and dry in the pattern and rock his wings on final. Once it's determined an aircraft is NORDO, lead will be directive with the rest of the flight to recover that aircraft IAW standards/local procedures. With an EP, the NORDO aircraft should do the same thing unless an immediate single-ship recovery is warranted. If a single-ship recovery is warranted, avoid overflight of pattern ground track at the current pattern altitude and turn opposite the traffic pattern.

5.9.5 **Blind.** If not visual with the preceding aircraft or if there is any doubt as to who you're looking at after rolling out on crosswind, cross-check altitude and stay 500 feet away

from base altitude for the pattern being flown. If descending to the base altitude, remain above the base altitude. If climbing up to the base altitude, level off lower than the base altitude. Clear your flightpath and transmit "(position number for the aircraft in front of you), SAY POSITION." The preceding aircraft should immediately answer the call with position and altitude. No other aircraft will transmit except those necessary to resolve the potential conflict. Follow-on calls must be as specific as possible.

5.9.5.1 **Post Blind – "Continue."** If the visual is reacquired OR you have high SA for which you have adequate deconfliction, call "CONTINUE." If on final and not directly involved in a "say position" situation, you may continue the pass and deliver ordnance unless a "KNOCK-IT-OFF" is called (assuming the RCO transmitted "CONTINUE DRY" prior to the "SAY POSITION"; if not, don't request clearance – go through dry).

5.9.5.2 **Post Blind - "Knock It Off."** If the situation cannot be immediately resolved, a "KNOCK-IT-OFF" should be called. All members of the flight and the RCO will acknowledge it; safe the master arm and fly the altitude, airspeed and ground track for the event flight lead is on. The blind aircraft will maintain briefed altitude deconfliction. Expect the flight lead to be directive and/or the preceding aircraft to give bearing, range, aspect, and altitude (BRAA) calls. Listen carefully and build SA on other members of the formation. When warranted, flight lead will direct the flight to continue weapons delivery (for example, "NEXT PASS HOT" or "GREEN'M UP").

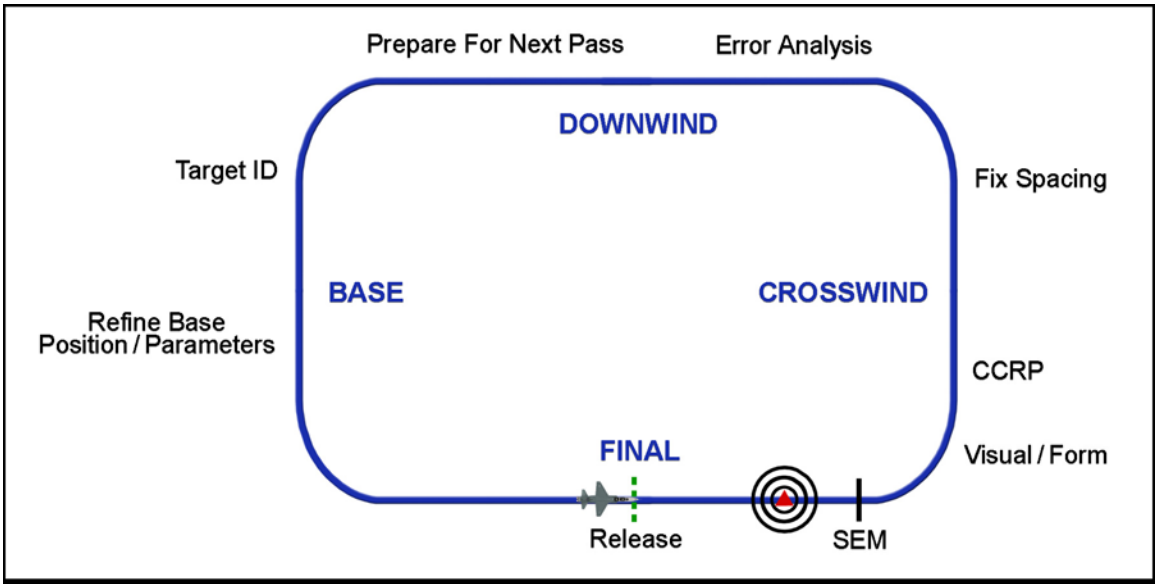
5.9.6 **Fouls.** Two fouls or one dangerous foul on range will usually result in that flight member either holding high and dry or being directed to return to base (RTB). Use judgment based on the severity of the problems. Since the T-38C does not physically drop anything, it will be hard for anyone outside your jet to assess a foul. Fess up to foul situations so that you can learn from them.

5.10 Conventional Pattern Procedures:

5.10.1 **Purpose.** The conventional pattern allows orderly, repetitive weapons delivery practice for up to four aircraft on the range. It is designed to allow you to get from one pass to the next as efficiently as possible to maximize learning basic diving weapons delivery.

5.10.2 **Conventional Pattern Overview.** The conventional pattern is similar in structure to a standard landing pattern, with the following segments: crosswind, downwind, base, and final (Figure 5.2). While the basic pattern remains the same between different events, altitude and base position will change to accommodate the various release altitudes and dive angles. Depending on the event, a complete "lap" around the pattern will take only 1 to 2 minutes or about 100 to 150 pounds of fuel. In addition to the required tasks for each segment of the pattern, you will have to maintain briefed altitude, airspeed, and ground track.

Figure 5.2. Conventional Pattern.



5.10.3 **SEM.** All SEMs will be executed IAW T.O. 1T-38C-34-1-1. Using 4.1 to 4.3 Gs in the pull is a good technique to ensure the SEM is valid while minimizing the potential for an asymmetric over-G due to jetwash. Use caution on steeper events; airspeed errors and dive angle increase over-G potential. Rapid G application is not necessary; you have 2 seconds to blend to 4 Gs. It is a good technique to complete an SEM anytime you commit your nose to the target, even if the decision is made not to release ordnance.

5.10.4 **Crosswind.** The first priority after the SEM is to regain visual on the preceding aircraft. With 8,000 feet of pattern spacing, the preceding aircraft should be near 10 o'clock and hold steady on the canopy until rolling out on. You will be looking at almost tail aspect making the visual tougher to reacquire. When turning crosswind (or any other place in the pattern), realize that you may be turning inside the preceding aircraft (the "coffin corner"). Look outside as well as inside your turn until you are sure your turn is clear.

5.10.5 **Check Spacing.** After finding the aircraft in front of you, assess your pattern spacing; you should be 6,000 to 9,000 feet behind the preceding aircraft. The AAT can be used to back up a visual assessment of 6,000 to 9,000 feet. TCAS and a 2.5-NM primary flight reference (PFR) scope may also be used to back up visual assessment. If you are close or wide, then adjust your turn to downwind to either increase or close range. If you are adjusting your downwind turn, orient your downwind leg so that you will arrive over the briefed ground track at your turn to base. If you are Number 2 or Number 3 of a four ship, avoid airspeed deviations as they will affect the aircraft behind you; instead use geometry. Prior to "cutting" any corners, you must be visual or have SA with comm with all of the preceding aircraft. This will prevent an unaware, belly-up pull on the preceding aircraft that can create a midair collision potential in the form of a "coffin corner."

5.10.6 **Downwind.** Lead will establish the downwind leg ground track in the brief. This is not a fixed position and may be varied by individual pilots if required to adjust spacing. Use the time on downwind to prepare for the next pass and analyze errors from the previous pass.

5.10.6.1 **Prepare for the Next Pass.** While not all-inclusive, the following checks cover the minimum and highest priority tasks while on downwind. In addition, continue to evaluate pattern spacing and analyze winds; adjusting as necessary to fly the correct ground track for the planned weapons delivery and spacing. The following techniques help the aircrew develop habit patterns that can be applied in future aircraft. The individual checklist items are discussed in this chapter.

5.10.6.1.1 **T-A-G.** An easy to remember acronym to aid in accomplishing downwind checks is T-A-G:

T – Target/Weapons Program.
A – Attack Numbers.
G – Gas (Complete Ops Check).

5.10.6.1.2 **W-A-M-O-E.** The W-A-M-O-E check is another common technique. It includes error analysis, which reminds aircrew to think through adjustments for the next pass.

W – Weapons Mode (A, B, C…).
A – Arm.
M – Master Mode (A/G, CCIP).
O – Ops Check.
E – Error Analysis.

5.10.7 **Base.** For accurate weapons delivery, base position is crucial. There are three major conditions required to begin a successful roll in: airspeed, altitude, and base distance. As you can see in Figure 5.3, there are nine places you can be, eight of which are not correct for a given set of weapons-delivery parameters. To arrive on the planned wire, base distance and altitude must be accurate. Airspeed deviations on base will cause you to devote excessive time on final to airspeed corrections. Shack your base parameters.

5.10.7.1 **Base References.** The proper base distance can be achieved via two sources: ground reference and canopy codes. Using ground references in a commonly used pattern is advantageous for learning the basics of surface attack and establishing canopy codes. In a more tactical environment, you will have to use canopy codes to visually assess your base position. If a ground reference is available, select a lead point to begin the base turn so as to roll out pointing toward the reference (Figure 5.3). Select MIL power, and execute a level turn with G to hold airspeed. While refining parameters on base, acquire the target. Another method used to set base distance is a visual assessment of the planned wire. This involves setting the correct target-to-canopy reference or "sight picture" while wings level on base (Figure 5.3). For no wind, put the target 1 1/2 fist widths above the canopy rail for a 10°, a fist width above for a 20°, on the canopy rail for a 30°, and for a 45°, the target will be a fist width below the canopy rail. These references are only valid when wings level, at the appropriate base altitude, and at a nominal sitting height which can be found in T.O. 1T-38C-34-1-1. These methods can be combined to help build the base sight picture and refine your base distance. For either method, the target should be your primary reference for planning the roll in.

Figure 5.3. Base References.

5.10.7.2 **Base Ground Track Corrections.** To make a correction, angle in or out from the target, and then roll out. Once the picture is set, if time allows prior to the roll in, return to the original base ground track that is perpendicular to the planned attack heading. Generally, there is time for one correction on base. While base position may be slightly altered to adjust pattern spacing, it is discouraged as this requires changes to the roll in to get to the planned wire on final. If you are excessively close to the preceding aircraft, consider using a normal base position and go through dry on final. Subsequently, adjust your pattern spacing on downwind.

5.10.8 **Wind Corrections in the Conventional Pattern.** When dealing with winds in the pattern, three adjustments need to be made: the lead point for your turn to base, the base position itself, and the heading to hold that ground track. For a headwind (on final), you will need to turn base slightly earlier compared to no wind. In addition, adjust the base distance closer to the target, and roll out with a crab into the wind. The opposite is true for a tailwind (on final). This will also affect the canopy references, so the target should be slightly closer to the canopy rail for a headwind or slightly further away for a tailwind. One finger width correction for each 10 knots of head/tailwind is a good ROT. For crosswinds (on final), adjust your roll in earlier or later, and expect to crab into the wind to achieve proper parameters.

5.11 Tactical Pattern Procedures:

5.11.1 **Purpose.** Like the conventional pattern, the tactical pattern allows “canned” delivery pattern training. In the tactical pattern you will perform popup attacks. Popup attacks are flown when weather or threats force you to ingress the target at low altitude.

5.11.2 **Tactical Pattern Overview.** There are two types of pop patterns that are flown in BSA: direct and indirect. Direct pop patterns involve a run-in directly to the target followed by an "action" where a turn is made a specific distance from the target to create an offset prior to rolling in. An indirect pop pattern is constructed so that the offset heading is flown immediately after rolling off of the base position. Both attacks allow for target acquisition during the pop and subsequent pulldown to a diving attack.