



F-22 LIGHTNING 3

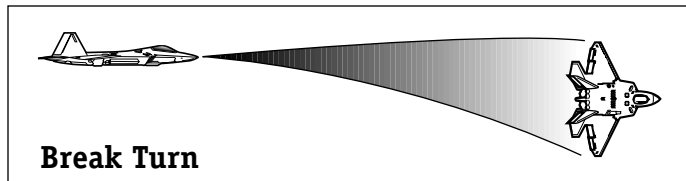
TACTICS MANUAL

TABLE OF CONTENTS

BFM (Basic Flight Maneuvers).....	2
Break Turn.....	2
Immelmann.....	2
Split S.....	3
ACM (Air Combat Maneuvers).....	3
Lead Pursuit.....	3
Line (or Pure) Pursuit.....	4
Lag Pursuit.....	4
Early Turn.....	4
One Circle Fight.....	4
Two Circle Fight.....	5
Co-Operative Bracket.....	5
Scissors.....	6
Offensive Tactics.....	6
Missile Combat.....	6
Guns Combat.....	7
Bomb Delivery.....	8
Defensive Tactics.....	9
Stealth Considerations.....	9
Electronic Counter-Measures (ECM).....	9
Missile Avoidance.....	10
GLOSSARY OF FLIGHT TERMS.....	11

BFM (BASIC FLIGHT MANEUVERS)

There are a few basic flight maneuvers (BFMs) that you should be aware of before you enter combat. Your opponent will be well versed in these tactics so it is recommended that you take the time to practice them yourself.

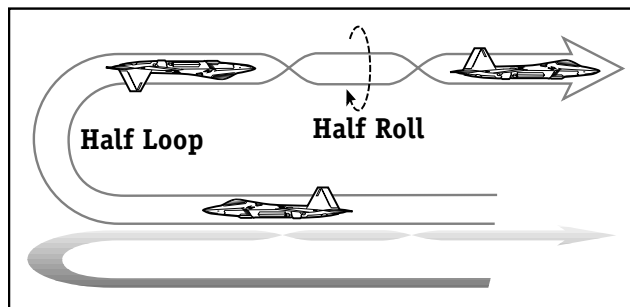


BREAK TURN

The Break turn (or maximum rate turn), should rightfully be considered an emergency maneuver and should never be used if a less severe bank attitude will suffice. Break turns are a means of cutting inside the turn radius of an incoming missile. They can be used equally well to throw off an opponent who is moving in for a guns-only kill. They are most effective when they are performed suddenly and unexpectedly.

Abrupt changes in direction may cause an attacker to overshoot and be forced out in front of you.

A Break turn is performed by rolling 90° so that your wings are perpendicular to the ground. At the same time, pull the stick back hard. Hold this attitude for as long as necessary but watch out, your airspeed will bleed off rapidly. Never maintain a Break turn for so long that you are unable to maneuver after the turn is completed. The high G force created by this maneuver is another danger. Blackouts (if the option is turned on) can result from Break turns performed at too high a speed. If you feel this beginning to happen, relax the stick to reduce the G forces or extend your speed brake.



IMMELMANN

Another basic fighter maneuver is the Immelmann. It's named after Max Immelmann, the German pilot who perfected this maneuver in WW I,. Basically, the Immelmann is nothing more than a climbing half loop as shown in the diagram. Enter the Immelmann from level flight or preferably a shallow dive. Begin by building up a little excess speed then start pulling back gradually on the stick. Keep back pressure on the stick until you reach a sheer vertical climb. (You can judge your aircraft attitude by keeping an eye on the HUD pitch ladder or by switching to a Virtual Cockpit view.)

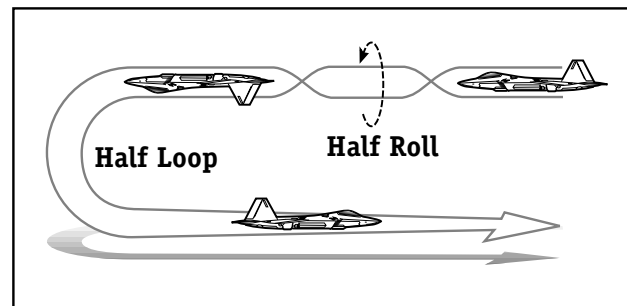
At this point, you can complete the Immelmann at any time by pulling back on the stick. Notice however that you will be flying inverted. A 90° half roll is required to return you to a normal flight attitude. The Immelmann is not just a reversal maneuver. Once you get really good at it, you'll be able to roll while climbing so that you can pull out in any compass heading you desire.

SPLIT S

As the diagram indicates, the Split S is really nothing more than an Immelmann in reverse, instead of climbing you are performing a dive. In fact if you combined an Immelmann with a Split S you would wind up flying in a complete loop. Like the Immelmann, the Split S can be used to effect a sudden reversal of direction but it is most effective as a means of instantly increasing your speed.

The first step in performing a Split S is to roll 90° so that your aircraft is now inverted. This is done so that you are pulling back on the stick to enter the dive rather than pushing it forward. (Your body can withstand positive Gs better than it can negative.) Rolling inverted from level flight telegraphs your intentions so wait until you are ready to dive before starting your roll. Pull the nose of your aircraft down to enter the dive and keep back pressure on the stick until you are vertical. (Again, use the Virtual Cockpit view or HUD pitch ladder to judge your aircraft's attitude.)

Reduce your speed to stay near your corner velocity and avoid losing too much altitude. Either cut the throttle before you enter the dive or slow the aircraft by opening your speed brakes (the B key). To complete this maneuver, pull back sharply on the stick, bringing the nose of the aircraft up to a level flight attitude. Like the Immelmann, you can wind up heading in any direction you desire by rolling slowly as you dive. The Split S is a great maneuver but you must use caution. Be careful not to engage this maneuver at too low an altitude, you may not be able to pull out of it in time.



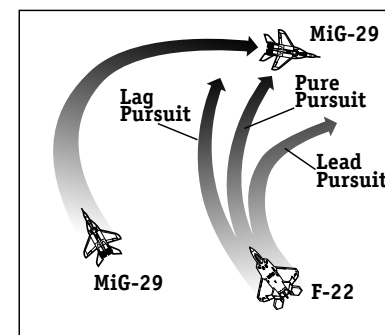
ACM (AIR COMBAT MANEUVERS)

PURSUIT ANGLES

Immediately after identifying an enemy target, you enter a phase of air combat known as the closure phase. This stage of combat is where you figure out how to get close enough to the enemy to shoot him down. It sounds fairly straightforward but it is actually a period of significant tactical decision making. If you are tasked with intercepting an enemy aircraft, there are three basic closure angles referred to as Pursuit Angles. These are Lead pursuit, Line (or Pure) pursuit, and Lag pursuit.

LEAD PURSUIT

A Lead Pursuit is one in which you keep the nose of your aircraft pointed ahead of your intended target. This pursuit angle demands the highest level of energy from your aircraft because you are forced into an ever-increasing turn rate as the pursuit continues. Of the three angles, it is the most dangerous. Not only do you need to be concerned about getting into an overshoot situation, the risk of reversal is great as well. Even so, it is easier to switch from a lead to a lag pursuit then vice versa. Though the risk of miscalculation is high, lead pursuits allow you to keep



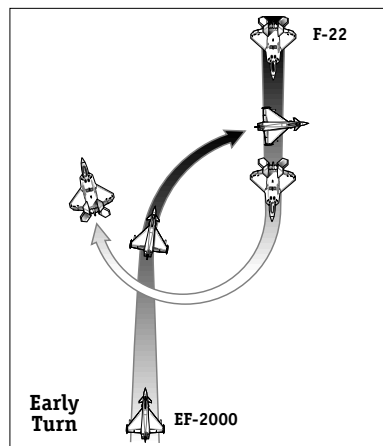
your tactical options open.

LINE (OR PURE) PURSUIT

A Line (or Pure) pursuit is one in which you keep the nose of your aircraft pointed directly at (in line with) your intended target. This pursuit angle is really a transitional approach that holds your attack options open as you close in. Essentially, a line pursuit extends the amount of time you have before committing yourself. As long as you can keep the nose of your aircraft in line with the bandit, you have the upper hand.

LAG PURSUIT

A Lag pursuit is one in which you keep the nose of your aircraft pointed slightly behind your intended target. Every intercept should start out as a lag pursuit because it generates the least amount of G forces and allows you to preserve your available energy for closure. This type of closure also affords you the best opportunity to remain hidden. It keeps your approach outside of your opponent's radar and visual detection envelopes. The lag pursuit allows you the most time to assess the situation as the pursuit continues. Should the intercept go wrong, it is the best of the three angles if you have to start thinking in terms of disengagement. A simple roll is all it takes to make your escape.



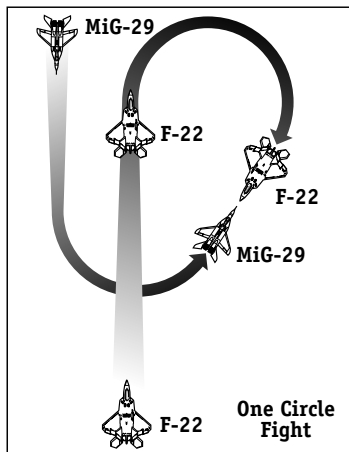
EARLY TURN

The Early turn is a conversion maneuver designed to put you on your opponent's tail from an initial head-on aspect. It is an extremely tricky maneuver to execute. It requires a keen sense of timing and a high degree of spatial orientation. The secret is being able to anticipate your opponent's actions at the merge. As shown in the diagram, an F-22 and EF-2000 are on a collision course. The F-22 pilot anticipates that the EF-2000 is going to turn into him and begins a hard right turn of his own. The affect of this early turn is that the F-22 has gotten the jump on its opponent. Its nose is already swinging around as the enemy aircraft passes by it.

In several more seconds, the F-22 will be neatly situated in the EF-2000's "six o'clock" ready to execute a guns or IR missile attack at close range. The EF-2000's pilot has only a couple options. If his airspeed is high, he can opt for a vertical disengagement, but that comes with problems of it's own. He could also continue his right turn and hope to cut inside the F-22's turn radius. But the most likely response open to him is to reverse himself and attempt a horizontal break to the left. Should he in fact choose this option, he will be initiating what's called a One Circle Fight.

ONE CIRCLE FIGHT

A One Circle Fight is a very common situation that occurs after two opposing, non-advantaged aircraft meet at the merge. As shown in the diagram, if one pilot decides to break left and the other pilot decides to break right they are in effect creating a large circle in sky. One good thing about these fights is that both aircraft are banked canopy to canopy so that both can keep an eye on the other. Whatever happens, they can see it coming and neither will be surprised. Another thing in your favor is the F-22, with its vectored thrust, does very well in these fights.

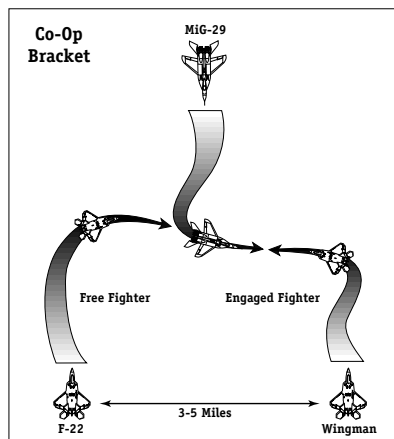
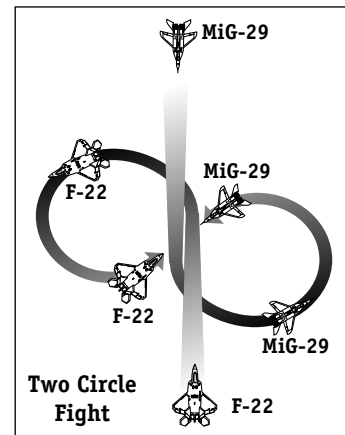


The bad thing about this type of engagement is that it soon becomes a series of smaller and smaller turns. Both pilots will be trying to turn inside the other in an attempt to be the first to get off a shot. If you enter one of these engagements flying above or below your corner velocity, quit this fight immediately. These are affairs of angles, not speed. Being able to turn sharply is more valuable to you than being able to turn fast.

TWO CIRCLE FIGHT

A Two Circle Fight is very different from the preceding engagement. Participants are presented with an entirely new set of tactical problems. Like One Circle Fights, these battles occur when two opposing non-advantaged fighters meet at the merge but here is where any similarities end. As shown in the diagram, Two Circle Fights result when the pilots involved meet at the merge and decide to turn in the same direction (i.e. they both break to the right for example.)

Although the object is to convert a head-on pass into a tail chase situation, Two Circle Fights take place at much higher speeds than One Circle Fights. This is because both pilots are attempting to be the first to bring the nose of their aircraft to bear on their opponent. The physical size of a Two Circle Fight is twice that of the former so missile combat is a viable option. Look for an opportunity to fire a sidewinder across the figure eight. Visibility will be a problem because you are not turning canopy to canopy with the enemy. You'll lose sight of the other pilot throughout most of the turn.



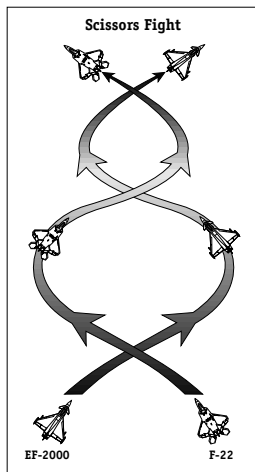
CO-OPERATIVE BRACKET

Most air to air tactics involve the efforts of both a flight leader and his wingman. The Co-operative Bracket attack is representative of exactly this type of multiple aircraft collaboration. It can be used quite successfully with both computer controlled wingman and other human players.

The objective of the Co-Op Bracket attack is to get the enemy to commit himself to attacking either you or your wingman. Once this happens, the enemy is open to being engaged by the other F-22. As you can see in the diagram, you and your wingman should laterally separate by at least three to five nautical miles. As the enemy closes to within missile range, it should become apparent which of you will be the target of his attack. The "free" fighter (i.e. the one not being targeted) should quickly maneuver on the attacking aircraft's "six o'clock." If the enemy presses his attack, he risks certain destruction at the hands of the free fighter.

This tactic can be performed when playing with a wingman being flown by your computer. The trick is to lock the enemy on your radar then direct your wingman to attack it. As your wingman

moves into a head-on closure position, fire up the afterburner in your F-22 and affect a 3 to 5 mile lateral offset. The enemy will invariably be forced to engage your wingman while you maneuver to get behind him. With luck, you'll get off a missile before the enemy takes a shot at your wingman.



SCISSORS

A Scissors fight is one of the most dangerous maneuvers a pilot can find himself caught up in. It involves a series of break turns between opposing aircraft each attempting to force the other to overshoot. Naturally, both aircraft will have to be performing at the peak of their turning abilities while at the same time making enormous demands on their respective energy states. As you can see by the diagram, a scissors fight gets its name from the peculiar shape it takes on when viewed from above. It is dangerous because the aircraft cross paths repeatedly throughout the maneuver.

Use your speed brake to hold you at corner velocity while keeping your engine thrust high. Flaps are also advisable. You'll want to generate lift to keep you in the fight while at the same time slowing down to cause the overshoot. The first pilot to get in the other's rearward arc will win a scissors battle. But this maneuver cannot go on indefinitely. Sooner or later, one or the other aircraft will have to disengage or stall itself out of the fight. It's better to disengage with some energy remaining rather than wait until the last moment and stall. If you feel the need to disengage from a scissors fight, wait until the enemy is in the middle of an outward turn, then roll into a Split S and separate. By the time your opponent notices your maneuver and reacts, you will be long gone.

OFFENSIVE TACTICS

MISSILE COMBAT

The introduction of the air-to-air missile (AAM) opened a new chapter in the annals of 20th century air combat. Back in WW II, radar made it possible to see things far away but it wasn't until a decade later that the missile would make it possible to kill things far away. Now, instead of dogfighting wing tip to wing tip, aircraft are equipped with weapons designed to fight "dot wars." In other words, the enemy only needs to appear as a "dot" or blip on your radar. You don't need to actually see an enemy aircraft before you blast it with a missile.

The F-22 is equipped with two different types of AAM missiles; Infrared (or heat seeking) and radar guided missiles. Refer to the F-22 Lightning 3 user manual for specifications and operating instructions for these two weapons. Keep in mind however, that enemy aircraft you encounter are similarly equipped. The only advantage you may have over them is the personal skill you bring to each engagement.

RADAR GUIDED MISSILES

The radar-guided missile is a medium to long ranged weapon. It gives both you, and the enemy pilots you encounter the ability to make BVR (beyond visual range) kills. This is the essence of dot wars, being able to target, engage, and destroy enemy aircraft that you can't

even see. The problem with using radar guided missiles is that you need to use your radar in order to engage the enemy. Not only is radar very susceptible to jamming, spoofing, and ECM, turning it on in the first place clearly broadcasts your position. For this reason radar should be used very sparingly by fighter pilots.

On the plus side, radar guided missiles can be fired at targets that are great distances away. They generally have large warheads that do not require the missile to physically hit the target. They can kill or cripple an enemy aircraft even if detonated at tens of meters distance. There are basically two subcategories of radar guided missiles represented in F-22 Lightning 3; active radar homing (ARH) and semi-active homing (SARH). The differences between the two are important to note.

Active radar homing missiles are “fire and forget” weapons. Once they are launched they require no further guidance from the parent aircraft. This means that an attacking aircraft can lock a target on radar, launch an ARH missile, shut down its radar and then fly away hopefully undetected. The missile will travel to a point in space via inertial navigation then switch on its own active radar. This internal radar provides guidance and steers the missile to the target. A proximity fuse detonates the warhead when the missile gets within a prescribed range.

A semi-active radar homing missile relies upon continuous updates from the parent aircraft. The launching aircraft must keep its radar locked on the target throughout the missile’s entire flight. If the target aircraft manages to break the attacker’s radar lock, the missile goes ballistic and is wasted. You can readily see the tactical advantages of ARH over SARH missiles. With SARH missiles, your attention must remain focused on the target. Fortunately, the AMRAAMs carried by the F-22 possess active radars whereas the missiles carried by your enemies often do not.

IR (HEAT-SEEKING) MISSILES

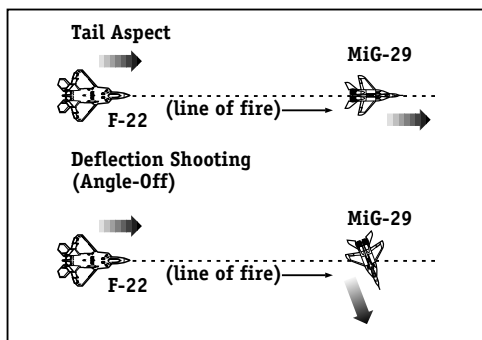
Infrared (or heat-seeking) missiles use IR radiation as a means of guidance instead of radar energy. IR radiation is primarily created by hot exhaust from an aircraft’s engines but it is also produced by friction between molecules of air and the skin of the aircraft as it flies along. IR missiles, like the Sidewinder and Archer, are lighter and smaller than radar guided missiles. As a consequence, they have much shorter ranges and smaller warheads.

These missiles are termed “fire and forget” because their guidance paradigm requires no help once released by the firing aircraft. The seeker tracks the target by the IR radiation it generates and sends course corrections via servos to the fin control surfaces. Because the firing aircraft cannot exercise control over the missile once launched, heat-seekers become a hazard to friend and foe alike.

Think of a heat-seeking missile as an intermediate step between the medium ranged AMRAAM and the up close and personal M61. If you are forced to use one, chances are good that you are, or will be soon, locked in a “furball.” It’s best to use a radar guided missile in order to keep the enemy at arm’s length. Don’t wait until he gets close in order to use a sidewinder if you still have AMRAAMs on board.

GUNS COMBAT

As high tech as air combat has become, there is still a need to be a skilled gunfighter. To a real fighter pilot, nothing is so satisfying as finishing off an opponent with a guns-kill. The F-22 carries a General Electric M61A2 20mm (0.8 inch) cannon which is accurate out to



about one and a half nautical miles. This fast firing, lightweight cannon is a welcome addition to your arsenal.

If the enemy is in gun range, so are you. Therefore your gun is best used against slow moving, unarmed air targets like heavy-lift transports or even enemy AWACs platforms. Never set out to attack an enemy fighter with guns. You should always start out with a missile attack. Guns are only practical if you have run out of missiles or botched your initial attack and have already closed to gun range.

The ideal gunfight situation occurs when you can shoot at your opponent while keeping him from firing back. But when it comes to gun combat, you can never be wrong if you keep the nose of your aircraft pointed at the enemy. At the very least, it puts pressure on the enemy to avoid your fire, throwing off his aim in the process.

As you can see by the diagram, gun fighting is a game of angles. Your best results come when you position yourself so that you are shooting down the target's flight path. Little or no lead is required to hit the target. A target moving across your line of fire is much harder to hit. Fewer of your shells intersect its line of flight and the lead angle is harder to judge. Always opt for a tail chase situation when it comes to gun combat. Head-on engagements expose you to return fire and angle-off intercepts require you to waste ammunition to ensure a hit.

The Enhanced Envelope Gun Sight is specifically designed to help you target enemy aircraft. For maximum effectiveness, you will want to line up the tips of your target's wings so that they are touching each side of the EEGS. Before you fire, take care to make sure you are within range, otherwise you are just wasting ammunition.

BOMB DELIVERY

Planning is an important part of every bombing mission. Your first action is to get straight in your head what you will be bombing, where it's located, what's around it, and who's likely to try and stop you. Only after you know all that and have committed it to memory should you think about taking off.

A complete mission briefing will include the composition and location of the air defense you are likely to encounter. You should plan your approach so that you avoid enemy radars and fixed SAM sites to the greatest extent possible. Sometimes radars will be co-located with your target so that it will be impossible to remain outside their coverage. Even so, pay close attention to your Defense Display. In most cases, you will be able to find the path of least resistance and minimize (if not completely eliminate) the enemy's chances of detecting you.

Once you have determined your route to the target you will then need to determine your flight profile. With the unguided BLU-109, your altitude and airspeed determine the range of the bomb at the time of release. The higher and faster you fly, the farther you'll be able to toss the bomb. Dropping the bomb from a higher altitude gives it more range and allows you to avoid getting too close to the target.

Once you have delivered your ordnance, choose a random compass heading out of the target area. Don't take a direct route back to friendly territory. The enemy will probably be expecting that. What you need now is time to collect your thoughts and let the excitement of bombing the target wear off. Check your Defense Display for signs of enemy activity. Establish contact with your

wingman and rejoin if necessary.

DEFENSIVE TACTICS

STEALTH CONSIDERATIONS

There is an axiom of modern combat that goes, “If you can be seen, you can be hit. And if you can be hit, you can be destroyed.” These days, remaining undetected is your best defense and your key to survivability. First and foremost, the F-22 was built with this in mind. From the shape of the aircraft to the materials used in its construction, your aircraft is designed for stealth. Making the most of these stealth features should be a priority on every mission.

Nothing gives your position away like transmitting on the radio or searching the sky with radar. The energy emitted by your radar is particularly detectable from hundreds of miles away, much farther in fact that it can detect objects. One of the most important things you can do to remain stealthy is to avoid using your radar, or at least use it as little as possible. Your radar is like a beacon in the night.

Limiting the use of your radio and radar is known as practicing EMCON (or emissions control). Get into the habit of keeping your radar off except in emergencies. This is one way of insuring that you’ll have fewer emergencies to deal with in the first place. As a way of demonstrating the difference EMCON can make, switch to your Defense Display and observe what happens when you toggle your radar On and Off with the R key. Enemy radar coverage effectively doubles in size when your radar is switched On. (Watch the red circles representing the radii of enemy radar sites.)

ELECTRONIC COUNTER-MEASURES (ECM)

The F-22 features two types of electronic counter-measures; chaff and flares. The defensive system will alert you to incoming missile threats and inform you of the proper counter-measure to use. It will also auto dispense the appropriate countermeasure when the missile is in decoy range.

CHAFF

The F-22 carries 100 bundles of chaff. A running total of your remaining chaff bundles is kept on your Stores Display. Chaff consists of strips of metal designed to cloud an enemy radar system. Think of the “snow” that appears on an improperly tuned television set. It’s tough to discern what’s going on because of all the foreground distortion. Chaff works the same way. It distorts enemy radar so that even though they know you are there, there is little they can do about it. Chaff masks your location and makes it difficult for radar guided missiles to track you.

Keep in mind that chaff doesn’t make you invisible to enemy radar. On the contrary, it creates a huge radar return around you so that your aircraft becomes indistinguishable. This is an important point. If you are trying to keep a low profile, dropping chaff is a decidedly bad idea. It’s tantamount to turning on your transponder and shouting, “Hey guys, here I am!!!” Of course, if somebody is already shooting at you there’s little point in trying to be stealthy. By the same token, there is also little point in making it easy for everyone else to zero in on you.

FLARES

If it helps to visualize these items, think of them as normal road flares that you might carry in the car. These flares are thousands of times stronger however. Your F-22 only carries 100 flares so use them wisely. A running total of your remaining flares is kept on your Stores Display.

Flares emit IR radiation that is detectable by heat-seeking missiles. They are dropped by an aircraft when the missile is close to impact. The idea is to use them in order to confuse the seeker-head inside the missile. With luck, the missile will lose track of the aircraft and focus on the radiation coming off the flares instead. It's not 100% foolproof though. The effectiveness of your flares depends a lot upon the sensitivity of the missile seeker and the range/ aspect angle between you and it. Therefore, it is recommended that you deploy flares in combination with evasive maneuvering.

MISSILE AVOIDANCE

Using evasive maneuvers to avoid an incoming missile is your only hope should ECM not do the trick. But you should know right off that getting away from a missile is tough work. For one thing, missiles travel faster than your aircraft can and they can tolerate far more G forces than a human being can. So the problem becomes how to get the missile to miss you and not cause yourself to blackout in the process. The answer can be found in simple geometry. Use the missile's speed as leverage against it.

Whenever the enemy launches a missile (this goes for SAMs as well as AAMs) the first thing you should do is find out where it is coming from. If you can't look outside and see its smoke trail, immediately switch to your Defense Display. Your objective, once you spot it, is to keep the missile approaching along the 3 o'clock/ 9 o'clock axis of your aircraft. Never put yourself in the position of heading directly away or directly toward the missile. It will continue to track you. You just make sure to keep the missile off your wing.

By keeping the missile off your wing, you force it to constantly use its energy to turn with you. Unlike your aircraft, a missile cannot renew its energy. It possesses a finite amount of propellant. Most of this propellant is burned up in the first few seconds of flight after which the missile depends upon inertia. Every time you force the missile to turn, you are also forcing it to use up its energy and slow down somewhat in the process. It can't go to the bank like you can so by the time it reaches you, the missile will be coasting. As its speed decays, so too will its maneuverability.

As the range decreases you will be looking for an opportunity to get inside the missile's turning arc. It's a dangerous game but the closer the missile gets, the easier this will be. Once you get inside, the missile will not be able to cut the corner. Good luck, you will need it.

GLOSSARY

A

AAA- Anti-Aircraft Artillery. Pronounced "triple-A," this term refers to antiaircraft guns.

AAM- Air-to-Air Missile. A missile designed to be fired from an airplane, with the intention of hitting another airplane.

AB- Non-US Air Base.

ACM- Air Combat Maneuvers. The basic movement techniques of air fighting.

ADA- Air Defense Artillery. Ground units that operate AAA.

AFB- Air Force Base. A base inside the United States. An air base in a foreign country is termed an AB-Air Base.

AFTERBURNER- A device for pumping raw fuel directly into the engine exhaust, dramatically increasing both engine power and fuel consumption.

AGL- Above Ground Level. One way to measure altitude, in units from the surface of the earth directly below.

AGM- Air-to-Ground Missile. A missile fired from an aircraft at a target on the ground.

AIM- Air Intercept Missile. The type prefix for U.S. air-to-air missiles, such as AIM-9 and AIM-120.

AIRSPEED- The velocity of the plane in relation to the surrounding air.

ALTIMETER- An instrument that measures altitude by monitoring differences in air pressure.

AMRAAM- Advanced Medium Range Air-to-Air Missile. The AIM-120 AMRAAM uses Active Radar Homing (ARH), so it is a "fire and forget" missile.

ANGELS- Thousands of feet. "Angels 10" equals 10,000 feet.

ANTI-RADIATION MISSILE- A missile that locks onto radio frequency radiation, such as the HARM.

AOA- Angle of Attack. The angle between the aircraft's wings' mean chord line and the relative wind.

APG-77- Multimode radar system on the F-22.

ARMSTRONG- Weapons are armed.

ASL- Above Sea Level. Another way to measure altitude, in units above sea level. Sometimes referred to as MSL (Measured from Sea Level).

Aspect angle- The angle between the flight path of an attacking aircraft and that of its target.

ATO- Air Tasking Order. A schedule of what targets are to be hit, who is to hit them, and with what.

AUTOPILOT- Flight control system feature, allowing the computer to fly the plane toward the next programmed Steerpoint.

AVIONICS- Electronic gear aboard an aircraft. Specifically refers to devices that help fly or navigate the aircraft.

AWACS- Airborne Warning and Control System. A powerful and sophisticated suite of radars and communications gear carried aboard an aircraft. An AWACS aircraft controls air combat operations over a wide area.

B

BANDIT- An aircraft positively identified as an enemy.

BANK- Rolling your aircraft to the left or right such that your lift vector is not vertical.

BARCAP- Barrier Combat Air Patrol. Combat aircraft positioned to act as a barrier against enemy aircraft passing through or past a given area.

BDA- Bomb Damage Assessment. A post-strike report on the damage caused to a particular target.

BEAMING- An aircraft crossing your path perpendicularly is said to be beaming.

BEAR- NATO code name for the Russian Tu-95 turboprop bomber.

BEARING- Relative direction, in degrees. The front of the aircraft is always 0 degrees, so a target bearing 270 degrees is directly to the left.

BFM- Basic Flight Maneuvers. The standard air maneuvers that every pilot should know.

BINGO- An aircraft with only enough fuel to return to base is at bingo fuel.

BITCHIN' BETTY- Pilot slang for the female voice of the onboard computer.

BLACKJACK- NATO code name for the Russian Tu-160 high speed low altitude bomber.

BLACKOUT- Loss of vision due to high positive-G forces. Blood draining from the eyeballs causes this condition.

BLIP- An image on the radar screen annotating a detected object.

BOGEY- An aircraft whose identity has not yet been positively established.

BULL'S EYE- A bull's eye is an arbitrary predetermined map coordinate used as a navigational point of reference by friendly forces.

BUSTER- Slang term for the afterburner, or for using it.

BVR- Beyond Visual Range. A target that is too far away to be seen with the naked eye. Also refers to missiles designed to engage such targets.

C

CALLSIGN- A code name given to a particular fighter pilot for reasons of identification.

CANS- Another slang term for the afterburners.

CAP- Combat Air Patrol. A defensive flight over a particular location.

CAS- Close Air Support. The practice of using aircraft to attack enemy ground forces in conjunction with friendly troops.

C3I- Command, Control, Communications, and Intelligence. The basic functions of battlefield management.

CHAFF- Metallic strips dropped from a fighter that can interfere with missile radar signals.

CHECK FIRE- Cease firing, or don't fire.

CLOSURE- Rate at which two objects are approaching one another.

COALER- NATO code name for the An-72P maritime patrol aircraft.

COLD- Retreating. A bandit is cold if it is leaving the combat zone.

COMMS- Communications.

CONTRAILS- Vapor trails generated from an aircraft during high G maneuvers.

CORNER VELOCITY- Minimum speed necessary to pull the maximum rated Gs of an aircraft.

COSSACK- NATO code name for the mammoth An-225 cargo plane, the world's largest aircraft.

CSAR- Combat Search and Rescue. The process of locating and recovering downed pilots in a combat zone.

D

DEAD-RECKONING- To navigate without the assistance of instruments.

DEATH DOT- The small aiming mark in the center of a target reticule. Also referred to as the "pipper".

DITCH- To put an airplane down in the water. Alternately, to eject, especially over water.

DRY THRUST- The power of an aircraft's engines, without afterburner. Measured in units of weight, as in "15,000 pounds of thrust."

E

ECM- Electronic Counter Measures. Electronic means of interfering with an enemy radar or radio transmission. Jamming is a form of ECM.

EGRESS- To exit. The route an aircraft takes out of the area after striking a target.

ENGAGE- Begin Air Combat Maneuvers against the enemy.

ENVELOPE- Effective range and positioning of aircraft or missiles.

F

FALCON- Designation for the F-16. Sometimes referred to as the Fighting Falcon or the Viper.

FANTAN- NATO code name for a Chinese-built fighter-bomber.

FEBA- Forward Edge of the Battle Area. Modern term for “the front lines”.

FIRE AND FORGET- Indicates a self-guided weapon that does not require the pilots attention after being launched.

FLAK- Nickname for antiaircraft gunfire. Derived from Fliegebwerkanon, a German WW II antiaircraft gun.

FLANKER- NATO code name for the Russian Su-27 air superiority fighter.

FLAPERONS- Control surfaces on the F-22's wings that allow it to roll about its longitudinal axis.

FLARE- A pyrotechnic released from an airplane to fool the infrared sensors on heat-seeking missiles.

FLAPS- Hinged surfaces on the wings of an aircraft used to generate extra lift.

FLOGGER- NATO code name for the MiG-27 fighter-bomber.

FLOT- Forward Line of Own Troops. A line behind which friendly forces are operating, and beyond which only enemies roam.

FLY-BY-WIRE- Computer system that controls the plane based on input from the pilot's flight stick.

FOB- Forward Operating Base. A temporary base close to the combat zone set up to support flight operations.

FOX 1- Pilot warning of the launch of an AIM-7 Sparrow radar-guided missile.

FOX 2- Pilot warning of the launch of an AIM-9 Sidewinder heat-seeking missile.

FOX 3- Pilot warning of the launch of an AIM-120 AMRAAM radar-guided missile.

FOXBAT- NATO code name for the MiG-25 fighter.

FOXHOUND- NATO code name for the MiG-31 interceptor.

FULCRUM- NATO code name for the MiG-29 air superiority fighter.

FULL GRUNT- Full Military Power; throttle setting of 100% thrust.

FULL MILITARY POWER- 100% thrust.

FUR BALL- A frantic multiple-aircraft engagement at close ranges.

G

G- Pressure exerted by gravitational force. Standing on the ground equals 1 G.

G SUIT- A suit designed to help the pilots counter blackouts during high G maneuvers.

GPS- Global Positioning System. Satellite-based navigation system that allows a receiver to locate itself within a few meters.

GUARD- Listen to the common radio frequency. You will often be asked to “monitor guard” to pick up vital information.

H

HARM- High Speed Anti-Radiation Missile. A missile that tracks a radar emission, and attacks the transmitter.

HAVOC- NATO code name for the Russian Mi-28 ground-attack helicopter.

HEAT SIGNATURE- The image of an aircraft as seen on infrared systems.

HEATER- Pilot slang for an infrared homing (heat-seeking) missile.

HEADING- Direction of flight, in compass degrees. Due east is a heading of 90 degrees.

HELIX- NATO code name for the Russian Ka-29 light attack helicopter.

HOT- Bandit is approaching, or entering the combat zone.

HOTAS- Hands On Throttle and Stick. A modern method of cockpit design, where one does not have to remove one's hands from the flight controls to operate other aircraft systems, especially weapons.

HUD- Head-Up Display. A flight information technique that places most flight and combat information on a transparent panel directly in front of the pilot.

I

ILS- Instrument Landing System. A device that allows aircraft to land safely at night and in low visibility conditions.

INGRESS- To enter. The route followed to approach a strike target.

IP- Initial Point (or Ingress Point)-The map location where a strike package begins its approach to a target.

IR- Infrared. A band of radiation just below visible light in frequency. Infrared radiation is associated with heat sources, and so can be used

to track objects with heat signatures.

J

JDAM- Joint Direct Attack Munition. The JDAM mates a normal GBU-31 1000-pound bomb, a set of control surfaces, and a GPS receiver to make a weapon capable of striking within a few meters of any selected ground location.

JINKING- A series of erratic maneuvers designed to throw off an enemy gun attack.

K

KIAS- Knots Indicated Air Speed. The aircraft's velocity, in nautical miles per hour.

KTS.- Knots or nautical miles per hour.

L

LGB- Laser Glide Bomb. An LGB glides to its target, like the JDAM, but uses reflected laser energy for guidance instead of the GPS.

LO- Low Observable. An aircraft designed not to reflect radar energy or visible light. Stealthy.

LOCK ON- To acquire a target with radar with the intent to fire a weapon.

LZ- Landing Zone. A temporary landing place, usually for helicopters or short-field aircraft, directly in a combat area.

M

MACH- The speed of sound at sea level. Approximately 760 ft/sec. This value changes with relative air pressure.

MAINSTAY- NATO code name for the Russian A-50u airborne warning aircraft.

MAVERICK- Nickname for the AGM-65 air-to-surface missile.

MAYDAY- An emergency call, from the French m'aidez- "help me."

MILITARY POWER- 100% thrust.

MFD- Multi-Function Display. Cockpit monitors which the pilot can configure to display a variety of flight, combat, and navigation information.

MSA- Minimum Safe Altitude. Altitude below which you are asking for trouble.

MSL- Measured From Sea Level. Also referred to as ASL (Above Sea Level)

MUZZLE FLASHES- AAA fire.

N

NATO- North Atlantic Treaty Organization formed in 1949 for purpose of collective defense against aggression.

NAUTICAL MILE- One-sixtieth of a degree of latitude, measured at the equator, which is one-sixtieth of a degree of longitude, or 2026 yards, or 1.15 miles.

NEGATIVE- A non-affirmative response; no. The opposite of "roger."

NO JOY- No visual or radar contact with enemy aircraft. The opposite of "tally-ho!".

NOE- Nap-of the-Earth flying- Flying as low as possible to avoid radar detection.

O

OTH- Over the Horizon. Usually refers to targets masked by the curve of the earth, or to missiles that can strike such targets.

P

PADLOCKED- Being unable to take one's eyes off a target for fear one will be not be able to find it again.

PICKLE- To release ordnance, as in pickle a bomb.

PIPPER- The small aiming mark in the center of a target reticule. Also referred to as the "death dot".

PITCH- Measure of aircraft motion around its lateral axis. The elevators control pitch.

POP-UP- A sudden climb from low altitude, usually as part of the bomb delivery process. Also called popping.

PUNCH OUT- Pilot slang for eject.

R

RADAR- Radio Detection and Ranging. A device which detects objects by bouncing a beam of microwave energy off them, then timing the return.

RAM- Radar Absorbing Material. Materials that reduce the amount of energy reflected from their surface.

RAMMER- Slang term for the AMRAAM radar-guided missile.

RED-OUT- A temporary blindness caused by blood forced into the eyeball by negative-G conditions.

ROE- Rules of Engagement. A set of instructions detailing the conditions under which a pilot may engage in combat.

ROGER- Affirmative; yes. A positive comment. The opposite of "negative".

ROLL- Measure of aircraft motion around its longitudinal axis. Roll is controlled by the aircraft's flaperons.

ROOKIE- A pilot with very little actual flying experience.

RTB- Return to Base. Radio call indicating that the current mission has been aborted, and that all pilots should come home.

RWR- Radar Warning Receiver. A device which detects hostile radars.

S

SADDLED- In a stable flight relationship alongside another aircraft.

SAM- Surface-to-Air Missile. A missile fired from the ground against an air target.

SAR- Search And Rescue. The process of finding and recovering downed flyers.

SCRAMBLE- A rapid takeoff, usually as the result of an alert or other emergency situation.

SCUD- A medium-range ballistic missile of Russian design. Not very accurate, but cheap.

SEAD- Suppression of Enemy Air Defenses. The process of destroying or otherwise degrading an enemy air defense system by means of strikes directed against radars, SAM sites, and AAA defenses.

SIDEWINDER- Nickname for the AIM-9 missile due to the peculiar back-and-forth motion it makes when tracking a target.

SIGNATURE- The electronic parameters of a radio or radar or heat from an engine.

SILK APPROACH- The act of bailing out of an airplane.

SIX- Directly to the rear. Check your six to keep from being surprised by enemy fighters sneaking up behind you.

SHACK- Pilot slang for a bomb that impacts directly on its intended target.

SLAMMER- Pilot slang for the AIM-120 AMRAAM.

SLICK- Clean or smooth. Refers to an aircraft with no external ordnance or equipment that could create drag or increase its radar cross-section.

SMOKE IN THE AIR- Incoming missiles.

SORTIE- A combat mission.

SPLASH- Indicates an air-to-air kill or weapons impact on a ground target, as in, "splash one MiG".

STALL- The separation of airflow from the upper surface of a wing, resulting in full or partial loss of lift. Aircraft that stall are no longer flying, they are falling.

STEERPOINT- The F-22 pilot's preferred term for a fixed reference point entered into the aircraft's autopilot and navigational computers. Also referred to as Waypoint.

STRIKE PACKAGE- A group of different aircraft assigned a particular mission.

STRIP- Peel off; break from the formation.

SU-34- Russian fighter-bomber.

SU-35- Russian air-superiority fighter. Most deadly aircraft in the Russian inventory.

T

TALLY- To get a visual sighting of something.

TALLY-HO!- Confirmed target sighted. Opposite of "no joy".

TAXI- To steer an aircraft while it is on the runway.

TRACERS- Cannon or machine gun projectiles with a phosphor coating that ignites on firing, allowing the shooter to follow the path of the bullets.

TRIPLE-A- Antiaircraft Artillery; AAA.

TURBULENCE- Violent shaking that occurs when your aircraft approaches its V_{max} or encounters conflicting winds.

U

USAF- United States Air Force.

V

VC- Velocity (closure). Speed at which two objects are approaching one another.

VNE- Velocity (never exceed). Speed at which you begin to risk structural damage to the aircraft.

VMAX- Velocity (maximum). The maximum safe speed for a particular altitude. An aircraft will experience turbulence as it approaches its V_{max} .

VECTOR- A direction, expressed in compass degrees; to send someone in a particular direction.

VERTICAL VELOCITY- Rate of change in the altitude of an aircraft.

VIPER- Nickname given by pilots to the F-16.

W

WATERLINE- The artificial horizon line.

WAYPOINT- Another word for Steerpoint. A fixed reference point entered into the aircraft's autopilot and navigational computers.

WEAPONS FREE- Freedom to fire weapons within a given airspace.

WEAPONS HOLD- The opposite of weapons free. Cease firing or withhold fire.

WINCHESTER- An aircraft with no ordnance left; an unarmed fighter.

WINDER- Slang term for the AIM-9 Sidewinder heat-seeking missile.

WINGMAN- Companion plane. Combat fighters usually fly in pairs.

WVR- Within Visual Range.

Y

YAW- The motion of an aircraft around its vertical axis, controlled by the rudders. A yaw is an inherently unstable flight attitude.